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Languages, Inclusion, Cultures and Pedagogy: Research and Good Practices II.

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Foreword

The path to inclusion is a major challenge for educators. They can only meet societal expectations if we help them through everyday ordeal with the right methodology and good practices. Sensitization programmes contribute greatly to their ability to perform the special tasks they face, without failure.

Several innovative initiatives support the practice of accepting behaviour and the realization of pedagogical aspirations.

Last but not least, research whose results open up new avenues for acquiring an integrative approach, also contributes to the mechanisms of integration and inclusion.

Our volume provides guidance for this with research in organizational and children's groups and sensitization events that present the disadvantages, solutions and special areas of different development of the different socioeconomic status.

Each special subject area is represented by faculty and researchers from ELTE BGGYK, ELTE TÓK, Apor Vilmos Catholic College, and Semmelweis University.

The importance of early intervention should be emphasized not only in the case of different development, but also in the case of disadvantaged and non-Hungarian-speaking children. The authors discuss the effects of neonatal factors and early neurological injuries on children's later development. If the institution and all its staff recognize and take into account the individual needs of children in time, children's development will move in the right direction and they will manage to overcome difficulties at school.

We also report on success stories where Roma students are about to obtain a university degree, and the issue of secondary socialization is a key aspect of analysis. The accelerating change in infocommunication technology has an extremely great impact on the socio-intellectual functioning of mankind.

The altered cognitive function in the child's nervous system is a response to environmental factors, and is manifested not only in performance disorders, but also in unusual or sometimes exceptional results and talents. Learning and / or behavioural disorders can be caused by disturbances in information acquisition processes, sensory modulation, and nervous system integration. Studies related to this topic comprehensively present the diagnostic process and the relationship between learning and behavioural differences associated with sensory integration disorders. Locomotor behaviour is an integral part of cognitive and social development. Two important factors affect performance: one is the accuracy of spatial and temporal coordination, and the other is the intensity of manipulation skills, reaction time, and speed of movement. The underactivity of these factors, whether in the case of limb paralysis, hearing-vision impairment or other abnormal functioning of the nervous system, has a negative effect on the process of acquiring knowledge and achieving healthy self-esteem. The prominent role of spatial and temporal orientation in the learning of mathematics can also be emphasized. Mathematical skills do not develop at the right pace in all children. The primary reasons for this are to be found in the different development of cognitive processes, but at the same time affective factors also have a significant influence on the development of performance. The process of learning to read is very fragile, as it depends on the early development of various cognitive processes. The main questions of the current research are: What characterizes children at risk of reading disorder among Hungarian preschoolers? What are the early language indicators of poor reading development? The results of short-term longitudinal studies clearly provide the answer and indicate directions for improvement. There are a lot of therapeutic options available to us. Their selection requires great care in parallel with the diagnosis. The Story-music method is an alternative pedagogical initiative that builds on knowledge of speech therapy and language therapy, as well as special needs education. Regular music therapy activity is an important part of rehabilitation processes because it regulates cognitive flexibility and deficiencies in control functions, which is caused by, among other things, the autism spectrum disorder.

VR systems are also evolving to meet rehabilitation needs, virtual reality therapy is an existing concept, more and more professionals beginning to use it for educational and development purposes, adapting to the development of technology and its professional use.

The range of development opportunities is numerous, professional assistance – no matter what area to be developed – increases the efficiency of pedagogical work and knowledge transfer. Timely intervention increases the potential for independent living and a good quality of life which is related to health, thus helping social integration processes.

Éva Márkus & Bernadett Svraka

Theory and Practice of Inclusion

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How can special teachers aid successful kindergarten inclusion?

Good practices in a district of Budapest

Báder, Melinda – Lukács, Szandra– Perlusz, Andrea

In our study, we would like to present an institutional development that furthered collaboration between mainstream kindergarten teachers and special education teachers, as well as the creation and functioning of a broader transdisciplinary team. This good practice can support the integration of children with special educational needs into kindergarten and the well-being of those involved. This process has grown in relevancy as integrated education becomes more widespread in Hungary, affecting more than 70% of SEN children today. According to the data published by the CSO (2020) for the 2019/2020 school year, 82% of children with special educational needs in the pre-school age group and 72% of those affected in the primary school age group receive integrated education.

Keywords: SEN, diversity, teamwork, good practices, teacher training, resource parent group

Introduction

It is evident that our societies, kindergartens/schools, groups/classes are natural settings for diversity. In most European countries, an increased level of diversity can be seen throughout populations, leading to the same result in schools and classes. This circumstance creates a challenge for education all over the world. Special Educational Needs (SEN) are only one element of this diversity and form the focus of our study. The education for all approach accepts the following statements:

– diversity among children is natural;
– the individual differences experienced by students are not problems to eliminate, but rather opportunities for enriching the learning process;
– every child has the right to access education in the nearest mainstream institutions, in their own local community;
– and the success of their education depends on the responses given by the school and kindergarten, determined by the curriculum requirements, classroom/group activities and teaching methods.

If the statements mentioned above are accepted, the current question is how these principles can be realised in everyday practice. How can we develop and change our practices to reach this goal? If we look upon the idea of education for all as a human right, it does not matter what an individual child looks like, nor is it a question whether the kindergarten/school has to adapt to the diversity of pupils (Kőpatakiné et al., 2006).

It can be stated that the practice of some countries is very close to the idea of school for all, and this is why the proportion of children/students accessing education in their local mainstream kindergarten/school is very high. In contrast, we can also claim that in other countries the ratio of those students attending special classes and schools is still high. In these countries, the education for all approach has not been put into effect, even if intensive care or an adapted environment is necessary for a percentage of SEN students. Differences can also be seen at different levels of education. Kindergartens handle differences between children more naturally as the system is more permissive. In contrast, much less can be expected in the school environment.

The situation in Hungary

In Hungary, a free early intervention program is available for every SEN child immediately following diagnosis, which is provided mainly in the child's home, or in Special Educational Methodology Centers. The diagnostic test is followed by kindergarten care, which is implemented in a special or integrated form. As far as the 26th article of the UN Convention regarding habilitation and rehabilitation is concerned, a child with special needs has the right for

- services from the earliest ages;
- supporting participation in their own communities;
- inclusion in local communities, including access to professionals and assisting technologies.

Children both in special and integrated settings get regular extra help from travelling teachers, which is free for the parents. In the Hungarian system, however, beginning in the 1970's the initial types of services were formed within the framework of special institutions for children with hearing and physical impairment, and this circumstance provided the backdrop for the establishment of the service system, out of which today's Unified Special Educational Methodology Centres emerged. (Kőpatakiné 2004, 2006, 2009; Faragóné & Papp, 2011). Earlier, these centres were special institutions: nowadays, they provide both special educational and integrational services. The Unified Special Educational Methodology Centres (MC) offer a wide range of services with the aim of helping mainstream institutions integrate pupils with SEN and instructing them on how to handle these students' special needs. On the one hand, the primary target group of their services are the pupils with SEN (including specific development, individual or group therapies, Individualised Education Plan (IEP), equipment rental); on the other hand, they also support mainstream teachers and communities in the areas of forming inclusive attitudes and incorporating special methodologies, techniques, differentiation, retraining, etc. Local institutions and communities can generate additional forms of support by creating their own work community, building a care system (for the provision of specific development, individual or group therapies, an Individualized Education Plan (IEP), equipment rental, community support, etc.).

The advantages of local employment over travelling teacher care (MC) are that the special education teacher (SET) is employed by the given institution, therefore he or she can communicate more flexibly with the teachers, professionals, and parents. By working in the institution, the SET can become a part of the everyday life of the kindergarten. When a special education teacher has an active relationship with colleagues, they trust the educator and consider he or she to be a member of the board of educators. In this case, the advisory role of the special education teacher becomes more important and includes elements such as consultations for mainstream teachers, a special education assistant, school psychologist, or parents. The task of coordinating the professional team is often undertaken by the special education teacher. This type of collaboration with mainstream institutions and teachers generated an absolutely new learning situation that created challenges for the special educators of the Unified Special Educational Methodology Centres. Not only was this cooperation a burden for them, but it also meant a change in their working conditions (Papp & Mile, 2012).

Teamwork

According to Kullmann (2015), good teamwork can be characterised by the following key concepts: interdependence, complementary competencies of teamworkers, communication, cooperation, and conflict management. Ideally, professionals carry out their activities with intense co-thinking and fuller involvement of the parent (in transdisciplinary teams). The existence of continuous and regular consultations and close cooperation among the participants is an essential condition for this form of work (Kereki & Szvatkó, 2015; Kullmann, 2015).

In accordance with Kullmann's definition (2015), our practical experience is that shared responsibility is also essential for teams to work effectively. We see that the kind of co-working mentioned above is rarely realised because the competencies and roles of the team members and the conditions of the team cooperation are not clarified and stated. Although every team member supports the family to the best of their competencies, instead of real cooperation, the team members try to find individual solutions to the problems that arise separately, within their own area of competence.

Teamwork also requires effective communication, which can be hampered by several factors, such as a misunderstanding caused by different qualifications, the passing on of irrelevant elements instead of important information, overly concise or overly verbose communication, inadequate timing of information, unclear communication, uninformed team members, the information provider's neglect in checking the accuracy of decoding, language problems (common among multinational workers), polarization, discomfort caused by constant physical proximity, unfavorable personality traits, increased workload, time constraints, changing communication styles, and conflicts within the group.

Kollár (2016) approaches the mechanisms that hinder communication from another aspect and distinguishes between managerial and employee roles while emphasising the importance of mutual trust and respect for one another among professionals possessing different qualifications, and the presence of a hierarchy, which is higher than professionally justified. In our opinion, these two definitions shed light on the factors that hinder effective communication, which, in our experience, can significantly impede the functioning of teams. In our view, the difficulties arising from the different qualifications of the professionals as well as the hierarchical operation of the institution and the lack of trust form key factors.

"That's not what I was prepared for in training to work with children with Special Educational Needs"

Teacher training is a key element in the development of inclusive education. We can claim that the gap between the inclusive institution system and everyday practice stems from the fact that teachers are not sufficiently prepared with the knowledge, skills and attitudes needed for dealing with the diversity experienced in the groups. The question arises of what teachers need in particular: special knowledge about the different disabilities or more in-depth knowledge regarding special teaching methods? In our opinion, training courses that explore differentiation, provide knowledge of the variety of teaching methods, and shape attitudes are the most important for successful inclusive education.

According to Flieger's research (1997), the main obstacle is that the way teachers are prepared is greatly affected by what experiences they gained in elementary and secondary schools as students. These experiences have a larger, more determining role compared to the skills acquired at university courses. This means that the frontal teaching methods and competition in the classroom future teachers experienced in the course of their own studies have an essential impact on their teaching practice.

In the course of our practical work, we formed the idea that, although we can be successful in supporting the co-education of children with SEN (by encouraging individual development, offering group help, helping children integrate into their age group and find friends, supporting parents, consulting with host teachers, providing kindergarten transition support, follow-up, etc.) we nonetheless often encounter the nostalgic statement from kindergarten teachers that in the past there were fewer problems with children, it was easier to work with parents, and they do not feel competent within the current, changed set of circumstances. In short, "I wasn't prepared for this (to work with children with SEN) during my training," is a common refrain. We have therefore set ourselves the goal of supporting educational bodies and educators in recognition of the fact that they do not have to solve problems alone, but can instead rely upon the professional team, heretofore seen as a resource in solving difficulties. As Booth-Ainscow states, "There are always more resources available to support learning and participation than are currently used in any setting" (Booth & Ainscow, 2011, p. 42).

Parents today are much more informed about their rights, new trends in their child's development and upbringing, and are far more active, purposeful, and articulate in expressing their needs and expectations. Educators are meanwhile thinking within the kind of a hierarchical relationship reminiscent of a medical model, while in our experience, parents are increasingly moving towards a service provider-customer relationship. Many times, this difference in attitudes and values between the two participants is obvious. In addition, the question of the limits of competence and the responsibility for the development and upbringing of the child is not clarified, a lack that may make joint cooperation more difficult. For the purpose of this analysis, it must also be stated that the authors of this paper agree with Booth-Ainscow that identifying children's diagnosis and disability as the main source of problems is a distraction from other dimensions of the institution and obscures the pitfalls experienced by typical children (Booth & Ainscow, 2015).

The point of departure: the idea of training

By the end of the 2016/2017 school year, we had recognised that there is a kind of "good practice" and protocol in the integration of district kindergartens yet kindergartens are at different points of development and have different knowledge about including children with SEN. Differences in the integration practice of kindergartens can be due to several reasons, including the high fluctuation of colleagues; a wide degree of variation among newcomers' integration experiences and knowledge; internal knowledge sharing does not always work; leaders' integration attitudes, experiences and routines are different, or communication difficulties. This is why the idea of a training that focuses on the formation of attitudes in addition to the sharing of knowledge and information while building teamwork among the participants was raised.

Framework for the implementation of training

The training sessions were implemented within the framework of non-educational working days. Due to the approach of integrated and inclusive education, we considered it important that all employees of kindergartens (including technical staff) participate in the training as they also meet the children every day. We also considered it essential that the training take place in a positive atmosphere and does not demand any extra time investment from colleagues, i.e., an extra burden. We felt that by involving a psychologist in the training, we could also deal more effectively with any emotional issues that might arise.

After the personal contact and meeting, we held a leadership training with the participation of all kindergarten leaders, the aim of which was for the leaders to gain their own experience and be able to pass on information to their colleagues in a credible way. The trainings were provided free-of-charge to the institutions, and the colleagues of the special education teacher and psychologist who undertook the training held them at the expense of their working time.

The structure of the training

Prior to the training, an anonymous electronic questionnaire was filled in by the members of each educational institution. The questionnaire aimed to form a preliminary image of the needs and attitudes of the educational body for the development of an individual training program adapted to the given educational body. Questioning colleagues using questionnaires is a preliminary information package that served as the basis for compiling the content of the training.

This questionnaire underscored the real needs, strengths and areas to be developed in each educational institution and kindergarten. The questions of the questionnaires were selected on the basis of the indicators in Booth and Ainscow's Inclusion Index and adapted specifically to preschool life. The questionnaire also provided an opportunity to formulate personal thoughts in the form of an open-ended question (e.g., how do you feel about the strengths of the kindergarten?; in what areas does it still need to develop?). We examined the correlation between the modified and full scales and found significant and strong positive correlation between most scales. (Pearson correlation 773**,818 **,587**,476*,794**,735**, Cronbach-alpha 0.0616).

The structure of the training day, types of games

Based on the preliminary information, together with the head of the institution we planned the day of the training, with information regarding the place and timeframe as well as the number of participants (possibly with the involvement of the entire educational body, including nurses and technical staff). The training courses followed the same structure and took place in an interactive, 'playful form.'

Two weeks before the training day, the institutions were given the opportunity to complete the preliminary questionnaire (online). The obtained results were evaluated before the training. We tried to adapt the content of the day to the formulated difficulties and local needs. We also strove to provide help and feedback in recognition of the fact that, although there are many factors that the participants cannot change (e.g., working conditions, quality of lunch), what aspects can affect them or be changed (e.g., the resources of the institution, whether they know each other's strengths and weaknesses, how the flow of information works within the institution, how they handle any tensions that may arise).

The training courses took place within a framed structure. The day was followed by a brief feedback session after the introduction and the creation of the group rules, in which we highlighted the strengths of the given institution and the areas where the community wants to change based upon the questionnaire. This session was usually followed by a feedback loop in which colleagues had the opportunity to make an honest statement (current emotional state, how they attended the training and their opinion on the topic). We always reflected on the statements of our colleagues while assuring them that they can communicate openly and honestly, express their opinions, their feelings, and that opinions and feelings that differ from the majority have a place. This was followed by activities that fit the profile of the institution (individual, small group, and whole group activities). There was an arc to the sequence of games, and we also considered it important to make the participants understand what we were doing and why by, for example, reflecting on the problem they raised or demonstrating how they can use it in their practical work. As a constant part of the training, a thought-provoking exercise followed. During the task, colleagues were able to experience that under the same choice (e.g., "We all support co-education") very different motivations may lie.

Activities

The following task types were a constant part of the training courses: a warm-up thought-provoking practice, a task demonstrating information distortion, a perspectives changing practice (when the participant has to insert himself or herself into different roles), games that motivate problem-solving skills within the institution, cooperation, constructive interdependence activities, the practice of promoting shared responsibility, or games that facilitate communication and getting to know one another within the institution. The training then ended with a feedback round in which participants had to reflect upon their thoughts, experiences, and feelings related to the training during the opening round (based on the choice of the individuals, there was also the possibility of visual and verbal feedback).

"There is nothing to replace this type/style of outside help and opinion." (A director of a kindergarten) – Results, experiences

Throughout the period of November 2017 to May 2020, we involved nine kindergartens in the training. Several of these preschools function as united institutions and thus include several member institutions, resulting in a total of fifteen building collectives that participated in the program.

The heterogeneity of groups of participants

In the course of our practical work, it has been confirmed that the educational bodies differ in many aspects despite unified district leadership. Based on the preliminary questionnaires, it was clear that the age distribution of educational institutions is unique and the average age in several institutions is over that of fifty-three years. There was a shortage of teachers almost everywhere and colleagues who had been re-employed as retirees were also employed in several places. During the training courses, we found that institutions support the practice of inclusion based upon very different sources of motivation. The 'educational' life path of educational institutions, their attitudes towards lifelong learning, and its leadership support also proved very different. It turned out that the participating institutions are on a very different path of development in terms of co-education. In addition to those reasons described above, this circumstance may be due to fluctuation, continuous redesign, or the reorganization of kindergarten groups and kindergarten teachers.

In which the educational groups were united

The participating institutions were maximally identified with the values assumed in the pedagogical program. Each kindergarten feels successful according to its profile (arts, eco, sports). At the same time, all groups raised concerns regarding the increased workload (e.g., administrative work, ongoing substitutions, communication and cooperation with families, the emergence of more and more 'problematic' children) and an uneven division of work. Although all children are welcomed by the institutions, the reception of children with special needs is perceived differently (there were also greater differences from one parent to another). Based on the feedback from the educational bodies, a looser atmosphere, direct style, and the habit of laying down group rules jointly at the beginning of the program promoted equality and the importance of individual opinion in the attitude-forming training. The tasks of the training were mostly found to be playful and enjoyable which nevertheless ensured the drawing of deep feelings, thoughts, and conclusions for the participants. Experiences and attitude exchanges made the participants more sensitive and open. As a result of the training, community-building, team-building nature were highlighted by all institutions. The post-coaching reflection was mostly used by the managers as help, the summary of the questionnaires filled in by the colleagues was considered informative and important, which provided a basis for the more efficient operation of the educational board.

Both leaders and employees of the kindergartens found the day to be helpful and highlighted the need to continue. The participants were also unified in that the different positions expressed in the educational bodies could clash and approached or reached a consensus.

Limitations of training

In connection with the training days, we worked with a specific time frame. Sometimes the many problems present in an institution could not be remedied within the given time: we therefore had to factor this circumstance into the planning process. In the program, we explained why particular issues were being addressed on a given day. On several occasions, the Board of Education would have been expected to solve problems that fall beyond our competence (e.g., the reduction of administrative burdens, quality of lunch, resolution of wage tensions). It was difficult for the educators to understand that we did not have proven recipes or concrete solutions to family problems. The differences between kindergartens proved that they would require different support (e.g., case discussions, continuation of training). In some places we could start therapy team discussions, but the pandemic significantly hindered these efforts.

In the following academic year, we expanded the range of services made available within the district to include the 'Resource Parent Group'. We have seen that families raising disabled children need more help. In our day-to-day care system, there is often no time or opportunity to accompany parents and help them accept their loss and support their grief process. We wanted to replace this with this resource group given that parents raising disabled children are under extreme psychological burden and responsibility in the expectation to develop their child. Often family-related educators and development professionals ask and expect parents to care for their child and be partners in the child's development, so that parents have not even had time to process the shock of their child's diagnosis. Parents therefore have not yet coped with or addressed this sense of loss. Of course, every life situation and family is different. However, based on the practical experience of recent years and the feedback from kindergarten teachers, we thought that there was a need for more assistance to families, to develop a support system that unites families.

The range of participants

The group was open to all families raising children with special educational needs, regardless of disability type. The condition for joining the group was that their child attend one of the district kindergartens. An important element in starting the group was the support of the District Municipality, through which the applicant parents had access to therapeutic opportunities. Over the two years, thirteen families participated in the groups. Families showed a highly heterogeneous picture in terms of the children's diagnosis (type, severity), the beginning of the child's entry into the care system, the workload of the family (how many family members are involved), the family's acceptance within the family, the distribution of family burdens, family model/structure (mosaic family, etc.), socioeconomic status and education. Although the group was open to all adult family members involved in the child's care, we found that those who enrolled in the group were mainly mothers (90%).

Competencies

We believe it is important to mention that this resource group management is tied to the completion of a professional training. The group leaders do not undertake therapeutic work but instead participate in the joint work as an accompaniment to the self-help group. Although the group leaders were special educators, in this case they were not represented in this role. This factor was also clarified during the first meeting with the applicant parents, as this session does not focus on the development of their child, but rather on therapeutic counseling. Participants had to accept that the occasions were about them, which could have an impact on family life. We started the group with peer-leadership for several reasons. A primary consideration was to support group members' sense of security: if either group member requires individual attention, the other can take the group further. Another aspect of increasing the sense of security is that if any team leader becomes ill, regular encounters continue anyway.

Group rules

Entry into the group was closed after the third meeting. During the first session, we created the rules together with the group members (confidentiality, self-disclosure, all thoughts and emotions have a place, avoidance of qualification, volunteerism of participation, etc.). The rules provided a relaxed atmosphere and a framework for all group members to express themselves. The group leaders were expected to ensure that:

- the families concerned receive more complex care, thus increasing parental satisfaction;
- if the tensions in the parents are resolved, the parents will be more involved in the conversations related to their child's daily development in the kindergarten, they will not experience the initiatives in an offensive way, so this will also have a positive effect on the kindergarten integration processes;
- the members of the group get to know each other, realize common points, similarities, and experienced situations, so they will be able to provide support to each other;
- they will be able to manage their resources in a better way;

The following topics were covered during the events: getting to know each other, telling their own story; how parents raising a child with SEN are treated; helpful vs. unhelpful solutions; focus on losses, drawing their own loss line; focus on how to inform the parents of the diagnosis; creating a family contact map; writing a letter to a person who is missing; holding a guilt conference; reserving power of resources (positive gossip, group, family); achieving closure.

Our experience

Parents expected the group primarily to understand, listen, and pay attention. A further expectation was for the meetings to provide ideas for difficult situations in the role of a 'peer community'. What they thought is that they could support their peers by sharing and listening to each other's experiences. Parents expressed frustration, insecurity, disintegration, exhaustion, compassion, and empathy. They described themselves as being exhausted, overwhelmed, uninterested, anxious, lonely, scared, tense, distant, and troubled regarding their child's diagnosis and the losses stemming from this life-changing situation.

For parents, accepting a diagnosis is difficult and takes many years. This path or situation is rarely helped by the environment or supported by means of statements that would help with acceptance, starting with the communication of the diagnosis. Instead, parents hear comments such as, 'Consider giving your child away!', or 'Be happy your child is not mentally disabled!' Mothers do not feel competent enough in raising their children and are often left clueless. Several sentences that left a deep impression and lingering pain were also highlighted in the conversations and were heard in connection with their child's diagnosis: 'There is nothing wrong with this child, only his mother!'; 'Behavioral problems are caused by ADHD and inconsistent upbringing'; 'It's all due to today's upbringing!'; 'I wouldn't be able to do that!'

Despite the challenging and emotional topic, the group members shared a mutual sense of trust and openly shared their thoughts, experiences, doubts, and feelings. During conversations and mutual group thinking, strong emotions often surfaced. For example, several people stated that they had already heard from their child that they were not good mothers. As the following parental quotes show, our initial assumptions were confirmed. Group members were often left alone with their problems, have not yet processed the sense of loss associated with their child's diagnosis, want support, and desire a peer community. The group members thought the meetings were useful and supportive and our group achieved its goal. The group members shared the following thoughts with us at when we met for the last time:

'There is a constant balancing in our little world. It was good to chew on a topic for weeks. The great pain of the world that I had in myself has been restored here! There are losses, but they can be put in place.'

'At first I thought how different we were. Now it's like we've known each other for a thousand years. It was good among you. Regularity meant a lot. Drawing the loss line was very instructive.'

'We still have to deal with the losses. It is difficult to believe, the good shocks me but here I have realized that there is a change in children, in development and at home as well. For two years we had no track to start with the two kids anywhere. But here I saw that someone else was having troubles too, yet he was getting around. We will give it a try.'

Parents soon realized that during group time, they create self-time for themselves and that, in general, it is important to pay attention to themselves in other areas of life. Participants understood and allowed themselves to devote time to themselves. They realised that, if they are well, the child is well and the family subsequently functions better. The group also had a positive effect on families and their relationships with their disabled children: they began to observe their disabled children, see their positives and small developments, spend shared times with each other in a way that had a positive impact on everyone, and see their relationships realistically.

Overall, families dared to use their own and group resources sooner than in a larger group. They exchanged contacts with each other sooner, started to rely on one another sooner (e.g., they went home together, helped each other in finding a job, brainstormed for improvements and time management). The strength of the peer community is that this has happened to others: they are no longer alone with their problems and have achieved a strength that they cannot receive within the framework of an individual therapy. This retaining power of group and peer community was felt most here in this group.

Conclusion, proposal

In our twenty-first century world, we live amidst a state of constant change that demands individual and systematic flexibility and adaptation. This circumstance in turn requires increasingly rapid adaptation from both families raising children with special needs and host educators. Responding to change is most effectively supported by transdisciplinary teamwork. By developing our two good practices, we undertook to support cooperation and communication between families and colleagues.

During the attitude-forming training, the differences between the educational bodies were confirmed (age, location, leadership attitude/management, inclusive approach, educational life path). Educational bodies need support tailored to the collective (e.g., case studies, continuation of trainings). In some institutions, we were able to start therapeutic team discussions, but the COVID19 pandemic significantly hindered these efforts. Although relationship of the colleagues to co-education revealed a broad spectrum, it can be said that they all moved in a positive direction after working together. The training's limitations are also multi-component and include factors such as timeframe constraints, different needs to continue, and irrelevant expectations.

With our resource group developed with the aim of supporting families, we strove to provide more complex care for those involved and thereby increase the satisfaction of participating parents. Parents raising a child with special educational needs became more involved in the development of their child by dissolving the tensions within and were able to become involved as partners in transdisciplinary teamwork, a change that had a positive effect on integration processes. Not only on their own but also among their peers, participating parents found a resource in the group to help them adapt to change and process losses.

Our future plans include the continuation of our attitude-forming work (development of individual solutions tailored to the collective) and its expansion (involvement of new educational bodies). The constant need to continue the parent groups has affirmed our decision to start new groups. Developing an online or hybrid version of the training has become necessary in response to the changes caused by the pandemic.

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Inclusive kindergarten education

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The early education of children with special educational needs in kindergarten with their typically developed peers is a great opportunity for the next generation to have experiential knowledge that diversity is a natural, everyday thing at the level of abilities as well. In our longitudinal qualitative research, we describe the integrational process of a kindergarten in Budapest, as we followed the institutional transformation almost from the beginning of the integration. Research methods: recording of semi-structured interviews and then qualitative text analysis using Atlas.ti software; and metaphor method with the target concept of kindergarten and integrated child. The results show that the actors in the process have mobilized their internal reserves to address inclusive education, both at the individual and institutional levels. The initiator and primary force behind the process was the director committed to integrated education, who steered the process along the way. During the process, the interviewees' awareness and critique of the task increased, and the relationship with special education teachers and parents became more important.

Keywords: kindergarten, inclusive education, longitudinal qualitative research, special educational needs

Theoretical background, research question

The integration of people with disabilities into society is a very important task and goal for the twenty-first-century Hungary. Two prerequisites are required to reach this goal. Firstly, the institutions used by the non-disadvantaged members of society – services, communities – must be available without limitations and made barrier-free. Secondly, people with disabilities must also be taught the competencies necessary for them to be independent and practice self-determination (to the greatest extent possible in their condition) within mainstream society (Zászkaliczky, 2012). Education is inevitable to reach these objectives, with a special emphasis on inclusive education, whose theory and practice is currently in the focus of (special) educational research conducted both in Hungary and abroad (see also Csányi & Perlusz, 2001; Zászkaliczky, 2002; Artiles, 2006; Mesterházi, 2007; Perlusz, 2008; Bánfalvy, 2008; Papp, 2012; Réthyné, 2013). The most relevant question currently is whether quality education can be realised within the framework of inclusive education. Proving this is currently one of the most important objectives of European Agency of Special Needs and Inclusive Education (European Agency, 2014). Parents generally wish their children to become more tolerant and empathetic at school, but they also want to provide the best education to their (non-disadvantaged) children.

The early education of children with atypical development and special needs who learn together with their typical peers in mainstream institutions is a huge opportunity for the next generation to recognise diversity as a natural, common, normal phenomenon in terms of abilities as well (Kron, 2006, 2010; Zászkaliczky 2002; Kőpatakiné, 2004). Research results suggest that quality early education is realisable in an inclusive education environment (Odom, 2002; Kőpatakiné, 2008; Kron et al., 2010; Garai & Kron, 2009). Since a kindergarten is a natural educational environment for children displaying different levels of development, this type of institution is an excellent opportunity for introducing the inclusive education of children with special educational needs. When doing so, the assumption is that inclusive education is both beneficial for children with and without special needs. Inclusive early childhood education is prerequisite for rendering inclusive school education high quality, efficient and equitable. The European Agency defines five key factors for successful inclusive education: (1) *As early as possible*; this category includes early detection and assessment as well as early intervention, early admission to the kindergarten and the support of transitions. (2) *Inclusive education benefits all;* equity and high-level school performance is achievable at the same time. (3) *It requires highly qualified professionals;* highly qualified professionals are indispensable in training teachers for inclusive education, developing competencies and holding in-service trainings. (4) *Support systems and funding mechanisms;* inclusive education requires the involvement of additional resources. (5) *Inclusive education must be based on reliable data* (European Agency, 2014).

For social inclusion, it is very important that children – the would-be adults of the next generation – accept diversity as natural (Kőpatakiné, 2004). Kindergartens have a key role in the process of educating children in this spirit, with openness and modern pedagogy (Papp, 1995; Bakonyi, 2005). A central topic of special education research is finding the circumstances which make the education of children with special educational needs successful in the kindergarten (Odom, 2002; Papp, 2003; Kőpatakiné, 2008; Garai & Kron, 2009; Kron et al., 2010; European Agency 2014). The personality, attitude, knowledge, and actions of participants in the educational process have a tremendous impact on the success of inclusive education (Papp, 2002; Kókayné, 2007; Perlusz, 2008). It is therefore essential to clarify areas of competency and cooperation between professionals (Papp, 2007, Szekeres, et al., 2013; Mile, 2016).

Although the process of integration is gaining momentum, kindergarten professionals and parents are often puzzled and mistrustful when it comes to inclusive education. Yet more and more kindergartens admit children with disabilities, albeit sometimes influenced by outside pressure. Partly due to age-related characteristics, children with special educational needs are often admitted to kindergartens without any official diagnosis. As a result, they do not receive professional help and state-guaranteed, extra funding is not made available, which leaves kindergartens facing the problem alone. Although subjects on inclusive education and differentiation are part of the teacher training curricula, teacher trainees rarely meet children with special needs during the practical part of their training (Baloghné Bakk, 2013).

Research on inclusion also places great emphasis on the various aspects of inclusion. Theoreticians of inclusive education describe inclusion as an infinite process that requires an ongoing effort by all participants (Odom, 2002; Kron, 2006; Booth & Ainscow, 2011). Inclusive education research suggests that the open attitude of teachers and peers is key to the success of inclusive education (Perlusz, 2008; Perlusz & Balázs, 2008; Szekeres, 2011a, 2011b). A special emphasis is placed on the teachers' view of human beings, children, and their emotional stability. All participants in the educational process must rethink how they see children, students, and the learning and developmental process.

Inclusive education also requires exploring the hidden resources of teachers and the educational institution. An institution can become a professional centre if it recognises this fact and views inclusive education as its central objective (Papp, 2002; Kókayné, 2007). The idea of inclusive education not only considers human diversity natural but sees heterogeneity as a resource and takes advantage of its opportunities in the educational methods, both in group and activity organisation (Kron, 2010). This approach rejects the view that homogeneous groups of students even exist. Inclusion assumes the adaptation of tools and methods, as it aims to create conditions which ensure the barrier-free participation of all children in the learning process and community activities while heavily relying upon special educational experience in doing so (Odom, 2002; Kőpatakiné, 2008; Kron, Papke & Windisch, 2009).

The quality of inclusion is affected by the cooperation of professionals and institutions (cf. Papp, 2002; Szekeres, et al., 2013), as they represent the sufficient expertise needed to educate children with special needs. The success of inclusive education requires establishing a partnership based on trust and the exchange of information between the parties of institutional education and the parents. In practice this cooperation often fails, and not only in Hungary (Meilinger, 2011; Podráczky & Marton, 2012; Belmont et al., 2012; Marton, 2019).

An inclusive approach utilised by early childhood teachers is key for the success of inclusive education. However, it seems that the formation of the culture of inclusion is not only a matter of determination and the fulfilment of conditions set out by the legislation, but a process that unfolds much more slowly. Creating the conditions for inclusion is a longer process on the institutional level as kindergartens proceed along their own learning curve.

Research methodology

In our research (Tamás, 2017), we analyse inclusive early childhood education by applying a qualitative strategy (Szabolcs, 2001*)*. We describe the integrational process in a kindergarten community by means of a longitudinal qualitative examination. As for the epistemology of our research, this is closest to the constructivist paradigm (Nahalka, 2003). We were primarily interested not in objective facts, but in the beliefs and thoughts that early childhood teachers have constructed in connection with inclusive education.

The selected kindergarten began the process of integrating children with special educational needs in early and mid-2000 as a response to political priorities and demographic pressures (Békési & Kasza, 2008). Research suggests this example is not uncommon among kindergartens. The process of creating the conditions took place in parallel with the introduction of integrated education. The central question of our research is whether an inclusive identity can be formed in these circumstances and, if so, what factors contribute to moving this process forward.

Research question

1. *How do early childhood teachers see the tasks of a kindergarten at the beginning of an integrated education process and later? What modifications of the methods do they consider necessary? What differences in the choice of words signify a change in attitude toward integral education?*
2. *How do early education teachers see integrated children? How do children with special educational needs appear in the accounts of early childhood teachers?*
3. *What changes are generated in the day-to-day life of a kindergarten that undertakes inclusive education? What milestones can be identified in the integrational-inclusive process? What is the characteristic relationship network of kindergartens? What is the impact of inclusive education on institutional culture?*

The framework of the research

The location of our research is a kindergarten found in one of Budapest's outer districts, in a suburban environment. The institution has two sites and educates a total of 210 children in eight groups. In 2013, thirteen of these children exhibited special educational needs. The staff consists of seventeen early childhood teachers, with eleven nurses, two pedagogy assistants and two support staff responsible for day-to-day maintenance and repair. Six of the groups are mixed-age groups, while two are homogenous in terms of age.

The kindergarten had conducted inclusive education for about a decade. It received the official task of the integration of children with special educational needs in 2004 as a result of different motives stemming from an obligation (the maintainer municipality had an explicit demand to transform district kindergartens into integrating kindergartens) and the demand of the population (parents applied for admission of their children with special educational needs). Education policy trends (merging kindergartens, the threat of closing some kindergartens) and, finally, the head teacher's intention to innovate also contributed toward this decision. The duration of the research spanned the period between 2007 and 2014.

Research methods

To answer our first and second research question, which is concerned with the views of early childhood teachers on the tasks of an inclusive kindergarten, the transformation of their work, and integrated children, we chose the qualitative interview method and the metaphor method. The narrative method is suitable for exploring several world views (Ehmann, 2002), by which the interviewee's interpretation of a part of the world can be mapped. The interview method describes phenomena in their context, with a limited possibility of generalisation (Sántha, 2009).

In the course of the research, we conducted 11-11 semi-structured interviews with the teachers of the kindergarten in both 2009/2010 and 2013/2014. We compiled the interview questions to cover three main topics: (1) The preliminary knowledge and experiences of the interviewee, the positive aspects of inclusive education: [How long have you worked with an integratory approach? What preliminary knowledge did you possess when starting the integrational process? What are your experiences? What have the difficulties been? What were the positive aspects of integrational work?] (2) Changes in the administrative work resulting from the integration: [What did you have to change in your work?] (3) The relationship of the early childhood teacher with his or her colleagues, the parents, and the special needs teacher: [Where did you receive help from? How was your relationship with the special needs teacher? How was your relationship with the parents? How did other parents react to integration? Would you continue the process in the future?] We used open-ended questions to avoid suggesting any answers to the interviewees and to give them the opportunity to elaborate on their opinions.

The metaphor method uses metaphors as a part of the qualitative research methodology, to explore human thinking. It helps in examining phenomena and concepts that are too abstract or too common, both of which make them hard to describe (Vámos, 2003). The analysis of metaphors brings us closer to understand how the person sees the world.

In our studies we evoked the use of metaphors for the target concepts of the kindergarten and integrated children. I performed this examination with every staff member of the kindergarten in December 2009 (N=30) and April 2014 (N=32). I instructed them to produce metaphors in writing, with an explanation. Interviewees were requested to finish the following sentences: Kindergarten is like... and An integrated child is like... I also instructed them to provide a short explanation to the metaphors.

Our third research question concerned any identifiable milestones in the integrational inclusive process, the relationship network of the kindergarten, and the impact of inclusive education on institutional culture. Beyond the interview method, we chose the method of document analysis. Document analysis is a non-intrusive technique. The basic documents of the kindergarten (articles of incorporation, the local educational program, annual reports, job descriptions, organizational and operational rules, institutional quality assurance program) were analysed from the aspect of inclusive education (physical, legal, personnel and organizational conditions, relationship network, initiatives to involve the parents).

The method of processing the interviews

We systematically followed the methods of qualitative content analysis in our work. As a novel approach in the research of inclusive education, we used content analysis software and followed an inductive path of analysis

(Szokolszky, 2004; Sántha, 2009) in forming the category system giving the results of our research. This kind of a system made it possible to compare the data and to form a theory.

Content analysis was based on the interview packages conducted in 2009/2010 (A) and 2013/2014 (B). During the preparation phase, we generated two hermeneutic units in the Atlas.ti 5.5 content analysis software. We did not use a preliminary category system for the coding of the interviews: instead, we coded based on the text and by using the methodology of the Grounded Theory (Glaser & Strauss 1967 quoted by Szokolszky, 2004), following an inductive path of research.

After cleaning up the codes (filtering out redundant and empty codes) we received 331 codes. These served as the basis of our analysis; we first ordered them, organised them into groups we named 'code families', then we generated new categories (supercodes) based on the exploration of their connections and the unfolding system of aspects. As regards qualitative research strategy, the majority of the dilemmas come from the need for the objectivity, reliability, and validity expected from scientific research (Szokolszky, 2004). Although qualitative strategy factors in subjectivity on the part of the researcher, the professional approach requires as much objectivity as possible. In order to attain this, we used a systematic method to process and analyse the data used for the research.

Research results

To answer our first two research questions, we have applied the code system gained by processing the interviews, and the results of the metaphor analysis. An important basic principle is that everything learned about the kindergarten is indirect information gained through the filters of the early childhood teachers: their views and personal beliefs are heavily reflected in the research material. The statements on other participants of the educational process cannot be seen as objective facts on the practice of integration but give information about how the interviewee perceives them. One of the most important results of this research is the code system gained by the content analysis of the interviews. We extracted the answers to our questions by unfolding certain segments of the code system.

How do early childhood teachers see the tasks of a kindergarten at the beginning of integrated education process and later?

Based on the interviews made with early childhood teachers, the primary purpose of the kindergarten is to support the development of healthy children. Initially, the early childhood teachers relied on their own beliefs, meaning that they thought they did not need to change anything and would be able to achieve success by instinct, by depending upon their inherent personality. In reply to the question, '*What did you have to change in your work?*', they usually emphasised personality traits rather than methods or changes in the environment. In their opinion, socialisation and raising integrated children was exclusively the task of other special needs educators. One positive element can be found in the fact that the teachers considered it their task to realise differentiated education and development.

The interviews made in the second round showed that the early childhood teachers had become more critical of the task and dared to communicate their negative and controversial feelings as well. It was an improvement that they did not disregard problems but rather recognised them and took them seriously. The main problems they mentioned were related to organisation and conflict resolution. It was hard for them to experience failure even when they had done their best with a given child, yet still did not achieve results. The factors pointing to inclusion could be detected in the interviews: the teachers recognised that teaching the children to play was also their responsibility. Recognising this role is especially important in inclusive education as it is hard for these children to start to play spontaneously: doing so requires the help of an adult. Progress had been made compared to the past in the sense that the educators tried to get to know the children, make them happy through individual activities, and noticed their individual differences and positive traits (diversity).

It was further considered a task of the kindergarten to form a habit system of children including special needs children as well; they did not exclude them but considered them members of the community. The use of special equipment was incorporated into everyday work, and the environment was made more suitable to inclusive education by structuring the available time and space. Early childhood teachers did not keep their problems to themselves but talked about their work-related demands. In the beginning, the early childhood teachers mentioned very few critical remarks regarding the task itself. They stated that the teachers had an accepting attitude, and groups were inclusive, everybody did their best in their work, but their wording also signified ambivalence and uncertainty.

The metaphor analysis of the role of the kindergarten suggests that the metaphors connected with the kindergarten were very similar in both cases. According to these, a kindergarten is naturally associated with a family, a home. In 2009, twenty respondents (compared to seventeen in 2014) completed the analogy to convey the meaning 'kindergarten is like a family', or 'kindergarten is like home/a second home'.

How do children with special educational needs appear in the accounts of early childhood teachers?

The interviews revealed that teachers mainly considered integrated children the ones whose behaviour caused problems for them and for the group. The most serious problems they mentioned were aggressive behaviour and unclear communication on the children's part. Education in a mainstream kindergarten with its social and physical environment and its incompatibility with children with special needs resulted in the failure of inclusion in several cases. Educators saw the children as the primary cause of this failure. However, they considered temporary inclusion a success that they ascribed to the competencies of the child in question. Early childhood teachers defined the following traits and competencies as factors supporting inclusion: quiet, calm, non-aggressive, cheerful, resilient, and cute. They considered it a child's positive trait if he or she did not disturb the life of the group. A competency helping the child to fit in was if they were adaptable, they liked going to the kindergarten, and were independent.

Later, the educators still mentioned aggressive behaviour as the primary obstacle to the inclusion of certain children. A factor leading towards inclusion was that the educators had become more reflective regarding the topic. They reported successes that they merited to their own work, but also mentioned some failures. Interviewees considered even small changes as results and noticed the improvement of children. Another important change was that interviewees realised that the children had different characteristics from what educators had expected, and that the problems were not exclusively related to the children's disadvantages.

Out of the metaphors received in 2014 (N=32, twelve of which were not metaphors) the following ones emphasise the differences: *Martian, black sheep, odd one out.* The number of metaphors meaning 'something to be deciphered, to be understood' had increased since the previous interviews. They included *a great mystery, an undiscovered continent, a special planet or star*. There were some metaphors with the meaning sensitive, vulnerable: *nestling, a sensitive little instrument*, *a special flower* and *a defenceless little being*. In 2014, we did not find any metaphors suggesting danger as these had been replaced by the notion of *task*. A characteristic element of the explanation of the metaphors was that interviewees gave feedback that was relevant to integrated children and working with them, but was not related to the given metaphors (e.g. the description of *miracle*: 'A curiosity, a task. It is a tremendous responsibility for everybody, it leads people to recognize that there is no connection without each other, and it is love that enables successful outcomes'). When examining the explanation of the metaphors, five of the interviewees mentioned that integrated children posed a special task to them. In summary, the metaphors recorded in 2014 suggested that an integrated child is a *sensitive, mysterious being, who shall be understood and poses a task*.

What changes are generated in the day-to-day life of a kindergarten that undertakes inclusive education?

Our results suggest that the initiator and primary force behind the process was the director committed to integrated education, who steered the process along the way. This process resulted in the transformation of the organisation. She organised the alignment of the institution documents to the task, participated in a training on integrated education, and joined the international research on inclusive early childhood education with her kindergarten. By modifying the organisation and forming work groups, she involved her colleagues and fostered their cooperation. An important aspect of employing new colleagues was their background knowledge, experience of integration, and their inclusive approach. Those who could not identify with the integrational ambitions of the staff changed jobs.

These changes pointed towards inclusion. The interviews that were recorded at a later date suggest that the early childhood teachers had become more critical toward the task over time. They recognised integrated children's improvement and did their best to support that process. They were proud of their achievements. They shared their experiences with each other, tried to get to know what the children were interested in, and approached them with individual methods. They marvelled at the uniqueness of each child and realised their special needs. This realisation also made them uncertain: upon feeling that their knowledge was insufficient, they became motivated to take part in trainings. After attending a methodological training organised by the director, they began to rearrange the environment and to use special tools. It was important that the whole staff of teachers took part in the trainings together at their own institution, and incorporated the methods learned in their work, thus enriching their own knowledge as well as practical skills.

The support given by special needs teachers is controversial. In the beginning of the process, there was no special needs teacher present who could have coordinated the transformation of the institution towards inclusive education and prepared the staff for the new task. Such preparatory work is needed to settle legal, technical, and organisational matters while also providing consultation in order to facilitate discussion of emerging issues. When approaching the issue from the task system of special needs teachers, it would be important to form a working relationship between the kindergarten or the special needs institution and the children's homes.

The admission of children with special needs was rarely preceded by any preparation on the part of special needs teachers. A close coherence exists between the extent of such work and the success of the inclusion process. In cases when the kindergarten teacher previously developing the child shared his or her experiences with the new kindergarten, the inclusion of the child was successful and long-lasting. A common trait of those cases was that this contact was established at the initiative of a cooperative, highly qualified parent.

In many cases, children were admitted to the kindergarten before the travelling special needs teacher could give them support. The roles of the travelling special needs teachers changed frequently (at the beginning it was customary that as many as three special needs teachers developed one child in one year). The special support of children admitted to the kindergarten was not always organised properly: one child was taken out of the kindergarten for this reason. In the beginning, the travelling special needs teacher only dealt with the child assigned to him or her, with minimal interaction with the early childhood teacher. In short, there was almost no cooperation among the various educators. The early childhood teachers did not know about the work of the special needs teachers: their experience was that the child was taken out of the group, allowing the early childhood teacher to concentrate on the other kids. The interviews revealed that, although special needs teachers spent a lot of time in the kindergarten, the staff members did not 'experience' their presence. Individual development and group work was not always coordinated; there were some cases when the child was taken out for individual development in the middle of his or her favourite group activity. The special needs teacher did not participate in informing the parents; in a questionnaire survey filled in by parents, none of the parents named the special needs teacher as a source of information.

However, a visible improvement did occur during the process, as the level of professionalism rose in the course of the educators' work. Kindergarten staff members took part in a methodology training on children with special educational needs (visual support, time, and space structuring). The process of implementing the material started, meaning that the environment, visual support, and the use of daily schedules were rearranged. Since 2013, the same teacher has supported the children and not only performs individual development, but also discusses her experiences with the early childhood teachers, attends kindergarten events, and supports the children in the group, together with the regular staff. Since the Public Education Act has entered into force, three educational assistants have also worked in the kindergarten; the director considered this to be a significant improvement. One of the assistants has meanwhile received a degree in special needs education and is constantly available as a counsellor and source of information.

The message of the research

Based on the findings of our kindergarten research, the peculiar way in which the obligations had been undertaken before the conditions even existed may be, in spite of all the difficulties it involved, successful after all. A very hard and slow process has begun, with all its pitfalls and hardships, but our research suggests that this approach may be viable in the long run. These results reflect that the stakeholders mobilised their internal reserves to manage the situation, both on an individual and institutional level. Early childhood teachers often quoted the director, who said that a good enough starting point is for the teachers to love the children. This approach has proved to be successful in that it helped reduce anxiety at the beginning. As a reference point, love corresponds with a great amount of work, if taken seriously. In this kindergarten this approach was followed by action and taking responsibility for the admitted children.

This research additionally suggests that it is necessary to transform special needs support. The tasks of the special needs teachers supporting inclusive education must include consultation with early childhood teachers: a necessary timeframe and institutional background must also be provided for this service. It is also essential that there be a person who has an overview of the administrative and professional tasks as well and maintains his or her sensitivity in working with people at various stages of the inclusion process who experience the natural ebb and flow of acceptance and refusal throughout these stages (Reiser et al., 1994).

A subject of further research may be to evaluate the state of special education in kindergartens, and the impact on the inclusive identity of the institution if the special needs teacher is a travelling teacher or the member of the regular staff. It would also be interesting to examine the consequences of separating professional tasks in kindergarten childcare. Another important question is what kind of organisation, cooperation, and educational policy development is needed to make the special education of small children flexible and easy to organize, since the time element is very important in their lives.

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Integration practices

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The pedagogical practice of acceptance paves the way to integrating those disadvantaged children who can only live their daily lives with support and would experience a learning process full of failures without the proper aid. Societal expectations and social integration can only meet successfully when the spirit of educational institutions and the attitude of teachers demonstrate an accepting attitude. The structure of the institution must furthermore undergo a transformation. When good practices are included in institutional regulatory documents and efforts are made to comply with them, i.e., the institution adapts to the individual needs of the child, then inclusion can be said to occur. Ensuring the conditions necessary for inclusion is a major challenge for the teaching community. Many creative initiatives launched for the purpose of implementing integration demonstrate that the harmonious cooperation of teachers, parents, and children is essential in the process. An example of such an initiative can be found in the second phase of our sensitising series.

Keywords: disadvantage, special attention, inclusion, good practices, learning support

Introduction

Integrating disadvantaged communities is one of society's greatest challenges. This paper relays our cooperation with two initiatives related to the empathy challenge launched by UKids, a social entrepreneurship education project. The first project concerned the implementation of a sensitisation programme that we conducted with lecturers and prospective kindergarten educators from the Eötvös Loránd University Faculty of Primary and Pre-School Education. Our lecturers and pre-service educators were joined by the fourth- and fifth-grade students of the ELTE Gyertyánffy István Practice School in Budapest. The aim of this programme was to increase participants' awareness of social issues while making children more aware of their civil duties. By targeting a range of age groups, it was our goal to encourage a sense of responsibility toward society's daily challenges while simultaneously developing their skills in seeking alternative solutions.

The second project to occur as a part of this effort began by establishing a joint-cooperation with the Ugyer Member Kindergarten of the Széchenyi Road Nursery School in the city of Cegléd. This institution was an essential factor in our further efforts. As a part of our effort to sensitise members of the majority society to the value in developing unity, inclusion, greater familiarity with other cultures and lifestyles, battling prejudice, and building common networks for communication, we turned our attention toward exploring the daily lives experienced by Hungary's Roma. Found not far from the city of Cegléd, the Roma children who attend the Ugyer Member Kindergarten come from the outlying, infrastructurally undeveloped farming area of Ugyer. As inspiring as this natural 'world of wonders' proved for those who had mainly been familiar with the urban world of Budapest, we chose Ugyer for its deep poverty and residential Roma community. Our aim was to expose project participants to this community's living circumstances while developing a greater level of responsibility and empathy toward their fellow man.

The Roma comprise Europe's largest ethnic minority group. Out of an estimated ten to twelve million Roma living in Europe, approximately six million are citizens or residents of the European Union. Many Roma are still victims of prejudice and social exclusion. For the purpose of this paper, it must be clarified that the term 'Roma' encompasses diverse groups, including Roma, Sinti, Kale, Romanichels, Boyash/Rudari, Ashkali, Egyptians, Yenish, Dom, Lom, Rom and Abdal, as well as Traveller populations (gens du voyage, Gypsies, Camminanti, etc.). While many Roma citizens who live in Hungary prefer to identify themselves as cigány, the term traditionally used in Hungary for Roma, we use 'Roma' in recognition of the great diversity of cultures and ethnic groups that this designation implies while distancing ourselves from the pejorative overtones that can sometimes be attached to the word 'cigány' when used in certain contexts. Given that some aspects of Hungarian Roma culture – most notably those related to music and dance – have virtually evolved into their own genre known as cigányzene ['cigány music'] or cigánytánc ['cigány dance'], in instances related to cultural heritage we use the term cigány out of respect for the numerous contributions Hungary's Roma communities have made to Hungarian culture.

According to the EU, all Roma should have the opportunity to realise their full potential and engage in political, social, or cultural life. Beginning in 2023 onwards, member states of the EU must report on the implementation of National Roma Strategic Frameworks[1] every two years, including measures to promote equality, inclusion, and participation.

As was mentioned previously, our project began with visits to the kindergarten in the settlement of Ugyer, located in the middle of a disadvantageous, mostly Roma-inhabited region that largely depends on agriculture. During joint play activities and outdoor games, our group gained familiarity with the kindergarten and gained insight into the everyday life of their attending children. Our aim was to assess the attitude-shaping role of the sensitisation program. We can conclude that this part of the program was implemented in a way that made sensitisation successful for both the school children and pre-school teacher students involved.

[1] https://ec.europa.eu/info/policies/justice-and-fundamental-rights/combatting-discrimination/roma-eu/roma-equality-inclusion-and-participation-eu_en#eu-roma-strategic-framework-for-equality-inclusion-and-participation

A continuation of this series of programmes is the realisation of the seemingly unattainable dream of preschool children from Ugyer: to travel to Budapest, the capital city of Hungary. Together with their companions, a group of preschool children from Ugyer visited the Eötvös Loránd University's Faculty of Primary and Pre-School Education, where pre-school teacher students and elementary school students awaited them with a variety of programmes. In this part of the project, the experience and implementation of the practice of inclusion played an essential role. The good practices detailed in this paper were tested and applied in the course of the Ugyer pre-school's visit to Budapest. For more international projects on Roma Inclusion, i.e., to improve the access of Roma children to quality early childhood education and care see the website of the European Commission (European Commission, 2011)

For a compilation of Roma inclusion good practices in Europe see the website of the European Commission (European Commission, 2010). To study a successful project in a little village in Slovakia see the Politheor website (Bajtosova, 2019).

Literature review

According to the *EU Roma strategic framework for equality, inclusion and participation for 2020–2030*, education is the area that has progressed the most in the past years, notably in the areas of reducing early school-leaving and improving participation in early childhood education and compulsory schooling (European Commission, 2020). However, cases regarding the segregation of Roma pupils in education have increased. The Commission has initiated infringement procedures against three countries (CZ, HU and SK) for the school segregation of Roma children. In contrast to the field of education, access to employment has not improved. Mainly due to inadequate and segregated residential areas, access to adequate housing also remains difficult. Antigypsyism, hate crime, and the human trafficking of Roma (in particular women and children) continue to be matters of high concern.

To achieve greater and faster progress, the current EU Parliament has laid out a new Roma Strategic Framework for the purpose of promoting effective equality, socio-economic inclusion, and the meaningful participation of Roma. In terms of education, the strategic framework aims to ensure that by 2030 at least 70% of Roma children participate in preschool education while fewer than one in five Roma children attend schools where most or all students are Roma. The Strategic Framework also aims to increase effective equal access to quality, inclusive, mainstream education. The National Strategic Framework should present a plan or set of measures for preventing and fighting antigypsyism and discrimination, segregation in education and housing, and anti-Roma prejudices and stereotypes, including those found online (European Commission, 2020).

In Hungary, there are settlements and districts where the disadvantaged social strata – mostly comprising citizens of Roma origin – form segregates. This social problem has also infiltrated educational institutions. In many cases, due to prejudice, parents do not enrol their children in institutions with a high proportion of Roma children. Given that this topic is a sensitive one across several disciplines, a clear position cannot be taken, but a stance can be supported by means of implementing integration practices. Implementation poses a particular challenge for teachers in those educational institutions where social integration should be a top priority. Ensuring fair treatment and individual needs goes beyond any effort to achieve equal opportunities.

In addition to an inclusive approach, institutions must also play a role in compensating for disadvantages. The biggest challenge is the language barrier as a limited language code and low level of speech comprehension hinder the development processes. Thus, this distinct disadvantage can carve a direct path to further learning difficulties or disorders later on. To avoid this circumstance, it is important to maintain contact with the parents of the children in kindergarten and define the parents' role in facilitating developmental processes. A good method for accomplishing this aim is furnished by the organisation of joint programmes where educators and parents can get to know one another in a way that reassures parents regarding the usefulness of the work conducted by educational institutions. Such a programme can further reassure parents that their children are in good hands on a daily basis. Once this relationship has been established, parents are happier to let their children go to kindergarten and school (Pankotai & Hegedűs, 2019). This study therefore presents an example of good practices utilised in the interest of this kind of an integration effort.

Good Practices

Accompanied by their parents and kindergarten teachers, on 21 March, 2019, a group of kindergarten children from Ugyer travelled by bus to the Eötvös Loránd University Faculty of Primary and Pre-School Education, located on the Buda side of Hungary's capital city, Budapest. Their reception required great organisation on the part of young and old alike.

Throughout this visit, our main goal was to develop a common language for the basis of communication. We planned to accomplish this aim by means of a series of interactive activities. When planning these activities, both individual needs and the factor that the majority of these children and their parents had never left their settlement were taken into account. In other words, we were certain that all the information they absorbed from the Faculty's environment would be new to them.

As a first step, we furnished the reception halls. A separate room was provided for the placement of bags and coats (Picture 1) and for the location of the activities.

Picture 1
The Reception Hall

Meanwhile, the primary school children who had accompanied us during our kindergarten visit, also arrived. We were fully prepared and excited to receive our little team of guests from Ugyer. We awaited the kindergarten children, their parents and kindergarten teachers at the building's entrance and accompanied them to the scene of our joint activities. (Picture 2)

Picture 2
A group photo of the participants

The pre-schoolers and their kindergarten teachers also had several surprises in store for us. First, the kindergarten teachers held a presentation for us. They brought us a basket full of the kind of skirts, aprons, and shawls that Roma women used to wear as a part of their traditional dress. Some of these clothes were borrowed from a grandmother who lives in Ugyer. (Picture 3)

Picture 3
A presentation of a traditional 'cigány' folk costume

This was followed by the performance of a *cigány* dance held by the children. (Picture 4) During this event, the children were able to demonstrate their own individual dance skills, which they performed freely and accompanied by their own musical instruments. Two little pre-school boys drummed on jugs and provided the musical background.

Picture 4
Performing a traditional 'cigány' dance

Then the kindergarten teacher students took control of the pre-school group and played the first Raindrop Game with them. (Picture 5) The purpose of this game is to acquaint children with matching oral directions to certain movements and sounds while they remain seated. When the "rain" is falling, the children are to tap the table with their pointer and middle fingers; to express a light drizzle they extend all of their fingers and tap the table as if hitting piano keys. When hail arrives, they then hit the table harder with their knuckles. Various associated forms of weather – heavy winds, snow, thunder, lightning, etc. – can also be added to this game. It should be mentioned that pre-school education in Hungary is firmly based in the method of teaching via various forms of games and/or free play. In pre-school, the main aim is to develop physical, emotional, mental, social, and communication skills while acquiring knowledge. The children do not study the weather-related facts and vocabulary mentioned above, but rather acquire this information via a game such as the aforementioned Raindrop Game. It is our contention that the flexibility and creativity demanded by utilising this methodology provides a suitable foundation for supporting inclusion in pre-school institutions: as the case of Hungary's Roma community demonstrates, the main issue is for educators and institutions alike to be better prepared to address the developmental challenges brought about by generations of poverty, antigypsyism, and inequal access to education.

In the end, both the pre-school and school children enjoyed playing this game very much, even though it could not be implemented according to the game's original rules due to difficulties in task comprehension. Adapting the game to the needs of our visitors still allowed everyone to have a good time while our pre-service educators also gained experience in altering a task to suit the needs of a group whose development does not fit a 'textbook' scenario.

Picture 5
Raindrop Game

These warm-up events and games were followed by team games. We took care to divide the teams so there would be a mix of pre-schoolers and schoolchildren on each team. This measure was taken so older children would be present to help the little ones with every task. At the first station, each child received a teddy bear-shaped passbook that they had to take with themselves everywhere, as they were given a sticker on their teddy bear passbook at the end of each of the five stations (Picture 6). Of course, each child took this passbook home with them at the end of the day as a keepsake.

Picture 6
Teddy bear passbook with stickers

At the second station, a game created for the purpose of developing eye-hand coordination (Picture 7) awaited the children. Loop sticks were inserted into a styrofoam circle, including four colours (red, blue, yellow, green) and two sizes (long and short). Pieces of drinking straws cut evenly into 2.5 cm pieces and in four different colours were placed in small bowls. The teachers discussed with the children the colour and length of the sticks. Then the children mostly figured out very skilfully how to place the pieces of straw onto the sticks. Some children could do this quickly and easily, but a few could only manage it more slowly due to difficulties in eye-hand coordination. Meanwhile, the schoolchildren tied line patterns on the sticks and then helped rearrange the game.

Picture 7
Sorting, tying, grouping

At the third station, the children put together pieces of images. (Picture 8) Four types of images were provided, including that of a duck, a grape, a ladybug, and a snail. When the picture had been completed, the station manager asked the participants if they remembered a song or rhyme that was about the image they could see in the picture. If they did, the children either sang the song or recited the chant or poem; if nothing came to mind, they got a little help.

Picture 8
Image puzzle

At the fourth station, children could play a game to develop their sense of rhythm. Quite aptly, the name of this game is Rhythm Phone. (Picture 9) After forming a line, the children must gently 'forward' the rhythm that the child behind them has already tapped on their shoulder. The pre-schoolers from Ugyer genuinely enjoyed the game while skilfully passing on the rhythm and even inventing very creative rhythms.

Picture 9
Rhythm Phone

At the fifth station, children had to place different images in a chronological order. (Picture 10) The children solved this task very skilfully as even the trickier pictures were quickly sorted. In one image, the seasons had to be placed in chronological order, a task that proved difficult for several children, but one that could still be learned with the help of the pictures. The school children were very helpful in that they supported the pre-schoolers throughout the entire process but did not solve the task for them. Instead, the older children tried to guide the younger children to the correct solution.

Picture 10
Image puzzle (chronological order)

At the sixth station, children played a game of trust. (Picture 11) Each pre-schooler was blindfolded while the schoolchildren led them along a track. The children had to reach the teddy bear called Jar and take him to the starting point. The schoolchildren were very helpful in supporting the pre-schoolers.

Picture 11
Game of trust

After the children got through all the stations, they ended by playing a relaxation game. The children sat in a circle and the pre-school teacher students placed a piece of paper in the middle, upon which they drew a man. Slow, relaxing music was played and the children closed their eyes, Jar, the teddy bear, walked around and touched each child on one part of his/her body. Then the children had to place a dot on the same body part that the teddy bear had touched on the picture of the man. The pre-school children sat with incredible patience and in silence until the teddy bear reached everyone. All people present were touched.

After the games ended, the children filed to the pre-set tables to have lunch. Following lunch, they received their well-deserved reward: each of them received a gym bag from the school, with a chocolate and a hand-sewn bunny in it. Before the children arrived at the university, the students had collected and bagged all the abundant donations that they and their university teachers had brought for the children. We were able to gift them a lot of good quality clothes, shoes, and toys. After the children got on the bus, they waved to us enthusiastically from the window, and we said goodbye to one another until the time comes when we meet again.

Summary

With a population of over 10 million, the Roma community comprises Europe's largest transnational minority. Often victims of racial and social discrimination, members of this minority group struggle to receive equal access to education, employment, and healthcare services. In recent years, the integration of Roma has become an important issue on the agenda of the European Union (European Commission, 2021, 2011, 2020)

In Hungary, numerous views and opinions exist regarding integration and inclusive pre-school practice. According to our Public Education Law, we refer to the co-education of children with special educational needs, Roma and multiple disadvantaged children. Whichever area is used as a basis, sensitisation should begin at a very early age. We joined the challenge of empathy of the UKids social entrepreneurship education project with two related sensitisation practices. The aims of the programmes are to implement social sensitisation in multiple areas and across age groups.

During the second phase of our project, we carried out charitable activities related to sensitisation. We hosted Roma pre-school children from Ugyer, who in turn introduced us to a taste of their own culture. Then we invited them to participate in a joint game that combined the developmental effect of perception with playful activities.

Throughout these activities, our pre-service teachers could observe that the preschool children displayed differences in several areas of development that could have been the result of intercultural variations. The children's communication was characterised by a limited language code, which we tried to replace with other means of expression, including rhythm exercises, touch, and games of trust. It was good to experience that children and adults turned to each other with great love, thereby setting aside all of our differences.

From this perspective, it can be concluded that the goal of empathy projects (sensitisation) has been fully implemented.

Throughout all phases of this project, both the children and the adults enjoyed themselves thoroughly and were able to learn a lot from one another. Sharing our time and discovering our similarities were only some of the short-term benefits to developing out mutually satisfying relationship. In the long-term, it is our hope that the experiences our pre-service teachers gained while in Ugyer and the good practices they were able to test among both the children from our practice school and the Roma pre-school students will enable the kind of pedagogical experience that fosters genuine inclusion. While much more admittedly remains to be accomplished in this area, we remain committed to any effort that halts the continued segregation of Hungary's school system.

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The role of the teacher in the educational achievement of Roma children

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This paper discusses the role of the teacher as the one who has the most profound influence on school mobility. My analysis draws attention to the teacher, who can facilitate the performance of Roma children at school by fostering a positive attitude toward learning, encouraging positive relationships, and thereby supporting the overall social mobility of this disadvantaged minority group. The research underlying this particular study consists of analyses of the life stories of Roma individuals who hold or about to obtain university degrees and have been particularly successful in the mobility channel of the education system by the standards of the Roma community. I point to the social factors that help or hinder the progress of the individual. In the analysis, particular attention was paid to the microsocial relationships affecting the school performance of Roma students as well as to the question of secondary socialisation.

Keywords: teacher role, socialisation, social capital, cultural capital, weak ties, educational mobility, romology, qualitative methods

Introduction

According to researchers, one of the key obstacles to the *social integration* of the Roma minority in Hungary is the low level of schooling attainment exhibited in the Roma population (Kemény & Havas, 1996; Liskó, 2003; Székelyi et al., 2005). Since the 1989 political transition from state socialism to democracy, the gap between the schooling attainment of Roma versus non-Roma children has grown wider. Nowadays, this gap appears in continued studies in secondary education. It is therefore particularly important to study the life story of young Roma people who have been able to take advantage of school mobility and are on the way towards social integration. By analysing successful life stories, we can also comprehend what underlying factors bring about the school failures affecting the majority of Roma students.

The background of this study is a qualitative research in which I examined the successful action strategies related to the school mobility of Roma individuals with the help of fieldwork conducted in different regions of Hungary. With the application of *narrative interview technique* (Elekes, 2015, 2018), I analysed the life histories of young Roma individuals who have or are on the way to holding tertiary-level degrees. It is furthermore important to mention that the selected participants openly express their personal affiliation with the Roma community, come from exclusively Roma families, and have been successful in the mobility channel of education by the standards of Roma society.

By learning about the diverse life stories that characterise modern societies, narrative interview research helps to explore society in all its complexity. The narrative interview analysis is based on *hermeneutic case reconstruction*, a technique that allows for the investigation of very complex social and psychic structures (Rosenthal, 1995). The analytical aspect of narrative life stories aims at identifying the typical patterns that emerge in different narratives relating the path to success. The aim of the analysis is to reconstruct the segments of the relationship between the individual and society, thereby revealing the diverse relationship between the individual and the social world (Kovács & Vajda, 2002).

The study seeks to examine *school mobility* from the perspective of the interacting relationship between individuals and society. Within this connection, we emphasise the determinative importance of the teacher whose role entails the ability to influence the *aspiration level* of young people, their school performance, continued studies, *the system of micro-social relations* with the peer group and, as a consequence, the social integration of the student.

Educational indicators in Hungary's Roma community

The Roma minority comprises Hungary's most populous ethnic minority. Almost completely uneducated before 1945 (Kemény et al., 2004), four-fifths of Roma youth were shown to have completed primary school during the post-1945 era. Yet it cannot be denied that this 'achievement' frequently entailed several years of delay and a lack of adequate knowledge on the part of graduates, while one-fifth never completed primary school at all. A representative study conducted in 1971 by István Kemény showed that 73-74% of young people remained practically completely illiterate despite the increase in the level of education of Roma youth (Kemény & Havas, 1996, p. 354). Already at this time, the study additionally pointed out that, as the distance between the educational attainment of Roma versus non-Roma children increased, the risk grew 'that the difference in educational attainment would become an ethnic feature and promote the formation of a colored minority' (Kemény et al, 2004, p. 78). Unfortunately, this prophecy has come true. During the 1970s and 1980s, the gap between the educational level of the majority versus the Roma population increased further and has remained so ever since.

Today this inequality appears most saliently when Roma students attempt to continue their studies in secondary schools. A very small proportion of Roma students have been able to gain admission to secondary schools while the drop-out ratio is very high among Roma youth (Liskó, 2003). (It should also be mentioned that all eighth-grade students in Hungary must take a national entrance exam in order to attend secondary school.) In the 1970s, 1.5% of Roma young people completed secondary school. This rate was 2%

in the 1980s, 3% in the 1990s and 5% in the 2000s (Kemény et al, 2004, p. 90). The results of research conducted in 1993 demonstrated that the prospects for attending further education have improved as more and more Roma young people (51%) continue their education after completing primary school. It must be stated, however, that most of these young people learn a trade at a vocational school while noticeably fewer young Roma people apply to a secondary school compared to young people from the majority society (Havas et al., 2002). When examining data collected during the 1990 and 2001 national census by the Hungarian Central Statistical Office (KSH), it can be seen that developments in educational attainment differ significantly for the Roma population in comparison to the non-Roma population (Hablicsek, 2007). Statistics from the 1990 and 2001 census prove that the Roma population displays an increase in primary education and vocational training in contrast to the non-Roma population, where the acquisition of secondary education and a higher proportion of tertiary education can be observed.

According to data from the Hungarian Central Statistical Office, there is still a tendency that Roma students do not succeed in secondary education after obtaining basic education. The proportion of Roma possessing no more than basic education is over 80% in all age groups, a factor that foretells weak labor market potential in the future (Hablicsek, 2007). Regarding educational attainment, territorial differences within Hungary also display vastly divergent trends. In terms of both primary and secondary school, Budapest's Roma community has the best indicators for completion of education. However, these data are only exceptionally good values as regards the Roma population; they are still worse than the capital's population of the capital, meaning that even this community lags behind the national level. Due to the fact that previous efforts to *integrate rural society* have remained unsuccessful, the statistics are even worse for the rural Roma population (cf. Bognár, 2009, 2010b).

When examining the education indicators of the Roma population, it can be seen that the proportion of Roma young people completing secondary school increased steadily in the 2000s, but decreased from 34.0% to 24.2% between 2013 and 2017 (a 10% decrease), while for non-Roma this same indicator remained unchanged (Bernát, 2018). Unfortunately, the figures for Roma young people in higher education are not high: slightly more than 1% of Roma youth attend a college or university while it remains uncertain how many will complete their studies with a degree.

The task of the teacher and the school in the process of social integration

As a result of demographic trends, Roma children are increasingly present in public education, a circumstance that imposes an additional workload on teachers who find it difficult to cope with this complicated situation. In order to teach Roma children successfully, educators should know whom they are teaching and the problems these children face daily. However, teachers have very little knowledge about the economically, socially, and culturally *heterogeneous composition of Hungarian Roma.* They are unfamiliar with Roma culture while the differences between *ethnic and poverty culture* are often blurred: understanding these traits could help to interpret students' behaviour in many cases. This lack of knowledge surrounding Roma culture also hinders the establishment of relationships with Roma parents because teachers at times misinterpret the family's motivation for schooling.

However, in order to realise the school mobility of Roma children and thus their social integration, the teacher should not only be aware of Roma culture but also make an effort to get to know the children together with their families. Ideally, the teacher should be in constant communication with the families. Thus, the school system should not only take the child into account but also his/her family when admitting a child of compulsory school age. With the child's school integration, the family should also be integrated into school life. This is especially difficult when the family itself is in a *deprived life situation*, e.g. unemployed, and/or deviant behaviour is present in the family. This means that the teacher faces the task of integration, a process society could not solve at the *macro level*, therefore its effects appear at the *micro level*. In many cases, the teacher has to deal with the financial and mental difficulties caused by unemployment and the deprivations that result from the family's disadvantaged position, a circumstance that becomes increasingly visible in the classroom day to day in the child's behaviour.

This situation naturally imposes another task and a different type of role on teachers, as a result of which the teacher's personality must be more strongly present in school life. Overwhelmingly occupied by women, the field of Hungarian education finds it difficult to cope with this extra role, one that suddenly requires them to become aides, *mental health professionals*, and thus exposes them to the danger of *burnout.*

Theoretically committed to *knowledge transfer*, *personality development*, *transfer of norms and values*, and *the social integration of the younger generation*, the school system's ability to fulfil these basic functions poses an increasing challenge for teachers. Unfortunately, institutional systems that support teachers (e.g., the school district's Pedagogical Education Centre, where specialists test children for learning disorders, provide psychological help, etc.) are slow to respond to the challenges faced by teachers. The Hungarian school system's failure to achieve accountable education is becoming increasingly apparent, a fact reflected in the results of deteriorating PISA surveys (Csapó et al., 2018). It can be stated that schools merely mediate the national system of requirements for knowledge acquisition and are less and less able to pass genuine knowledge on. Meanwhile, teacher autonomy in areas such as grading, assessment, and administration is decreasing. In the end, teachers find it impossible to bridge the gaps in knowledge levels that originate from social inequalities.

It is well known fact that one of the most important components of *social status* is educational attainment, an element that fundamentally impacts the risk of poverty. Hungary's rural population is most at risk for impoverishment. Based on statistical indicators, the proportion of people living in poverty or exclusion is increasing in the settlement hierarchy (Bernát & Gábos, 2018), another factor that vastly affects Hungarian Romas. The European Union Agency for Fundamental Rights (FRA) conducted a research project containing the Second European Union Minorities and Discrimination Survey (EU-MIDIS II). Based on this survey, 75% of Roma in Hungary live in income poverty (Bernát, 2018). However, it is important to emphasise that this is by no means the worst indicator of the situation of Hungarian Roma in Europe as this result can even be said to be better than that found in other surveyed countries.

Overall, it must be stated that the cornerstone of social integration for the Roma is an increase in educational attainment, a process that should go hand in hand with prolonging school life, that is, helping children stay in school and improving the quality of education. Unfortunately, between 2013 and 2017 the *indicators of early school leaving* (Bernát, 2018) reveal that Roma students are seven times more likely to drop out than non-Roma students. Nor is this phenomenon independent from the government decision that lowered the *compulsory school age* from 18 to 16 years.

Weaknesses in the Hungarian school system

Sociological research conducted before the millennium has already underscored the weaknesses in the Hungarian school system. At this time it was proven that the Hungarian school system effectively *perpetuates social positions*, thus hindering the school mobility of lower social groups. A number of mobility studies examining school inequalities in Hungary (Bukodi, 2000; Róbert, 2001) have furthermore confirmed Bourdieu's theory of *cultural capital* (Bourdieu, 1978a). These studies highlight the fact that in the cultural relationship between the individual's origins and schooling attainment *cultural capital* is a more dominant intermediating variable than is economic capital. It is important to mention that according to *Bourdieu's capital theory*, the amount of cultural capital even determines one's strategies governing his investment in studies and education, thereby creating a special habitus comprising the relation of the given social class to school-gained knowledge as well as its inclination toward actual use of school services (Bourdieu, 1978a). Therefore, Bourdieu's theory also regards *cognitive factors* as hard *structuring factors*, considering them as manifestations of *reconversion strategies* (Bourdieu, 1978b). In light of this theory, the main task of the Hungarian school system is to motivate Roma children to participate in school more effectively in order to successfully integrate them socially. This could be helped by introducing innovative pedagogical methodologies or activating the reserves inherent in secondary socialisation, when the school could aid Roma students' social integration. However, the process of segregation that is increasingly observed among domestic schools does not support the above factors. Like the lower social strata that Roma increasingly occupy in Hungary, the educational institutions attended by Roma are becoming increasingly isolated or even permanently detached from the education system.

One of the important conclusions connected to the school segregation research results gathered by Havas and Liskó (2004) is that the parental decisions made in the school selection process are exerting a growing impact on Hungarian primary schools. (In Hungary, it is not compulsory for a child to attend the school that is within the residential district. Theoretically speaking, Hungarian parents can choose a school anywhere in the country: in practice, this 'freedom of choice' has compounded the issue of school segregation.) When parents deliberately avoid sending their children to a school that has a large number of Roma students, a significant proportion of Roma pupils become concentrated into a specific group of schools. In other words, the segregation of Roma pupils at school is also a consequence of school selection (Havas & Liskó, 2005). The previous research results attained by István Kemény and his research group also confirm this phenomenon while adding that the number of schools that can be classified as ethnic and social ghettos has increased as a result of school selection and negative social processes, such as factory closures, unemployment, the declining demand for uneducated labour, etc. It must be mentioned, however, that these 'ghetto' schools are also attended by children from non-Roma poor families. Havas, Kemény and Liskó's (2000) research study (which also extended to intra-school selection) states that segregation also occurs within schools. In such cases, children of higher social status are provided a higher standard of education in certain classes. This type of a class generally includes families in the best social position as well as some Roma children who display a higher level of integration or come from families that are more integrated. While this class is being taught, another class is created for less integrated Roma children and those children from uneducated, non-Roma families who possess low status and income level (Havas et al., 2002).

Upon examining the qualification data of teachers, researchers have found that the more frequently a teacher discriminates against Roma students and the worse students' sense of well-being is at school, the more unprepared the teacher is, both professionally and pedagogically (Havas & Liskó, 2005). In these schools, teachers explain the low school performance of Roma students with short-cut responses that blame the socio-cultural environment of Roma families. That is, these educators are unaware of the fact that children's learning motivation is influenced by the relationship between the child and the teacher. By referring to this type of an excuse, teachers are ridding themselves of the responsibility that primary school should play in socially integrating Roma via the provision of remedial courses, extra support, etc. To compound the situation further, when students fail to catch up despite the use of special curricula and methods, the student is released from the obligation of attending school regularly. According to Havas and Liskó (2005), this procedure is twice as common among Roma students as it is among non-Roma students. Based on the 2018 data of the Social Report, this trend has further deteriorated, with indicators measuring school *dropout rates* between 2013 and 2017 showing (BERNÁT, 2018) that Roma students are seven times more likely to drop out than non-Roma students are. It is easy to see that in the social environment presented above, it is becoming increasingly difficult to develop a system of successful secondary socialisation conditions that could improve the increased school mobility data of Roma children.

The significance of the teacher's personality in secondary socialisation

In the following sections of this study, we seek to argue the importance of *secondary socialisation*, which has been highlighted by the identity perspectives presented in the 'successful' narratives analysed throughout the course of our research.

Primary socialisation takes place through deeply emotional communication, through communication with the parents, predominantly with the mother, the '*significant other*' (Mead, 1973). By the end of the process, the individual's perspective, value system, semantics, and ideology have formed. The process of secondary socialisation is based on *primary socialisation* (Berger & Luckmann, 1998, p. 183) and in the majority of cases there is little ability to modify it. In its institutionalised form, secondary socialisation takes place in the education system; in a non-institutionalised form, socialisation may be linked to the peer group and/or the mass media (Bognár, 2010a). Accordingly, there is a chance of altering the *socio-cultural patterns of primary socialisation* and encouraging successful Roma mobility where the features and perspective of the developing personality is shaped by an emotional content similar to that of primary socialisation. This is why those teachers tend to produce results who can develop emotional relationships with their pupils wherein they turn into 'significant others' who can influence the social and personal identity of primary socialisation. If the relationship between the teacher and the student is formalised and anonymous, it is a lot easier to brush aside and eliminate the responsibility of secondary socialisation when, for instance, the student leaves school (Berger & Luckmann, 1998, p. 198).

The 'traditional' role of teacher (which renders the child a passive receiver and is preoccupied with order building) formalises the relationship between student and teacher. This pedagogical role provides little opportunity for the relationship to be filled with emotion and for the teacher to become a 'significant other'. In other words, successful secondary socialisation – at which time the 'traditional' role of the teacher appears in strengthened form in the Hungarian education system – does not help. This 'traditional' relationship is characterised by excessive control, the strong structuring of children's time, and the exclusion of natural impulses. The primary function of the 'traditional' teacher type is to prescribe the child's thought process and render him or her a passive receiver, a condition that can only be achieved via very strong disciplinary methods. This kind of atmosphere precludes spontaneity and creativity, aspects that should be paramount in the teaching of Roma children for successful secondary socialisation. In other words, in the lower grades of primary school, a reform pedagogical approach that puts creativity, spontaneity, and a creative approach to the transfer of knowledge in the forefront while simultaneously providing students with positive reinforcement. Ideally, this approach also takes into account the characteristics of Roma ethnic culture, knowledge that can help the teaching process.

It has to be highlighted that the reality of secondary socialisation – in this case, the school – is an 'artificial' reality. Even if only due to its secondary nature, school is less deeply rooted in awareness, i.e., it is easy to uproot. The 'confidential' atmosphere created by the teacher may, however, change this when it evokes the 'confidential' world of primary socialisation, thereby alluring the child to turn his 'attention from the natural objects' to these 'artificial' ones (Berger & Luckmann, 1998, p. 200). In other words, the key to success in secondary socialisation can lie in building a relationship of trust, an element formulated today by *reform pedagogy*. Reform pedagogy is an approach that emphasises the importance of personality education and getting to know the child and presupposes a different quality of pedagogical role, according to which the teacher must be present in the teaching process in a 'creative way', with his or her whole personality.

The narratives of the Roma interviewees who participated in the research also prove the above findings. For Roma interviewees, school as a channel of mobility is particularly crucial, as most families have little economic or relational capital that could be used during social uplift. For Roma youth, a frustration-free encounter with school and a successful school career are therefore particularly important. The narratives show that the majority of successful Roma in the research were neither discriminated against in primary school nor by teachers, who helped them catch up, and smoothed out their further school careers.

> *Right from the first grade on, up to the eighth my average grade was between 4.5 and 5.0 all along. Er... it was he, my form teacher himself who suggested that I should go on to study in a secondary school providing a GCSE, well, that was something indeed, back in those days. Aah ... primarily among Gypsies as it was back in 1979.* (Interview 2)

> *On top, on top, on top of the fact that the school I liked very much. I went to a small village school, there were ten of us to a class, when the flu came there were only four of us, so this was a little "funny" (giggling), it was pretty funny at times but it was good. So to me the school was, I came to realise, the family. So ... I escaped to it, by the way, so for me, well, that was the very reason why I could study.* (Interview 1)

In the interviewees' narratives there always appears a teacher in primary or secondary school who encourages, helps, and advises the interviewee on his or her continued studies. In addition, several of the narratives include NGOs involved in Roma programmes, who open up new perspectives and also help with counselling and positive reinforcement, not only during further education, but also during higher education. That is, one necessary element is for the teacher to demonstrate a supportive, understanding attitude in the teaching process itself, thereby creating an atmosphere of trust between the teacher and the student that can make the transfer of 'artificial knowledge' natural. The other necessary element is for the pedagogical role to be supplemented by a *mental health helper*. This kind of support is especially urgent for *disadvantaged and cumulatively disadvantaged children*, who are full of different types of (emotional, economic) insecurities due to family conditions. However, if the teacher does not help the child develop positively in the classroom, the child may lose his/her motivation to learn or fall into a community that hinders his/her successful school career. Consequently, another key aspect of Roma integration is the pattern of *individual networks* and the values they convey.

The significance of the teacher's personality in shaping the micro-social relations system of students of Roma origin

Analyses of *networks of relationships* are increasingly drawing attention to the fact that individuals live embedded in networks of relationships (e.g., family, schoolmates, colleagues at work, neighbours, people one spends one's spare time with, etc.) that turn into *social facts* throughout the course of daily life (Angelusz & Tardos, 1991). According to the results of international studies conducted in the field of individual-focused networks, the *pattern and quality of relationships* affect the individual's position, behaviour (Coleman, 1988), *social mobility* (LIN, 1997, 2001), and school performance (Hoffer et al., 1985; Stanton-Salazar & Dornbusch, 1995; Carbonaro, 1998).

Quantitative analyses prepared among Hungarian ecclesiastical secondary school students point to correlations between *social capital* and *school performance* and the intention to continue learning (Fényes & Pusztai, 2004). In addition to cultural capital, this research highlights the importance of social capital, the role of *strong and weak links* between school achievement, and the intention to continue learning. It also points out that the resources inherent to this system support the learning intentions of disadvantaged students.

Judit Lannert's (2018) recent research confirms previously observed research findings based on PISA results. Her research points out that 'student composition in schools has a greater impact on student performance than a student's individual family background' (Lannert, 2018, p. 11). In the Hungarian school system, student composition is determined by school selection, a process by means of which students become more and more homogenised, meaning that students from similar social groups attend the same school. Consequently, the social groups who have been 'left behind' also attend other schools or types of schools, with the long-term consequence of increasing distance between *social strata*. The end result is an increasingly less open society.

The mobility perspectives found in the different life stories increasingly highlighted the role of *Granovetter's weak and strong ties* (1991) as well as their perspectives determining courses of lives. According to Granovetter (1991), the strength of relationships is determined by the time, emotions, and intimacy invested in them. *Weak ties* can bridge large social distances and are crucial from the aspect of mobility. Close friendly or closed family relationships – i.e., strong ties – are not suitable for the channelling of external information. Individuals with few weak ties are therefore at a disadvantage because they remain excluded from the flow of information as they are isolated within a cocoon of strong ties. Their isolation thus keeps them in a disadvantaged situation, even when they wish to change their social position. The interviewees in the research mentioned this aspect as follows:

> *Sometimes it's your own family which is your main burden, so I can tell they are my worst critics. And, well, the trouble is, they never praise you, never. Strangers do, but my family never does. I don't know what else to say… There's a lot of bad things. A difficult childhood. It was very difficult.* (Interview 4)

My foster parents did not like it, by the way. And when they did not like that I was studying, they never sat down besides me to hold my hand. Me, never! So I am dead serious when I tell you that they never asked me questions to check what I had learned... Never, ever! You understand? They never ever asked me about my grades or anything else. And yet, I was still a good student. Indeed. And I was thus happy about it. And it was as though I felt envy. And I did feel envy indeed. I am sure I trained well. (Interview 1)

So they were workfolks. And so though they did not impede my studying but when I told them, shortly before the secondary final examinations, that I would like to go on studying, then they did ask me how much more I want to study. But without any ill feeling. But then the main thing was that after the final exams I worked in my trade. (Interview 2)

Analyses of the fieldwork and the life stories of young Roma people interviews additionally demonstrate that the school relationships with the peer group of the majority society are crucial for school mobility and social integration.

Well then… I didn't even think about it at that time that I was in an A class. That is to say there were a Class A and a Class B. Almost everyone I knew was in Class B. Well, I'd get to know those who were in Class A too, later. Because they weren't ... so I was a Roma alone. Well, now then… how it was at that time… what the decision was based on by the teachers, I don't know. But, sure, most of the children were good students, they were prepared, so it wasn't cool not to learn, not to prepare. Hmm… I have no very negative experience whatsoever. So as far as I know, what they were... or what they used to be ... in school. (Interview 2)

The previous two excerpts were taken from an interview with a disadvantaged man of *Vlach Roma* descent who lives in a *Roma settlement*, did not attend kindergarten, and coped with school challenges with the help of his teacher. The interviewee learned how to study, endure the monotony of the learning process, and experienced that the work invested in learning leads to success. Thanks to his teacher's contribution, his secondary socialisation was successful, and his classmates accepted him into Class A as the only Roma, with many *heterogeneous weak ties* to the peer group. In his life story, primary school was directly followed by secondary school and graduation, but in the absence of family support, he was only admitted to university decades later.

Summary

The research results providing the background of the study confirm the hypothesis that the academic performance of Roma ethnic youth is inseparable from *the students' micro-social relationship system*.

The findings also indicate that *upwards mobility* processes are not random phenomena. The life stories reveal that they are related to a number of social facts and sociological dimensions. The mobility processes were found to have been equally affected by *macro and micro factors*. A look at the most important micro factors reveals that the mobility processes could not have taken place without successful secondary socialisation in which the 'artificial reality' of internalised knowledge is confirmed by means of pedagogy.

From the narratives that were collected and analysed in the course of our research, it becomes clear that, for Roma who graduate, school appears as an integration space where social integration begins. One of the key elements in successful school mobility is successful secondary socialisation, a process that demands an active teacher role. The importance of the integrative role of the teacher is demonstrated by the fact that other channels of secondary socialisation (e.g., mass media) cannot fulfil this role and in many cases reinforces *socio-cultural disadvantages* (Angelusz & Tardos, 2005). Aiding a child's successful secondary socialisation not only requires the strong presence of the teacher's personality, but also the development of a creative and facilitator approach that does not allow for impersonality or a 'policeman role' on the part of the teacher. Another important aspect of successful school mobility is the significant role played by micro-social relationship systems, i.e., the weak bonds that the students develop not only with the adult (teacher) but also with the peer group. *Weak ties to adult society* help students make better learning decisions through counselling and information sharing. *Weak ties to the peer group* help the individual integrate into society. Meanwhile, the mobility of young people with these types of relationships is less stressful. In addition, the significance of macro-factors, such as institutional regulations, scholarship schemes, and civic and church initiatives, must also be mentioned as underlying elements that create the conditions for successful school mobility.

The results of the present research confirm the enhanced importance of the school institution and the pedagogical task, both of which influence the school performance of the Roma students and, at the same time, their social integration. Attention is drawn to the fact that the future of lower social groups, including the future of the Roma children, is decided in primary school due to the lack of economic and social capital. This reality justifies the reform of the Hungarian school system and the establishment of well-equipped schools where highly qualified teachers would positively shape all students' attitudes towards socially relevant knowledge by devoting all their energies to children.

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Inclusive Society – Reality and Virtual Reality

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After clarifying the concept of inclusivity, the chapter lists the factors that need to be borne in mind by a society that treats people with disabilities as equal citizens. Possible means to achieve this goal are properly applied virtual reality methods. The chapter highlights some of the methods that can be applied to people with autism, learning disabilities, cerebral palsy, and wheelchairs, and to help these people with disabilities live as independent life as possible for them. The tools of virtual reality can also play an important role in sensitizing and shaping attitudes in an inclusive society. The third part of the chapter focuses on these possibilities.

Keywords: incusive society, virtual reality, disabilities, autism, cerebral palsy, wheelchair.

What does an Inclusive Society mean?

What happens if a wheelchair user wants to roll into a school? In a desired case, several people jump up, open the door, and help him or her. What happens when we enter a school and see everyone sitting in a wheelchair while we do not? Acting normally means doing something that is done by many, or at least often. If we belong to a minority, we feel uncomfortable, even when surrounded by people with helpful intentions. We do not feel equal to others. We do not feel as we were "normal". This feeling also appears when surrounded by people with helpful intentions. How can the missing balance be created?

The concept of inclusiveness is most aptly formulated as follows: 'We define inclusivity as the practice of including people across differences, and we assert that inclusivity implies an intentional practice of recognizing and working to mitigate biases that lead to marginalisation or exclusion of some people' (Dewsbury & Brame, 2019). Inclusive education means that 'teaching involves being responsive to the diversity represented in the classroom and assisting learners to focus on their culture, attitudes, and beliefs while learning to communicate and collaborate with each other and their patients' (Billings, 2008).

Viewing the word 'inclusive' as a type of acronym may provide better insight into the meaning of the word. As such, every letter can correspond to the following elements:

I = Independent
N = Non-judgemental
C = Closeness
L = Limitation-free
U = Understanding
S = Safety
I = Import
V = Valuableness
E = Early

I = Independent. The final aim in educating people living with disabilities is to aid them in being as independent as possible. In this context, independence not only means that people with disabilities can manage with as little help as possible, but also that they do not suffer discrimination from those in their environment. Independent people are able to represent their interests, stand up for their rights, and help one another in this effort. Society's responsibility is crucial in accepting that people with disabilities are the best experts in their own lives, as they experience their situation from within, something the rest of society can only view from outside.

N = Non-judgmental. Being non-judgmental means non-judging or criticising other people whether they live with disabilities or not. It may come as a surprise, but withholding criticism is not only the task of the host society, but also that of people with disabilities, their relatives, and caregivers. 'I see them staring at my son on the bus. I would love to slap all the onlookers', was a statement made by the parent of a boy with Down syndrome when she described how she experiences other people's reactions regarding her son. (Kollár, 2013). Being non-judgmental is to be open-minded: this also means being open to the events and phenomena of the world. Being non-judgmental is being tolerant, to accept the opinions of others, even if they do not agree with ours. Being non-judgmental is being receptive to fresh ideas and different forms of behaviour.

C = Closeness. One of the symptoms of discrediting people is emphasising different opinions, not maintaining eye-contact, and remaining distant from them. If we take a closer look at a group of people we know less, we can gain knowledge about them that can fundamentally change the way we think about them. I like to take my medical students to institutions where they can make contact with people with disabilities as a kind of 'field exercise'. In my experience, each visit radically changes their attitudes toward people with disabilities. Even my foreign students are able to memorise some Hungarian words that help them to communicate with people living with disabilities. Even a handshake can make wonders.

L = Limitation-free. This applies not only to physical limitations, but also to the limitations inherent in thinking. It is very important that there should be no obstacles impeding the free movement of people with wheelchairs. It is also important that travel agents include them in their travels so that they can open the world to them. At the same time, it is at least as important that the 'benches and bumps' inherent to thinking about the environment should not become barriers to the acceptance of people with disabilities.

U = Understanding. Where understanding cannot find a medium, imitation of understanding often appears. Understanding and cognition goes hand-in-hand. Without cognition, comprehension is difficult to imagine. It takes openness and courage to get to know one another. There is a need for society not to be afraid to get to know people who, because of their different physical and / or intellectual abilities, do not look like the majority. Fear, the root of prejudice, often lies in the fact that we cannot include people who are less like us in our ideas of a perfect world. If obstacles are removed from the path of cognition, understanding also becomes much easier.

S = Safety. When two groups are averse to one another, mutual acceptance and the expression of this acceptance are essential for both to feel safe. This revelation can take the form of words, such as laws designed to protect the rights of people with disabilities. More importantly, it can take the form of deeds. Laws provide the legal basis for actions, but do not replace them. The security of an inclusive and accepting environment is fundamentally created by actions.

I = Import. An inclusive society is always open to the constructive initiatives it experiences in other countries and societies. This openness makes it possible to localise, import, and adapt these experiences to the home environment. This process, of course, requires mutual openness, the exchange of experiences, organisation of joint conferences, study tours, and exchanges between host societies.

V = Valuableness. It is very important that the achieved results and extant shortcomings be regularly assessed, as the criteria and tasks of moving to the next level of social inclusion can be established in light of this knowledge. It is very important that both results and shortcomings be measured in concrete numbers and steps: only by this means can we ensure the objective valuableness of progress, i.e., the demonstration that one has succeeded in moving from a certain level to the next.

E = Education. The role of education is essential to ensuring social inclusion. Of course, an entire society cannot be sent back to school for the purpose of educating them, but the principle of 'If you want to teach me, reach me' can be used to find the channels through which certain sections of society are susceptible. Thus, books, films, film series, games, songs, scientific publications, etc. provide the means for reaching different people, thereby enabling the idea of inclusion and mutual acceptance to become a natural medium for society.

Using Virtual Reality to Promote an Inclusive Society

Is it possible to create, even temporarily, a world in which people with and without disabilities can feel equal? Answering this question comprises the purpose of virtual reality, a tool that allows us to create an environment within which everyone can feel equal and thus achieve the state of democracy to which every human being is entitled.

Depending on the extent to which it helps the user immerse themselves in the experience, three types of virtual reality can be distinguished: non-immersive, semi-immersive, and immersive types. Non-immersive VR applications include, for example, Nintendo Wii, a tool originally developed for gaming purposes that was quickly found to have uses for rehabilitation as well. While a semi-immersive application (for example using large scale projectors together with computer graphics) can provide a realistic experience, the user can also look around to make sure that the image is only a representation of reality. Fully immersive application provides the most realistic experience and is usually achieved with high resolution VR goggles. The realistic perception can be further enhanced with the help of VR gloves, which also provide a tactile experience for the user.

In short, virtual reality can open a door to a world that its user is unable to enter on his or her own due to a kind of (material, physical, intellectual, etc.) barrier. In this paper I would like to provide a small insight into some of the application possibilities that can provide the user with the experience of being equal to others. I would like to guide the reader to areas where both people with disabilities and people without disabilities are able to form a community together by accepting and feeling comfortable about each other. Attaining this mutual space can only be accomplished when direct help and the process of attitude forming occur. The following examples will further reveal how virtual reality technology can aid the achievement of inclusivity.

Helping People Living with Disabilities

Autistic Children in Schools

Teaching children with autism poses special challenges for teachers. Attention must be paid to teaching the necessary curriculum, to children having different interests, and to eliminating possible disturbances caused by unexpected stimuli. Creating this special balance is not an easy task. It is necessary to find VR software that kids love, is not overly challenging for them visually and physically, is sufficiently exciting, contains reassuring elements, and, of course, develops children's learning skills. This challenge is further complicated by the fact that autism manifests itself as a spectrum disorder, meaning that we no longer speak of 'autism' but instead refer to this phenomenon as 'autism spectrum disorder (ASD)'. Since this condition is actually a communication disorder, children with ASD tend to have difficulty expressing themselves, are unable to focus on one thing for extended periods of time, are awkward in their social relationships, and have difficulty expressing their feelings (Manju et al., 2018; Orm, 2020). However, given that it is a spectrum disorder, it is very difficult to find a universal educational method that is appropriate for all children with ASD. The cognitive abilities of children with ASD also differ significantly. Individual education plays a significant role in this situation.

Creating an appropriate software is a great challenge since the creation and animation of (to mention one example) realistic-looking and natural-behaving humanoids to simulate students and professor activity in a classroom environment. A similar issue lies in providing proper facial expressions and lipsync abilities for the purpose of conveying emotion and speech in real time based on user interaction during the experimental scenario. Despite the obvious difficulties, accomplishing these aims is nevertheless possible. A group of researchers used a type of software for developing children with ASD that included common scenes such as entering a classroom, choosing a seat, and participating in group work (El-Shehaly et al., 2013).

Newbutt et al. (Newbutt et al., 2020) studied children with ASD focusing on the following areas of immersive VR use: developing social skills; preparing for things that scare the children in the real world; going to places that present uncertainties in real life; meeting people/making friends; relaxation; doing things independently; developing learning opportunities for school in virtual reality; and going to places virtually to see what the world looks like. According to their results, the most frequent answer given by children with ASD was that 'It [VR technology] relaxes me and I feel calm'. This opinion highlights one of the general benefits of using VR technology in children with ASD. In other words, with virtual reality, educators may be able to create a soothing environment for children in a short period of time, where they will be able to deal with events that may be too stressful for them.

The opportunities in applying virtual reality techniques also affect many other areas. Due to individual differences in development, an important feature is choosing developmentally suitable treatment goals. Virtual reality may provide tools for this: considering the need for tailored intervention in order to achieve individualised treatment goals, a wide range of environments and exercises can easily be realised in a virtual environment. VR therefore possesses an advantage in providing the ability to adjust interventions concurrent with the achievement of teaching goals. Virtual reality enables child-initiated teaching episodes and environmental arrangement that goes beyond the possibilities of real-life situations. When the child can choose the preferred training episode, this decision additionally provides motivation for learning. Teachers can create an environment that motivates a child to conduct a teaching process that is considered to be relevant or helpful.

A virtual environment can be arranged in several ways with the ability to simulate environments and situations that are usually impractical or inaccessible in traditional teaching. The environmental arrangement in virtual reality may also be advantageous; for example, it is possible to present less stressful social environments that are safer than traffic situations, for instance. By means of positive reinforcement, children can learn new social skills in a virtual environment while the child's visual experiences can be monitored on a laptop, tablet, or smartphone. Such technology can also be used for modelling situations to simulate more complex events compared to what is feasible in real life. Thus, the attentional focus of the child can be broadened (Dechsling et al., 2021).

In an experiment involving 120 children with ASD (Zhao et. al., 2020) cognitive training was applied by using virtual reality methods. The researchers focused not only on cognitive training but also verbal social, computational, large muscle, and physical coordination training of children with ASD. As a result, it turned out that the training improved social communication, speech quality, the range of interests, and rigid behaviour. VR emerged as an effective tool for intervention in the health field.

As was previously mentioned, the aim of helping people living with disabilities is helping them to be as independent as they can be. Portuguese scientists (Bernardes et. al., 2015) developed a virtual reality program for children with ASD in order to prepare them for bus travel. The software could display a three-dimensional city and set tasks involving taking buses to reach specific destinations. Participants had to validate tickets, not sit in priority seats, and had to press the stop button by a certain timely pressed the stop button. At the beginning of the game, the player had the opportunity to choose the task and its difficulty, thereby allowing for progression as tasks were completed. A tutorial was also included since different participants may need different time to become used to the game. During the tutorial, participants were asked to read the current objective aloud. This type of a project could help people living with ASD to live more independently while applying the advantageous effects of gamification.

People with Learning Disabilities

Teaching people with learning disabilities is a special challenge as this type of student requires specific training programs while both the student and their teachers need extra motivation for participating in this challenging task. In an experiment using virtual reality (Standen et al., 2000) participants with learning disabilities spent twelve sessions learning to use desktop virtual environments designed to teach independent living skills. They had to practice in four different environments. In a virtual supermarket they had to create an icon-based shopping list, select items from the shelves, find all the items from the shopping list and pay for goods at the checkout. In a virtual café the tasks included making choices and decisions, ordering drinks from a list for oneself and others, practicing social skills when ordering, communication with staff and public, money handling (paying for drinks), appropriate behaviour (table manners, etiquette), choosing appropriate dress, toilet use in public situation, and dealing with alcohol (what drinks can be ordered at what ages and the effects of these drinks). In a virtual transportation environment, participants had to select the correct coins for the bus, leave the house with enough time to catch the bus, cross the road safely, catch the correct bus, pay the bus driver, collect their ticket, and get off at the correct stop. Finally, in a virtual factory the tasks comprised selecting correct clothing before entering the factory, learning the dangers of crossing black and yellow lines, understanding the storage methods of chemicals, fire safety drills, the importance of COSSH (the law that requires employers to control substances that are hazardous to health), and hygiene within the factory. According to the results, these tasks maintained the attention and motivation of participants while the positive feedback they acquired improved their willingness to learn.

Virtual reality can also be used for controlling memory impairment (Optale et al., 2010). The researchers implemented a virtual realty training intervention to try to lessen cognitive decline and improve memory functions by involving elderly individuals with memory deficit in six months of training that involved auditory stimulation and virtual reality experiences in path finding. These elderly individuals participated in social, creative, and assisted-mobility activities. The researchers found that participants who received the treatment displayed improvement in general cognitive functioning and verbal memory. The largest effects were observed in long-term memory, a result that is in keeping with the cognitive abilities stimulated by the auditory session.

People with Cerebral Palsy

Cerebral palsy is one of the three most common lifelong developmental disabilities. Motor disorders in people with CP are often accompanied by disturbances in perception, cognition, and communication, as well as other behavioural issues. Epilepsy and secondary musculoskeletal difficulties are also common. The importance of early recognition and rehabilitation is very important. Non-immersive virtual reality methods like Nintendo-Wii have already been proven useful in this field. By using this tool, both gross motor function and the participants' internal motivation regarding the exercises could be improved (Gordon et al., 2012).

In another experiment using immersive virtual reality (Gagliardi et al., 2018), sixteen school-aged children with bilateral cerebral palsy diplegia who were attending mainstream schools were recruited for a pilot study in a pre-post treatment experimental design. The virtual reality rehabilitation system was designed for the development of interactive and immersive virtual reality applications within which the subject was a central part of a real-time feedback loop. This VR system integrated a treadmill on a motion frame, a motion-capture system, and a 180^{o} cylindrical projection screen. The participants underwent eighteen immersive virtual reality therapy sessions throughout a four-week period. Walking patterns, speed, endurance, gross motor abilities, and most kinematic and kinetic parameters significantly improved after the intervention.

People in wheelchairs

One of the essential uses of virtual reality is to provide safe conditions for carrying out dangerous activities. One such activity comprises using a wheelchair given that collisions due to a lack of experience can result in severe injuries. Virtual reality can also be used for providing a risk-free environment for improving driving skills (Harrison et al., 2002; Headleand et al., 2016). A review (Arlati et al., 2020) gathering scientific literature aiming at the effectiveness of applying virtual reality for training wheelchair users collected 62 articles describing 29 wheelchair simulators. It was proven that incorporating an observer into a virtual environment is an effective method for training and that virtual experiences are transferable to the real world (Alshaer, et al., 2020).

Sensitisation, attitude formation

It is very important that people who have not received training in working with people with disabilities should have access to knowledge and experience in this area as well. Experiments aimed at this field appeared decades earlier, when it was possible to try out different types of wheelchairs and special glasses imitating individual visual impairments were created to demonstrate what it is like to live as a visually impaired person. Making such tools popular is particularly important in the field of education, as teachers and their fellow students can meet peers with disabilities on a day-to-day basis. With the advent of virtual reality, the repository of tools for sensitisation has been expanded.

How VR can be used to aid wheelchair user was previously discussed; another question remains regarding how wheelchair usage can be made livable for people living without disabilities. Of course, the easiest way would be for the individual to sit into a wheelchair, but this opportunity is not always available. Virtual reality can help in this kind of sensitising exercise as well. It has been proven by investigations (Chowdhury et al., 2019) that disability simulation affects information recall and participants' implicit association towards people with disabilities. The researchers hypothesised that a disability simulation with a tracked head mounted display and a wheelchair interface would have a significantly larger effect on participants' information recall and their implicit association towards people living with disabilities compared to a desktop monitor and gamepad. Their study results show that the participants in an immersive head mounted display condition performed better in an information recall task compared to those in the non-immersive desktop condition. Moreover, a tracked head mounted display and a wheelchair interface garnered significantly larger effects in participants' implicit association towards people living with disabilities than a desktop monitor and a gamepad. In an additional experiment, US researchers (Chowdhury, Shahnewaz Ferdous & Quarles, 2019) recruited 71 unpaid students displaying normal or corrected-to-normal vision for an experiment wherein participants had to navigate real wheelchairs in a virtual environment. Virtual reality could provide the experience of 'being there' and thus raised awareness towards people living with disabilities and promoted empathy.

By using virtual reality tools, the aim of another study (Kollár, 2020) was to change the attitudes of medical students towards elderly people with dementia in a positive way and raise awareness toward the importance of studying dementia in the elderly. Medical students who had studied old-age dementia only in textbooks are generally removed from elderly, demented patients. Usually, the students do not understand the feelings or reactions of such patients and view communicating with older adults as time-consuming and challenging. Their initial impulse is to cut such conversations as short as possible. Nevertheless, the attitude of students who have had a personal relationship with this particular group of elderly individuals usually feel closer to the subject, and their attitudes toward dementia in old age are quite different. Virtual reality can help bridge the gap between future doctors and their patients. In a five-minute virtual reality experience, students had the opportunity to live 'in' the circumstance of an elderly people living with dementia while hearing the patient's thoughts and acting as if they were the patients. This short experience was significantly able to change students' attitudes toward patients with dementia in a positive way. Some opinions students wrote after the virtual reality experience can be read in the following:

> *'The VR experience gave me a shock… Through VR I could feel how it really is for the elderly to fight against dementia.'*

> *'I thought I have to be kind to my grandfather and grandmother. It was really interesting study and I really appreciate this chance.'*

> *'The VR application I used were usually interactive and immersive in your own perspective but being immersed in someone else's perspective, especially with a condition like dementia, really does help in understanding and empathising with the patient. I look forward to seeing further development in these tools for both doctors and the families of patients.'*

> *'I became completely touched while using it. It would be important for many of my colleagues to try it for their future doctor-patient relationship as well. But not only medical students, everyone should be more involved, it would even make life easier for family members.'*

Summary

In an inclusive society, it is both important to help those in need and develop accepting attitudes towards them. To do this, it is worthwhile to use modern methods that are both attention-grabbing and effective. Rehabilitation methods based on virtual reality have proven to be such, as this technique can directly help people with disabilities while additionally influencing the attitudes of people living without disabilities towards their fellow human beings. In this paper, I have primarily focused on VR's possibilities, as opposed to its limitations. Of course, using virtual reality method is only recommended for those who welcome it, do not experience dizziness or headaches, and do not find that it disturbs their image of the world. Since VR may exert a strong influence on users, care must be taken to prevent addiction. In my examination, I have only mentioned a few of the available options. Several other topics could have been explored, such as that of applying virtual reality to experience concerts, exhibitions, music learning, world travel, etc., as doing so would open doors to worlds that the user may not be able to reach due to physical or other limitations. My aim was to draw attention to an opportunity that is worth dealing with wisely, but which certainly has a place in the 'toolbox' used for building an inclusive society.

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Atypical development and the cultural background underlying neurological maturation

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Learning, attention, hyperactivity, and autism spectrum disorders have common neurological roots. They are manifested in differences in the development and functioning of the neurological processes involved in neurological maturation. Neurological maturation is a product of the cultural evolution of Homo Sapiens. The transition to an agricultural, ranching lifestyle required behavior and cognitive functions that were markedly different from the previous foraging, nomad lifestyle. The result was a more precise and reliable ability to control and think systematically, which later became the base of literacy. The recent spread of learning difficulties, control disorders, and autism spectrum are due to the vulnerability of brain functions that are very new to human development, most of all executive functions. There are significant changes in culture since the last century, whereby the developing nervous system receives less natural cultural developmental effects but more harmful agents than before. Changes in the environment change the way the brain develops. Atypical neurological development is a consequence and a sign of a new era. It is only considered a disorder if education fails to find an appropriate response to the challenge.

Keywords: atypical development, learning, attention, hyperactivity, autism disorder spectra, neurological maturation, digital age

Introduction

The human nervous system develops in interaction with environmental influences and therefore both reflects and adapts to any changes in the environment. The accelerating change in technology (and info-communication technology in particular) has an exceptionally large influence on humanity's social-mental functioning. These factors have an even more significant influence on the neurological development of small children. What underlies the increasing rate of diagnoses in learning, attention, hyperactivity, and autism spectrum disorders is a neurological response to environmental effects. Neurologically-based performance disorder – i.e., atypical development – is an indicator that points to the incompatibility between children and the systems of education and development. Currently called disorders, syndromes that are responsible for performance issues that might not always be apparent can be construed as an evolutionary response to environmental factors. The flexibility of the human nervous system, neuroplasticity, comprises the brain's immense capacity for renewal, regeneration, and compensation (Merzenich, 2001). In a child's nervous system, altered cognitive functioning is a response to environmental factors and does not only manifest itself in performance disorders, but also in results that are different from the usual or even exceptional in some cases.

Atypical development

Dyslexia, dysgraphia, dyspraxia, dyscalculia, and attention, hyperactivity, and autism spectrum disorders have been thoroughly proven to be rooted in shared neurological exceptionalities, a fact that is also indicated by their highly frequent co-occurrence in various combinations. According to studies by Richardson and Ross (2000), the reason for this frequent comorbidity lies in abnormalities in the production of fatty acids that play an important role in neural transmissions within the brain.

Movement planning and coordination, sequentiality, and the ability to keep rhythm and time are all problem areas in the case of learning disorders, attention disorder, hyperactivity disorder, and autism spectrum disorders alike (Denckla et al., 1985; Schonfeld et al., 1989; Barkley et al., 1997; Greenspan & Wieder, 1999; Piek et al., 1999). According to Pauc (2005), these co-occurrences are so frequent that the symptoms could in fact be jointly identified as delayed development syndrome.

Atypical development does not affect the entirety of an individual's mental ability: the area of deviation can be clearly delineated and lies in the field of neurological harmony and maturation. At least three mutually independent systems are at work through the course of cognitive performance. Although these systems are independent in terms of neurological functioning, all of them play a role in cognitive performance. Any deficiency or disorder found in any one area will manifest as a cognitive disorder. The following three factors comprise mutually independent units of key importance in cognitive functioning:

1. The maturation of the nervous system, the individual characteristics of the neurological system, typical or atypical neurological functioning.
2. Intelligence, the level of efficiency in thinking and learning.
3. Abilities (linguistic, musical, visual, kinaesthetic, etc.), the foundations for thinking and learning that form a system of abilities specific to the individual.

Atypical development affects specific parts of the cognitive system and is independent of intelligence and ability areas, although high intelligence and outstanding abilities in a specific area offer opportunities for compensation.

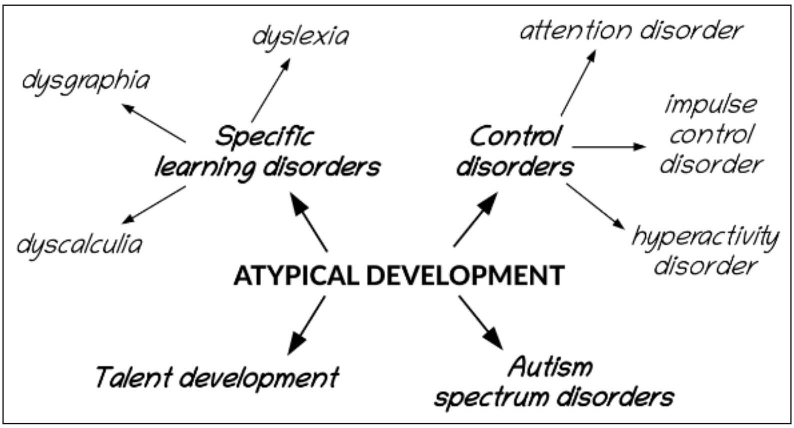
Forms of atypical development

The shared neurological exceptionalities that underlie different forms of atypical development determine the core of the syndrome. At the same time, other internal and external factors can result in different combinations and intensity patterns of cognitive deviations in reading, counting, literacy, attention and behaviour control, the concreteness of perception and information processing, and outstanding cognitive performance. The following characteristics apply to all forms of atypical development:

- it is rooted in a different-from-normal neurological functioning;
- it has both advantages and disadvantages throughout the individual's lifetime;
- it is independent of intelligence;
- it is environment-dependent.

The final item explains why changes in the twenty first century have had a particularly significant effect on the occurrence of atypical development. Increased prevalence owing to environmental factors has brought each of these exceptionalities, along with their study, into the spotlight. The final item in the list also entails the factor that atypical development can be readily influenced by shaping the environment – that is, through early development and appropriate education.

Figure 1
Forms of atypical development



Other than performance disorders, a neurological system displaying atypical development can also produce advantages in performance, that is, some evolutionary benefit can be associated with exceptionalities. Together with the fact that exceptionalities diagnosed as disorders often co-occur with both one another and talent development, the presence of shared neurological processes underlying all of them indicates mutually overlapping developmental exceptionalities. Characteristics associated with performance disorders occur with high frequency among the features associated with talent and giftedness. Examples include an efficient management of spatial-visual wholes, the ability to abstract (primarily characteristic of learning disorders), a strong associative disposition (mainly characteristic of attention disorders), low tolerance of monotony, quick reactions (primarily characteristic of hyperactivity), methodical thinking and perseverance (characteristic of autism disorder). In many cases, not even professionals are able to decide which forms of atypical development (or possibly talent development) intertwine in an exceptional child (Gyarmathy, 2009).

The neuropsychological background underlying the culture of literacy

Thom Hartmann (1995) hypothesises that individuals diagnosed with attention disorder are descendants of the hunter *Homo sapiens* and are characterised by modes of information processing and responses that are different from those who turned into farmers and now form the majority of humanity. By now, Hartmann's hypothesis has been supported by other study results. What is more, this insight might also apply to learning and hyperactivity disorders.

While its relevant behaviour and associated cognitive functioning might now be considered a disorder, these phenomena had definite advantages in early human cultures. In fact, for millions of years, the human neurological system used to be optimised toward the hunter-gatherer lifestyle. The mode of perception and actions of hunter-gatherers are characterised by the following:

- spatial, visual, impulsive, cooperative
- acquires rather than stores
- looks for, finds, selects
- searches, explores, gathers, moves along
- guesses, imagines, intuits
- risk-taking and trial-and-error.

It was only approximately ten thousand years ago that a form of functioning emerged that rendered the human neurological system suitable for the lifestyle of agriculture and husbandry. In other words, from a neuro-evolutionary point of view the mode of perception and activities that make husbandry possible is quite recent and characterised by the following traits:

- temporal, fixed, controlled, sequential
- sows, tends, harvests, stores
- foresighted, economical, methodical
- the work is tied to a place and organised
- plans and implements methodically
- thinks systematically

As can be seen, the features that enable the methodical, planned type of work suitable for an agrarian lifestyle are virtually the opposite of the neurological functioning necessary for a nomadic way of life. Individuals whose neurological system had become suited to agricultural activities would have gained a significant evolutionary advantage. The agricultural-animal breeder lifestyle is much steadier, more certain and far more efficient compared to the hunter-gatherer lifestyle. This change is basically what set humanity on the path toward a rapid development that in turn led to significant socio-cultural changes.

Rooted in the neurological functioning that developed together with agriculture, the culture of literacy is suitable for controlled, planned, and methodical activities. In itself, reading and writing – i.e., 'literacy' – is the application of agriculture, that is, a type of methodical and rhythmical work that occurs at the fine motor level. All of these processes are made possible by stronger executive functions. The development and school education of children precisely target these modes of functioning; disorders in learning and control functions can be attributed to an instability in the area of these executive functions.

Precision tools that can be linked to the prefrontal areas of the cortex in the human brain, executive functions are thus the product of a cultural era in which success, and even survival, was largely determined by an individual's ability to maintain self-control, carry out activities with precision and in a controlled way, and remain attentive in the course of task performance. What we are discussing is a relatively new neural functioning package, one that is only a couple thousand years old and which humanity has consciously attempted to pass on to successive generations through developmental activities. Sports, juggling, Eastern movement arts, arts in general, strategic games, etc. are all tools of culture that work toward 'cultivating' the brain (Gyarmathy, 2012). The term 'cultivation' is also used to describe the cultivation of land, yet also signifies the preparation of the brain for methodical activities. (It is no coincidence that the word 'culture' has taken over from its Latin counterpart a dual use containing both an agricultural meaning and a more abstract, metaphorical one that originally refers to the cultivation of the mind.)

In the twenty-first century, the culture of literacy is being taken over by the culture of info-communication and technology. As a result, the development and role of executive functions is undergoing a fundamental change. Rather than signalling some random decline in the abilities of masses of children, the increasing prevalence of performance disorders is a sign of this shift.

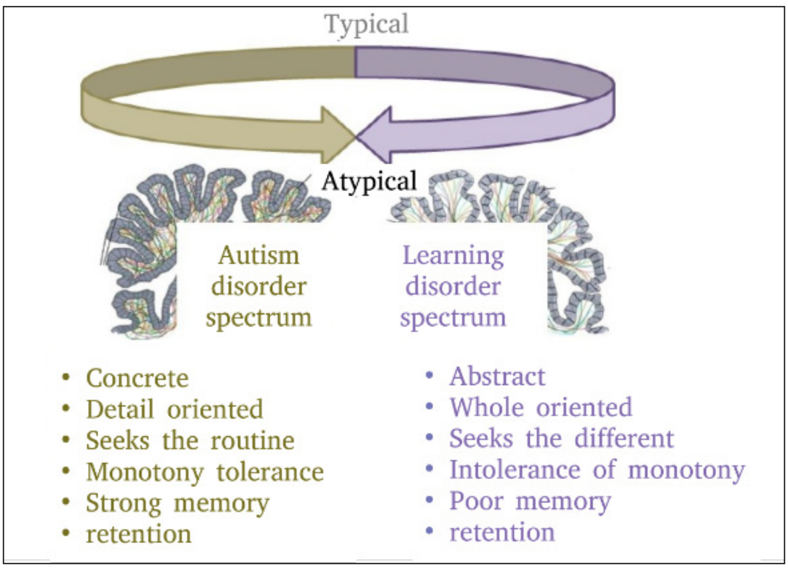
The role of executive functions in the emergence of performance disorders

A neuropsychological umbrella term, 'executive function' refers to behaviour planning, maintaining activities and goals, controlling impulses, ordering the elements of an activity and inhibiting them as necessary, monitoring a process, and maintaining and focusing attention. All of these functions comprise indispensable cognitive processes for methodical work: a disorder in these areas is definitive in the development of neurological performance disorders. Learning, attention, or hyperactivity disorders are typically characterised by a weakness and underactivity in most executive functions. In the case of autism, difficulties originate in the overactivity of certain functions.

Thus, in several respects we encounter opposite problems when it comes to the different groups of developmental disorders – the learning disorder spectrum versus the autism disorder spectrum – in atypical development. Still, experience shows that autism disorder can also be accompanied by dyslexia, dyscalculia, attention, and/or hyperactivity disorder. As has been remarked above, studies have confirmed that the very same biochemical and brain physiological deviations can be identified in all forms of atypical development, including autism spectrum. This commonality only appears contradictory if we treat the two types of atypical development as mutually independent spectrums. In fact, discussing two separate spectrums is not possible since developmental disorders are caused by disorders in the exact same neurological functions. A system is overturned both when it is underactive or overactive, resulting in something different from normal – in this case, atypical cognitive functioning.

MRI studies also confirm that a continuum can be identified, at the opposite ends of which learning disorder and autism spectrums can be found. Although these disorders are embedded within the very same system, they lie in different directions (Williams & Casanova, 2010). To simplify the issue slightly, it could be said that those on the learning disorder spectrum are characterised by a hunter-gatherer type of information processing while those on the autism spectrum comprise the extremely good "farmers". From the perspective of the school system, autistic individuals actually count as good learners. Although they possess exactly the qualities that a school wants, their strong sense of rules and memory renders them inflexible and incapable of change while their partiality to monotonous tasks makes them almost caricatures of the good pupil. Controlled by inflexible executive functions, such overregulated behaviour is as atypical as a weak executive system is. Still, a high-functioning autistic individual is more ideal at school compared to the exceptionalities belonging to the learning disorder spectrum.

Figure 2
Typical and atypical spectrums



Yet, as the layout in *Figure 2* suggests, atypical development does not simply appear on either one end or the other of the cognitive spectrum. Instead, it appears on one and the same end, where, owing to unstable functioning, it can move from one extreme to the other. For this reason, the characteristics of the two spectrums often mix and combine and a learning, attention, and/or hyperactivity disorder can appear even in the case of autism. In many cases, even professionals are at a loss as to how a specific case should be categorised. As such, it can be stated that atypical development is atypical even in terms of its diagnosis. In contrast, there are no extremes in the spectrum of typical functioning, not even when the mode of information processing shifts a bit in one direction or the other. This slight shift only determines the cognitive style and does not entail exceptionality or cause a disorder because the functioning remains stable.

Neurodiversity and education

According to the definition of neurodiversity, atypical brain development is rooted in natural human differences (Jaarsma & Welin, 2011) and has profound significance for the survival of humanity. The culture of literacy was based upon the emergence of strong executive functions, a form of neurological functioning that counted as atypical ten thousand years ago. The success of this change is demonstrated by the fact that this mode of functioning has come to be viewed as typical. It therefore follows that a new cultural change can once again bring about alterations in the area of neurological functioning. Non-typical development is either reinforced by environmental factors or not: the way society handles differences, however, definitely possesses enormous significance. Since they could be signs of a new direction in development, differences and deviations that are becoming increasingly more frequent in a changing culture warrant particularly close attention.

Reading, writing, and counting constitute knowledge stemming from a form of neurological functioning that is necessary for an agricultural lifestyle; most of our info-communication activities are based on these ‘school’ skills. In addition to targeting the acquisition of skills, schooling also prepares children for methodical work. An agricultural lifestyle requires a brain that

- is able to carry out routine tasks,
- knows the process beforehand and plays safe,
- is characterised by vast professional knowledge as its forte.

In contrast, in the ancient hunter-gatherer culture, the kind of brain that proved useful to humanity for hundreds of thousands of years was one that

- is ready to solve tasks arising from situations on the spot,
- can adapt to an unknown future,
- is characterised by problem-solving ability as its forte.

For the purposes of attaining any kind of achievement, it is best to have access to both kinds of thinking; how much of each is needed changes somewhat by task. For example, for a hunter-gatherer lifestyle, the latter approach is the more efficient one, while the former is more effective when breeding animals.

Among other factors, this difference is where cultures differ from one another. In the twenty first century, progress in info-communication has reached a level that is leading to a cultural change. In the age of literacy, knowledge had to be sown, grown, harvested, and stored just like crops. In the info-communication age, it has become possible to acquire information by picking, gathering, and 'hunting' for it while rapid changes require individuals who are suited to solving problematic situations. Those who are capable of this will be more successful compared to those who continue to follow the lengthy process of simply producing and storing knowledge. In other words, an earlier, more ancient mode of functioning has once again become useful, merely not in the way its original form was manifested.

The role of harmful biophysical and biochemical effects

The development of the neurological system is not only influenced by the mental environment. The brain is affected by a number of biophysical and biochemical environmental stimuli which can alter the developmental processes. Mild traumas to the brain before, during or after birth, premature birth, physical impacts like head injuries, or illnesses often result in a certain amount of change in the nervous system that is not very deep, yet is overarching and specifically affects the executive functions. It is no coincidence that these effects have long been shown to contribute to learning, attention, hyperactivity, and autism spectrum disorders. The term 'minimal cerebral dysfunction' (MCD) reflects this phenomenon. Indeed, MCD signifies nothing more than a small deviation in brain functions, meaning that the maturation of the nervous system somehow did not follow the usual path.

Brain functions that are newer from an evolutionary point of view are less stable and can therefore fall more easily victim to harmful environmental effects. As was previously stated, the innovations related to the 'agricultural brain' count as very new ones from an evolutionary perspective. In the twenty first century, there has not only been a proliferation in access to information, but also in harmful effects to the brain. Chemicals against which the human defence system could not have been prepared pass through the blood–brain barrier and affect even fully developed nervous systems. These factors influence, alter, and mix up the development of small children at a far more exponential level of severity.

Even if it cannot be precisely known in every case of chemicals, drugs, cleaning products, additives, petrol fumes, lead, etc. what kinds of effects each will enact upon the developing nervous system, we do know that these substances will affect it. For some time, research results have already confirmed the connection between foods containing various synthetic materials and developmental disorders (e.g., Feingold, 1974; Healy, 1990). According to Campbell-McBride (2004, 2010), antibiotics harm the normal gut flora and substances produced by the abnormal gut bacteria start poisoning the brain already from early infancy. This 'Gut and Psychology Syndrome' could be contributing to the emergence of learning, hyperactivity, attention, and autism spectrum disorders, as well as to depression and schizophrenia. Abnormal gut flora has been shown to increase the risk of developmental disorders in children with a propensity for these spectra (Ward, 2001).

Mobile phones and other radiation sources, along with electronic gadgets that induce magnetic and electronic fields, all affect brain development (e.g., Cotgreave, 2005; Ferreri et al., 2006). There are individuals in whom even slight exposure to magnetic and electronic fields can lead to significant changes in brain functions while no effect at all is detected in others.

The interaction of genetic and environmental factors plays a role in the emergence of atypical development. Although no single element can explain this multi-factor exceptionality, researchers have found clear connections to several harmful effects, including

- industrial pollution
- urban environmental pollution
- mercury, lead, manganese, and other chemicals
- antibiotics, drugs
- synthetic chemicals, phthalates used in the production of PCB, PFC and PVC – found in water, soil, air, and food alike
- copper, zinc, iron, folate, and omega-3 deficiencies
- electronic media
- strong and constant stress and traumas.

While the aforementioned phenomena can all be triggering factors (Lewandowski et al., 2009; Becker, 2010; Leslie &Koger, 2011; Froehlich et al., 2011; Matsuzaki ET AL., 2012; Yoshimasu et al., 2014), individual susceptibility is determined genetically. Consequently, diverse harmful effects do not influence the development of all children equally. Different levels and forms of disorders can emerge during the maturation of the nervous system as a function of, among other things, individual neurological characteristics. One child may be more likely to develop a learning disorder, while another child may be more prone to autism spectrum disorder.

Atypical developmental is a deviation in neurological maturation

Owing to the change in culture, natural diversity and the extreme plasticity of the brain (combined with the prominent role the latter plays in adaptation) is becoming increasingly more apparent owing to the increase in stimulus and information richness that has reached consummate levels by the twenty first century. In the info-communication age, children have far more opportunities to explore the information space and satisfy their interests within this environment. For children possessing outstanding intelligence, this access presents an extreme opportunity for development. At the same time, activities that prepare a child for literacy have fallen into the background. Less reading aloud occurs while more moving pictures are seen. Less active music-making takes place in favour of more listening of music. Fewer physical, bodily experiences occur in comparison to more mental experiences. As a result, children's development is becoming unbalanced. While their intelligence and knowledge may even develop at a faster rate than before, deficiencies in important areas of ability may also arise.

The emergence of increasingly more highly developed technological tools and especially the advent of info-communication technology has transformed everyday life in the following ways:

- children are surrounded by a huge amount of experience and a large number of stimuli, so they can pick and choose;
- the brain is subject to a large number of stimuli, which strengthens the short-term memory system and diffuses attention;
- compared to earlier times, there is far less need for children to exercise restraint (washing machines can make anything clean again, plastic tools do not break as easily, lost objects can be replaced, etc.);
- there are more holistic and visual stimuli and fewer situations requiring sophisticated and verbal processing;
- due to less movement, less activity is necessary to access information and experience, resulting in fewer precision-based, manual activities and sensory-motor experiences.

When compared to the requirements for school readiness, this list reveals, point by point, how environmental effects impede maturation via reduced reinforcement of the executive functions.

Small children have the brains of hunter-gatherer nomads and are optimised for movement and exploration. The different forms of atypical development that can be identified as delayed or deviant maturation are in fact deficiencies and disorders in the process of the neurological system that turns children into the 'farmer' type. In the case of small children, the neurological functions that are newer from an evolutionary point of view and established the foundations for literacy for humanity embody school-readiness. These functions mean that the child displays the following characteristics:

- has developed a toleration of monotony, is able to sit still;
- is able to focus their attention and maintain it for at least 15 minutes;
- is able to remember sequential pieces of information;
- is able to control impulses and wait with patience;
- their perception is refined and can identify details and relations;
- their movements are coordinated, are able to maintain rhythm.

All of these elements are necessary for both methodical work and the acquisition of school skills. When these abilities are not available to an individual, disorders will arise.

Although the nomadic, hunter-gatherer brain functions may once more be an advantage, the methodical, agrarian, literacy-based activities that have developed the human brain remain indispensable. This is not only true in the case of school: methodical and analytical information processing is also essential for higher-level, synthesising, critical modes of thinking. For this very reason, we need to reinforce the cognitive processes efficient in twenty-first century culture while simultaneously maintaining extant innovations in the human neurological system. A way to assist this process is to begin regarding neurologically-based performance disorders, which have become more frequent over the past decades, not simply as a developmental disorder in children, but as a signal and guiding light for the directions to take in education and development.

Summary and conclusion

While not always apparent, atypical forms of neurological functioning often lead to atypical development (i.e., learning, attention, hyperactivity and autism spectrum disorders) and are becoming more and more frequent. These atypical forms are not an illness and cannot be cured because they are characteristics of and exceptionalities in the maturation and functioning of the neurological system. These divergences used to contain numerous advantages and may still do so in the future.

Human activity – and changes in it – significantly affect the development of the human nervous system. That is, if the environment changes or is changed, this shift leads to an alteration in the neurological system on the level of both the individual and humanity itself. This change is what happened in the transition from the nomadic lifestyle to agriculture. Founded upon this new lifestyle, literacy subsequently began to spread. In contrast, the twenty first century has seen an unprecedented rate of transition in environmental and human culture, a state that can be best detected in children's development. In children, neurological functioning will adapt to the environment. Atypical development is not a disorder: it is a signal. Its increasing prevalence indicates a slower or different-from-normal development of the neurological functions that prepare an individual for literacy, at the root of which cultural and physical-biological adaptations can be identified.

The culture of info-communication has created a world remarkably close to that of the hunter-gatherer lifestyle. In a growing number of children, we can expect literacy-related maturation to be atypical because developing brains receive less environmental reinforcement associated with the culture of literacy. Beyond cultural factors, other environmental effects influencing the maturation of the nervous system additionally play a role in the occurrence of atypical development. Radiation or chemicals can most readily affect the newer, less basic functions of a developing nervous system. Even though this influence may often not be apparent, it will significantly alter children's development. The neurological maturation that prepares an individual for agriculture- and literacy-related activities, that is, the development of executive functions, is particularly vulnerable to this kind of change given that these functions are more recent from an evolutionary perspective and are consequently less stable.

A deviation in neurological functions can result in under- and over-functioning alike, a phenomenon that occurs in an atypically developing brain. Although each entails opposing kinds of cognitive functioning, this is why both the autism spectrum and the learning disorder spectrum are in fact potentially co-occurring forms of atypical development. In some cases, unstable functioning entails that under-functioning may appear alongside over-functioning.

Atypical development-causing disorders that are not directly apparent are quite easy to influence due to the lack of any serious, underlying injury or developmental anomaly. At the same time, all types of atypical development can take a more severe form (Gyarmathy, 2012). In itself, a change in culture would not lead to so many disorders if we were able to create a learning environment suited to the kind of neurological development that typifies these new circumstances. In order to achieve this task, however, we must first revise our views regarding 'normality' and 'typical development'.

Like the first farmers who were capable of methodical work and controlling their impulses, atypically developing children are indicators of a change in humanity. As humanity faces new challenges, new kinds of activities will prove advantageous. The winner will emerge as a kind of neurological harmony that combines all the functions acquired during the history of the development of the human nervous system. All key elements in children's development, the parental home, school, and info-communication technology must work in concert to attain this goal successfully.

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Prevention and treatment of behavioural and learning disorders with sensory integration therapy

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Sensory integration disorders, which are often hidden in the background of learning and/or behavioural disorders, can cause serious difficulties in the daily activities of the students, in the implementation of learning and/or behaviour. Upon hearing the term 'sensory integration', two interpretations appear in the minds of professionals. On interpretation refers to the integration, sensory interconnection coordination and interdependence of sensory systems as a typical, neurological maturation process that provides the basis for subsequent learning and behavioural organisation processes. Based on a second interpretation, 'sensory integration' is a therapeutic methodology, diagnostic, and therapeutic procedure that provides assistance to people who are lagging behind in the maturation of sensing systems and perception processes. Learning and/ or behavioural disorders can be caused by impaired information acquisition processes, sensory modulation, and integration in the nervous system. The following study comprehensively presents the diagnostic process and the relationship between the learning and behavioural differences related to sensory integration disorders

Keywords: learning disabilities, behavioural disorders, nervous system, information processing, sensory integration, neuroplasticity, sensory integration therapy

Introduction

In the rapidly changing world around us, constant adaptation, quick recognition of opportunities, adequate modification of our behaviour, and the continuous renewal of knowledge are necessary skills. Children face the need to acquire these competencies as soon as they enter school; as they age, this progress becomes more and more intense. In addition, we can conclude that even with the most dynamic and modern curriculum development, it is not possible to learn everything in school that an individual will need throughout his or her adult life. This finding has led to the realisation that, in addition to knowledge transfer, our schools need to emphasise skills and prioritise their development. As a third step after information transfer and skill development, modern pedagogy has now come to realise the importance of devoting time and energy to underscoring the role of non-cognitive factors related to knowledge and experience. Given its support of knowledge acquisition, we consider such a psychological factor as essential for the development of a child's need to acquire knowledge, shape knowledge-related values, teach children different ways of acquiring knowledge, and discover their surrounding environment for themselves, while also becoming active participants and creators (Csapó, 2002).

The transformation of public education, the shift of the school system towards a skills-developing, child-centred school, and the social program of ensuring equal opportunities point in the direction of increasing diagnostic needs (Gereben, 2004). This statement is subsequently true in the treatment of students with behavioural issues: after a comprehensive diagnosis of the child and the exploration of his/her bio-psycho- and social background, a personalised, individual development plan is prepared in each case.

This work is facilitated by the development of diagnostic methods originating from the knowledge system of clinical special education, which has started to develop dynamically in recent years. The greatest momentum driving this development lies in the multifaceted research conducted in the field of cognitive psychology. The subject of cognitive psychology is the study of cognition, that is, the learning process as it occurs in the broadest sense. To use the metaphor of a computer's operating system, it introduces the cognitive person as an information processing system. To simplify the term, cognition can be understood as the sequence of the following three main processes that both overlap and increase by level: 1) the senses absorb information; 2) visual, acoustic, tactile, spatial perception abilities evaluate and decode these stimuli; 3) stimuli are interpreted with the help of higher-order cognitive functions and integrated into the system of existing knowledge, i.e., an internal representation of knowledge is created.

Cognitive therapies help to make this processing procedure as perfect as possible. In a broad sense, cognitive therapy is a procedure that, in contrast to automatically processing events, teaches clients to focus on the information of a given situation, thereby attempting to reduce reliance upon erroneous assumptions and schemes. During the therapeutic process, a dynamic 'behavioural correction' function steps into place that is capable of self-regulation and helps the client overcome new problems independently, thus enabling the improvement of problem-solving skills (Zsoldos, 2004). A number of cognitive developmental therapies have emerged, including Marianne Frostig's Visual Perception Development Program (Frostig, 1978), Felice Affolter and Heide Helstab's Perception Development Procedure, Brigitte Sindelar's Cognitive Developmental Program, and Jean. A. Ayres Sensory Integration Therapy (Ayres, 1979a).

Sensory integration disorders and their therapy

The phylogeny of the development of the sensory integration method

The dual meaning of the term sensory integration can be interpreted as follows. On the one hand, we can define it as all perceptual processes and their neural coordination that are based on neurological and neuropsychological processes which ensure the organisation of adequate behaviour that adapts to the environment. In the course of sensory integration, information acquired through sensory organs, the neural processes of perceptual and information processing, and the planning and execution processes of these units are connected. The process of sensory integration is therefore essential to each of our everyday activities, be this playing, learning, speaking, the world of work, or even taking care of ourselves (Schaefgen, 2002a). On the other hand, the term 'sensory integration' also refers to a therapeutic practice in which the client is examined and the process of therapeutic treatment occurs when the client is disturbed to such an extent that it manifests as a disorder in the individual's day-to-day activities. Both terms are the result of the professional activity, research, and therapeutic practice of American occupational therapist and psychologist Anna Jean Ayres. She was the creator of the term 'sensory integration' and the associated therapeutic procedure (Ayres, 1979a). A. Jean Ayres defined the term sensory integration as 'the neurological process that coordinates the functioning of our interior and the outside world and allows our bodies to function effectively by adapting to the environment' (Ayres, 1979b, p.17). Rega Schaefgen, one of the German followers of Ayres' therapeutic work, described the essence of the process of sensory integration as 'the most efficient way of acquiring and processing information that is necessary for our daily activities' (Schaefgen, 2000, p. 21).

Based on spatial and temporal differences in incoming information, different sensory modulations are activated, coordinated, and connected. Sensory integration can be interpreted as a way of processing sensory information. In Ayres' professional view, the processes of proprioception are the basis of complex perceptual processes. As a fundamental finding, she stated that the areas of vestibular, tactile, and proprioceptive perception do not receive sufficient emphasis on the part of doctors and educators in connection with the development of children. Thus, the starting point of her professional research was that she situated these sensory areas in the focus of her work based on the understanding that neural processing methods are fundamentally decisive in the organisation and execution of human behaviour (Ayres, 1979b),

Ayres developed a standardised test (Southern California Sensory Integration Test / SCSIT/) to support her research as well as the development of her theory. Each test task measured and evaluated a neuropsychological function. However, the measurement of visual and tactile functions was associated with specific motor functions. In this test, Ayres used the method of factor analysis to develop a nomenclature for sensory functions or dysfunctions. Later, when SCSIT came under revision, using the group-building method a new test (Sensory Integration and Practice Test / SIPT) was used to group children based on similar test profiles (Fisher et al., 1999).

One of the most important professional issues in connection with therapy is the behaviour, participation, and activity of the therapist during the sessions. In Europe, Sweden, and Germany, the motivational factor is primarily the person of the therapist who instructs, for example, the usage of the sensory devices. According to the American practice, the child is instead motivated to use the sensory devices. In this latter approach, collaboration with the therapist is a less important factor, but in both cases the goal is the same: to improve function (Schaefgen, 2006).

Based on the researchers who continue the work of Ayres, the main findings found in connection with the theory of sensory integration have been summarised in Chart 1 (Roley et al., 2004; Reményi et al.,, 2014, p. 299).

Chart 1

Main findings of Ayres' followers (Roley et al., 2004; Reményi et al., 2014, p. 299)

1. Neuroplasticity	The genetic and biological endowment of the nervous system that is capable of transformation and develops and forms via interactions with the environment.
2. The 'top-down' and the 'bottom-up' processes	In a complex integrative system of the nervous system, the integration of cortical and subcortical information is a back-and-forth process in which subsystems are built and to which regulatory mechanisms are attached. The appropriate activity and implementation is created as a result of the two systems' cooperation.
3. Behaviour organisation and regulation	The individual is in constant interaction with the environment. Changes in the environment and opportunities for cooperation together develop the ability to respond appropriately. A sensory-matched integrated central nervous system regulates and directs our behaviour.
4. The structure of the central nervous system	The reactions of our body are triggered and shaped by changes in our external and internal environment around and within us. Activated nervous system structures form their function. The creation of this is influenced by individuality, the social context, and sensory and motor experiences. Together, these form the process of sensory integration and activity and execution.
5. Implementation process and the learning process	The process of carrying out an activity is determined by the individual and his/her previous experiences. Based on this, sensory integration can be shaped within biologically determined boundaries according to the concept of learning theory.
6. Motivation	Sensory and motor activity are generated in response to environmental changes. Proper integration of sensory information in performing the right activity is responsible for creating the right behaviour. Upon success, this tried- and-tested method of integration is stored and incorporated into the functioning structure and function of the nervous system.

Based on Chart 1, some experts believe that these disorders fall somewhere between the neurotypic area of development and the psychiatric-neurological disorders. However, sensory integration disorders can have a lasting and severe impact on children's neurological development, thereby providing a foundation for the conformation of later learning and behavioural disorders. 'Consequences can include behavioural disorders, learning disabilities, problems with physical activity, cognitive performance, and interpersonal relationships. Performance disorders, emotional underdevelopment, insecurity also strongly affect the ability to learn as well as the ability to thrive in life, so it becomes clear that sensory integration disorder is currently a very underestimated problem' (Schaefgen, 2006, p. 23).

The mechanism of action of sensory integration therapy

It is crucial for each therapist to be aware of the exact components upon which the therapeutic activity is based. According to Schaefgen's (2002a) course, the following elements play an important role in the mechanism of action in therapy. Defining and recognising the problem, clarifying the given situation, the relationship between the therapist and the client, their interaction, the course of the treatment, the expected consequences, the involvement of the individual's possibilities, and the mobilisation of their reserves all comprise essential aspects of any given therapy.

In addition to the components mentioned above, in connection with sensory integration therapy it is essential to mention the important role that the perception of one's own body and the use of various body movements play in therapy. After all, one of the most important pillars of therapy is to perform the planned and tried-and-tested movement activities in the therapy room with the help of therapeutic aids. During sensory integration therapy, the following factors can be observed that are specific to this therapy (Borchardt 2001):

1. Achieve performance improvement through exercises to be performed
2. Use of therapeutic devices
3. Use of technical means
4. Changing the environment / physical, social /
5. Improvements to acquire and maintain sensory and motor skills

Various joint activities, movements, sequences of movements, and play can be categorised as mediating tools of therapy. In sensory integration therapy, it is necessary for the child to have the opportunity to solve the given task or play situation based on his/her own idea, as well as for the therapist to guide them playfully in the correct direction or to the implementation of a better solution, as needed. Param, Cohen and Koomar (2003) list the following components that are absolutely essential to the mechanism of action in sensory integration therapy:

1. Therapist-child interaction (Therapeutic relationship)
2. Tasks that are appropriate to the child's level of development
3. Well-organised environment from a sensory point of view (Appropriate room, therapeutic devices)
4. Tasks that regulate the sensory system, hidden in therapeutic activities

Diagnoses of sensory integration disorders and their meaning in everyday practice

Disorders in sensory integration can cause milder or more severe behavioural and learning disorders in the development of motor and cognitive skills in children. However, these problems may be related to a lack of proper motor coordination, a reduced sensory processing or integrating ability, or a problem with the cognitive-motor system's ability to control and organise, even though the symptoms could clearly be linked to a central nervous system injury or a sensory partial ability problem. In these cases, the focus of therapy is therefore on the tactile, vestibular, and proprioceptive areas, as well as on the important role of sensory information in movement planning.

When observing signs of sensory integration disorder in a normal community of children, we can conclude that not all children show the same clinical condition. Various manifestations of this disturbance are possible, as well as various ancillary symptoms that may occur in addition to the underlying problem, such as general developmental delay or delayed speech development (Schaefegen. 2005b). It is therefore important to state that in the event of a possible disorder of sensory processing, the most important reason for diagnosis is different performance or underperformance that has been observed in various areas. This usually arises during the acquisition of reading, writing, and counting and is associated with problems in fine motor skills and spatial orientation.

The occurrence of these problems can be observed and predicted at an earlier stage of life, when a problem arises in the following areas (Schaefgen, 2005a). (Chart 2)

Chart 2

Observations predicting sensory disturbances (own edition)

Self-dressing	Putting on and taking off shoes, tying and unfastening shoelaces, putting on and removing trousers, jumpers, buttoning up shirts, blouses, jackets
Eating	Primarily when using cutlery or a napkin, unpacking and packing for snack-time, opening beverage bottles, peeling oranges, opening and resealing packaging
Personal care	Problems with nail trimming, hair washing, combing, hair trimming, brushing teeth, nose blowing, potty-training
Playing and completing tasks	Clumsiness in construction games, board games, catching and throwing the ball
Communication	Difficulty making and keeping connections
Free time activities	Lack of ideas and contacts

Consistent with all these observations, the following conclusion can be drawn: 'clumsiness' in different areas always has a social consequence in the future.

In the first stages of development, games and movement tasks are always the driving force of development. Movement dexterity gives the child a higher sense of competence; consequently, their self-esteem will be more developed. In sports and games, dexterity is a very important component as it determines a child's social status. The more skilful the child is when playing games or doing sports, the happier. He or she will have more friends compared to a clumsier child. Less dexterous children tend to become more introverted, shy, and less confident in themselves and others.

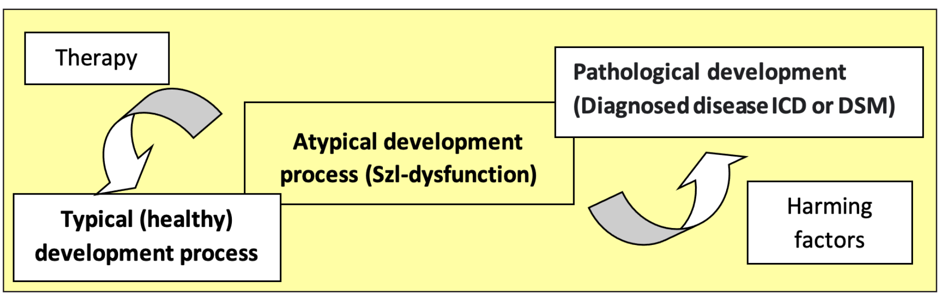
Children who experience a developmental lag or 'clumsiness' during eating and dressing are much more likely to cause conflict or provoke their environment during these awkward situations, thereby diverting attention from their condition. In my work, this finding can be observed in many cases. I can also add that in these cases we cannot achieve results by means of discipline because the clumsiness underlying these outcomes has not been eliminated. In such situations, practice is the only solution (Czigler, 1999; Schaefgen, 2000).

The relationship of sensory integration disorders to international classification systems (BNO, DSM)

According to the approaches applied to date, the problem of sensory processing does not lead to clearly diagnosable, classifiable problems and diseases. However, recent approaches suggest that sensory processing disorders may appear as a trigger in the background of diagnosable diseases. Sensory integration disorders should therefore number among the risk factors for diagnosed childhood neurological and mental illnesses. This necessity is because pre- and postnatal brain and nervous system development can be problematic due to various damaging factors (e.g., poisoning, alcohol, nicotine, etc.). Such chronic, non-specific factors can lead to persistent, pathological reactions that are risk factors for sensory processing disorder.

In the non-typical developmental process, attention deficit disorder, execution planning disorder, movement clumsiness and hyperactivity, learning disorders and behavioural disorders, communication disorders, social communication disorders, emotional injuries (shyness, lack of motivation), emotional lability and aggressivity can occur. This is why it is important that these problems are recognised, diagnosed, and treated in a timely manner. (Graph 1) Thus, despite these problems, at these sensitive stages of the nervous system, a healthier course of development can be ensured.

Graph 1
The effect of therapy on development (Borchardt, 2005, p. 42)



Among children aged 5–11 years, the incidence of dyspraxia is 6% (DSM). As with other disorders, these problems are more common in boys than girls. However, these differences often have a cultural background as well. For example, girls tend to have greater problems with large movements and coordination, an issue that is most likely due to the fact that parents are more likely to prohibit girls from activities such as climbing trees. In the gender distribution in general, strenuous activities and gross motor skills are weaker in girls while the results of boys lag behind in drawing and other activities requiring fine motor skills. For most tests, these gender differences cannot be taken into account; an exception is Marianne Frostig's test for movement development (FTM), wherein differences between boys' and girls' results can be included in the evaluation table (Schaefgen, 2002c).

Possible underlying causes of sensory integration disorders

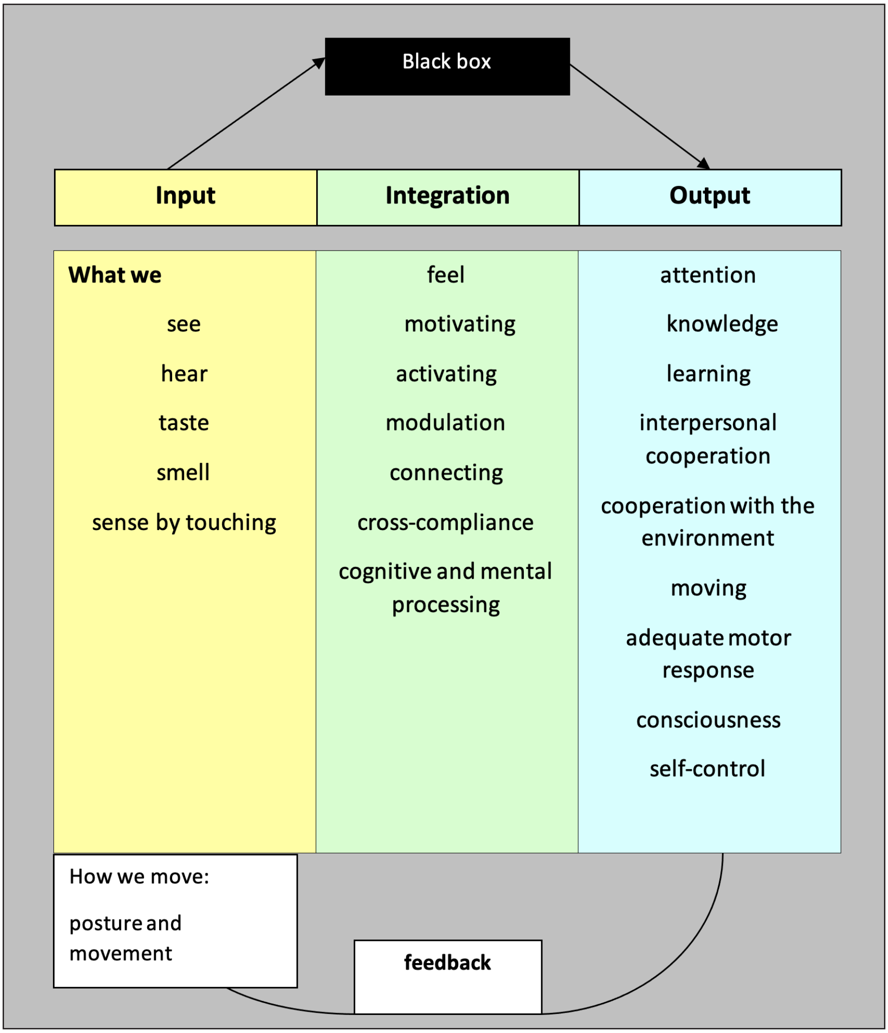
In many cases displaying sensory integration disorder, a single cause cannot be named while, the condition's background often remains indefinite. The several different causes of sensory processing disorder most often occur in combinations. The multifactorial causal background can often be combined by factors influencing development (Schaefgen, 2002a):

– genetic factors
– complications during pregnancy
– complications during birth
– childhood diseases
– brain injuries (hypoxia, accidents)
– developmental disorders
– family factors
– disciplinary problems (inadequate communication of rules)

Basic concepts and the theory of sensory processing

The theory of sensory integration was developed by Ayres essentially to prove the relationship between the issue of sensory processing and the difficulties encountered in acquiring mobility as well as school skills (Schaefgen, 2002a). The theory's starting point was that poor sensory integration performance without additional disabilities (e.g., deafness, blindness, etc.). leads to learning difficulties. However, the process of sensory integration cannot be observed from the outside since exactly what processes take place in the central nervous system cannot be seen. We can only assume what may happen within the 'black box'. This is shown in Graph 2.

Graph 2
The process of sensory integration (following Borchardt, 2005, p. 52)



A child's behaviour can be observed while he or she notices a dog, for example. As the dog is being perceived, we can draw conclusions based on the child's activities and reactions regarding the process and quality of sensory integration that has meanwhile taken place, yet we cannot examine the process itself (Schaefgen, 2004b). It is therefore very important for professionals to be aware of the processes that take place in the nervous system, the problems that may arise, and their consequences, all of which can be manifested in the child's different behaviours. Because of the problems that occur during sensory processing in the nervous system, we can only infer from the product, i.e., the child's behaviour and reactions.

The theory of sensory integration consists of three components (Schaefgen, 2002a):

1. The theory of sensory integration itself (nervous system function)
2. Test procedures and therapeutic tools developed on the basis of theory
3. A specific method of treatment and development (special therapeutic method (Chart 3)

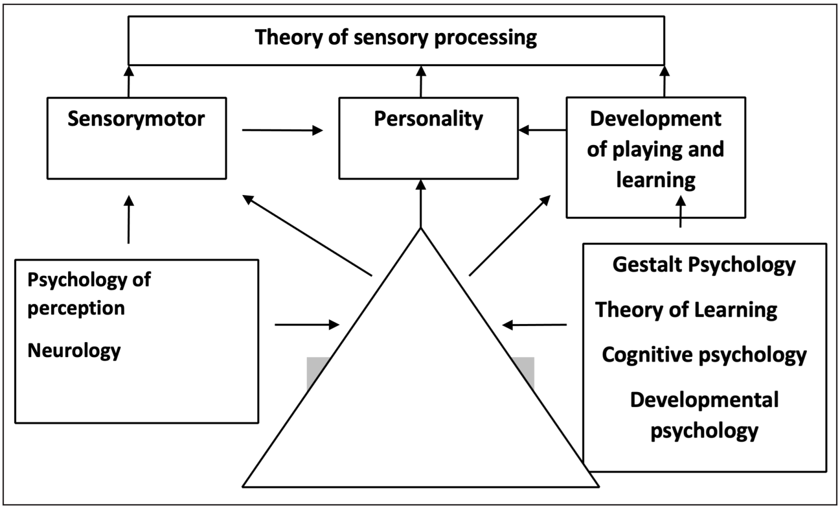
Chart 3
Components of the theory of sensory integration

1. Theory	2. Examination	3. Method
The success of the learning process depends on the quality of sensory integration.	Disorders of sensory integration lead to a learning problem.	Targeted development of sensory integration improves the quality of the learning process.
The process of learning depends on the ability of an individual to absorb, process, and respond to information received from the environment and movement.	If the uptake and / or processing of information, stimuli is impeded, the individual is unable to respond properly, and thus the learning process is impeded as well.	Better stimulus uptake and processing leads to better responses, thereby enabling a more appropriate learning process.

Graph 3 shows what a diverse body of knowledge has been built into the theory of sensory integration from its very conception. This knowledge system can be found in America and Germany primarily in the training of occupational therapists, but Hungarian special education training also has almost all its components. After all, any therapeutic, developmental profession can only function properly by seeking the most perfect problem and striving to solve it. Ayres summarised her theory as follows: proper self-perception of the body is essential above all, since only if the child has this, will be able to respond appropriately to the stimuli of the environment. A good body scheme is essential for an individual to recognize directions and to place and use their body in the environment.

While information from the environment gains meaning, at the same time the triple process of conception, design, and execution (which can also be called the ability to respond appropriately) must be completed. This triple activity is a unique ability that requires all three components for performing the proper reaction. Perception and activity are both the end product of sensory integration. Somatosensory, vestibular, and visual information are integrated and regulated, controlled through the activity scheme, and thus the individual's interaction with the environment is organised (Ayres, 1989).

Graph 3
The science of special education and its frontiers (following Roley, 2004, p. 54)



The sensory systems

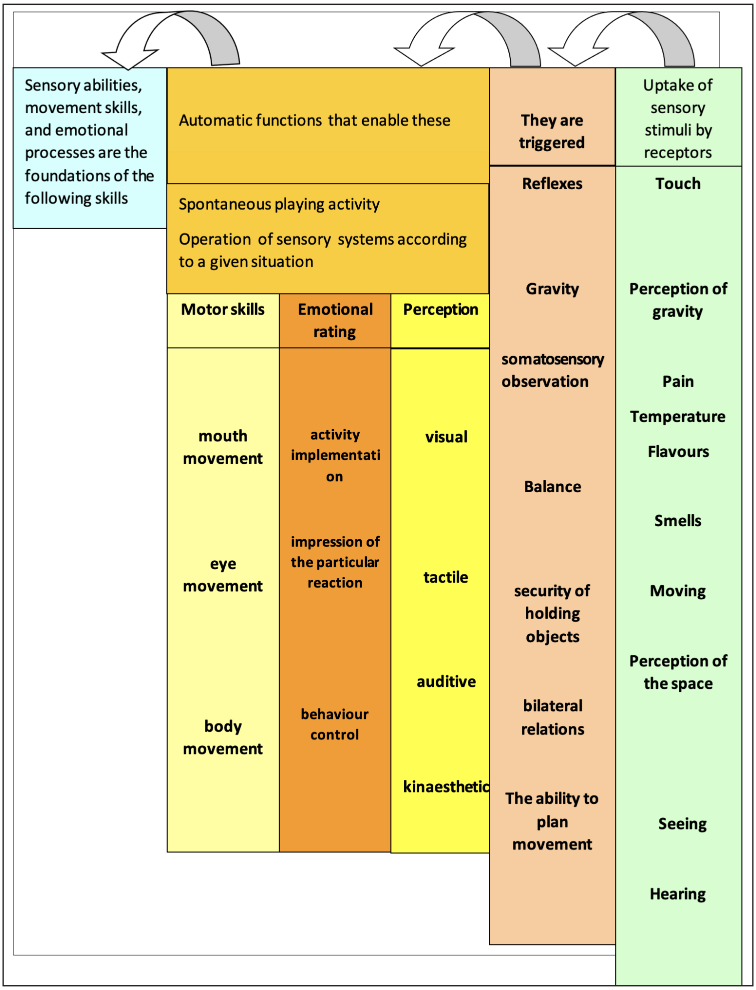
Higher sensory systems: proprioceptive, tactile, and vestibular systems

In developing the theory of sensory integration, the three systems she called the foundational sensory system were essential to Ayres. These include the proprioceptive, tactile, and vestibular systems. Just as important is a basic knowledge of the anatomy, the neuropsychology of the nervous system, and human developmental psychology. When discussing the entire sensory system, we must mention the following seven basic systems (Schaefgen, 2003a).

1. proprioceptive system
2. tactile system
3. vestibular system
4. olfactory system
5. gustatory system
6. auditive system

Ayres' starting point for these systems was that the proprioceptive, vestibular, and tactile systems pave the way for the unfolding of visual and auditory systems that in turn allow the unfolding of final skills, i.e., fine motor skills, thinking, imagination, etc. (See Graph 4). This interpretation represents a significant departure from other cognitive ideas, such as the Frostig method. At the forefront of Frostig's theory, visual perception analyses and develops problems in one or another area of visual perception (e.g., shape-background perception) more thoroughly. However, Ayres examines the disorder from a more comprehensive perspective, as she believes that if the basic sensory systems (proprioceptive, vestibular, tactile) are not properly integrated, then the development of the visual system, for example, may not be optimal either (Schaefgen, 2002a).

Graph 4
The course of sensory processing (Schaefgen, 2002a, p. 146)



However, the operation of sensory systems is not an independent, regulatory process and is furthermore strongly influenced by the level of alertness. The arousal level of each sensory system may be different, but they may be interconnected and thus this level of excitement may be amplified. In addition to stimulating the level of excitement, inhibitory factors also act in the regulation of alertness levels. The combination of the two effects can result in the appropriate level of activity, the basis for the proper functioning of sensory systems. Central sensory processing can be considered adequate if all sensory systems work well modulated and integrated (Schaefgen, 2003b). However, the most important role in the development of the appropriate level of activity is played by the inhibitory and stimulating processes, as the result of these two processes is the appropriate level of alertness, which facilitates sensory integration and the learning process. Ayres (1984) calls this organisational process the modulation of sensory systems. Normally, this level of activity moves in the middle area of the continuum, with children looking for different but not extreme stimuli to form it. In case of attention deficit and / or hyperactivity, the problem is mainly detected in this area (Schaefgen, 1999). If the sensory system is well modulated, it is possible that the sensory processing will proceed properly. The following levels of activity can be observed (Schaefgen, 2003b, p. 98). (Chart 4)

Chart 4
Possibility to monitor the activity level (Schaefgen, 2003b, p. 98)

Ability to sensory discrimination	Each sensory system has an information processing component that aids central nervous system processing.
Co-construction	Stabilisation against increased resistance in case of proper muscle tone is called co-contraction
Muscle tone regulation	Creating the right muscle tension to perform a given activity.
Balance regulation	Movement coordination activity performed by the cerebellum and posture regulation regulated through balance, related to the given movement.

The reticular system (*formatio retikularis*) is the part of the brain where the switch occurs between nervous system activity and awareness, behaviour, and response. Stimuli from all parts of our body, from the sensory, motor, and somatosensory areas, from the perception of the external and internal environment, and even from the autonomic nervous system converge in the reticular system. This is why this system is called an 'activation system' that is part of a large regulatory circle. It has a bottom-up process (brainstem) and a top-down process (cerebral cortex) (Schaefgen, 2002b).

The proprioceptive system

'The perception of one's own body is important in the performance of all movement activities, be it an automatic reaction or a planned movement' (Ayres, 1972, p. 66). When referring to the perception of our own body, we mean information coming from our system (blood pressure, tendons, muscles, joints, etc.), by means of which we receive internal feedback regarding our own movements and activities. This area only processes information coming from our bodies, not stimuli from the outside world. Also, with the help of this system, it is possible to be able to react to the given situation. Proper functioning of proprioception is also essential for the development of the body scheme (Schaefgen, 2002a).

The tactile system

'Tactile functions are the earliest. In individual development, a person's main source of information is the tactile system with which it picks up information from its environment and tells the body that a particular stimulus is acceptable to the body or indicates that it is unacceptable and triggers an offensive or escape reaction. However, in this reaction, the limbic system also interacts with the tactile system' (Ayres, 1984, p. 61).

With the help of the tactile system, we detect a lot of stimuli from our environment. The tactile system also plays a fundamental role in infancy, and it is even very developed and ready to record information even before birth. The tactile system often comes into contact with the proprioceptive system: the two are collectively referred to as the tactile-kinesthetic system. If the proprioceptive system is associated with the touch-based part of the tactile system, it is also called a somatosensory system.

Hands, feet, and the mouth are the most sensitive body parts in terms of touch. Think of babies: information about the objects surrounding them is gathered primarily with their mouths and hands. By using this information, infants become more and more informed. A further example can be found in the fact that a number of activities have to be done when we cannot use our eyes (e.g., tightening a screw in a hidden place, or orienting in the dark). In such cases, we call upon our tactile system for help (Schaefgen, 2002a).

The vestibular system (Balancing)

'The vestibular system is a unified system. The functions of all other sensing areas work based on basic vestibular information. The operation of balancing allows us to carry out all our other life activities' (Ayres, 1972, p. 55).

The vestibular system absorbs information from both our bodies and the outside world. The vestibular system develops in the womb and is fully operational at birth. The vestibular system is a complex sensory and motor system that can affect muscle tone in most of our body. Numerous studies and observations confirm that the primary function of this system is to develop the ability of spatial orientation and balance (Schaefgen, 2002a).

Chart 5

Summary cahrt of superior sensory systems (based on Kahle, 1996, p. 147)

Sensory system	Proprioceptive system	Tactile system	Vestibular system
Mode of detection	Mechanical sensing: pressure, pulling, pain, vibration, temperature	Mechanical sensing: pressure, vibration, touch, temperature	Mechanical detection: Posture change, body acceleration
Sense, receptor	muscles tendons, joints	Skin	Inner ear: sacculus and utriculus
Task	- force distribution - position of body parts - movement of body parts - temperature change	- Stereognosis - detection of the shape of objects - temperature change	- direction, e.g. lifting the head - posture - movement coordination: position, walking
Function	motion planning, movement coordination	Touch, tactile sensing	Placing the body in space, balancing

The subordinate sensory system: visual and auditory system

The uptake and processing of both auditory and visual stimuli play a subordinate role in sensory integration. Both systems (visual, auditory) are of great importance in cognitive processes (Chart 6). Visual perception is one of our most important channels of information acquisition. By processing visual stimuli, we create our own image of the world. Shortly after birth, the baby follows the changes in the environment with their eyes. The ability to recognise faces begins to develop and continues to develop in the first year of life (Lightfoot et al., 2014). The components of visual perception are: shape perception, colour perception, depth perception (spatial vision), and motion perception.

Auditory perception is just as important as visual perception since hearing is the basis of communication. The baby hears its mother's voice, recognises it, and can also distinguish whether the mother is in the same room. Components of the auditory perception (Roley, 2004):

– tone, pitch
– volume
– localisation
– distinction
– recalling auditory patterns
– time factors

Nor is the role of olfactory (smelling) and gustatory (taste) systems negligible; these systems are less researched and explored areas within the theory of sensory integration and therapeutic application.

Chart 6
Table summarising subordinate sensory systems (own editing based on Kahle, 1996, p. 189)

Sensory system	Olfactorial, olfactory system	Gustatory, taste system	Audit system	Visual system
Mode of detection	Chemical: gaseous molecules	Chemical: sweet, salty, bitter, sour	Mechanical: sound waves	Electromagnetic light waves
Sense, receptor	Nose, mucous membranes	Mouth, tongue, mucous membranes	Inner ear, auditory hair cells	Eyes, cornea, retina
Task	Vegetative and hormonal regulation, distinction between sympathy and antipathy	Taste discrimination, liking or not liking the taste of food	Distinction of noises and sounds, spatial orientation based on hearing	Three-dimensional perception, colour vision
Function	smell	taste	hearing	seeing

Sensory integration and development

Ayres believed that the development of sensory integration would take place in the first seven years of life. Undoubtedly, the majority of children reach a high level of development in sensory integration by the age of 7-9, an age that is already close to the level of adult maturity. The development of sensory integration is closely related to the complexity of the nervous system's organisation of sensory information and the appropriate level of activity in sensory systems.

As a result of the development of sensory integration, it can be observed that the child is able to organise play activities for a longer period of time and also has more control over the regulation of emotions. Children's internal motivation drives them to choose things from their environment that are the most developmental for them, i.e., neither too complicated or too simple. Thus, by observing the activities of children, we can easily determine which stages, sensory processes, and levels of development can be considered appropriate at a given age (Schaefgen, 2002a). The role of sensory integration in development is reviewed based on Chart 7.

Chart 7
The role of sensory integration in development

The main aspects of sensory integration in terms of development
Sensory integration is part of normal development.
Sensory integration develops through sensorimotor activity.

Sensory integration is the basis for:
- posture and movement
- the development of the body image
- spatial and temporal orientation
- cognitive and emotional development
- activity planning and implementation
- learning

The integrational processes can be found:
- in sensory processes
- between body parts
- between the components of the central nervous system
- between the right and left hemispheres

Sensory integration contains:
- neuropsychological
- sensorimotor
- cognitive
- emotional processes

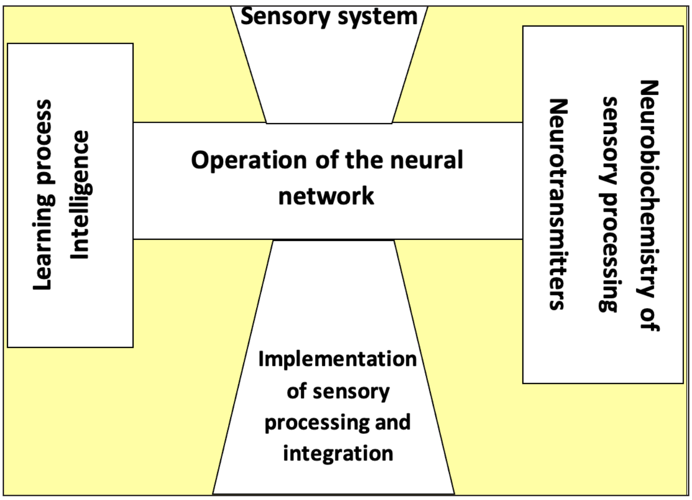
Nervous system (neurophysiology and neurobiology) bases

In this part of the study, I will outline the neurological and neurobiological foundations, formulas, and processes that led to the development of the theory of sensory integration and demonstrate the functioning of sensory integration in the nervous system. A prerequisite for the formation of a network of neurons is the establishment of secure connections of sensory information. The implementation of the processing of sensory information, and in particular its quality, can be observed primarily in practical activities: the learning process, social interactions and everyday life situations. However, it is also important to see below the surface and be aware of what processes are taking place in certain parts of the nervous system. (Graph 5)

The graph below is intended to show the relationship between the senses, the functioning of the nervous system, and the learning process. Even with the knowledge of the many nervous system formulas and the interactions among them, we must not forget that (whether it seems irrelevant or unnecessary or not) in the background of dealing with all this information only one important goal must be kept in mind.

Graph 5

Sensory integration and the nervous system (Schaefgen, 2002a, p. 136)



If we know exactly what is going on during the functioning of the nervous system called the 'black box' (see Graph 2 above), we can effectively help the child who appears in therapy.

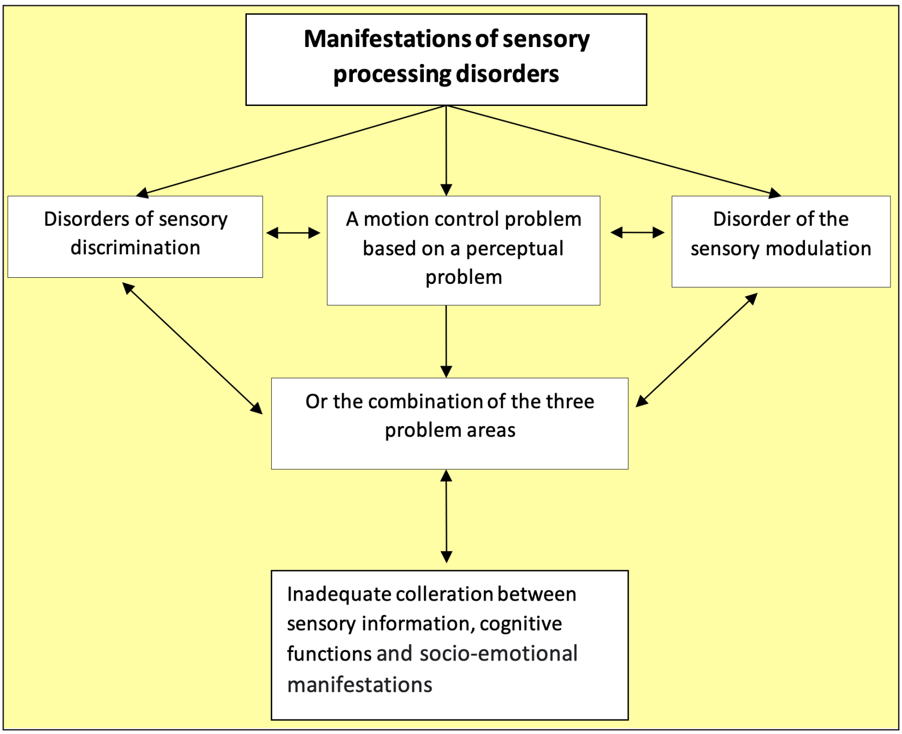
Comprehensive categories of sensory integration disorders

Ayres' research was taken up and continued by her followers, leading to changes in categorisation. Although researchers have been examining sensory processing and working to improve categorisation [Clarc, Mailloux and Parham (1989), Fisher, Murray and Bundy (1991), Kimball (1993), Dunn (1999), Miller (2001), Smith-Roley, Balche and Schaaf (2001), they remain unable to take a common position on the issue of a unified categorisation system and diagnosis. Yet it is clear that many overlaps and common elements exist in their developed systems, as is exhibited in the following categories: (Schaefgen, 2006, p. 160).

1. Disorders of sensory discrimination (sensory discrimination and perceptual disorders)
2. Disorders of sensory modulation
3. Sensory-based movement control disorder (posture problems and dyspraxia)

In the first two categories, disturbance in sensory processing can be observed based on responses to sensory stimuli and socio-emotional responses. In the case of the third category, the disturbance in sensory integration is reflected in motor responses, however an underlying disturbance in sensory processing can often be observed. The correlation among these three areas can be seen in Graph 6:

Graph 6
Disorders of sensory processing (Schaefgen, 2006, p. 165)



Disorder of sensory discrimination

Sensory discrimination entails the qualitative, quantitative, and emotional distinction between individual sensory information. We can differentiate our responses to each sensory stimulus depending on the intensity, length, and subjective judgment of the stimulus. Even limited or malfunctioning sensory discrimination can affect our sensory perception. Thus, from a spatial or temporal point of view, we cannot perceive our contacts and movements with proper discrimination. The same can apply to our tastes, smells, balance, hearing, and sight. If a stimulus cannot be detected for a sufficiently long period of time, it may not leave a clear impression on the nervous system and this may lead to further uncertainty. Limited sensory discrimination can easily cause a sensory-based movement disorder (Schaefgen, 2005b).

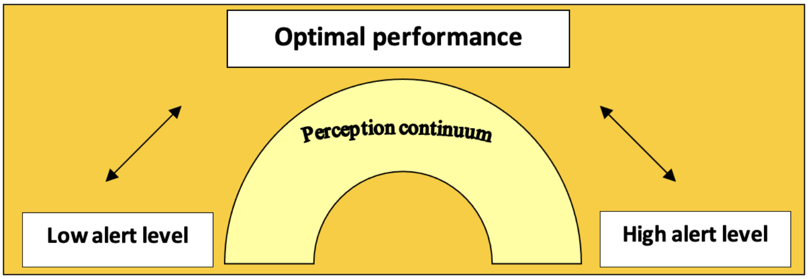
Chart 8 below shows what kinds of problems are caused by discrimination difficulties in each sensory system, according to Ayres (Ayres, 1989, p. 122, own editing).

Chart 8
Discriminatory ability of sensory systems (own editing)

Sensory system	Differentiating function	Abnormal functioning of dis-crimination
Proprioceptive	Distinguishing between torque, direction, and acceleration of motion.	Inability to distinguish between torque, direction, and acceleration of motion.
Tactile	Recognition of shape, form, size is possible through touch.	Recognition of shape, form, size is not possible only through touch.
Vestibular	Appropriate displacement to maintain balance during head and body position changes.	Improper movement to maintain balance during head and body position changes. Further balancing activities are needed
Olfactory	Distinguishing odours and smells is not a problem.	Difficulty in identifying odours and smells, recognising danger. E.g., the smell of gas
Gustatory	The different flavours are well distinguished.	Distinguishing flavours and avoiding danger is problematic., e.g., rotten food
Auditive	It is possible to distinguish and localise sounds and noises and filter sounds from background noises.	Identification of sounds and noises is impaired, speech hearing is problematic.
Visual	Shape-background distinction, clarity, colour, shape distinction is appropriate.	Difficulties in visual distinction: e.g., shape-background, constants, and distinction of similar colours.

If a problem with sensory systems occurs in this area, very different symptoms can appear. Each sensory system receives, identifies, and processes information from the outside world. However, this process can only take place properly with an appropriate level of activity (Graph 7). If there is a problem during the differentiation and identification of sensory information, then the processing course of the sensory systems cannot take place optimally either. This disturbance can also cause the modulation disruption of incoming information, as both cognitive and emotional structures receive only an approximate piece of information.

Graph 7
Level of activity required for detection (Borchardt, 2005, p. 89)



Ayres defined modulation as a management process implemented through the nervous system's own level of activity. If this control process does not work properly, then the incoming sensory integration cannot be processed properly by the nervous system, i.e., the modulation of the information is not proper. Below, Chart 9 displays how the operation of each sensory system is affected by the appropriate, too low, or too high activity level (following Schaefgen, 2003b, p. 176).

Chart 9
Modulation of sensory systems (own editing based on Schaefgen, 2003b, p. 176)

Sensory system	Appropriate level of activity, appropriate reaction	Low activity	High activity
Proprioceptive	Identification of proprioceptive information and appropriate response	The position of the hands, feet, movement, muscles does not seem to be perceived.	Movement of muscles and joints is too strong or too uncomfortable.
Tactile	Different touches can be distinguished / people objects, animals, garments /	We do not feel pain, we do not notice any injuries. Distinction is problematic.	Even gentle touches are painful, irritating. Touch of people, animals, clothing is not or hardly tolerated.
Vestibular	Balance and feeling self-confident	No attention to height, depth, fast and dangerous movements.	Postural problems. Fear of change of posture and relocation.
Olfactory	Appropriate response to odours and smells.	The perception of odours and smells doesn't seem to work.	Overwhelming odours can even irritate and cause disgust.

Gustatory	Proper perception of flavours.	Takes everything in the mouth.	Temperature / tea / overreaction, does not tolerate food, toothbrush in the mouth.
Auditive	Proper perception of sounds and noises.	Orientation is problematic, nor do loud noises bother.	Normal noises and sounds are annoying, often provoking anger.
Visual	Visual orientation is appropriate even during changes.	Changes in the position and location of objects and persons do not provoke a reaction	They react sensitively to any change, the intensity of the lighting can be confusing, irritating. Fear in the dark

Sensory-based motion control disorder

In addition to motor performance, the following functions are required to achieve proper performance: space and form perception, appropriate attitude, school skills (writing, reading, counting), speech and articulation, emotional regulation, appropriate level of activity, appropriate relationship with the environment. Chart 10 below summarises the regular and irregular operation of these functions, which have a significant impact on the appearance of learning and behavioural disorders (Schaefgen, 2004b, p. 180).

Chart 10
Regular and irregular function operations following Schaefgen, 2004b, p. 180

Function	Regular operation	Irregular operation
Space and form perception	Problem-free perception of space and form and use of information	Spatial orientation is difficult, problem in shape-background perception, reading and counting difficulties are likely
Appropriate attitude	Attitude appropriate to age, situation, and environment	Behaviour that does not correspond to age, tasks, situation, cooperation with the environment
School skills	Adequate performance in reading, writing, arithmetic, abstractions, and analysis	School performance lags behind the age-average level

Speech and articulation	Speech and articulation work at an age-appropriate level	For no apparent reason, the level of speech and articulation is below average
Emotional regulation	Emotional regulation is appropriate, awareness is age-appropriate	Emotional control is undeveloped and awareness is immature
Proper activity level	Level of activity appropriate to age and situation, with established self-control and independence	Low activity level, low motivation, depressed impression High, aimless level of activity, lots of movement, insufficient self-control
Proper connection with the environment	Proper interaction with the environment, proper problem solving, execution	Interaction with the environment is difficult, tasks are not performed properly

Upon reviewing the main categories of sensory integration disorders, it becomes obvious how many elements of the complex syndrome of sensory integration disorders may play a role in a child's inability to respond appropriately to an everyday situation, resulting in behaviour that is not adequately organised.

Summary

The theoretical and practical model of sensory integration therapy developed by Ayres proves to be an effective method for both the treatment of partial abilities in childhood and the rehabilitation of nervous system injuries. In our study, we demonstrated that, based on the basic concept, Ayres and her followers developed an increasingly complex diagnostic and therapeutic system that responded sensitively to specific educational needs.

The comprehensive categories of sensory integration, such as sensory discrimination disorder, sensory modulation disorder, and sensory-based motion control disorder, can be diagnosed and effectively treated from an early age. Thanks to research, it is becoming increasingly clear that sensory integration disorders can predict the later appearance of syndromes of learning and / or behavioural disorders. Due to this fact, the latest editions of the International Classification Systems (BNO, DSM) already include the main category of sensory integration disorders, a factor that is of great importance for the wider dissemination and acceptance of the theory and practice of sensory integration and the feasibility of further research. This status also draws attention to the fact that the treatment of behavioural and disciplinary problems arising from behavioural disorders requires a much more complex, holistic approach on the part of educators and should not be limited to finding the 'right' means of discipline.

Recognising the role of sensory disorders is especially important for the study of the effect our rapidly changing lifestyle exerts on nervous system maturation and development. The need to do so becomes increasingly urgent as professionals encounter more and more children with developmental characteristics that present atypically from the perspective of the nervous system development process. In many cases, these symptoms act as an early-stage predictor of dysfunctional development while performance disorders may also appear at preschool or school age during the organisation and implementation of more complex activities organised at a higher level. The method of sensory integration therapy presented in this study provides an explanatory principle for understanding these phenomena and an effective diagnostic and therapeutic method for preventing learning and/or behavioural disorders and treating pre-existing disorders from infancy to primary school.

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Impacts of premature birth and low birthweight on the development of language and executive function

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The increasing rate of survival of preterm newborns raises many questions given that preterm and low-birthweight children are at risk for impaired development of various cognitive abilities. The purpose of this article is to summarise the research evidence concerning the outcomes of language and executive function development in this risk group. The authors will discuss what influences neonatal factors and early neurological injuries have on the late outcomes of these high-risk children from the perspective of potential protective factors and intervention.

Keywords: premature birth, low birthweight, perinatal complications, executive functions, language development

Introduction

Preterm birth and low birthweight are the most frequent perinatal risks endangering a child's development. Normally 37 to 43 weeks in length, the gestational period spans the time between fertilisation and birth. An infant born before the thirty-seventh week is considered premature. In 2019, the frequency of preterm birth was 8.3 % in Hungary. The degree of risk depends on how immature and tiny the baby is. Both gestational age and birthweight are used as a basis for classification of preterm neonates. According to maturity, the preterm birth categories are the following: extremely early (<28 weeks of gestation); very early (28-32 weeks), and moderate to late (32-37 weeks). The percentages of preterms falling to each of the above categories are 4.9%; 10.6%; 84.5%, respectively (KSH 2021).

Concerning birthweight, infants are born with extremely low birthweight (<1000 g); very low birthweight (1000-1499 g), and low birthweight (1500-2499 g). The percentages in each category are the following: 7.4%; 8.7%; 82.9% (KSH 2021). Complications associated with premature birth are the fourth leading cause of infant mortality. A wide variety of factors underlie premature birth including physical illness or psychosocial hazards affecting the mother, organic anomalies or disorders of the uterus, twin (multiple) pregnancies, maternal age (below 16 or over 35), or multiple prior abortions. Fetal factors may be infections as well as various impediments of development, including excess amniotic fluid. The development of children born prematurely or with low birthweights may deviate from the norms, therefore it is essential to follow the progress of these infants with a mind to their individual developmental paces.

Perinatal complications and development of the central nervous system (CNS)

The immature organism is more vulnerable to diseases affecting the respiratory organs (respiratory distress-syndrome, RDS), the central nervous system, and the sensory systems. The prevalence of intraventricular haemorrhage (IVH) among the ELBW and the VLBW infants is 50% and 20%, respectively (Balla & Szabó, 2013). The more immature the baby is, the more severe IVH tends to be. Among ELBW, the prevalence of mild IVH (stages I and II) is 21.3%, and severe IVH (stages III and IV) is 12.6% (Bolisetty et al., 2014).

Periventricular leukomalacia (PVL) is a typical white-matter injury in preterm infants which, along with the more severe degrees of IVH, may cause cerebral paresis and the loss of oligodendroglial cells (Mulder et al., 2009).

Bronchopulmonary dysplasia (BPD), a chronic lung disease, is also a common concomitant of premature birth and occurs in more than 40% of ELBW preterms (Glass et al., 2015). Ventilatory therapy and oxygen toxicity may cause diffuse damage of alveoli and serious pulmonary fibrosis (Hargitai & Marton, 2018). Ventilatory therapy (mostly by hyperoxia) may cause an abnormal vascular proliferation of the immature retina too, leading to an ocular disease called retinopathy of prematurity (ROP) (Behrman & Butter, 2007).

The development of the central nervous system in preterm infants deviates from that found in their full-term counterparts. The gyrification occurs between 26-40 weeks of gestation, therefore in very immature preterms the brain surface is nearly flat. Before the thirty-second week of gestation, oligodendrocytes are in their early stage of development and are very sensitive to harmful environment. Disturbances of brain maturation may cause axon and astrocyte death (Back, 2015). Anomalies are often found in the structure of both the white and the grey matter. The entorhinal cortex and the corpus callosum can be thinner (Feldman et al., 2012) and the volume of the hippocampus as well as that of the cerebellum can be smaller than in term newborns (de Kieviet et al., 2012). Among low-risk preterm infants, no significant differences in the volume of the dorsal prefrontal and the orbitofrontal lobe were found (Peterson et al., 2000). The effects of prematurity on the central nervous system development seem to differ across the brain regions. One region may be affected severely while others may remain intact, and there are compensatory processes, such as plasticity, reorganisation processes, and environment factors (e.g., cognitive stimulation), which influence the development of the CNS.

Cognitive development in preterm children

Intelligence

It is apparent that the neurodevelopmental consequences of premature birth affect the development of cognitive functions and academic abilities, although the bulk of research evidence is not consistent. The IQs of the VLBW/ELBW preterm children as a group were found to fall into the average (Grunewaldt et al., 2013; Nagy et al., 2021) or low-average zone (StÅlnacke et al., 2019). However, according to a recent meta-analysis reviewing 71 studies, the IQ's of the very preterm children significantly lagged behind those of term comparison groups (Twilhaar et al., 2018). The authors of the meta-analysis also noted the heterogeneity of results across studies. The IQ of an individual is a composite measure which reflects the levels of a host of various cognitive abilities which are differentially affected by the neurodevelopmental sequelae of prematurity.

IQ per se does not give much information about the difficulties risk children encounter in their academic progress. If the aim is to understand and, ultimately, remediate the delays and disorders of cognitive development in preterm children it is far more fruitful to focus on specific abilities. Language and executive functions are among the abilities of paramount importance for both academic achievement and managing everyday life.

Do premature birth and low birthweight have a negative impact on children's learning and linguistic development?

Researchers have established four separate categories of infants based on the predominant development trends:

– spontaneous development
– development gap – predominantly motor development problems
– minor neurological deficits and/or mild learning problems
– profound central nervous system dysfunctions (disabilities) serious problems with living skills

A study of that included care of premature infants with birthweights of less than 1000 grams found the following (Müller-Rieckmann, 2001):

– one fifth of these premature babies had profound central nervous system deficits resulting in intellectual disabilities and serious difficulties with living skills
– few cases displayed mild neurological deficits and/or slight learning impairments
– for about 50 percent, deficits in motor development, particularly in gross motor skills, were clearly demonstrable
– good spontaneous development was observed for half of the children in this group

A vast number of research projects have begun to ascertain the developmental abilities of premature and low birthweight babies and the results are quite diverse. A series of domestic and international studies have found that if even extremely low weight preemies do not have serious neurological deficits, they will be normal in intelligence if raised and socialised in an appropriate family environment. By the time they are ready for school, they can catch up to their peers who were born with normal birthweights. Another significant domestic research project (Ittzésné Nagy et al., 1991), involved formerly premature babies (who were an average of 9.6 years old at the time of the study). Based on parental information, they found three typical behaviour patterns that were significant: extremes in activeness, mood swings and demanding behaviour.

Henry Truby began researching the phenomenon of fetal language in 1975, at which time he linked the development of speech initiative and preverbal abilities and reported that language development was underway before birth (Lengyel, 1981). According to Truby, a fetus is not merely a passive recipient of the patterns of maternal speech but also a ‘practitioner’ of the motor abilities needed to emit sound as a premature infant or a full-term neonate. Truby’s research raised a number of issues that went far beyond his immediate research: the roots of a communication deficit which go back to the pre-birth development phase. The analytical school of modern Hungarian psychological literature (relationship analysis) investigates active communication between fetus and mother. This body of literature urges us to move beyond the concept that the first nine months of life in the womb are a low-stimulus period.

There are many factors that go into determining the development of preverbal abilities. All congenital deficits and injuries in the initial weeks and months of life will affect the child’s development, including his/her preverbal and language skills. The deficits can be transitional in that they interrupt development for only brief periods. The child can bridge the gap that results from the consequence of the deficit as he/she gets older. However, sometimes processes are irreversible: when left to his or her own devices, the child will be unable to compensate, as can be seen by the many children who require some form of assistance or development therapy.

Throughout over forty years of investigation, researchers have been unable to offer a clear and acceptable answer. Several studies have pointed out that when the linguistic development of these children is compared to that of children born at term and with normal weight, they show a delay. Other researchers have drawn exactly the opposite conclusion, finding that delayed language development was no more common among preemies than among full-term babies, or if there were early differences, they could be made to disappear from the age of 2 or 3 on if diagnosed in a timely manner.

According to empiric Hungarian data, studies of speech perception and speech comprehension that were carried out when examining children to determine their readiness for school found that very low birthweight babies were worse performers than children born at term and with normal weight. Perception and comprehension were found to be related to intelligence test outcomes which suggested that speech development was a good predictor of later cognitive performance (Beke et al., 2001).

In 1998, Tanya M. Gallagher and Kenneth L. Watkin published an article (Gallagher et al., 1998) in which they concluded that numerous language difficulties are not apparent among children born prematurely, for possible impacts on the nervous system are not generally manifest until language development reaches the expression level.

When studying parental empathy and its impacts on the child's communication development, researchers found that the communicative attitudes of mothers and fathers – in combination with their emotional communication abilities (empathy levels) – do influence the socio-cognitive skills of the children including the development of linguistic communication. In her investigations conducted in 2001, Júlia Kádár-Sugár (Kádár-Sugár, 2001) found that, when combined with the parent's emotional communication, interactions involving the child's activities and desire to communicate determine 'vocal' communication and speech development. Thus, it was possible to demonstrate the defining role of the early social roots to speech development and the role the continuity of speech development plays in socio-cognitive development.

The object of our research was to compare the preverbal development levels of six- to eighteen-month-old children who were born preterm but with satisfactory birthweights or born prematurely with very low (including extremely low) birthweights. This study was conducted while focusing on both the productive and the receptive sides. (Nagy & Szanati, 2008) We found no correlations between duration of gestation, birthweight and the development level of preverbal abilities, nor did we find significant gender differences in the children's performances. As regards the order of birth, we found that the communication abilities of first children were farther behind those of second children. We have verified that possible deficits in the preverbal abilities of children born prematurely (with normal, quite low, and extremely low birthweights) can be discovered at a very early age, in infancy. We did not verify that low birthweight and the shorter gestation period have primary influences on the level of linguistic development among children born prematurely. We did not find difference between results of speech production and speech comprehension and results of toddlers (aged twelve to eighteen months) better than infants aged six to eleven months. It appears that qualification of mothers determines preverbal abilities of children. Children with extremely low birthweights achievement are not equalised.

It has been described in the literature that early exposure to the extrauterine environment can be advantageous for neurodevelopment. The emphasis mostly lies on the fact that preterm birth may have an unfavourable effect on numerous aspects of development such as cognition, language, and behaviour. Various studies reported atypical language development in preterm born children in the preschool years but also in school-aged children and adolescents. This review gives an overview of the course of language development and examines how prematurity can lead to atypical linguistic performances. They mainly focus on environmental and neurophysiological factors influencing preterm infant neuroplasticity with potential short- and long-term effects on language development. According to the discussed research, it can be concluded that during the first years of life, a period that is crucial for gaining adequate social and adaptive skills, language development can be affected by preterm birth. Altered brain maturation, leading to atypical functional organization and structural changes, was associated with abiding language impairments. In addition, environmental factors such as a long stay in a NICU with underexposure to significant auditory stimuli and nonoptimal infant-caregiver interactions have been associated with weaker language outcomes. Several intervention methods have proven useful in promoting the parent-child relationship, resulting in better interactions which have positive effects on cognitive and language development of children born preterm (Vandormael et al., 2019).

The aim of another research project was to study whether prematurity, associated with prenatal and neonatal risk factors, affects specific literacy skills among school children born at a very low gestational age of <32 weeks (VLGA). The study group comprised 76 followed VLGA children born and 51 term controls. The conclusion was that very low gestational age school children performed poorer in reading comprehension and spelling than term children. In addition, poor fetal growth in VLGA children was associated with literacy problems. (Heikkinen et al., 2020)

Very low birth weight, preterm infants have a higher rate of language impairments compared to children who were born full term. The early identification of those preterm infants who are at risk of language delay is essential to guide early intervention during the period of optimal neuroplasticity. This study examined near-term structural brain magnetic resonance imaging (MRI) and white matter microstructure assessed on diffusion tensor imaging (DTI) in relation to early language development in children born very preterm. A total of 102 very low birth weight neonates (birthweight≤1500g, gestational age ≤32-weeks) were recruited to participate. Language development was assessed using the Bayley Scales of Infant-Toddler Development-III at 18 to 22 months adjusted age. Children with cerebellar asymmetry had lower receptive language subscores. Infants at high risk for language impairments were predicted based on regional white matter microstructure on DTI with high accuracy (sensitivity, specificity) for composite, expressive, and receptive language. The conclusion was reached that multivariate models of near-term structural MRI and white matter microstructure on DTI may assist in identification of preterm infants at risk for language impairment, thereby guiding early intervention (Vassar et al., 2020).

The question remains of whether preterm infants have a higher risk of language delay throughout childhood. The ability to integrate audiovisual speech information is associated with language acquisition in term infants; however, the relation is still unclear in preterm infant. Imafoku et al. found that preterm infants did not clearly show visual preference for the congruent audiovisual display at any age, whereas term infants looked at the congruent audiovisual display longer than the incongruent audiovisual display at six and eighteen months. Preterm infants' receptive and expressive vocabulary scores were lower than those of term infants at twelve and eighteen months. Furthermore, the proportion of looking time toward the congruent audiovisual display at six months was positively correlated with receptive vocabulary scores at twelve and eighteen months for both groups. These findings suggest that better audiovisual speech perception abilities are one factor that results in better language acquisition in preterm as well as term infants. Early identification of behaviours associated with later language in preterm infants may contribute to planning intervention for developmental problems (Imafoku et al., 2019).

Children born VP had language difficulties that were not expected from their significantly higher VIQ and vocabulary knowledge. Clinicians assessing these children should be aware of possible language issues which cannot be detected by means of a simple vocabulary task. Stipdonk et al findings provide evidence of the need for adequate language assessments by a speech-language pathologist in children born VP, especially in those with VIQ scores in the low average range. Highlights of this study include that language scores are worse than verbal IQ and vocabulary in children born VP (very preterm). At the same time, language scores are significantly associated with verbal IQ, parent's vocabulary knowledge is a stronger predictor than parent's educational level, meaning that a follow-up test conducted by a speech language pathologist or, better yet, a multi-disciplinary team is advised (Stipdonk et al., 2020).

These results call attention to the psychological consequences of the medical intervention needed by premature and low birthweight infants. Neonates born under these conditions often spend a lengthy period of time separated from their mothers. Often their first experience following birth is that of separation. By the time the infant has the chance to get to know its mother in an uninterrupted manner, it is no longer a neonate. Until that time, the more often the parents visit, and fewer the specialist interventions on the part of doctors and nurses, the greater the chance for parents and child to bond. We also have to realise that, among these parents, tension in their relationship can occur, either as an outcome of overprotection or emotional rejection of the child. These factors all influence communication with the child and therefore of the preverbal and language-skills development of the infant.

Why are the executive functions in preterm children worthy of interest?

Research interest in executive functions (EFs) – which is an umbrella term encompassing conscious, goal-directed, problem-solving thinking and the higher-order control processes (Lee et al., 2013; Zelazo et al., 2008) – is relatively recent. A universally accepted theoretical model of EF is not yet available, but cognitive flexibility (shifting), updating/working memory, and inhibition have been generally regarded as its core components (Diamond, 2016; Józsa & Józsa, 2018; Miyake et al., 2000; Miyake & Friedman,2012). The higher-order executive functions (thinking, problem-solving, and planning) are built upon these core components (Diamond, 2016). Similar to the maturation of the prefrontal lobe, the development of the EFs is a long process and lasts until adolescence (Csépe, 2005). The various components mature in different rates, then start to decline in time (Diamond, 2016).

In light of the majority of research evidence, executive function is more sensitive to the biological risk involved by prematurity than the elementary cognitive abilities assessed by the IQ test. Four-year-old, preterm children performed more poorly than the term comparison group in direct measures of EF, and their teachers reported that they had more difficulties with inhibition, working memory, planning/organisational skills, and self-control (O'Meagher et al., 2017). School-age ELBW/VLBW preterms scored more poorly compared to their non-risk counterparts in tasks requiring inhibition, working memory, and shifting (i.e., cognitive flexibility) (Aarnoudse-Moens, 2012; Ford et al., 2011; Stålnacke et al., 2019). In the study by Ritter et al. (2013), eight- to ten-year-old VLBW children performed significantly more poorly than the control group in inhibition, working memory, and shifting, whereas ten- to thirteen-year-old VLBW children reached the same level as the control group in all three EFs. The authors concluded that the poor performances of the younger VLBW children might reflect a delay rather than a deficit. The catch-up tendency presumably stems from the plasticity of function and organisation of the human brain (Ford et al., 2013). A study by Costa et al (2017) calls attention to the variety of developmental trends of executive functions in ELBW children. In the majority of their subjects, the EFs remained stable between eight and eighteen years of age, with more than half of them scoring in the typical range and 15% performing persistently low. However, the EF performances of about one quarter of the subjects changed markedly, with late-onset difficulties and remitting trends occurring in equal proportions.

Diamond et al. (2013) reported a strong correlation between the processing speed and the updating/working memory and interpreted it as the processing speed having a crucial role in executive function. Lee et al. (2013) also emphasised the importance of processing speed, claiming that the development of response inhibition and working memory was mediated by the development of processing speed. Our study conducted with nine- to ten-year-old preterm children and a full-term comparison group (Nagy, 2019) supported the link between the processing speed and the updating/working memory only among the VLBW preterms. Among the ELBW preterms, the assessments of the IQ test (full-scale IQ, working memory, processing speed) were related to cognitive flexibility, hence corroborating the claim by Rose et al. (2011) that there is a direct link between birth status and cognitive flexibility. In this study, the effect of processing speed was significant for all three core components of executive function, but preterm birth had an independent impact on cognitive flexibility. The authors have yet to explain this phenomenon but assume that perseveration might be independent of processing speed.

Background of the development of executive functions in preterm children:

One of the most remarkable findings of our own study was the massive scattering of the individual scores falling below the group means; some of the preterm children, even a few born with extremely low birthweights, had chances for developmental outcomes comparable to the non-risk, full-term children (Nagy, 2019; Nagy et al., 2021). The substantial inter-individual variations within the performances as well as the variety of developmental trends of the executive functions (Costa et al., 2017) among the preterm children underline the issue of prediction, the prerequisite of which is to reveal the factors explaining these variances.

Research evidence suggests that the most powerful covariates for the preterms' development are gestational age (Mulder et al., 2009; O'Meagher et al., 2017; Stålnacke et al., 2019; Nagy, 2019; Nagy et al., 2021) and birthweight (Ford et al., 2011; Twilhaar et al., 2018). Perinatal complications, disturbed maturation, and injuries to the CNS have untoward effects on cognitive development, including executive functions (Arhan et al., 2017; Loe et al., 2018; Iwata et al., 2012; Nagy, 2019; Nagy et al., 2021). Gender also seems to have a role: within the groups of EP/ELBW and VP/VLBW, female preterms performed better on IQ tests and EF tasks than their male counterparts (Aarnoudse-Moens et al., 2012; Baron et al., 2009; O'Meagher et al., 2017; Nagy, 2019; Nagy et al., 2021).

When attempting to explain why the lag between the EF performances of VLBW children and those of the normative group was not found at later ages, Ritter et al. (2013) argued for the potential remedial effects of environmental factors. O'Meagher et al. (2017) reported that social risks and particularly low maternal education were the strongest associates of impaired EF outcomes while the perinatal variables had no predictive power. A study by Ford et al. (2011) provided a more complex picture of the background of the development of the EF and revealed interactions between the neurobiological risk factors and maternal education in ELBW children. In accordance with the phenomenon described above, a cluster analysis of our data corroborated the substantial effects of biological risks, yet also suggested the power of protective factors, including maternal education, which made it possible for even a few ELBW preterms to qualify for the top cluster (Nagy, 2019; Nagy et al., 2021). A recent eighteen-year longitudinal study by Stålnacke et al. (2018) revealed a complex mechanism underlying the development of EFs by using a serial multiple mediator model. The results showed a remarkable stability in both working memory and cognitive flexibility from ages five-and-a-half to eighteen years. Parental education had direct effect on both EF measures for children aged 5.5 years, while perinatal medical complications and intrauterine growth had direct effects on cognitive flexibility at eighteen years. In addition, mental development at ten months of age mediated the influences of perinatal variables and gender by having direct relation to the EF measures for children aged 5.5.

Conclusions

Drawing an association between early neurological hazards and developmental handicaps is statistically strong but not necessary as this parallel does not apply to each, individual case. The prediction of the outcome at the individual level is very uncertain, therefore conducting a long-term follow-up assessment of preterm and low birthweight children is essential. This follow-up assessment should be interdisciplinary and consist of a team of experts in neonatology, child neurology, ophtalmology, otolaryngology, child psychology, somatotherapy, speech therapy, special education, social work, etc. The adverse effects of neurobiological risks can be compensated (whether fully or at least partially) by favourable social backgrounds while early developmental training can either correct the adverse effects or attenuate the severity. Research can provide information on the protective factors families and professionals can utilise in creating optimal conditions for the children's development. Theoretically grounded and empirical evidence-based intervention can contribute substantially to the favourable outcomes of children born at perinatal risk (Beke et al., 2004).

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Preschool linguistic indicators of elementary reading achievement

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Literacy is a relatively new development in the evolution of human cognitive abilities. This biological-cultural gap can be bridged only by explicit instruction that modifies the operation of the underlying visual and linguistic neural structures. Literacy development relies on very different fundamental abilities, some of which are genetically determined while others are shaped by early experiences. The process of reading acquisition is therefore very vulnerable as it depends on the early development of different cognitive domains. The main questions of the current research are: (1) What characterises children who are at risk of reading disorders among Hungarian preschool children? (2) What are the early linguistic indicators of poor reading development? Our short-term longitudinal study followed 148 children from kindergarten to first grade through the initial processes of learning to read. We explored the relationship between earlier linguistic skills and later reading achievements by measuring a set of linguistic skills in kindergarten age and reading performance in first grade. Our preliminary results suggest that the group of children with the poorest reading outcomes has not only been significantly weaker in phonological processing tasks but in a number of language skills according to preschool assessments. Poor readers showed significantly lower levels than children with average reading outcomes in phonological, lexical and morphosyntactic tasks. Results suggest that reading outcomes among first-grade children might be predictable based on a screening test measuring linguistic skills at different levels of language. This result makes the early identification and development of children at risk for reading disorders possible.

Keywords: linguistic skills, risk of reading disorders, cognitive – linguistic indicators, preschool

Introduction

In today's (post-literal) age, many say that due to a new iconic turn, literacy has lost its hegemony in the transmission of information, and thus some of its roles. However, this loss can not only be interpreted as a rearrangement in terms of individual well-being, but also in terms of social change. In social development, it is still treated as a statistical fact that educated countries are able to sustain a more efficient economy than the uneducated (Glaser et al., 2004; Diamond, 2006; quoted by Keller, 2011, p. 15–16). Reading is therefore one of the most important human abilities even in our technology-based society: especially in the age of life-long learning, it is the skilled application of reading that enables us to access our cultural heritage. Failure to use literacy skills efficiently will not only result in a disadvantageous position among fellow students, but also in all areas of daily life, positions in the labour market as well as the advocacy of our own interests. Other than their financial consequences, these handicaps manifest in serious distress and lower quality of life. Hungarian PISA results suggest that about 25% of fifteen-year-old students do not reach the initial level of functional reading (Ostorics et al., 2016). This means that when they start vocational training, they do not have the minimum comprehension skills needed to learn any profession. Moreover, the Hungarian education system currently conserves or even increases socio-cultural disadvantages during the primary school period. It is therefore crucial to understand more precisely the process of development of literacy and its underlying skills in order to gain an even more differentiated picture about the initial phase of reading acquisition through the detection of typical and atypical ways of development. Screening the risks of written language acquisition in preschool age could provide the basis of an evidence-based, efficient preventive intervention which has long been a tradition in the Hungarian language therapy introduced by *Ildikó Meixner* and *Emőke Vass-Kovács.*

Theoretical background of the research

Current research is established on interdisciplinary foundations applying the tools and methodology of cognitive sciences. From a linguistic aspect it works within the framework of oral-written paradigm, therefore reading acquisition is regarded as the process of written language acquisition (Benczik, 2001; Ong, 2002). According to cognitive pedagogy, literacy is a complex multidimensional ability, which is in Kampis's (1991) view a psychical component system organised from cognitive routines, cognitive skills, and a store of learning. These are the elementary parts of knowledge, from which an ability-system is built. According to the views of József Nagy (2002), the acquisition of written language has two interrelated component systems which he calls text-comprehension and text-creation competences. According to cognitive psychology, reading ability can be divided into two major components involving the ability of decoding and text comprehension, both of which contribute to successful reading. Researchers assume that these component processes are driven by different underlying skills. The exploration of the linguistic skills underlying the decoding ability has been ongoing ever since the 70's, therefore we know considerably more about its developmental processes whereas the detection of the underlying variables of text comprehension seems to be a more complex task. In the present research, we examined the results of the initial phase of reading acquisition. Thus, we mainly tracked the results of decoding as well as elementary text comprehension. Accordingly, in our study, we placed more emphasis on the linguistic-cognitive skills behind decoding and less on the language skills behind text comprehension.

The cultural recycling hypothesis

Literacy is a relatively new development in the evolution of human cognitive abilities, thus our brains are not innately pre-wired to reading. This biological-cultural gap can be bridged – in Dehaene's view (Deahane & Cohen, 2007) – by our brains adapting to written language. Instead of creating a specialised, morphologically distinct processing unit for the new function, brain areas close to that function are 'reused'. The three basic ideas of Dehaene's theory of neural recycling are the following: (i) The evolutionary feature of the human brain is that its anatomy and connections are inherently limited. Already at an early age, ordered neural formulas appear that greatly influence the direction of later learning. (ii) Every new cultural invention must find its own neural 'niche', that is, a neural network whose function is close enough to the new function to be learned and whose resources can be used efficiently enough to serve the new learning process. (iii) When the skills required by a new culture 'occupy' the former neural organisation, it is not erased. This means that neural barriers significantly affect the acquisition of the new skill (Dehaene, 2005, p. 152–154).

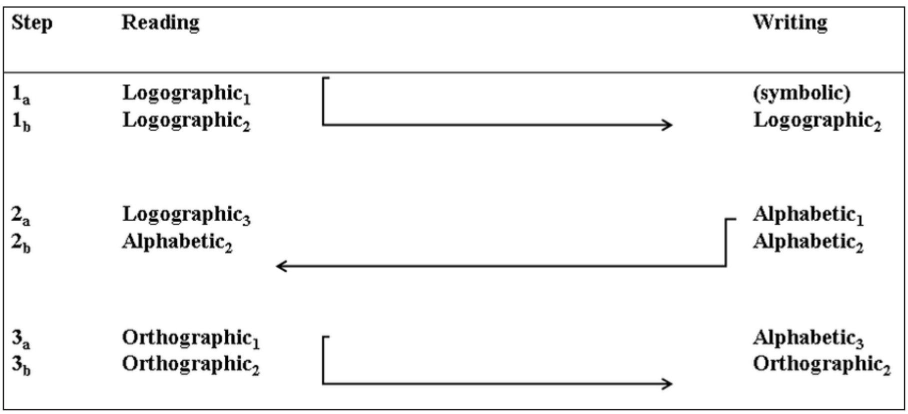
During reading acquisition, the child relies on the existing cognitive structures of visual processing and spoken language abilities. These early mechanisms transform during the acquisition of writing and reading and form a special network enabling skilled reading. Literacy development relies on very different fundamental abilities, some of which are genetically determined while others are shaped by early experiences. The process of reading acquisition is therefore very vulnerable as it depends on the early development of different cognitive domains. Due to the complexity and vulnerability of the process, reading can only be mastered in its entirety by explicit instructions even if some children might spontaneously reach the level of early reading. In this conscious, learning-teaching process designed according to the peculiarities of the mother tongue, the neural structure and functioning of the underlying visual and linguistic systems are also modified in the right direction.

The development of reading

The basis of the decoding ability is the fact that the majority of European languages use alphabetical writing in which each speech sound (phoneme) is mapped by a letter (grapheme). By this means, a finite (22-44) number of graphemes can be combined to create an infinite variation of words. As a first step, children have to understand the letter-sound correspondences, then learn the graphemes belonging to each of the phonemes (Csépe, 2006). When using this strategy, the child reaches the decoding of single words by mapping the graphemes respectively, a time-consuming and tiresome process (Shaywitz & Shaywitz, 2009; Vaessen, 2010; Csépe, 2014). During this process, more and more graphemic images of words get imprinted into the visual word-form area of the brain (Deahane, 2005; Deahane & Cohen, 2007). The reading of single words thereby becomes increasingly fluent. Finally, the child can apply this acquired skill during reading larger units, words, sentences, and texts. By this time the graphemic sequence is directly linked to its phonological and semantic equivalent as well. During this development, the emphasis shifts more and more from the slow sequential letter-by-letter reading to rapid automatic word recognition performance. This shift can be considered typical in other learning processes, too (Blomert & Csépe, 2012; Csépe, 2014a).

The afore mentioned development of reading ability has been described by several level- or phase-models displaying more or fewer differences. It has been found that children typically develop through similar levels using different reading strategies. Frith (1985), for example, determines three levels that are further divided into three more transitional levels taking the development of writing levels into account. At the logographic level, children do not recognise the word as a whole but instead guess the word by finding one or two visually significant feature within the context. This process cannot be considered real reading: it is rather an example of visual sample recognition. Within the logographic level, development acts in the direction of segmentation. The child recognises more and more internal features of the word, until it eventually reaches the smallest unit to letter. When the child recognises the rule that each letter corresponds to a speech sound, he enters the alphabetical level of reading, wherein the phoneme-grapheme mapping and phonological level of language play a great role. The last level is called the orthographic level of reading, where the direct transformation of the visual word form to a complete speech sound sequence becomes possible. At this level, the visual form of the word is already engraved in full sublexical detail into the visual word form lexicon. This will also allow for the development of spelling.

Figure 1
Six Step Model of Literacy acquisition from Frith (1985, p. 311)



Frith's model, as well as other level and phase models, has been shown in a new light by Share's "self-teaching theory" (2008). Share draws attention to the fact that a child's strategy usage not only depends on which level or phase their development is currently at, but also on the familiarity of the word they are actually facing. The more of the given text they are able to recognise by using their visual word-form area, the more experienced their reading is. However, even an experienced adult reader can face unknown words, or a specialised text, which can only be decoded by means of grapheme-phoneme mapping, that is to say, with the alphabetic strategy. According to Share, the reading performance can be regarded as a continuum as opposed to the practice of classifying the readers into well-defined categories. This continuum ranges from unfamiliar to familiar with regards to the text; however, from the point of view of the reader it ranges from the level of beginner to experienced.

Cognitive-linguistic indicators underlying decoding performance

Since reading is a rather complex cognitive ability, it is worth investigating what underlying skills and abilities are needed in order to achieve accurate and fluent reading. Since the 1980s, researchers' attention has turned to linguistic abilities, most especially to those which are in specific relationship with other cognitive abilities. The most significant underlying factor proved to be phonological processing, particularly phonological awareness (PA) which not only means the skill of differentiating speech sounds, but also the meta-ability for the explicit analysis and manipulation of the phonological form of words. This enables us to perceive the units of speech smaller than a word (syllable, rhyme, and phoneme) for performing different operations. For example, the first phoneme can be isolated from the speech sound sequence of the word and can be replaced by another resulting in a different meaningful word, etc. (Adamikné, 2006; Lőrik, 2006; Vaessen, 2010; Blomert & Csépe, 2012; Jordanidisz, 2012).

Research suggests that the majority of individuals exhibiting written language disorders perform significantly poorer in PA tasks compared to average readers (Shaywitz & Shaywitz, 2009; TÓTH & Csépe, 2008; Pennington, 2009; Peterson – Pennington, 2012; Jordanidisz, 2012; Csépe, 2014b). The pace of the development of PA especially accelerates between the age of five to eight years. In the case of Hungarian children, the first level to appear is the syllable level, followed by the rhyme operation level, and finally the phoneme operation level. More detailed observations have proven that reading acquisition and PA have a reciprocal relationship. Thus, PA is both a precondition and consequence of reading acquisition.

The basic function of word recognition relies on rapid and smooth access to items in the mental lexicon based on visual information. This skill has its precursor in rapid automatic naming (RAN) of overlearned items such as colours or simple objects, etc. The process means practically the 'translation' of visual stimuli to verbal ones and has a close relationship not only to the accuracy and pace of reading but with reading comprehension as well (Peterson & Pennington, 2012; Blomert & Csépe, 2012).

Recent studies emphasise the determining role of the automatic letter-speech sound mapping among the background indicators (Vaessen, 2010; Blomert & Csépe, 2012; Mohai, 2013). During reading acquisition, a strong association has to be established through which a tight integration of several modalities emerges. While it was previously believed that the process of letter-speech sound integration is completed in the initial phases of reading acquisition, it has recently been accepted that the child needs years for this relationship to be imprinted and integration to be used automatically (Vaessen, 2010). As a result of this, a new quality, a completely automatised skill is at the skilled reader's disposal as opposed to beginners. Current research proved that this transmodal connectivity problem contributes to the emergence of a severe reading disorder (Blomert & Csépe, 2012).

Contemporary researchers suggest that the three skills mentioned above form the classic triad of the cognitive-linguistic indicators that underlie reading acquisition. These three skills are supported by verbal working memory which has a less clarified relationship with reading (Pennigton, 2009). At the moment, it is not exactly known to what proportion and way its domain-general and language-specific components contribute to reading performance (Peterson & Pennigton, 2012). However, it can be claimed with certainty that the phonological loop, the articulatory repetition, and the executive functions must be taken into account as well (Baddeley, 2003; Németh, 2006).

Cognitive-linguistic foundations of elementary text comprehension

The first but not sufficient condition for text comprehension is proper decoding. After word recognition, the reader has access to the content of the text. The complex process of text comprehension involves word recognition, access to meaning, activation of prior knowledge, and their continuous interaction that Nation and Angell (2006) describe as a system of calculations from conclusions and reanalysis. Nation and Snowling's four-year study (2004) showed that individual differences in reading comprehension were related in all cases to speech comprehension, vocabulary, and semantic performance. The organisation of the mental dictionary develops along lexical nodes. It includes (1) the linguistic role of a word (e.g., word type, stem type), (2) its form (pronunciation and spelling), (3) its hierarchical or associative relationship with other terms, (4) its reference to the world (external psychosemantics), and (5) includes images and concepts. Thus, it stores lexical, phonological, visual, morphological, syntactic, and semantic information as well (Lukács et al., 2014). Moreover, written texts are more complex grammatically. While a conventional conversation displays low lexical density and high redundancy being less coherent due to its interactive nature. In contrast, written language prefers different grammatical structures, typically with high lexical density and low redundancy (Kamhi & Catts, 2014). Thus, it can be assumed that the lexical, morphosyntactic, semantic, and pragmatic levels of language are all involved in the process of comprehension.

Aims and questions of the research

In Hungary, several studies have examined the performance of decoding and the related language skills among preschool and first-grade children. According to descriptions in the international literature, these studies mainly assessed phonological awareness or phonological discrimination performances (Csépe et al., 2000; Csépe et al., Szűcs 2001; Tóth & Csépe, 2008; Lőrik & Kászonyiné, 2009; Jordanidisz, 2009, 2012). As a new aspect, the present research not only focuses on the phonological level of language when examining the relationships between language performances and reading outcomes. It adopts a broader perspective with wider scope of different levels of language skills. We hope that speech and language therapists and teachers can attain a more detailed picture of the linguistic skills behind reading, especially decoding. This might contribute to the preventive treatment of reading disorders in a broader context.

The purpose of our research is twofold. First, the aim is to investigate the initial phase of reading acquisition as studied at the end of first year's first semester of school, from a cognitive-linguistic point of view, and involving the exploration of Hungarian children's reading performance while measuring aspects related to accuracy, fluency, and sentence comprehension. The second goal is to explore the relationship of these three reading outcomes with the cognitive-linguistic skills in the final kindergarten year and first grade. Beyond the role of phonological processing as a core deficit of decoding, it is essential to identify its correspondence with rapid lexical access, working-memory functions, and lexical and morphosyntactic linguistic skills. Our results should also serve as a validity study of the Hungarian reading readiness screening procedure.

The present study focuses on the growth of linguistic skills from kindergarten to school-age, the variance in elementary reading outcomes during first grade and early linguistic characteristics of the children at risk for low reading achievement. Accordingly, we raised three research questions:

1. What kind of developmental dynamic is characteristic of the linguistic skills related to reading readiness between the final year of kindergarten and the initial year of school in the case of native Hungarian children?
2. What characterises children at risk for reading disorders among Hungarian kindergarten children?
3. What are the early linguistic indicators of poor reading development in Hungarian?

Method

Sample and procedure

To explore the initial processes of learning to read, our short-term longitudinal study followed 148 randomly selected children from their final year of kindergarten to the first grade of school up to the end of first semester. As regards demographics, our sample consisted of 78 children from Budapest and 70 from the countryside (Fejér County) and included 80 males and 68 females. Two assessment waves has been conducted: (1) an assessment of reading readiness (core linguistic skills) has been administered during the first two months (Sept-Oct) of their final year of kindergarten and (2) an assessment of reading achievement and related core linguistic skills has been conducted at the end of first semester (February) of their first school year. Participants' average age at the kindergarten assessment was 71.2 months (range: 59-89 months; standard deviation: 6.2 months). Reading readiness (core linguistic skills) has been assessed with the same tests in both waves allowing for a direct comparison between kindergarten-age and school-age performances to explore developmental trends. A preliminary analysis did not reveal any significant differences in reading performance according to age and gender within the group of first graders, therefore we can consider them as a unified group in the following part of the research.

Assessment tools

The assessment of skills related to reading readiness in both kindergarten and school age used the screening procedure known as *SZÓL-E?* (Kas et al., 2012).

Figure 2 shows the structure of the screening test by listing the subtests in the top two rows with arrows leading to categories of speech, language and reading difficulties that signal possible risks based on the subtests' results. In the present study, we have restricted ourselves to presenting only the core seven subtests that assess linguistic and verbal memory skills. Brief descriptions of the subtests are given below grouped according to the levels of the language hierarchy with the characteristic of cognitive processing.

Phonological skills:

- Nonword discrimination: a phonological processing task requiring the child to judge the conformity or difference between two nonwords spoken by the investigator;
- Nonword repetition: a classic phonological working memory task requiring the child to repeat nonwords exactly after the investigator;
- Phonemic awareness: a classic PA task requiring identification and segmentation of word-initial phonemes;

Morphosyntactic skills:

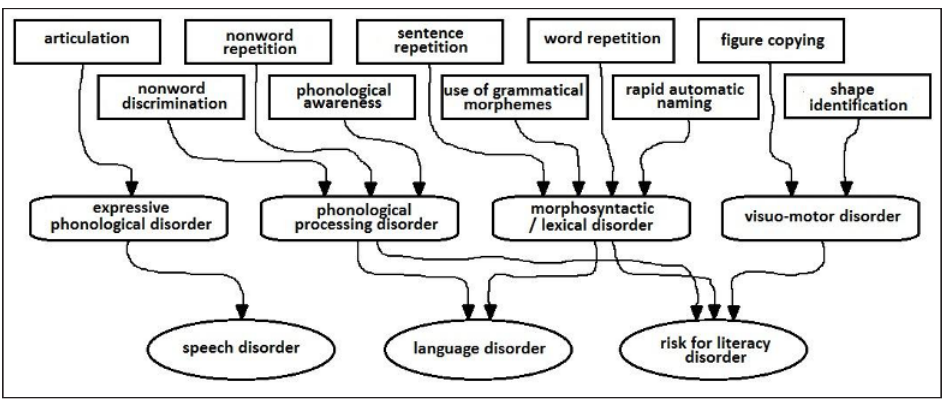
- Sentence repetition: a syntactical processing and working memory task requiring immediate repetition of spoken sentences with different syntactic complexity;
- Use of grammatical morphemes: a morphological task consisting of two parts requiring the child (i) to provide verbal descriptions of actions with toys performed by the experimenter using locative inflections and function words (Expressive morphology) and (ii) to act out instructions for placement of the same toys (Receptive morphology);

Lexical skills:

- Word retrieval: a verbal memory task requiring immediate retrieval of short lists of one-syllable words;
- Rapid automatic naming: a classic RAN task requiring sequential speeded naming of object pictures under time pressure;

Figure 2

Structure of the Hungarian speech and language screening test SZÓL-E? (Kas et al., 2012)



In the kindergarten studies, in addition to the language test, the children's intellectual ability was examined with Raven's Coloured Progressive Matrices (Raven, 1984).

Assessment of reading outcomes has been carried out using a self-developed test consisting of basic decoding tasks measuring sequential reading of letters, syllables, nonwords and common words. The Hungarian professional tradition – unlike the usual one in the English language – does not interpret letter-sound correspondence as a linguistic indicator of decoding but as an elementary reading skill. Therefore, the task of letter-sound matching was also included in our study as the first reading task along with syllable reading, which is traditionally part of Hungarian reading tests due to the peculiarities of the Hungarian language. Below, we present in detail the tasks of the reading test.

Elementary reading performances:

- reading letters: measuring basic letter-speech sound correspondences (25 vowels and 30 consonants);
- reading syllables: measuring sublexical elementary reading performance of CV and VC syllables (30 syllables);

Reading performance of the alphabetical level in Frith's sense:

- reading nonwords: measuring the efficiency of alphabetical strategies (Frith, 1985) without semantic support (25 nonwords consisting of 1-4 syllables);
- reading common words: measuring the level of orthographic reading (Frith, 1985) with the possibility of word-retrieving from the visual word form lexicon representing semantic support (60 commonly used word with 1-3 syllables).

For all the above sections, the number of correctly read items and the duration of the reading (in seconds) has been recorded to measure both the accuracy and the efficiency of the individuals' reading skill. For the purposes of the current study, a variable expressing reading efficiency has been constructed. The sum of all the numbers of correctly read items in each of the elementary reading performance sections (letters, syllables, nonwords and common words) has been divided by the sum of the durations (in seconds) of the same reading sections. This way, a single variable expressing basic reading efficiency that involves both reading accuracy and speed has been created for each participant. This variable served as the grouping variable to distinguish participants with different levels of elementary reading performance for the analyses of early indicators of later reading achievements.

Elementary reading comprehension:

- reading comprehension: a comprehension task requiring the child to draw simple pictures depicting the content of written sentences (six sentences consisting of double and triple instructions, e.g. 'Draw an ice cream in the hands of the little boy and a flower in the hands of the little girl!').

In parallel with taking the tests, we also conducted interviews with the teachers involved, consisting of semi-structured questions. In this, we also asked about the reading instruction's method used. For the sake of brevity, results of the comprehension task and the interviews will not be presented here.

Results

Firstly, the results of repeated assessments of core reading-related linguistic skills will be presented (3.1.), then the variance of elementary reading performance in first grade and the grouping according to reading efficiency will be introduced (3.2.). Finally, the correspondences between preschool verbal skills and first-grade reading performance will be explored (3.3.).

Growth of linguistic skills related to reading readiness

To explore the developmental characteristics of the core linguistic skills related to reading readiness, a comparison of performances in the same tasks between the final year of kindergarten and the initial school year of school has been conducted. Descriptive data is shown in Table 1.

Table 1
Descriptive statistical data of school readiness test results (raw scores) in the first (kindergarten) and second (school) wave of assessments

Subtest	N	Mean	Me-dian	SD	SE
Word retrieval (kindergarten)	148	7.71	8.00	3.015	0.2479
Word retrieval (school)	148	9.47	10.00	2.538	0.2086
Nonword discrimination (kindergarten)	148	7.76	8.00	1.839	0.1512
Nonword discrimination (school)	148	9.32	10.00	1.131	0.0930
Visual shape discrimination (kindergarten)	148	3.49	4.00	1.431	0.1176
Visual shape discrimination (school)	148	4.39	5.00	0.952	0.0783
Expressive morphology (kindergarten)	148	8.69	9.00	3.075	0.2527
Expressive morphology (school)	148	10.74	12.00	2.097	0.1723
Receptive morphology (kindergarten)	148	11.64	12.00	1.011	0.0831
Receptive morphology (school)	148	11.91	12.00	0.386	0.0317
Nonword repetition (kindergarten)	148	23.84	25.00	8.335	0.6852
Nonword repetition (school)	148	26.70	27.50	7.222	0.5937
Sentence repetition (kindergarten)	148	8.42	9.00	3.141	0.2582
Sentence repetition (school)	148	9.86	11.00	2.317	0.1905
Phonological awareness (kindergarten)	148	4.44	4.00	2.298	0.1889
Phonological awareness (school)	148	7.91	8.00	0.605	0.0498
Graphomotor sequence reproduction (kindergarten)	148	8.13	9.00	3.472	0.2854
Graphomotor sequence reproduction (school)	148	9.76	10.00	2.384	0.1959
Rapid automatic naming accuracy (kindergarten)	148	35.05	36.00	1.953	0.1605

Subtest	N	Mean	Me-dian	SD	SE
Rapid automatic naming accuracy (school)	148	35.62	36.00	1.431	0.1176
Rapid automatic naming time (kindergarten)	148	64.40	60.00	24.597	2.0218
Rapid automatic naming time (school)	148	43.80	40.00	13.384	1.1001

Descriptive data shows age-related growth in each task with decreasing variance. Paired sample t-tests conducted on the raw scores of the same tasks administered in the first assessment wave (kindergarten) and in the second assessment wave (1st school grade) marked significant growth in each task performance (Table 2.). Cohen's d values revealed small to large effect sizes, with the greatest growth being observable in phonological awareness, rapid automatic naming (speed), nonword discrimination, expressive morphology and sentence repetition (in descending order).

Table 2
Paired sample t-tests and effect sizes comparing kindergarten and school assessment data by subtest

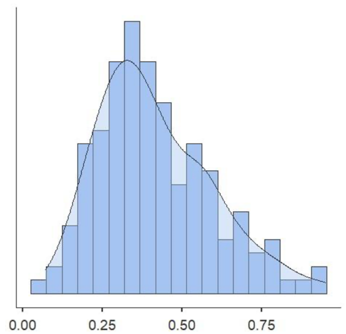
Subtest	Student's t	df	p	Effect Size (Cohen's d)
Word retrieval	6.38	147	< .001	0.525
Nonword discrimination	10.94	147	< .001	0.900
Expressive morphology	9.20	147	< .001	0.757
Receptive morphology	3.30	147	0.001	0.271
Nonword repetition	3.99	147	< .001	0.328
Sentence repetition	7.51	147	< .001	0.617
Phonological awareness	18.17	147	< .001	1.494
Rapid automatic naming (accuracy)	3.19	147	0.002	0.262
Rapid automatic naming (speed)	-11.23	147	< .001	-0.923

These results show that linguistic and verbal memory skills related to reading readiness such as morphosyntactic processing, word retrieval, phonological discrimination, and manipulation are still in progress in children between five to seven years of age.

Variance in reading outcomes

For the purposes of the current study, basic reading achievement of the participants is represented by a variable combining measures of reading accuracy and speed. This 'reading efficiency' measure has been derived as the ratio of the sum of all the numbers of correctly read items in each of the elementary reading performance sections (letters, syllables, nonwords and common words) and the sum of the durations (in seconds) of the same reading sections. The mean value is 0.414 (SD = 0.179). The population data is mesokurtic (kurtosis = 0.116; Std. error = 0.396) but considerably positively skewed (skewness = 0.687; Std. error = 0.199) and deviates significantly from normality (Shapiro-Wilk W = 0.963; $p < 0.01$). This is a result of the greater variation of children's data on the positive side of the average (Fig. 3.).

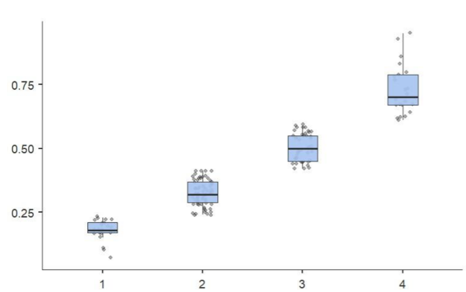
Figure 3
Distribution of reading efficiency in first-grade children



Thus, a single variable expressing elementary reading efficiency that involves both reading accuracy and speed has been created for each participant. This 'reading efficiency' variable served as the grouping variable to distinguish participants with different levels of elementary reading performance for the analyses of possible early indicators of later reading achievements. Based on each child's reading efficiency score, four groups with different reading achievement has been created in accordance with their deviation from the average (Fig. 4.). The resultant groups were the following:

1. more than 1 SD below average – 21 children (14%)
2. less than 1 SD below average – 64 children (43%)
3. less than 1 SD above average – 41 children (27%)
4. more than 1 SD above average – 22 children (15%)

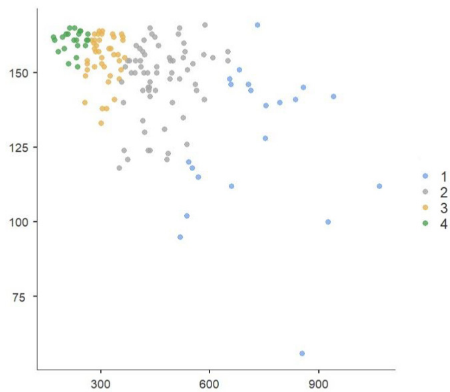
Figure 4
Reading efficiency in first-grade children by group



The proportion of students in Group 1 compared to the total sample is almost twice as high (14%) as the proportion of children with developmental dyslexia within a population (7%) according to statistics (Peterson, & Pennigton, 2012). Based on their reading efficiency results, we can say that the current poor performance of Group 1 suggests the risk of a future reading disorder. Figure 5 also demonstrates that the interaction between reading accuracy and reading speed is not constant across groups with different reading achievement. Children with more successful reading performance (Groups 3 and 4) exhibit consistently accurate and fast reading without significant deviance in any of these dimensions. However, the interaction between speed and accuracy in children with lower reading performance (Groups 2 and, mostly, 1) are much more scattered. There is a great inter-individual variation in both speed and accuracy and there are children with significant problems with either speed or accuracy while showing average or even better results in the other dimension.

Figure 5

Sums of reading accuracy raw scores (y axis) and reading times in seconds (x axis) in first-grade children by group



Early Indicators Of Reading Achievement

To explore the correspondence between preschool linguistic skills and elementary reading performance at the end of first semester of first-grade school year, we compared the above groups with different reading achievement in each of the subtests administered during the preschool assessment of school readiness. Checking the normality of the data using the Shapiro-Wilk test revealed that normality is violated in most of the subtests' data: Word retrieval ($W = 0.990$; $p = 0.344$), Nonword discrimination ($W = 0.970$; $p = 0.002$), Expressive morphology ($W = 0.928$; $p < .001$), Receptive morphology ($W = 0.580$; $p < .001$), Nonword repetition ($W = 0.967$; $p = 0.001$), Sentence repetition ($W = 0.943$; $p < .001$), Phonological awareness ($W = 0.951$; $p < .001$), Rapid automatic naming (accuracy) ($W = 0.643$; $p < .001$), Rapid automatic naming (speed) ($W = 0.958$; $< .001$). Thus, the one-way analysis of variance of the four groups' data has been carried out using the non-parametric Kruskal-Wallis rank sum test.

The analysis revealed a significant effect of Group in *Word retrieval* (χ^2 = 14.03, df = 3, p = 0.003), *Nonword discrimination* (χ^2 = 10.47, df = 3, p = 0.015), *Expressive morphology* (χ^2 = 10.14, df = 3, p = 0.017), *Receptive morphology* (χ^2 = 16.76, df = 3, p < 0.001), *Nonword repetition* (χ^2 = 10.11, df = 3, p = 0.018), *Sentence repetition* (χ^2 = 20.21, df = 3, p < 0.001), *Phonological awareness* (χ^2 = 8.46, df = 3, p = 0.037), *Rapid automatic naming (accuracy)* (χ^2 = 11.94, df = 3, p = 0.008), *Rapid automatic naming (speed)* (χ^2 = 21.66, df = 3, p < 0.001).

For pairwise comparisons Dwass-Steel-Critchlow-Fligner tests were conducted (Table 3). These tests revealed a quite uniform pattern with the lowest achieving readers in Group 1 exhibiting significantly lower scores than the other groups that did not differ from each other. Examples of the performance of the groups in the different subtests are demonstrated in Figure 6.

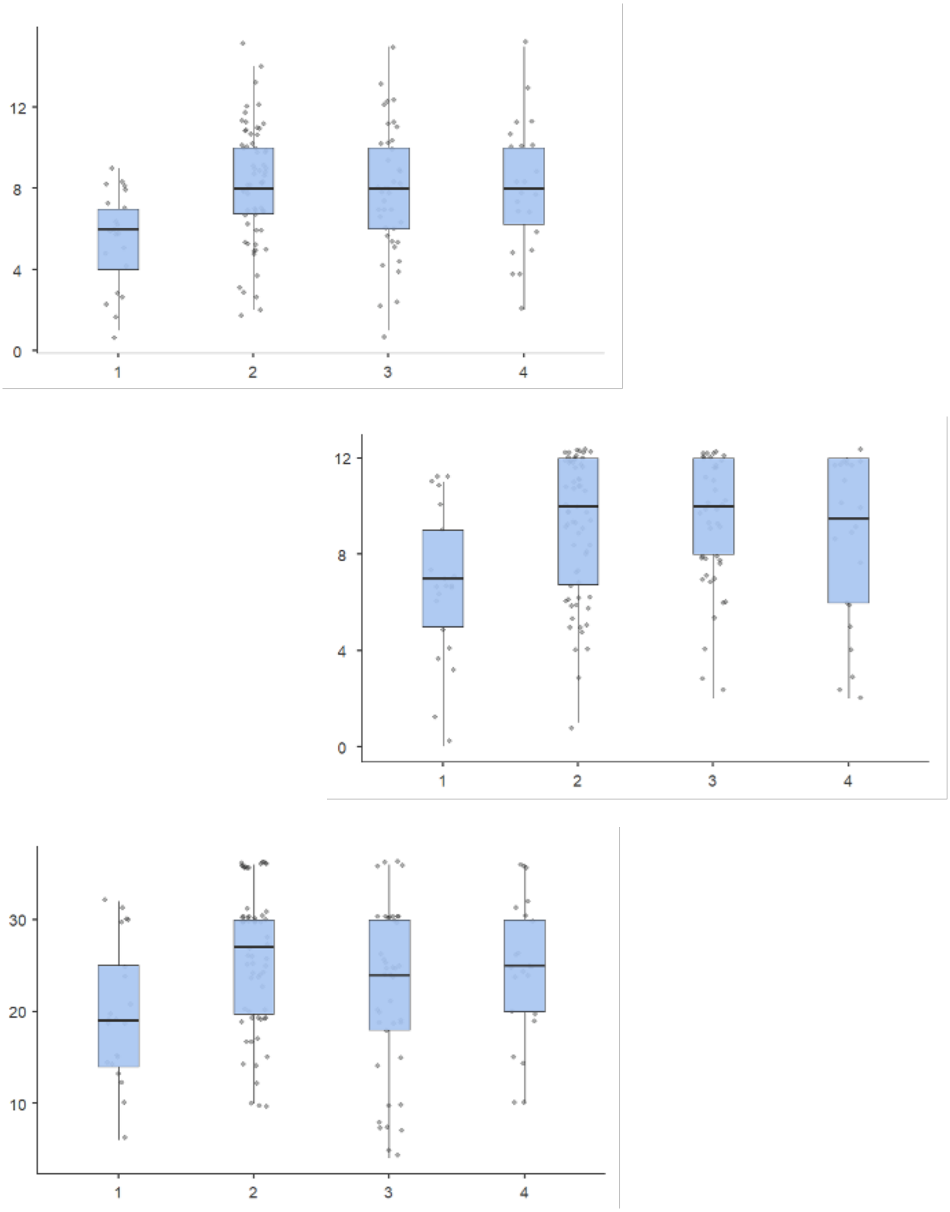
Table 3
Summary of Dwass-Steel-Critchlow-Fligner pairwise comparisons between groups with different elementary reading efficiency by subtests administered in the first (preschool) wave (< marking significant differences at 0.05 level)

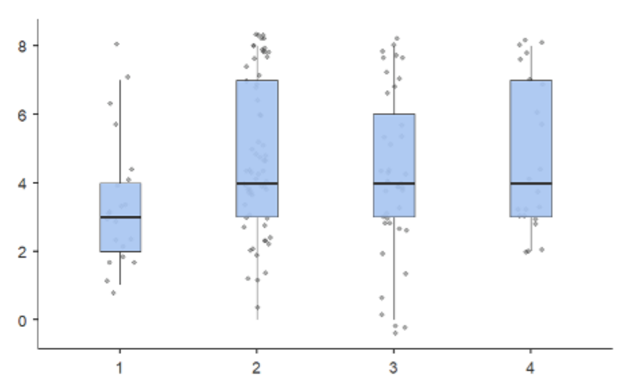
Subtest	Pairwise comparisons
Word retrieval	1 < 2 = 3 = 4
Nonword discrimination	1 < 2 = 3 = 4
Expressive morphology	1 < 2 = 3 = 4
Receptive morphology	1 < 2 = 3 = 4
Nonword repetition	1 < 2 = 3 = 4
Sentence repetition	1 < 2 = 3 = 4
Phonological awareness	1 < 2 = 3 = 4
Rapid automatic naming (accuracy)	1 < 2 = 3 = 4
Rapid automatic naming (speed)	1 < 2 = 3 = 4

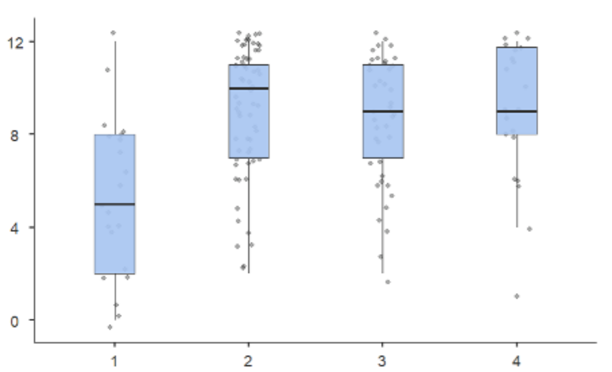
Group 1 has thus proved to perform consistently lower in each task measuring linguistic skills in preschool children. To control for general intelligence and non-linguistic skills, the Raven Coloured Progressive Matrices test as well as a graphic figure sequence reproduction task and a visual form discrimination task has also been administered. Although children in Group 1 performed significantly lower in the graphomotor task, they did not perform significantly lower in visual discrimination and exhibited the same level of general intelligence as it was revealed by Kruskal-Wallis rank sum tests: Visual form discrimination (χ^2 = 7.75, df = 3, p = 0.052), Figure sequence reproduction (χ^2 = 8.27, df = 3, p = 0.041), Raven IQ (χ^2 = 4.71, df = 3, p = 0.195).

Figure 6

Average raw scores of subtests administered in the preschool assessment by groups with different elementary reading efficiency (p. 139). Word retrieval: up, Expressive morphology: middle, Nonword repetition: down (p. 140). Phonological awareness: up, Sentence repetition: middle, Rapid automatic naming (time): down)







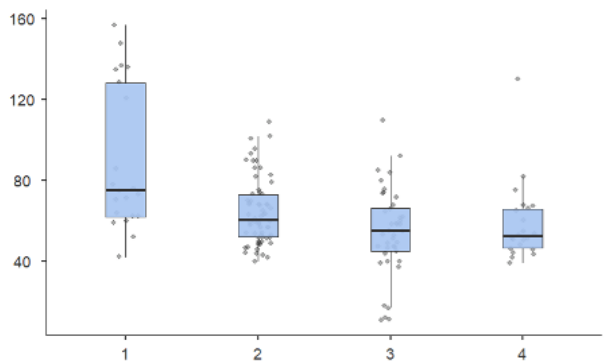


Figure 6 shows that there is great variation between individuals in terms of language skills in all groups. In general, the best performing students in Group 1 do not reach the highest levels in Group 2, such as in word retrieval, expressive morphology, nonword repetition or phonological awareness. It can also be discovered that there are language skills in which the 75 percentile value of Group 1 is at the 25 percentile value of Group 2, for example: word retrieval and sentence repetition. Based on this, it can be stated that children with the lowest reading outcomes (Group 1) perform significantly under Group

2 in all linguistic measures, while the linguistic performance of Group 2 does not differ significantly from those of Group 3 and Group 4. Thus, a group of students with poor decoding in the first grade showed lower performance at all linguistical levels during preschool. Further analysis of item-based predictive correspondences between preschool skills and first-grade reading outcomes are plausibly the next directions of the current research.

Discussion

Based on the data presented above, we can give the following answers to our research questions:

1. What kind of developmental dynamics is characteristic of the linguistic skills related to reading readiness between the final year of kindergarten and the initial year of school in the case of native Hungarian children?

When comparing the linguistic skills, a significant growth can be observed in the kindergarten-school transition in all language skills related to reading readiness. Phonological awareness shows the greatest developmental change. Among kindergarten children, only 13 percent can recognize the first speech-sound of the word, but in the middle of first class almost every child is mastering this skill. While nonword discrimination – as an early developing skill that requires less awareness – does not show a similarly high rate of development, this also represents a statistically significant change. Both Hungarian and international studies claim that phonological awareness is a reciprocal ability (Tóth & Csépe, 2008; Lőrik & Kászonyiné, 2009; Vaessen, 2010; Peterson & Pennigton, 2012). The syllable-operational level of phonological awareness shows strong development in the case of Hungarian children even before learning to read (Lőrik, 2006; Jordanidisz, 2009). However, in the first stage of learning to read, there is a significant change primarily in the operations of phoneme-level consciousness. During this reading phase, the emphasis is on learning letter – speech sound correspondence. In accordance with Frith's theory, this is the alphabetical level of reading acquisition. The rate of change in phoneme awareness during this period is so significant that it is doubtful whether preschool values can predict school performance in all cases.

Significant change can be detected even in those background skills related to reading, which almost show a ceiling effect already in kindergarten. The accuracy of rapid automatic naming has already reached a ceiling effect, but regarding fluency, first graders solve the task in a much shorter time. However, there is very few data available in the Hungarian literature on typical language development in the preschool period. When using the screening procedure SZÓL-E?, our results showed that significant development takes place not only in the skills closely related to reading readiness, but at all three linguistic levels (phonological, lexical, grammatical) from the beginning of the last kindergarten year to the end of the first semester of school. We emphasise the importance of the grammatical level that is characterized by a significant change during this period.

2. What characterises children at risk for reading disorders among Hungarian kindergarten children?

According to the reading efficiency index created based on reading (decoding) performance, four groups could be distinguished. Group 1, consisting of children with the lowest reading achievement, lag significantly behind all other groups in all of the language skills related to reading readiness including the two skills traditionally mentioned the most: phonological awareness and rapid automatic naming (accuracy and time). The other groups consisting of children exhibiting at least average reading levels do not differ in either of these skills. This means that the risk of reading difficulties can be recognized in the last year of kindergarten on the basis of two or three language indicators determined by international consensus. Preschoolers who perform under average levels in phonological awareness and/or phonological (nonword) discrimination, and rapid automatic naming during preschool language screening are also expected to show weakness in reading acquisition, thus they are at risk for written language disorder (more precisely, for dyslexia as a decoding disorder). This result is consistent with studies claiming that in transparent orthographies, fast and accurate reading develops between the ages of seven and nine, and its pace is also influenced by the level of orthographic consistency and the method of teaching to read (Ziegler & Goswami, 2005).

Our results are also in line with the double deficit hypothesis of Bowers and Wolf (1993), according to which phonological awareness is a significant weakness of all dyslexics and fast automatic naming for some dyslexics. Despite the ceiling effect, it seems that the rapid automatic naming accuracy is an essential element of linguistic screening, as weak accuracy in kindergarten predicts poor decoding performance. The combined presence of the two impairments (phonological awareness and rapid automatic naming) can not be compensated for easily, it detracts the prognosis of the reading disorder, presumably because, in addition to phonological categorization difficulties (that shake the foundations of the alphabetical level of reading according to Frith's theory), they will also perform poorly in orthographic reading, as words are retrieved from the visual word form lexicon with inadequate speed or accuracy.

Phonological working memory performance, which is closely related to phonological distinction and phonological awareness, is also worth considering in the early stages of learning to read. A novice reader who is only capable of alphabetic decoding should keep the deciphered phonemes in phonological working memory until the whole word is decoded, otherwise there is no chance of understanding. The role of phonological working memory in reading development so far is not so clear. In our investigation it seems to play a supporting role in determining the variance, but poor readers (accuracy and comprehension) show a significant difference in all verbal memory skills measured.

3. What are the early linguistic indicators of poor reading development in Hungarian?

Our research showed that novice readers with poor decoding performed significantly lower in not only phonological awareness and rapid naming tasks considered well-established risk factors for dyslexia, but also in lexical, morphological, and syntactical tasks. These linguistic difficulties are not viewed as general developmental deficits since they do not differ from their well-reading peers in visual discrimination tasks or non-verbal IQ levels.

As lexical-level processing (word repetition, rapid automatic naming) was not strongly represented in the preschool screening test, in the following analysis of the results we compare the reading performance with the results at the morphological, syntactic-linguistic levels. While we obtained the same result as international and Hungarian references for the language indicators behind decoding (phonological awareness and rapid automatic naming), our results for other language skills do not fully agree with previous studies. The morphological-syntactic level of language (for example, receptive and expressive morphology and the sentence repetition) is mostly associated with the ability of text-comprehension and not as the main underlying skills of early decoding (Peterson & Pennigton, 2012; Blomert & Csépe, 2012; Mohai, 2013). Lyytinen and Lyytinen (2004) for Finnish novice readers have shown that morpheme identification problems pose a higher risk in identifying dyslexia. Still, it seems that in Hungarian language (probably related to agglutinating morphology and variable word order in the sentences) these higher language skills have a stronger role in the initial phase of reading acquisition. In their preschool age, these students showed the same weakness in receptive language skills (morpheme comprehension) as in expressive language tasks (morpheme production and sentences repetition). Despite the ceiling effect in the preschool population, it seems that morpheme comprehension is an essential element of linguistic screening as a criterion-based task, as weak morpheme comprehension plays a role apart of the puzzle in kindergarten predicts poor decoding performance.

Overall, in our research, we identified a group of novice readers (Group1) with poor reading efficiency that differed not only in their decoding performance from average- or excellent-readers (Group 2, 3, 4), but also in their preschool language skills. This group showed marked differences at all levels of language performances, while the linguistic performance of the other three groups did not differ significantly. The same group (Group 1) showed no difference in verbal IQ performance and visual discrimination from other groups, so it is their linguistic weakness that is related to poor decoding performance. Our results only partially correspond to previous international and Hungarian data. From the present research, it seems that the success of initial reading acquisition in Hungarian children is not only predicted by the known linguistic-cognitive indicators (such as phonological awareness and quick automatic naming), but morphosyntactic skills are also part of the picture.

In addition to interpreting the results, we also consider it important to draw some practical conclusions of the research. Conclusions regarding pedagogical and speech therapy practice:

1. In preschool children, development of language skills should be monitored as being crucial for learning to read. There is a significant growth in the lexical and grammatical levels of receptive and expressive language, and the recognition and manipulation of sublexical elements should also be treated as a priority area.
2. The use of evidence-based screening tests in the preschool year is of great importance because reading disorders can be prevented with the evidence-based help of screened children. This is not only professionally but also economically relevant, as prevention is easier and less costly than subsequent prolonged treatment.
3. Most of the currently used Hungarian teaching methods recommend a short (4-6 weeks) preparatory phase and a relatively fast letter learning phase. From the present research, it seems that this concept is not sufficiently preventive and proactive, as a significantly lower developing group has to be reckoned with already in the first grade. The reasons for this are summarized as follows:
   - Although the orthography of the Hungarian language is among the most transparent alphabetic languages (almost one by one), the Hungarian alphabet contains a relatively high number of letters. Many of them are phonologically and / or visually similar. Therefore, more time should be devoted to their careful, separate learning.
   - Based on interviews with the teachers of the examined children, it can be stated that the lettering phase is preceded by a four- to six-week preparatory phase at the beginning of the first school year. It is likely that this time will not be enough for students with poorer language skills.
   - In addition, most (except one) of the reading instruction procedures used in the study group do not follow the principle of the closest development zone in the structure of skill development, for example they go with too big steps in the development of sublexical breakdown.
4. It would be necessary to monitor children at risk for reading difficulties until at least the second grade, until the initial stage of reading learning is completed.
5. Contrary to current general practice, school development educators should pay much more attention to preventive language assistance in the early reading era. Today, these children often receive treatment only when they are diagnosed with dyslexia (in the third grade). Thus, it usually takes two years without help.
6. It would be worthwhile to develop short-term phonological awareness programs for school developmental educators. In this way, they can support the teacher's proactive work to developing phonological skills and carry out preventive short-term interventions for children to reduce the risk of dyslexia.

The authors offer the present study to emphasise the professional tasks aiming to support building a bridge between oral and written language for children over the biological cultural divide.

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Mesezene: Introducing a new Hungarian approach in fostering language skills to prepare reading in kindergarten

Szűcs, Antal Mór

The *Mesezene* method is an alternative pedagogical initiative that builds upon the knowledge of speech and language therapy and special needs education. The present study introduces the pillars of the method as well as discussing the pilot studies conducted in the field. According to previous assessments, the application of the programme in kindergarten has a positive effect on children's phonological awareness on both the phonemic and syllable level. The training programme also provides a specific effect on children's rapid automatised naming, while leaving the phonological short-term memory untouched.

Keywords: Phonological awareness, phonological short-term memory, rapid automatised naming, Mesezene method

Becoming literate

The term *print awareness* refers to a complex, overall knowledge of the form and function of a text that appears during printing (in a book, newspaper, etc.). A good summary of the concept, development, and significance of print awareness for reading can be found in a study by Pullen and Justice (2003) who claim that the child, although still unable to speak, already takes the book in his hands, flips through it, and pretends to read the story. By 'reading' from a book, he learns that written language is formally different from spoken language. Beyond that, he acquires knowledge that can later be used in the process of learning to read (e.g., left-to-right, top-down spatial orientation, or the empty space between letters).

In addition to learning about the peculiarities of the written text (*print concept*), recognising the relationship between the speech sound and a symbol is another aspect of print awareness. Establishing the object-symbol relationship is therefore the first step in developing the principle of speech sound-letter (phoneme-grapheme) correspondence that is essential for proper reading. Its formation is facilitated by any experience in which a real object is replaced by a symbol. The third aspect of print-awareness is letter knowledge which is not a matter of simple letter recognition because this ability already presupposes the function of the written text and knowledge of its relationship with the speaker's language.

The most important cognitive abilities underlying reading

In the process of becoming literate, three general stages can be distinguished, regardless of language: *prior to literacy*, *becoming literate*, and *literate*. The first stage begins with birth and lasts until the child first encounters a printed text (book, newspaper) and begins to understand its function and use. The second stage lasts from this time until the beginning of formal (school-based) reading instruction which, according to the undivided opinion of the research, is of paramount importance in the process of development. As a result, in the final stage of becoming literate, word processing becomes effective and reading becomes a source of pleasure and a means of learning (e.g. Linan et al., 2012).

In the second period of development, which overlaps with the last years of preschool, children can acquire skills that make it easier for them to learn to read, while children who develop these skills later in school are at a disadvantage in this respect. According to Adams (1991), the individual differences within acquiring these abilities persist until the fifth grade. Phonological processes, print awareness, and spoken language development are good predictors of later reading success (e.g., Dowing & Valtin, 1984; Scarborough, 2005; Caravolas et al., 2012). While the former skills play a key role in the initial stages of learning how to read and are necessary for the development of fluent (sufficiently fast, accurate, and expressive) reading, an appropriate level of spoken language development is more likely to be related to reading comprehension.

Phonological processes

Phonological processes are mental abilities in the processing of verbal information for both speech comprehension and reading. Among the phonological processes, the most studied areas related to the initial stage of reading learning and the developmental disorder of reading are *phonological awareness*, *rapid automatised naming,* and *phonological working memory*.

Phonological awareness

Phonological awareness (PA) refers to the knowledge that allows one to reflect on smaller units that make up words (syllables, rhymes, speech sounds) (Ziegler & Goswami, 2005). The term 'awareness' refers to intentional, explicit processing. In this approach, the level of phonological awareness can be evaluated by tasks that require the child to perform different operations on different phonological units of the spoken word, such as the syllable, elements of the syllable structure (beginning or rhyme), or phoneme. In this case, the term 'rhyme' does not have a lyrical, but rather a phonological meaning that covers the core of the syllable structure (the vowel) and the surrounding consonant(s). The operations of phonological awareness include *identification* (e.g., determining the position of an item), *synthesis* (e.g., identifying and pronouncing isolated speech sounds as words), *segmentation* (breaking down into units), and various *manipulation* options (e.g., adding, deletion, replacing).

The development of phonological awareness moves from larger units to smaller components. Units of syllables are formed first, then syllable structures, and finally phonemes evolve (Caroll et al., 2003). A pre-school child has access to syllables, to the onset and the rhyme of a word, but breaking words into speech sounds without learning to read is rare, even in typically developing children (Goswami, 2001; Jordanidisz, 2015). Jordanidisz (2015) examined Hungarian-speaking children and found that six-year-olds achieved the best results in syllable segmentation and synthesis. In comparison their results on subtests requiring phoneme-level awareness were significantly lower, moreover there was a significant difference between six-year-olds already in school and still in kindergarten in all areas of operations at the phoneme level. Thus, syllable-level operations appear as part of spontaneous linguistic development, while phoneme-level metalanguage awareness shows greater development due to external influence and structured activity. Such a context is created by reading learning in school education, the pivotal point of which is the acquisition of the phoneme-grapheme relationship. Phonemic awareness, however, can be developed through explicit targeted sessions as well (Brady et al., 1994). Phonological awareness is a good precursor to later reading skills, and development before institutional reading instruction has a positive effect on early literacy (Brady et al. 1994).

Phonological short-term memory

The 'upper' unit of working memory processes information from the central executive. Its operation is area-general and controls the operation of area-specific components. The *phonological short-term memory* (PSTM) is a stimulus-specific sub-unit of the short-term memory. The phonological loop is a specific area whose task it is to store the linguistic input for a short time. Its two putative subunits are the phonological short-term store, which stores verbal information for a few seconds, and the articulatory control process (repeating component), which sub-vocally re-reads items to reload the information into the phonological store (Baddeley & Hitch, 1974). The capacity of the phonological repository is not constant and increases with age. There are several ways to measure the PSTM, but there is still no consensus regarding the most appropriate way. The instant replay of letters, digits, words and nonwords are commonly used. Racsmány et al (2005) show that the average memory size of 5-year-old Hungarian children is 4.11 syllables (SD = 1.43). For reading tasks, regardless of the decoding strategy, the phonological working memory stores the language input for as long as necessary. Based on the international literature, working memory is a good predictor of reading comprehension in both adults and children (Daneman & Merikle, 1996; Cain et al., 2004).

Rapid automatised naming

Rapid automated naming (RAN) refers to a verbal response given to a familiar visual stimulus under time pressure. The stimuli can be colours, objects, or symbols (e.g., letters, numbers). The task requires the intact operation and synchronicity of complex perceptual, lexical, and motor processes. The smooth integration of visual symbols, phonological units, and the attention system plays a prominent role (Neuhaus & Swank, 2002). The tests can be analysed in terms of speed of response, number, and quality of errors (Denckla & Rudel, 1974). RAN is closely related to reading accuracy, speed, and comprehension alike. Deficiency in the preschool life stage is a good precursor to later reading disorders, especially to the disorder of reading tempo (Wolf et al., 2000; Wagner et al., 1997; Bowers & Ishaik, 2006; Norton & Wolf, 2012; Tóth, 2012; Blomert & Csépe, 2012). Cross-linguistic studies suggest that rapid automated naming (as a predictor of reading ability) is less dependent on orthographic transparency in individual languages (Lyytinen et al., 2015).

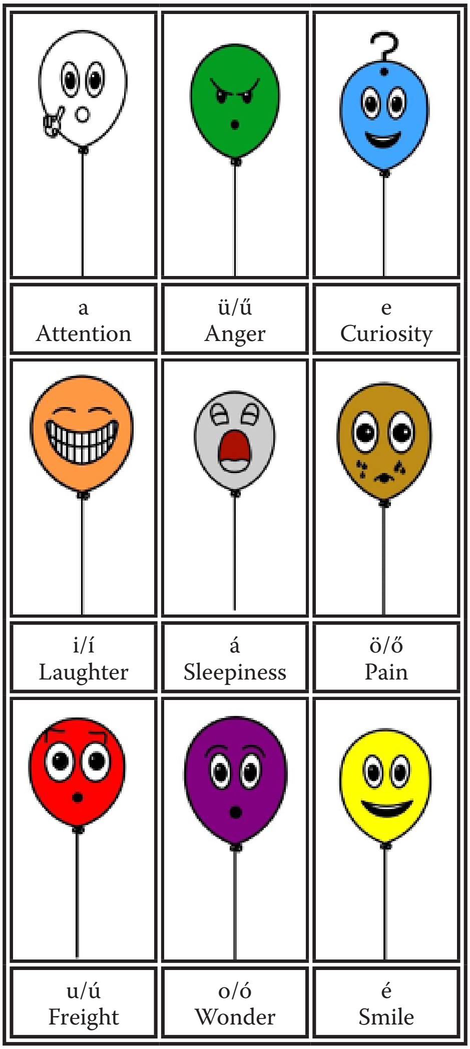
The *Mesezene* method

The *Mesezene method* is a two-module programme that can be used in preschool education to prepare reading skills and applied in primary school education as a pedagogical tool in the early stages of reading instruction. Both options provide a system that spans the entire school year (Ványi et al., 2014; Szűcs, 2019). According to the authors, in order to develop a successful reading ability, it is essential to apply an appropriate motivational system that emotionally engages children. In this method, this aim is achieved by means of various tales and collectively played games. According to Szűcs and Ványi (2020) and Sándor (2020), these specifics can have a positive effect on children's emotional and social intelligence as well, however, this assumption requires further investigation at a later stage.

The method connects speech sounds to symbols, thus contributing to the development of *print awareness* while simultaneously helping to consolidate the phonological system. Vowels and consonants are marked by a separate symbol system; moreover, the establishment of the association is well separated in time as well. In the last stage of the programme, pictograms symbolising sounds are 'read together'. These are always closed (VC) syllables. Articulation based on vowel and consonant images forms the basis of one of the fundamental steps of reading teaching, the blending of letters, and contributes to the development of print awareness and the formation of synthesis within phonological awareness. In addition, the programme also includes the development of explicit phoneme awareness in which children are asked to identify the actual speech sounds in words.

In this method-specific association system, vowels are connected to colours and emotions of balloons. It is therefore a common task during the application to name coloured balloons (either based on their colour or associated qualities, such as the speech sound or the emotion), which can potentially affect the ability for rapid automatised naming.

Figure 1
The Mesezene method associates vowels to colourful balloons with specific emotions



Review of studies on the efficacy of Mesezene *method*

The current study demonstrates the results of pilot studies carried out in order to assess the possible effects of the method on phonological awareness, rapid automatised naming, and phonological short-term memory. Szűcs and Tar (2020a) conducted a study with children displaying typical development, living in Hungarian cities, as well as another study carried out among children living in socially and economically disadvantaged conditions (Szűcs & Tar, 2020b).

It is important to highlight that the sociocultural situation affects language use. Communication between middle- and lower-class parents may differ in the elaboration of the language code used. School success, including reading performance, is greatly influenced by family language use. The development of phonological awareness before institutional reading instruction is essential (Nagy, 2018), their effect can be remarkable even in longitudinal perspective (see: Nancollis et al., 2005; Lundberg et al., 2012).

Study on phonological awareness, rapid automatised naming and phonological short-term memory

Szűcs and Tar (2020a) sought to evaluate the effects of the method on phonological awareness, rapid automatised naming, and phonological short-term memory. In their study, Hungarian-speaking children living within an urban environment and possessing typical intellectual development and intact hearing participated. The performance of ten children (for each group) has been analysed. The two groups were matched based on age as well as their results gained in the phoneme identification task. The mean age of the experimental group (three boys, seven girls) at the time of the first assessment was 6;5 years (6;1–6;7), while the mean age of control group (five boys, five girls) was 6;3 years (6;0–6;7). The average of the points achieved in the phoneme identification task was 3.1 in the experimental group and 2.4 in the control group, and the two groups were the same in terms of minimum and maximum points (0 and 7 out of ten).

The tests were performed twice, with a seven-month difference between the input (which took place in the autumn, before the start of the training programme) and the output (immediately after the end of the training). A self-developed set of tasks was used to examine phonological awareness. The operations of identification (syllable and phoneme level), deletion (on both syllable and phoneme level), and synthesis (only on phoneme level) were examined. The vocabulary consisted of ten words of one or two morphemes in each task. The phonological unit to be identified or deleted was in the beginning and end position of the word. Deletion always resulted in a meaningful word.

To examine rapid automatised naming, the Columbia RAN test was used (Marosits, 2007), during which the child had to name visual signs of serially arranged colours and images of familiar objects. During the evaluation, we looked at the time (sec) and the number of errors. The task has no normative data in Hungarian.

The capacity of the phonological short-term memory was measured based upon the non-word repetition test (Racsmány et al., 2005). The children's task is to repeat meaningless non-words corresponding to Hungarian phonology. The evaluation is based on the number of syllables repeated correctly.

Statistical analysis was performed to explore the differences between and within groups. The SPSS 22.0 software package was used. Since the data did not show a normal distribution for most variables, a non-parametric test (Mann-Whitney U test) was performed.

The statistical data (mean, median and standard deviation) of the examined variables are summarised in *Table 1*.

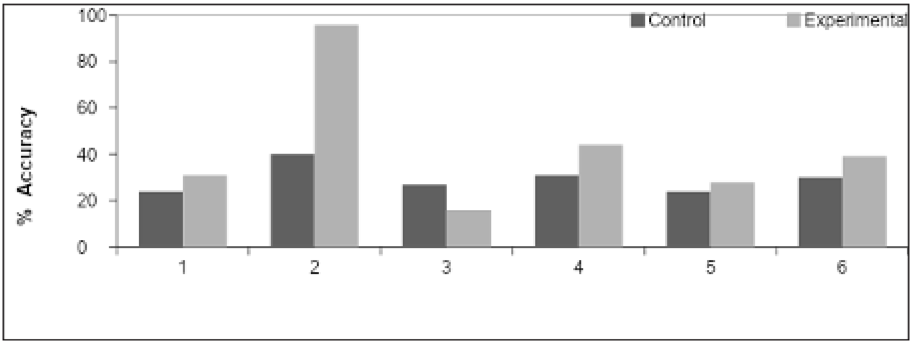
Table 1
Statistical results of phonological processing (Szűcs & Tar, 2020a)

			Before training			After training		
			Average	Median	St. dev.	Average	Median	St. dev.
			Control group					
PA	Phoneme	Identification	2.40	2.00	2.17	4.00	4.00	2.83
		Synthesis	2.70	1.00	3.92	3.10	2.00	3.31
		Deletion	2.40	0.50	2.95	3.00	1.00	3.80
	Syllable	Identification	5.40	7.00	3.60	6.70	9.00	4.00
		Deletion	4.90	5.50	2.85	6.30	7.50	3.50
RAN	Colour	Time	81.00	79.00	26.20	68.70	63.50	18.70
		Errors	0.20	0	0.42	0	0	0
	Object	Time	107.70	98.00	52.01	86.00	87.00	24.31
		Errors	0.10	0	0.32	0.50	0	0.85
PSTM		Syllable numbers	4.87	5	1.00	4.7	5	0.90
			Experimental group					
PA	Phoneme	Identification	3.10	2.00	2.85	9.50	10	0.70
		Synthesis	1.60	0.00	2.67	4.40	3.00	2.50
		Deletion	2.80	0	3.63	3.90	3.50	3.54
	Syllable	Identification	4.40	4.00	3.63	8.10	9.00	2.96
		Deletion	2.60	1.50	2.95	5.50	6.00	2.41
RAN	Colour	Time	76.60	73.00	16.87	63.80	61.00	13.46
		Errors	0.70	0	1.06	0	0	0
	Object	Time	94.30	93.00	20.52	75.90	75.00	14.38
		Errors	0.40	0	0.52	0.2	0	0.42
PSTM		Syllable numbers	5.1	5.5	1.52	5.0	4.5	1.49

At the level of the phonemes, the experimental group performed better in the identification (U = 0,00, z = -3,87, p = 0,000) and synthesis (U = 16,50, z =-2,58, p < 0,05) tasks compared to itself. This was not detectable in the deletion *(*U = 37,50, z = -0,98, p = 0,33*)*. The development of the experimental group in the task of speech sound identification was significant not only within the group but also in the intergroup comparison (U = 6,50, z =-3,41, p < 0,01).

Chart 1

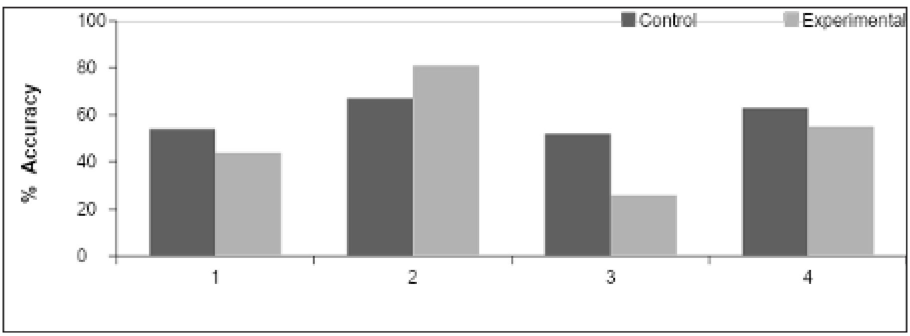
Phoneme level results (Szűcs & Tar, 2020a)



During the syllable-level tasks, the intergroup studies did not reveal any significant differences (identification: U = 43,50, z = -0,50, p = 0,62; deletion: U = 27,50, z = -1,72, p = 0,09). However, the experimental group achieved mathematically verifiably higher scores compared to the input measurement in both examined tasks (identification: U = 22,50, z = -2,11, p < 0,05; deletion: U = 23,50, z = -2,03, p < 0,05), while the difference between the first and second values of the control group is not significant (identification: U = 28.00, z = -1.69, p = 0.09; deletion: U = 35.00, z = -1.14, p = 0.25).

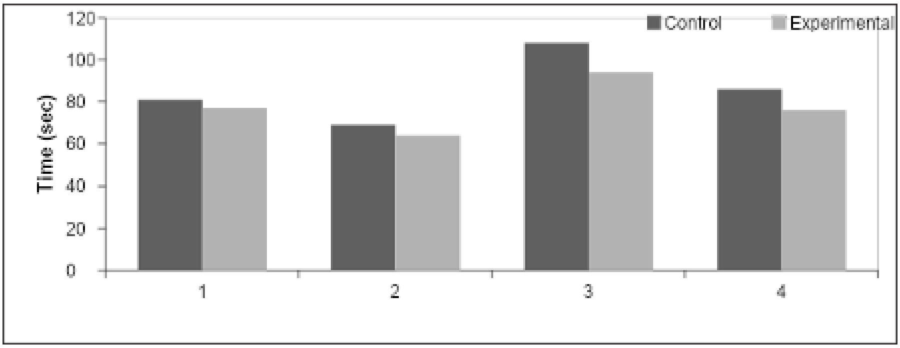
Chart 2

Syllable level results (Szűcs & Tar, 2020a)



In the rapid automatised naming task, there was no difference between the two groups during either the input or output measurement. A verifiable difference was found only in the experimental group object naming time (U = 20,50, z = -2,23, p < 0,05) and in the colour naming error numbers (U = 20,50, z = -2,23, p < 0,05).

Chart 3
Rapid automatised naming (Szűcs & Tar, 2020a)



There was no detectable difference between or within groups in the study of phonological short-term memory. The mean syllable range in the phonological short-term memory task was slightly higher in the experimental group in both measurements *(Table 1)*, but according to the statistical analysis, the difference was not significant between the groups either (input: U = 34.50, z = -1.22, p = 0 , 22, output: U = 47.50, z = -0.20, p = 0.84), nor within the groups (Control group: U = 48.00, z = -0.16, p = 0.87 Experimental group: U = 45.00, z = -0.38, p = 0.70).

Study carried out with socially and economically disadvantaged children

Szűcs and Tar (2020b) sought to answer the change in phonological awareness, phonological short-term memory, and rapid automatised naming in children living among cumulatively disadvantaged conditions. A total of fifteen children participated in the study. An age-matched control group (N = 5, of which three boys, two girls) was created to compare the performane of the expertimental group (N = 10, of which three boys, seven girls). All children are Hungarian monolinguals with intact hearing. During the research, the children attended the kindergarten found in a village in Szabolcs-Szatmár-Bereg County, Hungary. The village has been rated as one among the 300 poorest settlements in Hungary. The mean age of both groups was 5;4 years (experimental group = 4;11–6;3 years; control = 4;10–6;7 years) at the time of the first screening. All children in both groups are socially and economically disadvantaged. They were acknowledged as underprivileged by the Hungarian Act XXXI of 1997 that is presently in force. According to the law's current provision, a child is socially and economically disadvantaged when entitled to a regular childcare allowance and displays at least two circumstances among those labelled as disadvantages (low parental education up to primary education, low employment and insufficient living/housing conditions).

The experimental group received the training programme of *Mesezene*, led by a trained special needs educator. The children participated in the training programme for twenty-eight weeks, which included a twenty-five-minute activity. During the sessions, according to the *Mesezene* method, the children are introduced to a symbol representing vowels and consonants each week, and then the VC (vocal, consonant) symbols are 'read' and articulated together. It is important to note that, due to digital education coming into force on 16 March 2020 as a result of the COVID-19 pandemic, both groups received home training until 4 May. The *Mesezene* training programme was given to the participating children online during this period under the online guidance of the leading special needs educator and with the assistance of the children's parents. From 4 May, the development programme was resumed in person, which lasted until the end of school year in June when the second assessment was carried out. The control group did not receive any other training on language or cognitive skills that the children in the study group would not have also received. Thus, we can assume that the only controllable difference between the two groups is the method (*Mesezene*) used.

The same assessment tool was used in this case that was described in the previous study (*see 3.1.1. Study on phonological awareness, rapid automatised naming and phonological short-term memory*). To assess phonological awareness identification (syllable and phoneme level), deletion (on both syllable and phoneme level), and synthesis (only on phoneme level) were examined. To measure rapid automatised naming, the Columbia RAN test was used (Marosits, 2007). The capacity of the PSTM was measured based upon the non-word repetition test (Racsmány et al., 2005). The screenings were performed twice. The pre-training assessment was performed in the fall, before the start of the programme, in September 2019, while the output evaluation was performed in June 2020, immediately after the end of the programme. Eight months elapsed between the two measurements.

The statistical data (mean, median and standard deviation) of the examined variables are summarised in *Table 2*.

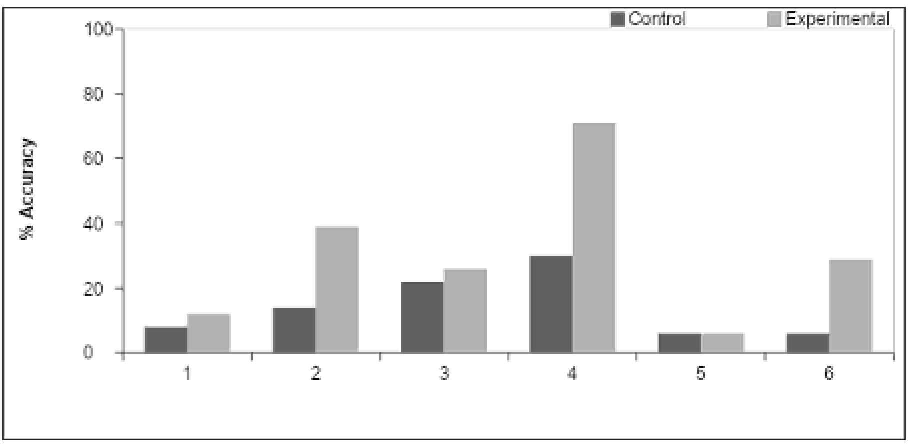
Table 2
Statistical results of phonological processing in children living in socially and economically disadvantaged circumstances (Szűcs & Tar, 2020b)

			Before training			After training		
			Average	Median	St. dev.	Average	Median	St. dev.
			Experimental group					
PA	Phoneme	Identification	2.6	2	2.32	7.1	7.5	2.33
		Synthesis	0.6	0	0.84	2.9	3	1.29
		Deletion	1.2	0	1.87	3.9	3.5	3.70
	Syllable	Identification	3.8	3.5	1.75	6.7	7.5	1.77
		Deletion	2	0	2.71	5	4	4.24
RAN	Colour	Time	107.8	96	30.26	78.3	78	10.01
		Errors	9.7	10	0.95	9.7	10	0.48
	Object	Time	113.5	106	27.85	101	100.5	16.77
		Errors	9.7	10	0.48	9.7	10	0.48
PSTM		Syllable numbers	5.2	5	0.63	5.2	5	0.63

			Control group					
PA	**Pho-neme**	**Identifi-cation**	2.2	2	2.49	3	3	0.71
		Synthesis	0.6	0	1.34	0.6	0	1.34
		Deletion	0.8	1	0.84	1.4	1	1.52
	Syllable	**Identifi-cation**	2.4	3	2.3	3.4	4	0.89
		Deletion	0.8	1	0.84	1.2	0	1.64
RAN	**Colour**	**Time**	87.4	93	21.43	73.2	73	15.27
		Errors	9.8	10	0.44	9.8	10	0.44
	Object	**Time**	106.8	101	18.54	94.4	98	11.26
		Errors	9.2	10	1.09	9.4	10	1.34
PSTM		**Syllable numbers**	5	5	0.71	5	5	1.22

When assessed before training, there was no statistically significant difference in phonological awareness tasks between the groups for any of the levels examined. After the training, the two groups differed significantly in the phoneme level identification ($U = 4.50$, $Z = -2.53$, $p <0.05$) and synthesis ($U = 7.00$, $Z = -2.37$, $p < 0.05$) operations (but not in the deletion: $U = 14.00$, $Z = -1.39$, $p = 0.16$) and in the syllable-level identification test ($U = 1.50$, $Z = -2.92$, $p <0.01$). Regarding the results of syllable deletion, the difference between the groups was trend-like ($U = 10.50$, $Z = -1.85$, $p = 0.06$).

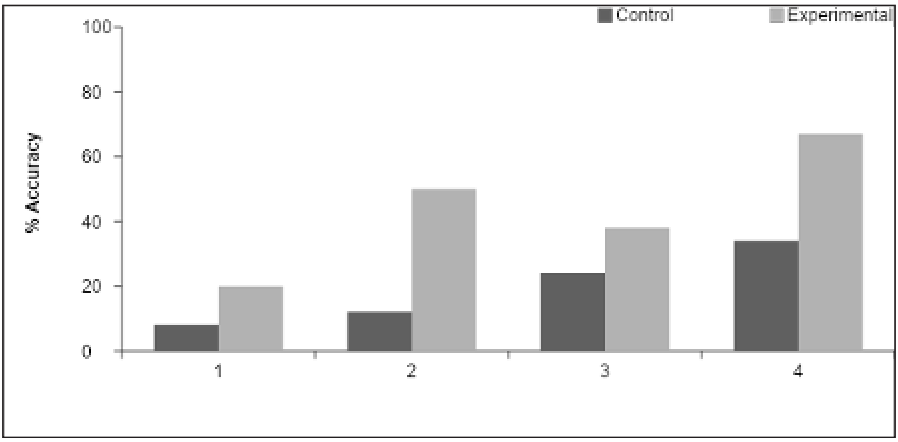
Chart 4
Phoneme level results (Szűcs & Tar, 2020b)



Examining the output and input results within groups, we can observe that in the case of the experimental group, the result was significantly better in case of several operations at both phonological levels (phoneme and syllable). After the training the group showed statistically remarkable difference in syllable identification (U = 12.00, Z = -2.90 , p <0.01), phoneme identification (U = 9.00, Z = -3.12, p <0.01) and phoneme synthesis (U = 8.00, Z = -3.30, p <0.01). There was no detectable significant difference in syllable deletion (U = 30.00, Z = -1.60, p = 0.11) and phoneme deletion, although the latter shows a trend-like change in statistical analysis (U = 28.50, Z = -1.71, p = 0.09). In contrast with these results the changes in the control group at the second evaluation did not reach a mathematically verifiable level in every examined instance (syllable deletion: U = 12.00, Z = -0.11, p = 0.91, syllable identification: U = 10.00, Z = -0 , 54, p = 0.59, phoneme deletion: U = 10.00, Z = -0.55, p = 0.58, phoneme identification: U = 8.00, Z = -0.98, p = 0 , 33, phoneme synthesis: U = 12.50, Z = 0.00, p = 1.00).

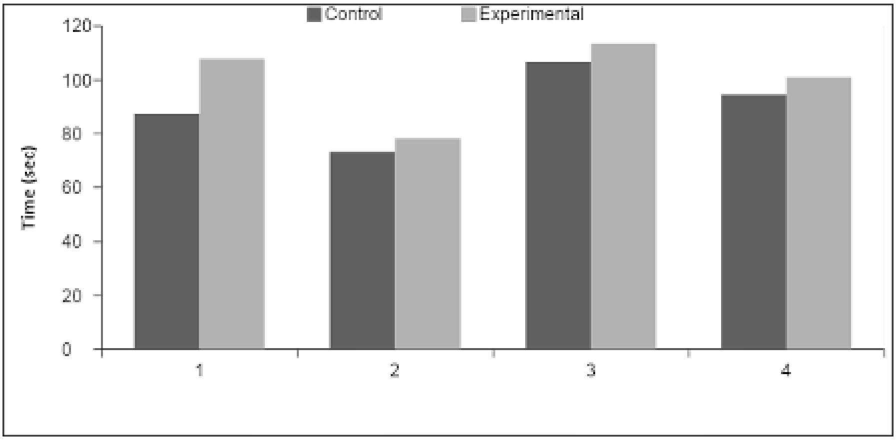
Chart 5

Syllable level results (Szűcs & Tar, 2020b)



No significant difference was observed in any of the rapid automatised naming tasks in within groups comparisons in the input evaluation (colour: U = 16.00, Z = -1.10, p = 0.27; objects: U = 21.50, Z = -0.43, p = 0.67), nor in the second evaluation (colour: U = 18.50, Z = -0.80, p = 0.42; object: U = 19.00, Z = -0 , 74, p = 0.46). These results are in accordance with the previously detailed study (Szűcs – Tar 2020a) that found no statistically relevant difference between the two examined groups during either the input or output assessment. As regards within group comparison, the children in the examination group at the end of the training named the colours faster than the initial measurement (U = 15.00, Z = -2.65, p <0.01). No similarly change could be detected in the rapid object naming task (U = 37.0, Z = -0.98, p = 0.32). The tempo of rapid automatised naming of the control group did not change in a verifiable way between the two measurements (colour: U = 8.00, Z = -0.94, p = 0.35; object: U = 7.5, Z = -1.05, p = 0.29).

Chart 6
Rapid automatised naming (Szűcs & Tar, 2020b)



There were no significant differences between groups (input: U = 21.00, Z = -0.56, p = 0.58; output: U = 20.00, Z = -0.69, p = 0.49), neither within the group (experimental: U = 45.50, Z = -0.40, p = 0.69; control: U = 11.00, Z = -0.34, p = 0.73) comparisons.

Discussion

The *Mesezene* method is a new Hungarian approach for teaching reading. *Mesezene* is a two-module programme that can be used in preschool education to develop reading skills and applied in primary school as a pedagogical tool in reading instruction. The method applies a specific motivational aspect using tales and collectively played gaming activities that emotionally engages children and provides a more profound cognitive development (Ványi et al., 2014; Szűcs, 2019).

The current study has summarised the pilot studies carried out in order to assess the possible effects of the method on *phonological awareness*, *rapid automatised naming,* and *phonological short-term memory*. Szűcs and Tar conducted two studies in the field: one with children developing typically and living in cities in Hungary (Szűcs & Tar, 2020a) and one with children who live in socially and economically disadvantaged circumstances in a rural environment (Szűcs & Tar, 2020b).

The greatest effect can be detected at the *phoneme level* in the field of *identification*. In this task, not only intragroup but also intergroup comparisons revealed significant differences in both presented studies. In the study of children living in typical conditions, the *phoneme synthesis* task showed significant differences in intragroup comparisons, while this was not present in intergroup terms. However, in the case of children living in socially and economically disadvantaged conditions, the extent of development is presumably higher, as there was a statistically significant difference not only within group comparison but between the groups as well. There was no detectable difference in any of the studies in the phoneme deletion subtest.

We could expect the present results with the profound knowledge of the method, as the training provides the participating children with a number of elements that contribute to the consolidation of the phonological categories and the blending of speech sounds. However, there is no implicit or explicit instruction in the methodology for the phoneme deletion task, so it is no coincidence that the present research in this area did not reveal any detectable difference between the study and control groups.

At the *syllable level*, an interesting phenomenon can be observed between the results of the two studies. In the simpler *identification* task, the study group of disadvantaged children displayed significant improvement in both intergroup and intra-group comparisons. In this respect, children living in typical conditions only performed better in intragroup comparison. On the other hand, in the case of *syllable deletion* only children living under typical conditions reached statistically significant difference in intragroup comparison.

The present results can be interpreted as meaning that socially and economically disadvantaged children can see a more outlined and focused development in simpler syllable identification, while in the case of more complex, operation-level deletion, there is no detectable effect. In contrast, in the case of children living in typical conditions, training has a greater effect in the case of a more complicated syllable deletion operation.

From the presented data, we can conclude that the method has an effect on phonological awareness at different linguistic levels and operational aspects. At the level of syllables, in the case of children living in better conditions, the effect is more pronounced in the operational tasks, while in the case of disadvantaged children the effect can be better detected in the identification tasks. In the latter case, we can talk about a deeper, more profound development revealed both in intragroup and intergroup comparisons with respect to phoneme identification and blending show reactivity to the training programme. This is highly important, as access to phonemes and the synthesis operation performed with them provide a significant part of the linguistic aspects behind reading skills. The preschool development of these can greatly contribute to later reading learning success.

When comparing the two studies, we can conclude that the effect on phonological awareness is even more pronounced among children situated in economically and socially disadvantaged circumstances than in children living in typical urban settings. The significance of the discovery lies in the fact that linguistic assistance in this relation can be critical for later life perspective. However, the results should be treated with caution as the current subject refers to pilot studies with a relatively small number of cases.

In either studies, none of the *rapid automatised naming* tests showed statistically significant differences between the compared groups. The control group did not show a significant difference between the two assessments in either of the two studies, while the children living in urban circumstances performed better compared to themselves in terms of the accuracy of colour naming and the pace of object naming. The examination group of the socially and economically disadvantaged children also produced better results in one of the RAN indicators examined: they named colours faster in within group comparison. This may be related to the rapid automatised naming activity used in the *Mesezene* method, which is carried out with colourful balloons. Rapid automatised naming is one of the main precursors for reading abilities. As deficiency in the preschool life stage is a good precursor to later reading disorder, enhancing the performance of RAN might produce better results in later reading skills (Wolf et al., 2000; Wagner et al., 1997; Bowers & Ishaik, 2006; Norton & Wolf, 2012; Tóth, 2012; Blomert & Csépe, 2012).

Based on studies to date, the method does not appear to have an effect on phonological short-term memory as none of the studies showed a detectable difference between the groups examined. As research suggests that the level of development of phonological awareness at the phoneme level is a good predictor of the success of word reading, children participating in the programme are expected to be successful in the early stages of reading learning. In the present article, the direct impact of the training programme has been demonstrated on the basis of two previous studies: in the future it would be worthwhile to explore whether the improvement of performance in the field of phoneme awareness will continue in the long run. In addition, the presented studies were performed on a relatively small sample size, therefore it would also be worthwhile to perform further tests with a larger number of elements in light of the already known (and presented) results.

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The Influence of Musical Activities on Cognitive Control Mechanisms

Overview and empirical findings

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This article provides an overview of the ways music therapy may contribute to the improvement of cognitive control mechanisms, which play a central role in managing our goal-directed behaviors. First, we introduce the cognitive control model of Cohen (2017) and we summarize the main findings of the literature about the near and far transfer effects of music therapy. The integration of these two theoretical frameworks will allow us to describe the associations between higher-level cognitive control functions and music processing. In the second part of this paper, we present the preliminary findings of our recent study. We examined the relationship between formal regular music training and cognitive control in young adults by focusing on working memory updating and cognitive flexibility. We used the N-back paradigm with manipulations in task complexity and modality (visual (letters and shapes); auditory (pitches and timbres)) to examine whether long-term musical experiences affect working memory updating and cognitive flexibility. Our results revealed that the musicians were more accurate in working memory updating than their non-musician peers. Further, the musicians' performance was significantly better in the pitch N-back task than in the timbre N-back. In contrast to accuracy, the groups did not differ in reaction time. Our first results support the notion that musical training may promote the development of certain cognitive control skills, but further research is needed to better understand this relationship.

Keywords: musical activity, cognitive control, cognitive flexibility, working memory updating

Introduction

Cognitive control is a complex mechanism, which underlies our ability to pursue goal-directed behaviours (Cohen, 2017). It plays a central role in educational success, work, and everyday life activities across the lifespan (Rhoades et al., 2009; Brock et al., 2009; Jacobson et al., 2011; Diamond & Fiske, 2013). Cognitive control intervention may be an important part of habilitation and rehabilitation processes. Several disorders have been shown to involve deficits in cognitive control functions: e.g., autism spectrum disorder (de

Vries et al., 2015; Solomon et al., 2016; Hogeveen et al., 2017), attention deficit hyperactivity disorder (de Zeeuw et al., 2012; Jarrett et al., 2016) and specific language impairment (Marton et al., 2014; Marton et al., 2016) among others.

Individual differences in cognitive control can be explained by the *cognitive flexibility* theory (Botwinick et al., 2001). In this widely accepted framework cognitive flexibility indicates the adaptability of the cognitive system to immediate changes in information that is being processed during task performance (Botwinick et al., 2001). A number of studies investigated the factors that contribute to cognitive flexibility (aging, socioeconomic status, occupation, life experience), among these are *musical activities* that have been in the focus of a growing number of studies in recent years (Thaut, 2010; Zuk et al., 2014; Siepsiak & Krejtz, 2016; Jaschke et al., 2018; Porflitt & Rosas, 2020; Chen et al., 2021).

The aim of this article is to demonstrate how regular musical activities can advance cognitive development by facilitating cognitive flexibility. First, we present an overview of the existing research on this topic, explain the underlying theoretical connections, address some of the main controversies in literature, and suggest potential directions for further research based on the results of our preliminary study.

Cognitive control and cognitive flexibility

Cognitive control is a complex construct (Cohen, 2017), which refers to the ability to pursue goal-directed behaviours instead of more habitual or immediately more compelling behaviours (Egner & Hirsch, 2005), allowing information processing and behaviour to vary adaptively over time with changes in task objectives. It supports the maintenance of the activation level of newly picked-up information and the retrieval of relevant contents from memory, as well as the suppression of irrelevant information and/ or behavioural responses (Dudukovic & Kuhl, 2017). More efficient cognitive control may be reflected by faster interpretation of information (shorter reaction times) (Marton et al., 2017). Although the terms cognitive control and executive functions are often used as synonyms in the literature, behaviours associated with the cognitive control account are more clearly defined and closely linked to specific neurobiological structures and processes (Marton, 2016).

The most prominent features of the cognitive control model are *flexibility* and *adaptation*: two mechanisms that play a critical role in information processing and learning. The adaptability of the cognitive control system can be illustrated by the *working memory updating process*. There are several frameworks and experimental paradigms associated with working memory updating, however, in the current study we are using the interference model by Oberauer to interpret updating performance, which involves rapidly refreshing working memory representations to focus on information relevant to the task goal (Oberauer, 2002). Successful updating requires two conceptually different mechanisms: stability and flexibility. In order to accurately recognize target items, strong, stable working memory representations of content-context bindings are needed, whereas flexibility is required to refresh the previous representations of content-context bindings in order to process new incoming information efficiently (Wadhera et al., 2018).

Cognitive flexibility is reflected by the cognitive system's responses to different contextual changes. (Cohen, 2017) For example, if certain items, conditions, or tasks are frequently repeated, our performance becomes faster and more accurate. Thus, performance becomes more automatized with practice because the cognitive system adapts to the repeated items and processes. In contrast, if the task becomes more complex, or more difficult, that is, if the conditions change, then we become slower and less accurate because the task requires more top-down control from our cognitive system.

According to the cognitive control account (Cohen, 2017), *controlled and automatic processes* create a continuum; the more cognitive control is needed, the less automatic the behaviour becomes. Automatization also means that more capacity can be freed up for other cognitive operations (Botvinick et al., 2001). However, the same behaviour may be more automatic in one situation and more controlled in another one, depending on the person's experience with a given task (learning effect) and on the contextual conditions, such as task features (e.g., set size) or interfering processes in a given situation (Botvinick & Cohen, 2014; Cohen, 2017). For example, in a memory task, the more items we must remember, the more control is needed. If there is interference among the items to-be-remembered (e.g., they are phonologically similar), then even more control may be required. Thus, performance on cognitive tasks depends on numerous factors including individual differences in control functions, task conditions, and familiarity with the task.

A number of these cognitive control phenomena can be observed directly in musical activities:

1. The execution of controlled tasks is slower than that of automatic ones. (Example: while practising a new piece of music we need more control, but later it becomes automatic.)
2. The controlled processes may be competing and interfering with each other and with some more automatic processes while playing music. (Example: while playing music one needs to look at the notes -even preview some beats-, listen to the other musicians, keep the tempo, and the right loudness, etc.)
3. The controlled processes may rely on a central, limited capacity system (Example: one's working memory capacity limits the activities performed in parallel, like it is difficult to play drums and sing at the same time) (Shiffrin & Schneider, 1977; Schneider & Shiffrin, 1977).

As these examples show, musical activities provide a rich set of opportunities to train cognitive control functions. In the next section we are introducing music's developmental mechanism of action and clarifying some important terms used in our study.

Music as a driving force of development

Playing, listening to and creating music involve practically every cognitive function (Zatorre & Salimpoor, 2013; Zuk et al., 2014). In addition, its emotional, psychological effects make music a good motivator in any pedagogical, developmental, and therapeutical situation. Musical activities are both social and enjoyable interventions with positive effects on functional and structural brain plasticity and may enhance general cognitive and perceptual motor function (Cooper, 2019). Music's widely known *transfer effect* can be explained by the greatly distributed brain areas involved in music performance that support many other cognitive and perceptual-motor skills (Mansouri et al,. 2017). Transfer of learning takes place when skills learned in one particular area either generalize to new areas or increase general cognitive abilities (Brookes et al., 2011). There are two broad categories of transfer to distinguish: near transfer (the transfer of skills within the same domain) and far transfer (the transfer of skills across two distant domains, for example music and mathematics) (Sala & Gobet, 2017).

Despite the rich relevant literature, it remains difficult to provide a complex model describing how music affects the different cognitive, linguistic, and motor functions for the following reasons:

1. Music is a multi-faceted phenomenon; it has numerous forms (e.g., listening to, creating or playing music), however, researchers studying these different aspects are still referring to these various activities by using the same terms (Schulze et al., 2012; Mansouri et al., 2017);
2. Music has different roles in different situations: it can be a means for an end, as in therapy; it can be the end itself in artistic or intellectual endeavor as it happens in composing, performance or pedagogy; it can also be the subject of a study as in music theory; or the object of an aesthetic experience, and so on (Abrams, 2011; Guetin et al., 2013, Francois et al., 2013; Krick et al., 2017);
3. The methods - how music is used in intervention - vary widely (music may be used in its entire complexity or there could be specific focus on different musical elements, such as meter, rhythm, melody, harmony, pitch, tonality, or volume);
4. The timeframe of music intervention may also differ across studies (the effects of music may vary over time) (Boso et al,. 2007; Aalbers et al., 2017; Bugos & DeMarie, 2017);
5. The effects of different musical methods also differ depending on the target population, e.g., subjects without relevant health problems; patients with brain injury, or cognitive delay (Hutter et al., 2014; Lesiuk et al., 2018; Cooper, 2019);
6. Finally, inconsistent results in different studies may be related to a lack of specific music instruction use: results of recent studies strongly suggest that far-transfer effects of active music participation depend on the nature of the instruction used in music-making (Norgaard et al., 2019).

For these reasons we need to distinguish and specify the terms "*musical activities*" and "*music training*". The former term is used as an umbrella term for any kind of musical activities where music can be both the goal and/or the tool in the process. Participants may exhibit different levels of musical proficiency (from none to high proficiency), and they may be a more passive or an active member during the process. The latter term refers to music studies (learning to play an instrument or to sing, typically in a music school or from a private teacher), where playing music is a goal and the process itself may involve many different types of musical activities in a complex way.

While the overall topic of this paper is the relationship between musical activities and cognitive control, we will focus on the developmental aspect of music. In the present chapter, we report results from a musical training study and based on the findings, we discuss the implications of musical activities in general.

Music – improving cognitive control

According to various training studies, cognitive control skills can be improved through targeted tasks and exercises (Diamond, 2012; Kolb et al., 2012; Diamond & Fiske, 2013, Janus et al., 2016). A large body of research indicates that musical activities can provide effective tools and structures for cognitive control improvement (Thaut et al., 2009; Thaut, 2010; Siepsiak & Krejtz, 2016; Guo et al,. 2018). Nonetheless, studies focusing on the effects of musical activities on cognitive control functions are still rare.

The results of a longitudinal study indicate a positive influence of long-term music education on cognitive abilities such as inhibition and planning, and support a far transfer effect from music education in primary school children to academic achievement mediated by cognitive control sub-functions (Jaschke et al., 2018). Music's benefits have been attributed to the practice of intensive memorization, visuo-motor skills, focused attention and the use of shared performance cues required for learning and performing music (Chaffin, 2007; Pallesen et al., 2010; De Dreu et al., 2012, Matthews & Kitsantas, 2013).

The following studies investigate the notion of a *modality-general* (regardless modality, both audio and visual) but *process-specific* (limited to specific processes of cognitive control) relationship between musical abilities and cognitive control skills – which have important connections to our later introduced research topic.

Zuk and colleagues compared musically trained and untrained children and adults on various cognitive control tasks (Zuk et al., 2014, Zuk et al., 2018). Both children and adults with musical training outperformed their untrained peers in different cognitive tasks (not modality specific), however, the group differences were not general (i.e. process-specific). Musically trained adults performed better than their untrained peers on measures of cognitive flexibility, verbal fluency and working memory measured by a standardized executive function battery. Children's groups were also investigated using functional Magnetic Resonance Imaging (fMRI) to monitor the neural correlates of cognitive functions. The two groups of children differed in measures of verbal fluency and processing speed, and musically trained children showed significantly greater activation in the pre-Suplementary Motor Area (pre-SMA) / Suplementary Motor Area (SMA) and the right Ventrolateral Prefrontal Cortex (VLPFC) during rule representation and task-switching. Results support a modality-general but process-specific approach of musical activities influence on cognitive control.

Similarly, Slevc and colleagues investigated whether musical experience and ability predicts individual differences on inhibition, updating and switching - in both auditory and visual modalities (Slevc et al,. 2016). Results show that musical ability predicted better performance on both auditory and visual updating tasks (a variety of potential confounds were controlled, like age, handedness, bilingualism, and socio-economic status). Another finding of this research was that musical ability was not clearly related to inhibitory control (as assessed with auditory and spatial Stroop tasks) or to cognitive flexibility (assessed with auditory and visual task switching tasks). Therefore, this study further supports the idea that cognitive advantages associated with musical ability are not limited to auditory processes, but are limited to specific aspects of cognitive control (Slevc et al., 2016). On the other hand Moreno and colleagues suggest in a study that musical experience might lead to general inhibitory control advantages (Moreno et al., 2015). The explanation might partly come from the difference between the theoretic backgrounds of these investigations. Inhibitory control is not a single function, it can be divided into response inhibition and several types of interference control (Botvinick et al., 2001). Previous studies that assessed the relationship between musical training and inhibitory control failed to investigate these separate components with the appropriate tools within the same experiment. It is also important to mention, that interference control (the ability to overcome distraction from irrelevant information) undergoes considerable improvement during childhood till the age of 13-14 and is fully developed in adults (Cragg, 2016), while response inhibition develops during preschool ages 4-6 (Davidson et al., 2006). These age dependent developmental components also interact with the relationship between musical ability and cognitive control.

Roden and colleagues' longitudinal study has shown that children with an 18-months long extended music education program (with 45 minutes of weekly instrumental music training) outperformed their peers in control group in working-memory capacity tasks. The computerized test battery included seven subtests, which address the central executive, the phonological loop and the visuospatial sketchpad components of Baddeley's working memory model. Results suggest that children receiving music training benefit specifically in those aspects of cognitive functioning that are strongly related to auditory information processing (Roden et al., 2014). In another study Moreno and colleagues have found that even a short-term, but intensive musical training with a computerized program can enhance verbal intelligence and executive functions tested with a go/no-go task (Moreno et al., 2011).

Taken together, musical activities have a positive effect on various cognitive control mechanisms in both children and adults. Former research is not unified regarding the modality dependent and process-specific nature of this effect, and neither the detailed mechanisms of this connection. Related literature is difficult to synthetize because of the following reasons:

1. Past studies have typically discussed cognitive control only generally without systematically differentiating between various aspects of cognitive control mechanisms.
2. Because of the differing theoretical frames, previous studies have used a variety of experimental tasks, evaluation methods, explanations.
3. There are also a wide variety of criteria used to distinguish musicians from non-musicians.
4. Relevant studies differ also in the definition of music (time frame, type of musical activity, is music a goal or a tool in the process, see previous section for full list).
5. The targeted populations are ranging from primary school children to elderly adults. (Slevc et al., 2016)

In the following section we present the preliminary findings of our current study which can help us to further explore the connection between musical activities and cognitive control.

Preliminary findings of our current research

In a current study of ours we look at the relationship between formal regular musical training and cognitive control in young adults. In the present paper we focus on *working memory updating*, which exemplifies the previously highlighted cognitive flexibility mechanisms. We used the *N-back paradigm* with manipulations in task complexity and variants of modalities to examine whether musical experience affects working memory updating performance.

Research Questions

1. Do musician and non-musician young adults differ in working memory updating if the tasks include interfering lures and manipulations of memory load?
2. Does the working memory performance differ perceptual modality (auditory vs visual) and stimulus type (especially pitch and timbre) of the test?

Hypotheses

Concerning question 1: According to Botvinick's conflict monitoring theory, we assume that the musician group will perform significantly better than the non-musician group, especially in the most demanding, third set size condition (Botvinick et al., 2001).

Concerning question 2: Previous research suggests that musicians perform better in the auditory modality than non-musicians (Ding et al., 2018), especially in the pitch variant in which they get much experience through musical activities. However, as music training doesn't emphasize timbre variations (Schulze et al., 2012) we expect that the between-group difference will be less expressed with respect to timbre. Musicians' knowledge of musical regularities might also contribute to a different, more efficient strategy use and better working memory performance in the auditory tasks (Ding et al., 2018).

Methods

Participants

39 neurotypical young adults were recruited for this study (see Table 1). 18 were trained musicians (studying music for at least 6 years) and 21 had no experience with music (except general music lessons in elementary school). Participants in both groups were matched for age, gender and socioeconomic status. All participants were university students in Budapest: musicians from Kőbányai Music Studio, non-musicians from ELTE Bárczi Gusztáv Faculty of Special Needs of Education. Exclusion criteria included bilingualism, regular dancing lessons, experience in martial arts, yoga and computer games (life experiences which improve cognitive control according to literature). Participants' hearing was also tested previously (entrance criteria: min. 20 dB or more on both ears on speech frequencies (0,5-1-2 kHz), min 30 dB on 3 kHz, and 40 dB on 4 kHz).

Table 1
Demographic data of participants

	Non-musicians	**Musicians**
N	21	18
Average age	21.3	21.2
SD of age	1.39	0.81
Minimum age	19	20
Maximum age	25	23
% of women	76%	61%

Stimuli and procedure

The N-back task is a commonly used as continuous performance assessment that measures working memory updating. The encoding, refreshing and retrieval processes during this task require attribution of each stimulus (content) to the appropriate temporal position (context), known as content-context bindings. The variations of the task differ in set size, stimulus type and modularity (for example in a visual letter task the subject reads the letters from a screen, in an auditory letter task the test could consist of the experimenter reading a list of letters to the test subject).

In our research we used both visual (letters and shapes) and auditory (pitches and timbres) versions of the task to investigate whether modality type influences working memory performance. Subjects' task was to judge, on each trial, whether the current stimulus matched the one that was presented n steps prior (Wadhera et al., 2018). For set size, the number of items to be held in working memory varied across three conditions: 1-back, 2-back and 3-back. Lures were only used in the visual task; in the auditory tasks the lure ratio was set to zero (Tsuchida & Fellows, 2009), This choice was made because the auditory stimuli seemed, on the basis of pilot tests, much more difficult to memorise than shapes and letters. In our pilot runs we found that lures in the auditory tasks resulted in chance-level performance for most participants.

In the proactive interference condition, 25% of the distractor items were lures presented prior to a target item at n-1 and n-2 positions. This condition was designed to measure the effect of previous target items presented as distractors on working memory updating performance across set sizes. In the retroactive interference condition, 25% of the distractor items were lures presented after a target item at n+1 and n+2 positions. This condition was designed to measure the effect of post target presentation of previous distractor items in incorrect temporal positions on working memory updating performance. Because of the nature of retroactive interference, it could only be manipulated in set sizes higher than the 1-back.

Testing took place in a quiet room at ELTE Bárczi Gusztáv Faculty of Special Needs of Education. The tasks were presented on the screen or via headphone, using E-prime software on a laptop, which collected accuracy and response time data. The laptop keyboard was used for response selection. The researcher provided detailed instructions and practice time (there was a 65% correct answer entrance limit to the test). There was an interval of 2400 ms between each stimulus item, which were presented for 600 ms. Participants were required to press the green button for a target and the red button for a distractor placed on the "M" or "X" keys. Location of the response buttons on the keyboard and presentation order of each condition were both counterbalanced across participants.

The letter and shape paradigms included eight conditions including three set size conditions: 1-back, 2-back and 3-back. Each set size included a neutral and a proactive condition. In addition, the 2 and 3-back set sizes also included a retroactive condition. The pitch and the timbre paradigm included only 2 conditions: 2-back and 3-back.

Table 2
N-back variations used in the current study

Modality	Stimulus	Distractor	1-back	2-back	3-back
auditory	timbre	none		✓	✓
	pitch	none		✓	✓
visual	letter	none	✓	✓	✓
		proactive	✓	✓	✓
		retroactive		✓	✓
	shape	none	✓	✓	✓
		proactive	✓	✓	✓
		retroactive		✓	✓

Data Analysis

There were three dependent variables used to analyze data for this task. *Accuracy* was defined as percentage of correct answers. For *reaction time* (measured in ms) we calculated mean, median, and trimmed mean (20% trimming). To characterize *sensitivity* we calculated (i) d primes (d') according to signal detection theory (SDT) and also (ii) hit/false alarm (HF) ratios. Since d' and HF ratios are non-linearly related, they may produce substantially different results in linear correlation tests. In particular, we were interested in correlations between RT on the one hand, and accuracy and sensitivity on the other, hence we used both accuracy, and the two sensitivity indicators in our analyses. Independent variables included previous musical experience (musicians/non-musicians), type of stimulus, set size, and presence of interference items.

The statistical methods used in the analysis were one-way comparison of independent samples, two-way mixed ANOVA and correlation tests. Since preliminary tests have shown that the distribution of our dependent variables was not normal, robust and nonparametric tests were used to analyze the outcomes.

Results

One of our main questions was whether musician and non-musician young adults differ in working memory updating. After type-I error correction no significant differences in reaction time or accuracy were found between the two groups: see *Tables 3* and *4.*

Table 3
Average reaction time

type of test				average reaction time		Cohen's d	Welch test		Yuen test	
modality	stimulus	distractor	set size	non-musicians	musicians		t	p	Y	p
auditory	timbre	none	2	1501,10	1358,00	0,256	0,798	0,4305	0,288	0,7760
		none	3	1361,80	1263,00	0,162	0,507	0,6156	0,002	0,9985
	pitch	none	2	1184,80	1107,10	0,214	0,641	0,5259	0,845	0,4081
		none	3	1257,50	1211,80	0,096	0,293	0,7712	-0,274	0,7864
visual	letter	none	1	623,03	568,19	0,237	0,737	0,4680	0,237	0,8152
		proactive	1	590,28	556,00	0,193	0,599	0,5541	-0,341	0,7366
		none	2	605,06	570,59	0,215	0,654	0,5178	0,512	0,6141
		proactive	2	631,17	589,23	0,222	0,663	0,5127	0,225	0,8244
		retroactive	2	610,72	568,71	0,218	0,669	0,5084	0,280	0,7823
		none	3	623,78	580,73	0,223	0,681	0,5008	0,141	0,8891
		proactive	3	616,14	588,40	0,158	0,478	0,6361	0,223	0,8261
		retroactive	3	613,37	617,82	-0,024	-0,072	0,9429	-0,192	0,8496
	shape	none	1	527,28	570,27	-0,323	-0,949	0,3501	-0,622	0,5409
		proactive	1	522,05	561,72	-0,345	-1,027	0,3122	-0,600	0,5548
		none	2	595,83	658,54	-0,300	-0,867	0,3930	-0,791	0,4387
		proactive	2	572,15	664,75	-0,415	-1,224	0,2300	-1,322	0,2024
		retroactive	2	587,20	632,51	-0,230	-0,683	0,4996	-1,044	0,3089
		none	3	572,55	667,88	-0,438	-1,312	0,1983	-1,337	0,1950
		proactive	3	613,95	682,66	-0,268	-0,819	0,4189	-1,157	0,2604
		retroactive	3	586,56	672,91	-0,375	-1,126	0,2682	-1,334	0,1969

Table 4
Accuracy

type of test				average reaction time		Cohen's d	Welch test		Yuen test	
modality	stimulus	distractor	set size	non-musicians	musicians		t	p	Y	p
auditory	timbre	none	2	0,765	0,822	-0,386	-1,202	0,2376	-1,373	0,1897
		none	3	0,682	0,709	-0,245	-0,740	0,4643	-0,829	0,4195
	pitch	none	2	0,848	0,940	-0,832	-2,634	* 0,0131	-2,384	* 0,0329
		none	3	0,720	0,790	-0,618	-1,889	0,0672	-1,973	0,0629
visual	letter	none	1	0,949	0,956	-0,204	-0,608	0,5471	-0,793	0,4391
		proactive	1	0,927	0,916	0,142	0,413	0,6830	-0,487	0,6310
		none	2	0,912	0,946	-0,506	-1,557	0,1300	-1,773	0,0922
		proactive	2	0,847	0,904	-0,613	-1,823	0,0782	-1,433	0,1675
		retroactive	2	0,914	0,925	-0,155	-0,468	0,6424	-0,540	0,5949
		none	3	0,857	0,886	-0,342	-1,027	0,3116	-1,125	0,2746
		proactive	3	0,806	0,849	-0,471	-1,390	0,1739	-1,374	0,1848
		retroactive	3	0,804	0,866	-0,723	-2,148	* 0,0392	-1,704	0,1059
	shape	none	1	0,871	0,935	-0,477	-1,448	0,1640	-0,971	0,3469
		proactive	1	0,850	0,926	-0,614	-1,934	0,0674	-1,436	0,1685
		none	2	0,797	0,860	-0,483	-1,484	0,1482	-1,030	0,3159
		proactive	2	0,768	0,838	-0,562	-1,689	0,1029	-1,383	0,1813
		retroactive	2	0,819	0,876	-0,452	-1,351	0,1870	-1,137	0,2685
		none	3	0,764	0,831	-0,600	-1,845	0,0749	-1,621	0,1194
		proactive	3	0,723	0,771	-0,387	-1,168	0,2511	-0,684	0,5044
		retroactive	3	0,721	0,768	-0,436	-1,311	0,1987	-1,265	0,2191

We also looked at whether the working memory performance of the two groups differed according to the modularity type (audio or visual). We hypothesized that group differences would be obtained with pitch stimuli. This hypothesis is supported: we found that in terms of accuracy and sensitivity to pitches musicians outperformed non-musicians (see Table 4. for accuracy, and table 5. for sensitivity)

Table 5
Sensitivity

test type	sensitivity (d')		Cohen's d	Welch test		Yuen test	
	non-musicians	musi-cians		t	p	Y	p
2-back pitch	2,281	3,193	-0,911	-2,815	** 0,0080	-2,713	* 0,0145
3-back pitch	1,144	1,642	-0,607	-1,834	0,0755	-2,217	* 0,0378

Since there were no significant differences in reaction time between the two groups in these tasks (see *Table 3.*) - this means that musicians tend not to be faster, but more accurate with pitch stimuli than their non-musician peers.

Finally, the effect of group and stimulus type on three indicators of cognitive control functions (RT, per cent of correct responses [accuracy], and d-prime) was examined in two-way mixed ANOVAS (Group (2) X Stimulus type(4)-within-subjects), for the to-back and three-back tasks separately. The results are summarized in *tables 6.a.* and *6.b.* In terms of speed the groups did not differ. There was, however, a marginally significant between-group difference ($p<0.1$) both in the accuracy and d-prime scores in the 2-back condition, and one for accuracy in the 3-back condition. In all these cases musicians performed better (see *tables 6a* and *6b* for the corresponding *group by stimulus type* means). Next, the effect of stimulus type was significant for each of the three dependent variables, for both set sizes. There was no interaction anywhere.

Table 6a
ANOVA for 2-back tests

Indicator	group	stimulus type				Welch's test for group effect		Geisser-Greenhouse's test of type effect		Geisser-Greenhouse's test of interaction effect	
		timbre	pitch	letter	shape	F	p	F	p	F	p
Average reaction time	non-musicians	1503,9	1165,9	605,1	595,8	0,246	0,6228	64,786	0,0000	0,814	0,3732
	musicians	1358,0	1107,1	570,6	671,6						
ACC	non-musicians	0,768	0,845	0,912	0,797	4,068	0,0541	18,397	0,0001	0,787	0,3813
	musicians	0,822	0,940	0,946	0,854						
d'	non-musicians	1,616	2,258	2,649	1,538	4,073	0,0524	24,522	0,0000	1,293	0,2635
	musicians	1,901	3,193	3,133	1,967						

Table 6b
ANOVA for 3-back tests

Indicator	group	stimulus type				Welch's test for group effect		Geisser-Greenhouse's test of type effect		Geisser-Greenhouse's test of interaction effect	
		timbre	pitch	letter	shape	F	p	F	p	F	p
Average reaction time	non-musicians	1377,6	1276,7	623,8	572,6	0,411	0,5265	45,196	0,0000	0,760	0,3896
	musicians	1263,0	1130,1	576,5	649,7						
ACC	non-musicians	0,680	0,726	0,857	0,764	3,565	0,0679	41,123	0,0000	1,110	0,2998
	musicians	0,709	0,805	0,894	0,836						
d'	non-musicians	0,869	1,194	2,012	1,163	1,828	0,1855	30,872	0,0000	0,550	0,4633
	musicians	0,999	1,642	2,345	1,554						

Due to the absence of interaction, and the modest or missing between-group differences, we decided to unite the two groups, and examine the effect of stimulus type in more detail. Figure 1 shows the corresponding graphs, and the results of post hoc tests (Tukey) are summarized in *Table 7.*

Figure 1
The effect of stimulus type on the three dependent variables: reaction time, accuracy – per cent of correct responses, and d-prime (Black bars show the means (based on the entire sample), gray caps represent CI95 half-width.)

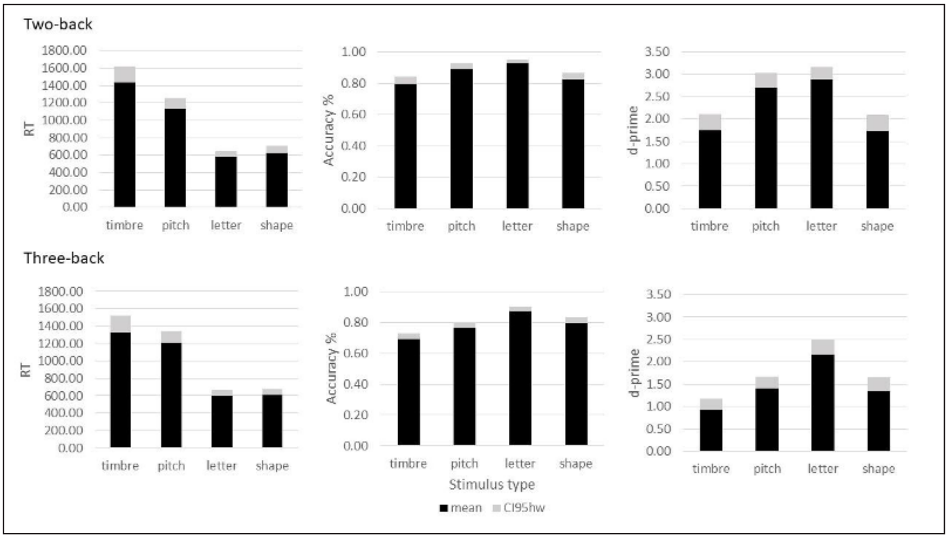

Table 7
*Summary of post hoc Tukey tests for the effect of stimulus type in the six ANOVAs (Abbreviations and symbols: tmb – timbre, ptc – pitch, lett – letter, shp – shape; *: p<0.05; **: p<0.01.)*

Indicator		timbre-pitch	timbre-letter	timbre-shape	picture-letter	picture-shape	letter-shape
2-back	Average reaction time	5,88**	16,76**	15,91**	10,88**	10,03**	0,85
	ACC	6,76**	9,46**	2,15	2,7	4,61*	7,31**
	d’	7,69**	9,14**	0,08	1,44	7,78**	9,22**
3-back	Average reaction time	2,04	12,78**	12,68**	10,73**	10,63**	0,1
	ACC	5,89**	15,46**	8,85**	9,56**	2,96	6,60**
	d’	5,11**	13,31**	4,48*	8,21**	0,63	8,84**

The pattern is quite similar for the two set sizes. With respect to RT, letters and shapes did not differ. Subjects were faster with pitch than with timbre in the two-back condition; however, this difference did not reach significance in the three-back condition. Responses to both pitch and timbre were slower than those to any of the visual stimulus types. Regarding performance, accuracy and d-prime show essentially the same pattern, although not exactly the same differences were significant in the two set size conditions. Timbre was more difficult than pitch, for both set sizes. Letters and shapes were not equally difficult (despite producing identical reaction times). Letters proved substantially easier than shapes. Letters were easier than timbres, for both set sizes. Shapes were easier than timbres when the working memory load was higher (3-back); not so, however, when it was smaller (2-back); the same was true of the relationship between pitches and letters (pitches were easier in 3-back, but not in 2-back). Interestingly the opposite trend was observed for pitches and shapes: pitches were easier than shapes when the working memory-load was smaller (2-back), but this difference disappeared with higher memory load (3-back).

Discussion

The present research aimed to explore the relationship between musical training and cognitive control abilities in young adults. Working memory updating performance was used to measure and illustrate how mechanisms of cognitive flexibility manifest in students with different musical experiences. There are two main findings to be discussed.

First, working memory updating performance doesn't clearly distinguish musician and non-musician young adults - although in terms of accuracy musicians performed better than non-musician.

Second, musicians' accuracy was significantly better in the pitch tasks of the auditory modality, but not in the timbre N-backs - while there was no significant difference in reaction time.

According to Botvinick's conflict monitoring theory (Botvinick et al., 2001) and former research with professional musicians (Herholz & Zatorre, 2012; Fennell et al., 2020; Chen et al., 2020) and previous studies on the long-term effect of musical training on working memory updating (Nutley et al., 2014) we assumed, that the group of musicians would perform significantly better than the non-musician group. In terms of reaction time we did not find a significant difference, and there was only a slight trend showing that musicians performed more accurately than non-musicians. Regarding accuracy musician performed significantly better in pitch tasks, for further details and possible explanations pls. see next paragraph. Investigating the lack of group difference in reaction time and accuracy in the most tasks, one explanation can be that participants of previous research where professional classical musicians, while our subjects were jazz and pop musicians. Given that training in classical music (including playing instruments) supports the development of other skills including cognitive control, it is reasonable to assume that jazz and pop music can do so as well. Earlier studies relied on cognitive control frameworks other than Cohen's CC paradigm, and Botwinick's theory, so failed to distinguish the different mechanisms of cognitive control from each other (like response inhibition and types of interference) in the same experiment and used also different working memory concepts (for example, Baddeley's or Cowan's). These studies used different assessment tasks, so their results are not directly comparable to ours (Schulze et al., 2012, Berz, 1995).

Our finding that musicians' accuracy was significantly better in the pitch tasks than that of non-musicians, is paralleled by similar results in the literature (Schulze et al., 2012; Fennell et al., 2020). In a recent experiment Fennel and colleagues found, that young musicians performed more accurately on the working memory tasks than their non-musician peers, particularly for the verbal and musical working memory stimuli – while have shown no significant different on working memory tasks with visuospatial stimuli. Musicians' knowledge of musical regularities might also contribute to a different, more efficient strategy use and due to this a better working memory performance in the auditory tasks (Ding et al., 2018). After summarizing the questionnaires about the strategies of the subjects we might find further connections between musicians' performance, strategy and modality type in the future.

While our findings provided support for the relationship between regular musical activities and cognitive abilities, this relationship warrants further investigation. Our next analysis will be focused on the question whether the musician group rejects more proactive distractors than the non-musician peers. For this reason, we plan to compare the reaction times for all item types (target, new distractor, proactive distractor and retroactive distractor) and also examine the average and median of reaction time. A further question is whether any variables related to musicians' past experiences, such as age of onset of music training, hours of practicing per week, or type of instrument played predict working memory updating performance. We hypothesize that the age at which music training starts influences later working memory performance. This is because there is a sensitive period for music learning, hence music training with early onset has a long-term effect on cognitive control performance (Chen et al., 2020). Relying on recent studies, we also assume, that subjects in the musician group have different cognitive control performance profile according to the instrument they play (Porflitt & Rosas, 2020) and the groups instrument distribution can also influence the groups working memory performance.

Conclusion

In the 21st century life success depends increasingly on skills and competences which are related to the mastery of cognitive control processes such as goal setting, planning, organizing, prioritizing, memorizing, initiating, shifting and self-monitoring (Fadel & Trilling, 2009; Gropen et al., 2011). Findings in the literature suggest that music may support cognitive and emotional development in many ways (Trainor et al., 2009; Herholz & Zatorre, 2012; Miendlarzewska & Trost, 2014 ; Schroeder et al., 2016; Guo et al., 2018). Musical activities' transfer effects on cognitive control mechanisms came recently often in focus, although literature is not united in many details. (Okada & Slevc, 2018; Sala & Gobet, 2020).

Our first goal in the current paper was to provide a brief review of the literature about both music as an influential factor in cognitive development, and cognitive control. Further, with the help of the first results of our ongoing research, our aim was to introduce the underlying cognitive control mechanisms that might be affected by musical activities and to identify those components that can help us to develop more focused and effective methods for music intervention in education, and in developmental or clinical populations. Our first results support the working hypothesis that musical training may promote the development and maintenance of certain cognitive control skills, although the introduced investigations form only a section on the entrance level of our ongoing wider research.

Musical activities provide a safe and joyful context for practicing and exercising cognitive control and can contribute as an impactful and cost-effective tool to improve 21st century skills. Further research in Cohens cognitive control theoretical frames, investigating musical activities effect on the separate cognitive control components can lead us to more detailed, comparable information and appropriate application of musical tools in education, development, and healthcare.

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Prevalence of cognitive and affective factors influencing mathematical performance

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Children's cognitive ability is the basis of all subject knowledge. It can qualitatively and quantitatively determine the content of the acquired curriculum, and its variation can significantly modify executive functions. There are a number of reasons for underachievement, including problems with genetic origin, parental expectations, the identity of the teacher, the class community, inadequate teaching methods, etc. These factors can trigger anxiety in students and not everyone may have the right coping strategies. The aim of our research is to establish a cognitive ability profile that focuses on the cognitive factors underlying mathematical abilities and the affective factors that influence them. Our research included at 10–15-year-old students in 8 Hungarian primary schools and explored the extent to which symptoms of anxiety affect mathematical performance. Our measuring instruments were the Pedagogical Examination of Dyscalculia and the Math Anxiety Test. The results were examined in the context of mathematical performance. Our research is also relevant in pedagogical practice, because it advances understanding of the cognitive and other psychological processes underpinning children's performance, and thus can help them to achieve the best performance to their abilities more effectively. In this way, we can provide them with mathematical and self-knowledge that is useful in everyday life.

Keywords: cognitive ability profile, mathematical skills, performance, math anxiety

Introduction

Cognitive processes and abilities realize intellectual functioning, the mental processes of perception, memory, and information processing by which the individual gathers information, makes plans, and solves problems (Atkinson & Hilgard, 2014).

Cognitive processes can be divided into two major groups: direct cognitive processes (perception, observation, attention) allow us to perceive the present direct reality that affects us at the moment; and indirect cognitive processes (memory, imagination, thinking) enable the perception and a deeper understanding of a reality that is not currently present, they affect the functioning of the individual based on direct cognitive processes (Meggyesné & Nagyné, 2013).

Thinking is one of the most complex mental processes, its definition poses a difficult task for psychologists (Mayer, 1992, cited in Csépe et al., 2007).

There is a sudden change in the thought processes between early childhood and school age. When children perform specific actions, they perform actions in thought, sort them out, transform them, or make a logical connection between specific objects. Children between the ages of 6 and 12 are not yet able to abstract, so these operations are limited to specific objects or events that have already been seen or actually present. Moving from the stage of specific operations to the stage of formal operations brings a significant change in problem-solving ability. This is when it becomes possible to think about more abstract problems. Children over the age of 12 will be able to systematically rethink logical relationships within problems and solve logical math problems (Cole & Cole, 2001).

Mathematical skills

Mathematics involves a wide range of knowledge that requires the proper functioning of different cognitive systems to acquire and understand, since performing a simple operation such as addition requires a number of theoretical operations (Krajcsi, 2010; Piros & Séra, 2017). Research on the exploration of numerical abilities examines abilities in terms of both average and atypical development. In the focus of the research, in addition to the development of mathematical skills, experts also place great emphasis on the study of the problems occuring in them (Jármi, 2012).

One of the best-known models for the development of mathematical skills is David C. Geary's evolutionary theory of cognitive development (1995), which distinguishes between biologically primary and secondary abilities. Biological primary abilities are innate endowments, such as the recognition of multiplicity in sets of four or fewer elements (Chan et al., 2013; Prado, 2018); understanding more / less quantitative relationships for small numbers; counting, determining the number of sets; and simple arithmetic, which is the sensitivity to change the multiplicity of small sets, the ability to add and subtract. The acquisition of biologically secondary skills, on the other hand, is a slow, deliberate process, acquired by practice, its most important scene is school. Skills can be hierarchically related to each other, so secondary skills are developed on the basis of primary skills, and their acquisition requires the transmission of culture and the institution of education (Geary, 1995; Jármi, 2012; Piros & Séra, 2017). The development of biologically secondary abilities can be well traced in mathematics education. By the age of 6, children can now count to ten and recognize simple operation symbols. By the time they start school, they no longer need tools for simpler subtraction and addition operations, they write and read multi-digit numbers at the age of 7–8, and they multiply and divide by one-digit numbers at the age of 10–11. In summary, it can be stated that in the case of average development in the Hungarian education system, the arithmetic facts, such as addition, subtraction, multiplication, are expected to consolidate in the 4th grade, and the complete development of the same representation network as in adults is expected for the 6th grade (Jármi, 2012; Piros & Séra, 2017).

If we are talking about a different development or developmental lag, we have to compare it to the level at which development is stuck. The norm is the requirements of the school curriculum, the subject of mathematics prescribed at the given grade level. However, this also requires a number of conditions that are not explicitly computationally specific, or even a skill. These are, for example, the ability to comprehend and interpret text, and the metacognitive component of students' thinking, by which they are able to monitor and evaluate their own way of thinking or their task-solving (Csíkos & Szitányi, 2020). Experience gained during practice shows that symptoms of stagnation do not only occur according to the level of development. Therefore, all possible factors should be considered when establishing a diagnosis of a counting disorder, in order to screen out students who do have a count-specific impairment. To help establish the diagnosis and gain a more accurate understanding of mathematical skills, several theoretical models have been developed to explain these disturbances.

The development of numerical abilities also shows significant individual differences in moderately developing children, but these variations – whether due to environmental or genetic reasons or their combined effects, may generate differences in some children which in the light of normal development can be considered atypical, possibly disturbed development (Jármi, 2012; Piros & Séra, 2017).

Effect of stress on math skills and performance

Mathematics is considered a difficult subject by many students, parents and teachers alike. The subject difficulties are mostly attributed to cognitive factors (lack of ability, readiness, practice, and knowledge). Emotional factors are often overlooked, as possible causes of specific learning difficulties. If these emotional problems appear in the mathematical learning process, they can act as a barrier to performance and discourage students with otherwise good ability from learning more mathematics (Szűcs & Mammarella, 2020). Examining the influencing affective factors, it can be concluded that the functioning of cognitive processes, and thus cognitive and mathematical performance, is also influenced by a number of non-cognitive factors. Stress plays one of the most important roles. Its effect on mathematical skills and performance has been demonstrated in a number of studies, as stress can affect all cognitive processes, from the ability to focus attention to decision-making. The effect of stress on mathematical skills may also be influenced by the characteristics of stress events, different aspects of cognitive functioning, and individual differences – such as gender, age, personality traits, stress vulnerability, and coping – also have great significance (Sandi, 2013). The most common situation of stress is a situation that requires a novel response in the process of interaction between the individual and his environment (Kopp & Skrabski, 2003,). Research results show that stress also greatly influences higher cognitive processes, the learning process, the performance of working memory, and the retrieval of previously acquired knowledge. During the experiments, it was discovered that there is a correlation between the intensity of stress, the difficulty of tasks and learning and memory performance. In case of simple problems, a linear relationship was found between intensity and performance, however, an inverted U-shaped curve was observed in solving complex problems The effects of stress can vary depending on intensity, endurance, and cognitive load: it can stimulate but also weaken cognitive abilities. So it only increases performance to a certain extent, and only weakens it under high stress (Sandi, 2013). Negative emotions experienced under stress during the performance of mathematical tasks may affect the successful performance of mathematical operations based on higher-order cognitive abilities (Caviola et al., 2017). Research shows that the effect of anxiety also appears in mathematical performance, despite the fact that, in principle, students have the skills to solve mathematical problems (Nótin et al., 2012).

Math anxiety, working memory and performance

According to the research results, among the cognitive factors determining mathematical performance, the functioning of working memory shows the highest sensitivity to the effects of stress.

In their model of the effects of general anxiety, Eysenck and Calvo (1992) describe that anxiety separates work memory processes. Anxious people turn their attention to their own intrusive, anxious thoughts and worries, instead of focusing on the task at hand. Thus, a specific form of anxiety is mathematical anxiety, which can occur during dealing with numbers and math problems. It elicits an emotional response that later negatively affects learning and performance, and can lead to emotional, physiological, cognitive, and behavioral symptoms of anxiety. Mathematical anxiety is often contextualized with mathematical ability. However, this is wrong, mathematical anxiety cannot be identified, it only affects cognitive abilities, as it impairs math problem-solving ability. When fear of math appears and at the same time an individual's self-esteem is low, it will impede the functioning of working memory, resulting in poorer math performance

A further topic of our research, in addition to exploring the causes and influencing factors, explores the components of mathematical anxiety. According to the most common approach, two factors can be distinguished, the affective and the cognitive components. The affective factor mostly refers to emotions related to mathematics, while the cognitive factor includes the beliefs, attitudes, attributions, and perceived abilities that affect mathematical anxiety (Trezise & Reeve, 2017).

Methods

Our research is based on our previous scientific work aimed at setting up a comprehensive competency profile. Present research allows us to better understand the background of math grading and performance of upper grade students in light of their true abilities.

It is clear from the studies above and from previous research (Szűcs & Mammarella, 2020) that mathematical performance – as measured by grades and the Pedagogical Examination Test for Dyscalculia – is influenced by several factors. Our primary study was to investigate the relationship between affective factors and cognitive performance. The present study presents the frequency of performance and concomitant anxiety and the tests which are used to examine them. Our suggestions are that math anxiety greatly influences performance and the development of cognitive ability levels.

Measuring procedures

The research methods consisted of quantitative assessments, using psychometric analysis. The main line of the research was given by the examination of the ability profile determining mathematical performance, for which we used the first semester test version of the sixth grade of the Pedagogical Examination of Dyscalculia (Diszkalkulia Pedagógiai Vizsgálata – DPV 6 / I), we conducted individual examinations. The students completed a group-based Likert-type questionnaire, the Math Anxiety Test (Matematikai Szorongásmérő Teszt / MSzMT/), to examine affective factors.

For the assessment of the mathematical cognitive ability profile, we chose the measurement method of the Pedagogical Examination of Dyscalculia (later DPV) (Dékány et al., 2020).

It is an individual (therapeutic) pedagogical measurement procedure for the evaluation of basic mathematical skills from the age of 5, which is a revised version of the Dékány - Juhász's Dyscalculia Pedagogical Examination supported by neuropsychological and psychological research. The revised method seeks to measurably differentiate between mathematical underachievement and lag caused by inadequate education or environmental disadvantage, as well as difficulty in math learning and developmental dyscalculia as specific learning disabilities. During the revision of the test, special attention was paid to the clear, precisely formulated, pedagogical approach to developing the questions.

It provides the child with an interpretation of the instruction, if necessary, in order to be able to purposefully examine the focused ability, skill. Thus the error resulting from comprehension and language impairment can be eliminated, as well as the influencing and distorting effect of partial abilities and processes irrelevant to the given task. In the scoring criterion, the emphasis is often on the meaning of the answers and the expected content, ignoring the child's level of language development where possible. We also chose this measure because the study not only measures numerical subfields, but also provides a comprehensive picture of a child's mathematical abilities and skills, as well as non-math-specific cognitive functions, thinking strategies, and compensation mechanisms.

During the revision, an age-appropriate and practical test package we prepared, which includes a detailed and accurate Test Guide, Test Form and Protocol, an Evaluation Table and Tables of Typical Errors, as well as the tangible assets necessary for the inclusion of the examination procedure were also developed and manufactured. (Polgárdi et al., 2018). The main goal of the study is to assess the state of the concept of numbers (abstract, discrete semantic representation), the concept of operations, as well as to map the operation of the underlying basic functions and partial abilities. The measurement procedure examines the separate hypothetical systems of internal representation, the analog quantity system (comparison, approximate calculation, estimation), the arabic numeral format (symbolic system of arabic numerals), the verbal system (arithmetic facts, eg. storage and retrieval of multiplication tables), basic output and input modalities (number processing, eg. writing and reading numbers). Among the components of computational operations, the observation of computational procedures (operations procedures) and conceptual knowledge (arithmetic rules and principles, eg. interchangeability, groupability, inversion) are also important aspects of the study.

In the measurement procedure, emphasis is also placed on the main basic functions (Geary,), the spatial-visual and central execution system (Szűcs et al., 2014), and the working memory (Baddeley, 2012; Szűcs et al., 2014), and also monitoring linguistic aspects, making it easily correlated with individual subsets of the WISC – IV intelligence test. The Discalculia Pedagogical Examination consists of several task groups (subtests), which contain additional sub-points / task groups, keeping the original test units.

Within the sub-points the number of tasks is different. The types of tasks compiled according to the age are based on each other in an analogous way, and the nature and number of the tasks also change according to the age characteristics. Each task is of a responsive nature, requiring an active verbal and / or action or written response, so some tasks may have multiple responses that are acceptable. The calculation tasks of DPV reveal the individual algorithmic operation levels and sequences.

In order to explore and record the sequence of elementary steps, counting techniques, levels of abstraction, thinking strategies, and compensatory procedures, the child is instructed to think aloud and formulate his / her strategy during the study. Thus, through standard questions aimed at objectivity in the measurement procedure, the study director can also collect information about the child's thought processes, metacognitive skills, and non-intellectual factors accompanying the task solution (e.g. motivation, frustration-tolerance). The result of the DPV test provides a structural analysis, within which the backgrounds of individual ability profiles can be explored by analyzing the response patterns.

Although the Pedagogical Examination of Dyscalculia has been developed for the assessment of mathematical skills, as it is in line with the National Curriculum, it also allows for the assessment of age – appropriate knowledge, i.e. informs about the students' mathematical performance, mobilization of cognitive skills and appropriate use in tasks (Polgárdi et. al., 2018).

When examining a subject-related anxiety, not only mathematical manifestations should be considered, but also the symptoms of anxiety should be measured. Taking these aspects into account and on this basis, the staff of the University of Debrecen has developed a new measuring tool with which we can assess all components of mathematical anxiety.

The name of the measuring device: Math Anxiety Test (Matematikai Szorongásmérő Teszt /MSzMT/). The test includes statements, and the student has to decide to what extent he / she can apply them to himself / herself by marking on a seven-point scale (1: Not characteristic of me at all, 7: Totally characteristic).

The test consists of 40 items, organized into two main factors: the first is emotional and physiological symptoms; the second factor includes items of cognitive symptoms: attitudes, attributions, and beliefs. Emotions that emerge during the learning of mathematics are subjective, such as fear, anxiety, restlessness, or just the opposite: a heuristic experience, joy, a sense of happiness. Anxiety often manifests itself in physical symptoms, with nausea, vomiting, abdominal pain, diarrhea, palpitations, shortness of breath, tremors, dizziness, lump in the throat. These physiological symptoms, which are closely related to the emotional factor, are consequences of each other and should therefore be classified into one factor. Behind the anxiety, negative statements can be assumed. whose subfactors are: attitudes, attributions, and beliefs. The Cognitive Symptoms factor is not subdivided into other sub-factors, all content related to mathematical thinking is displayed here, no group breakdown is required. Attempts were made to formulate the statements in such a way as to cover the content as much as possible. Twenty items were generated for both factors, based on MARS, MAS, and ATMI questionnaires. They also paid attention to make the statements easy for the age group of the students to understand.

Thus, in terms of age, during the development of the test, special attention was paid to the fact that the youngest age group to be measured, i.e. the upper secondary school, could be measured, as according to some literature data, mathematical anxiety can appear at the age of 9–11 (Nótin et al., 2012).

There is no upper age limit for the use of the questionnaire, as the content of mathematical anxiety does not change, but rather intensifies with age (Svraka, 2016).

Introducing the Math Anxiety Test (Annex 1.)

The questionnaire is the Math Anxiety Test (Matematikai Szorongást Mérő Teszt /MSzMT/), which consists of a total of 40 items. The questionnaire contains statements on which the student has to decide how characteristic they are. To judge each item, a 7-point Likert scale was developed for better differentiation. The values of the scale are as follows:

1: not typical of me at all
7: completely characteristic of me

The factors and contents of the questionnaire are presented below. The individual factors are fundamentally separate, but due to the complexity of the structural factors of mathematical anxiety, it is not possible to completely separate the individual symptoms.

1. Emotional and physiological symptoms (20 items)

Items related to emotions and physiological symptoms that occur during math tasks have been included in this factor. Statements include, on the one hand, the learner's emotions in a specific task situation and in general in mathematics. For example, a statement about a specific task situation: "If I have to solve math problems, I will be very anxious". A more general emotion about math, for example, is, "I'm often irritable and restless from math". Physical-physiological symptoms are, on the one hand, symptoms that appear in a math task situation, such as "While solving math tasks, I feel like I have a lump in my throat". On the other hand, those symptoms also appear in the statements when students think about math, such as "My stomach twitches when I think about math". Most of the items contain negative symptoms as these indicate the presence of mathematical anxiety. The more characteristic the student considers the statement to be, the bigger his or her mathematical anxiety is.

Items in the factor: 4, 6, 8, 10, 13, 15, 17, 19, 21, 25, 27, 29, 31, 33, 37, 39, 40
Reverse items: 1, 23, 35

2. Cognitive Symptoms- Attitudes, Attributes and Beliefs (20 items)

There are three sub-factors within the cognitive factor:

a) Attitudes
b) Attributions
c) Opinions

a) The items belonging to the Attitude sub-factor include attitudes related to the subject of mathematics and dealing with mathematics. Attitudes represent a kind feeling towards a particular attitude object that also plays an important role in mathematical anxiety. If a student has negative attitudes towards math, he or she may develop anxiety about math."

The higher a student's score is on negative attitudes, the more he or she indicates the presence of math anxiety.

Items belonging to the attitude subfactor: 11, 18, 30
Reverse items: 7, 38

b) The sub-factor Attributes refers to the factors to which a person attributes a good achievement in mathematics or a poor performance. As we have seen earlier, girls and students in Eastern countries often tend to attribute their mathematical success to external factors, such as luck, while boys tend to attribute good results to their good abilities. If a student believes that success in math does not depend on him/her, math anxiety may appear, which could increase the chances of failure. Attributions often include gender stereotypes, such as "Boys tend to be better at math than girls". Other items included in the questionnaire are related to math performance ("Sometimes I don't get a good grade in math because I have a hard time understanding the subject") and learning math ("I often have a hard time learning math").

Items belonging to the sub-factor attributes: 5, 12, 14, 16, 24, 32, 34
Reverse items: 3, 20

c) The sub-factor Opinions includes those thoughts and opinions that largely determine the attitude towards mathematics. If a student is negative about math in a way that is stressful, difficult, or even unnecessary for him or her to deal with the subject, he or she may develop a negative attitude that can affect math anxiety and performance. The formulated items refer to: The usefulness and importance of mathematical knowledge, e.g. „Right now, the knowledge of math is completely unnecessary in my life" Application of mathematics e.g. „I am not able to do mathematics in practice" Subsequent use of mathematics e.g. „I won't need math at all later"

Items belonging to the sub-factor opinions: 2, 9, 22, 26
Reverse items: 28, 36

Among the 40 closed questions, there are six negative wordings to reduce deformation. These were already reversed during encoding and entered into the computer at the time of data recording with the corrected value (Nótin et al., 2015).

The first analysis performed was the reliability test, which shows whether the applied psychological tests and the pedagogical test reliably measure the given sample. The Math Anxiety Test (Matematikai Szorongásmérő Teszt / MSzMT/) has a high internal consistency of both factors: Cronbach-alpha a = 0.838 for emotional-physiological symptoms, and α = 0.717 for cognitive symptoms. The DPV measure also reliably shows cognitive abilities in our given sample, the value of Cronbach- alpha is α = 0.826 (Svraka, 2016).

Study population – Sample presentation, frequency indicators

Our sample consisted of a total of 999 upper secondary school students in Hungary, ranging in age from 10.67 to 15.08. Of which 483 boys, which 48.3% of our sample, and 516 girls, who make up 51.6% of our sample.

Our sample can be considered homogeneous as there is no significant difference in terms of gender and grade.

We examined a total of 253 students (25.3%) in the 5th grade, 249 students (24.9%) in the 6th grade, 253 students (25.3%) in the 7th grade, 244 students (24.4%) in the 8th grade.

The distribution of the sexes by grade is as follows:

123 (12.3%) boys and 130 (13%) girls participated in the study in the 5th grade, 120 (12%) boys and 129 (12.9%) girls in the 6th grade, 124 (12.4%) boys and 129 (12.9%) girls in the 7th grade, 116 (11.6%) boys and 128 (12.8%) girls in the 8th grade. (Table 1.)

Table 1
The distribution of students in the sample by grade and sex

	5th grade		**6th grade**		**7th grade**		**8th grade**		**Total**	
Gender	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**
Boy	123	12.3	120	12.0	124	12.4	116	11.6	483	48.3
Girl	130	13.00	129	19.0	129	12.9	128	12.8	516	51.7
Total	253	25.3	249	24.9	253	25.3	244	24.4	999	100

In Hungary, knowledge is evaluated with grades. Excellent (5) rating means the best result, insufficient (1) means the worst result.

The end-of-the-year grades of the students shows the following distribution. (Table. 2.)

Table 2
The distribution of students' grades at the end of the year

	5th grade		6th grade		7th grade		8th grade		Total	
Mark	N	%	N	%	N	%	N	%	N	%
1	2	0.2	5	0.5	5	0.5	3	0.3	15	1.5
2	30	3.0	29	2.9	41	4.1	24	2.4	124	12.4
3	66	6.6	81	8.1	76	7.6	90	9.0	313	31.3
4	104	10.4	84	8.4	94	9.4	75	7.5	357	35.7
5	51	5.1	50	5.0	37	3.7	52	5.2	190	19.0

A total of 15 students (1.5%) got insufficient grade, 124 students (12.4%) got sufficient grade, 313 students (31.3%) got medium grade, 357 students (35.7%) got good grade, 190 students (19.0%) got significant / excellent grade.

We have compiled a set of tasks from a diagnostic test bank to measure current knowledge in order to measure the answer to the question of the extent to which mathematical anxiety affects mathematical performance. Children had completed the knowledge meter before they did the anxiety meter test.

Results

The result is given as a percentage. The average of the knowledge measured on the sample is 73%, which shows a grade of 3.58 in the grade. The average grade of the girls is 3.66, while that of the boys is 3.53.

The basis for the acquisition of knowledge is the appropriate level of cognitive abilities. To measure this, we used the criteria-based measurement procedure of the Pedagogical Examination of Dyscalculia (Diszkalkulia Pedagógiai Vizsgálata /DPV/).

Mathematical learning problems, learning difficulty, and learning disorder divided the sample into three major bands by deliberate professional decision and measurement process.

There are 580 (58.1%) students with minor problems, 405 (40.5%) students with learning difficulties, and 14 (1.4%) students with predictable learning disabilities.

The cognitive criteria recorded during the test showed the following percentages: orientation problems were predicted in 28.4%, memory problems in 31.7%, attention problems in 30.7%, and motivational problems in 34.3%.

Broken down by gender, 277 boys have no problems with mathematics, 198 boys have moderate difficulty, and 8 boys are presumed to have learning disabilities. 144 boys have a lack of orientation, 152 boys have a memory impairment, 151 boys have an attention deficit and 180 have a lack of motivation.

In the case of girls, 303 of them have no problems with mathematics, 207 girls have moderate difficulty, 6 girls have a presumed learning disability, 140 girls have a lack of orientation, 165 have a memory impairment, 156 have a lack of attention and 163 girls have a lack of motivation.

The highest score available on the Math Anxiety Test is 280 points on the two main factors and sub-factors. The test has no standard value, it can always be interpreted by the results of the given group. It is highly criteria-oriented and takes into account the atmosphere of the group, external influences, circumstances, methods, standards of teaching mathematics, the role of the educator, and factors that may all influence the development and persistence of anxiety. However, it can be seen that the lowest score of the sample is 44, while the highest is 246, the average score of the sample is around 131.6126, which is considered to be average compared to the maximum available. Mathematical anxiety is typically moderately present in our sample, but there are also students with exceptionally high levels of anxiety, they are among the girls.

Conclusion

Mathemathical anxiety is an emotional reaction that inhibits the performance of mathematical operations and thus may reduce cognitive performance.

Problems in the field of computation are most easily observed in mathematics lessons or computational situations.

Dysfunction of numerical abilities can manifest itself in the symbolic interpretation of numbers, difficulties in learning and applying arithmetic facts, barriers in understanding and using positional notation, or in the memorization of operational methods.

Affective factors often aggravate the situation, anxiety may generalize.

Since numbers can appear in any number of classes during the lessons from the beginning of the upper grade, the shortcomings in this area become particularly obvious. Therefore, we conducted our research among upper secondary students in Hungary.

Eight schools undertook the survey, with 999 parents agreeing to the study. Our goal is to set up a cognitive ability profile with a specific emphasis on mathematical skills. In parallel, we also examined the appearing affective factors. Our test tools were measured in a preliminary study that attempts to nuance the relationship between cognitive ability, mathematical performance, and mathematical anxiety with a myriad of factors and subfactors.

The results clearly highlight that mathematical anxiety is moderate in our sample, with higher values in girls.

Nevertheless, girls are also more effective in terms of abilities and performance. It is clear from this, that anxiety does not necessarily occur with a lower ability profile and lower performance. In our study, only frequency data are presented, and a number of interesting correlations can be deduced from the results, which will provide additional useful information for professionals, educators, and parents to address the problem effectively.

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Annex 1

Math Anxiety Test (Matematikai Szorongásmérő Teszt /MSzMT/)
Circle the correct number.

1: Not characteristic of me at all
7: Totally characteristic of me

Q_1 I'm always calm in math class	1	2	3	4	5	6	7
Q_2 I am not able to apply math in practice	1	2	3	4	5	6	7
Q_3 Since the tasks that need to be solved in the dissertation are not too difficult, I usually achieve good results	1	2	3	4	5	6	7
Q_4 Sometimes I get so confused about solving math problems that I am almost unable to pay attention to my problem.	1	2	3	4	5	6	7
Q_5 I think I'm moving slower from math than I should be	1	2	3	4	5	6	7
Q_6 I think I'm moving slower from math than I should be	1	2	3	4	5	6	7
Q_7 I love math	1	2	3	4	5	6	7
Q_8 I never feel like I can properly learn the actual math material	1	2	3	4	5	6	7
Q_9 I won't need math at all later	1	2	3	4	5	6	7
Q_10 If solving math problems doesn't go easy, I may start to shake and sweat	1	2	3	4	5	6	7
Q_11 It doesn't matter to me that I have good results from math	1	2	3	4	5	6	7
Q_12 I think boys are usually better at math than girls	1	2	3	4	5	6	7
Q_13 If I have to solve math problems, I will be very nervous	1	2	3	4	5	6	7
Q_ 14 I tend to get worse results from math because sometimes there are more difficult tasks in the test than I did at home or in class.	1	2	3	4	5	6	7
Q_ 15 When I have to solve math problems, I am unable to think with a clear head and come up with a solution.	1	2	3	4	5	6	7
Q_16 Most subjects go relatively well, but math isn't so much	1	2	3	4	5	6	7
Q_17 I remember almost nothing of what we learn in math class, and that makes me feel bad	1	2	3	4	5	6	7

Q_ 18 Math is the most disgusting subject of all of me	1	2	3	4	5	6	7
Q_19 When I have to do math, I often feel uncomfortable	1	2	3	4	5	6	7
Q_20 I get good results from math because I usually understand the material	1	2	3	4	5	6	7
Q_21 I'm afraid it turns out in class that I have a hard time doing math and I lag behind others	1	2	3	4	5	6	7
Q_22 Right now, my knowledge of math is completely superfluous in my life	1	2	3	4	5	6	7
Q_23 It is completely relaxing and a pleasure to do math tasks	1	2	3	4	5	6	7
Q_24 I'm never sure I solve math problems well	1	2	3	4	5	6	7
Q_25 While solving math problems, I feel like I have a dumpling in my throat	1	2	3	4	5	6	7
Q_26 I often have to ask for help with math problems because I can't solve them alone	1	2	3	4	5	6	7
Q_27 I am often afraid of getting a bad mark for my math test	1	2	3	4	5	6	7
Q_28 I use my math after school	1	2	3	4	5	6	7
Q_29 Solving math problems is often frightening	1	2	3	4	5	6	7
Q_30 I wouldn't be happy for him if I had to do more math than that	1	2	3	4	5	6	7
Q_31 When I do math, I feel a violent heartbeat, which is uncomfortable for me	1	2	3	4	5	6	7
Q_32 Many times I have a hard time learning math	1	2	3	4	5	6	7
Q_33 My stomach twitches when I think of math	1	2	3	4	5	6	7
Q_34 Sometimes I don't get a good mark from math because I have a hard time understanding the material	1	2	3	4	5	6	7
Q_35 I feel very enthusiastic when I do math	1	2	3	4	5	6	7
Q_36 Math skills can help me manage my affairs well later, e.g. the money	1	2	3	4	5	6	7
Q_37 I worry a lot about solving math problems well	1	2	3	4	5	6	7
Q_38 I love everything related to math	1	2	3	4	5	6	7
Q_39 I usually understand math, but I'm afraid it will get harder later	1	2	3	4	5	6	7
Q_40 I am unsure when I need to solve math problems	1	2	3	4	5	6	7

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Opportunities for recognising, assessing, and providing online support among elementary school students with dyscalculia

Options for recognising, surveying, and online support for dyscalculia in primary school students

Farkasné Gönczi, Rita

Mathematics is present throughout our lives. Already in infancy, children become acquainted with quantities and the differentiation of quantities (Starkey & Cooper, 1995; Huntley et al., 2000; Csépe et al., 2007, 2008). According to von Aster and Shalev (2007), the quantitative core system (cardinality) develops in infancy. An infant is capable of subitising, estimating, and comparing the quantities of a small number of items. After learning from their environment in early childhood, children perceive quantities and then understand the strategy needed for counting and are able to count verbally. They use different classifications to determine the quantities. Kindergarten prepares the knowledge needed for the application of the concept of numbers and lays the foundations for the concept of operations. As a continuation of knowledge acquisition of knowledge, in primary school the establishment of a unified and broad foundation takes place with a focus on the development and consolidation of the concept of numbers and operations. Number words representing quantities are associated with digits, therefore school children express them with symbols without the presence of quantities (von Aster & Shalev, 2007; Jármi, 2013, p. 50). This developmental process allows for the learning of written operation performance in the lower grades, while the internal number line (analogous quantity representation) develops in the child, which strengthens spatial thinking. In the initial stage of the lower school grades, active knowledge acquisition dominates, which is the first level of abstraction of mathematical activities. In the grades that follow, the constantly and spirally repeating, expanding nature of knowledge strengthens the fourth level of abstraction, i.e., the independent application of symbols.

Keywords: ability components, diagnostic system, dyscalculia, development

Dyscalculia in the diagnostic system of pedagogy and special education

The competence and ability components of mathematics do not develop at a pace similar to the majority for all children. There are cases where there is a developmental delay that can be addressed through tutoring within a school setting. There may be a difference in the child's motivation, attitude towards mathematics, and level of frustration. In many cases, these factors are due to personality or environmental effects, or possibly caused be neurocognitive abnormalities (e.g.: amygdala function).

In the case of mathematical learning disorders, individual development does not approach the developmental curve of most children, therefore remedial tutoring is not enough since these children need complex special education assistance and dyscalculia therapy. As a phenomenon, dyscalculia is the result of neurocognitive impairments (core system of numbers, arithmetic concept, short-term memory, working memory, attention, visuospatial abilities), as well as impaired basic numerical and arithmetic abilities, and non-numerical cognitive functions. It is therefore necessary to conduct a complex dyscalculia diagnosis which maps the neurocognitive deficiencies and base areas in order to determine the direction of development.

Based on the factors listed above, a definition of complex dyscalculia definition is given as the following:

> Dyscalculia is a difficulty with a wide spectrum of symptoms occurring in mathematical performance, which is not related to the general intelligence level, associated with mental dysfunctions, which is caused by a difference in the structures and functions of multiple processing circuits that can be specifically related to numbers, which, in the case of comorbidity, affects further neurological networks or functions as a result of an inherited and/or acquired injury. The form, size, and extent of the appearance of dyscalculia is greatly influenced by the environment but does not constitute a causal factor (e.g. personality, attitude, behaviour, frustration, family habits, educational methods). The presence of dyscalculia can change the social participation of a person and their environment, hence their quality of life depends on their own copying strategy and the opportunities provided by their environment (Farkasné Gönczi, 2008, 2011, 2018).

The mathematical learning disorder comorbid (combined) may be associated with other disorders, such as dyslexia, in which case there may be a grapheme and phoneme classification disorder, or ADHD, in which execution functions are impaired. In this case, a complex image of symptoms is mapped through a complex differential diagnostic procedure. In this case, the diagnostic goal is injury-specific isolation and then the definition of a direction of development.

The table below provides information on the types of test procedures used in the case of math learning difficulty and math learning disorder and the diagnostic focus. This is supplemented by Table 2, which summarizes the symptoms that appeared during the studies.

Table 1
The special pedagogical focus of the mathematical learning disability (MLD) clusters according to the definitions based on the work of Kaufmann and von Aster (2012) and Farkasné Gönczi (2017, 2018)

Definition	Background	Diagnostic focus	Dyscalculia diagnostic focus
Mathematical learning/ performance difficulty	Personality or environmental impact, which in some cases provides a neurocognitive background (e.g. amygdala function)	Motivation, attitude, frustration, environmental barriers and support	Complex pedagogical diagnosis (discovering deficiency and base areas, defining the development direction)
Mathematical learning/ performance disability (MLD) - counting difficulty DYSCALCULIA (DysC)	Neurocognitive background: numbers core system and related neurocognitive injuries (arithmetic concept, RTM, WM, attention, visualspatial ability). (table 3 of dissertation)	Basic numeric and arithmetic abilities, non numeric cognitive functions	Complex dyscalculia diagnosis (mapping of neurocognitive deficiency and base areas, defining the development direction)
Mathematical learning/ performance disability (MLD-CD) DYSCALCULIA (DysC-CD) - with comorbid difficulties	Neurocognitive background: Dyslexia comorbidity (grapheme and phoneme classification), ADHD comorbidity (executing functions)	Arithmetic, language, attention, executive cognitive functions	Complex differential diagnosis (injury-specific separation according to complex symptom characteristics, then determination of a development direction)

Based on the breakdown of the concept of mathematical learning disorders shown in Table 1 and the definition of the diagnostic focus of dyscalculia,

> the primary goal of complex dyscalculia diagnostics is to develop and successfully implement the therapeutic activity taking into account the autonomy of the individual being examined or, in the absence thereof, exploring the complex personal and environmental profile required for the individual development of coping strategies applicable to everyday life, ensuring permanent control of processes with regard to counting, numerical ability, mathematical attitude, etc. (Farkasné Gönczi, 2019, p. 53)

In order to achieve the above diagnostic goal of complex dyscalculia, the first task of answering the question, “Who?” is to get a symptomatic child or student into the special education care system in time. Professionals working in the field of public education are the primary signalling system, which requires the creation of a well-structured and usable list of symptoms for kindergarten teachers, educators, and teachers. To recognise the symptoms, it is essential to know the complex skill and ability profile of mathematical competence (see Table 2), the absence of several elements of which indicates the possible presence of dyscalculia.

The complex skill and ability profile of mathematical competence presented in Table 2 on the following page shows what other ability and skill components children need to have in order to activate different mathematical skills. For example, in the case of solving a textual task, it is not enough to have the ability to count or perform operations: text reading pace, text comprehension, highlighting, mathematical data interpretation, strategy selection, spatial-visual sketchpad necessary for operation performance, procedural system operation, result interpretation, working memory, and text forming skills are also required.

Table 2

Complex skill and ability profile of mathematical competence with the related numerical processing and other systems (table drawn up based on Fábián et al., 2008, p. 14; Dékány, 2009; Csonkáné Polgárdi & Dékány, 2013; Jármi, 2013, Polgárdi, 2015; Farkasné Gönczi, 2018)

Skills	Numerical processing systems	Other psychological systems	Other knowledge	Thinking skills	Communication skills		Knowledge acquisition skills		Learning skills
					linguistic	visual	task solving	problem solving	
counting in ascending and descending order	verbal system, list presentation, central executive, mathematical core system (ANS, OTS, analogue quantity representation	tactile-motor-spatial system, procedural system	the principle of one-to-one correspondence, cardinality	systematisation	knowledge of number words, relational vocabulary			problem sensitivity	attention
counting			compensation strategy, principle of clear assignment, continuous calculation	combinatoriality	comprehension, text analysis, language development	partial-whole perception	reaction time	problem representation	verbal working memory, phonological loop
global quantity recognition	spatial-visual sketchpad, verbal system		fine motor skills	interconnection of representations, intermodality, association		test scheme			
quantitative deduction quantity constancy	central enforcement system		principle of invariance	deductive reasoning		spatial awareness, spatial relations		originality, creativity	memory extent, associative memory, meaningful memory

Skills	Numerical processing systems	Other psychological systems	Other knowledge	Thinking skills	Communication skills		Knowledge acquisition skills		Learning skills
					linguistic	visual	task solving	problem solving	
quantitative relations	approximate quantity system, list representation	spatial-visual system			language development, knowledge of relational symbols				verbal working memory, phonological loop
numeric-digit matching	verbal system, visual Arabic numeral format, abstract discrete representation, list representation	spatial-visual sketchpad, connection of representations	seriality, semantic knowledge, semantic coding, the principle of clear assignment			visuomotor coordination			
place value concept	verbal system, approximate quantity system, abstract discrete representation	spatial visual sketchpad	semantic transcoding seriality	grouping, quantity constancy, abstraction					
number memory	central enforcement system		compensation strategy	inverse thinking		spatial visual sketchpad			verbal working memory, phonological loop
estimation, measurement				inductive reasoning		representation, presentation, length estimation	problem solving		task management

Skills	Numerical processing systems	Other psychological systems	Other knowledge	Thinking skills	Communication skills		Knowledge acquisition skills		Learning skills
					linguistic	**visual**	**task solving**	**problem solving**	
basic operations	verbal system, visual Arabic numeral format, central executive, object tracking system, approximate quantity system, abstract discrete semantic system	spatial-visual sketchpad, procedural system	tactile-motor-spatial system, representation of multivariate numbers	analysis-synthesis, abstraction, analogies, algorithmic thinking, arithmetic conceptual knowledge, seriality	other language functions				working memory
unit conversion				quantitative deduction		task solving speed		metacognition	
solving textual tasks				reasoning, proof	reading speed				
comprehensive skills				speed of thinking	language development		operation performance speed		learning speed
motives, attitudes									

In the case of mathematical learning disorders, the components summarised in Table 2 are missing or do not match the additional abilities and skills. Based on the analysis of the gaps, Desoete (2006, quoting Krajcsi, 2010, p. 100; Farkasné Gönczi, 2019, p. 87) typifies the series of symptoms for the appearance of dyscalculia into four groups:

1. *semantic memory deficit*: confusion in the recalling of numerical facts. Incorrect or slow mental and written counting. Poor working memory performance is common in various tasks.
2. *procedural deficit*: a disorder in the planning and execution of complex arithmetic operations, suggesting a poor understanding of the concepts behind them.
3. *spatial-visual deficit:* disturbance of spatial-visual perception and memory, frequent reflection of digits and confusion in their placement, problematic arrangement of the elements of number sequences, difficult solution of spatial and possibly geometric problems.
4. *numeracy deficit:* confusion of transcoding between modalities (e.g.: semantic coding), confusion of number production and numbering.

Desoete's breakdown into four categories can appear in a complex manner during elementary school mathematical activities. For example, according to Table 2, up to all four areas may be affected in ascending order during a counting task.

From the point of view of screening for dyscalculia, the complex skill and ability profile of the mathematical competence listed in Table 2 provides a basis for the development of the list of symptoms:

– number concept: counting in ascending and descending order
  – swapping or omitting numbers from the number sequence
  – direction or rule confusion
  – uneven rhythm, stagnant, slowing pace
  – uncertain analogue quantity representation
– counting: knowledge required for counting
  – lack of application of the stable ordering principle, i.e., the invariance principle
  – lack of application of the clear assignment principle
  – lack of application of the principle of cardinality
  – abstraction from qualitative properties or spatial arrangement is incomplete
  – partial-whole relationship is uncertain
  – formulation and execution of "crossing ten" equations is inaccurate
  – global quantity recognition is uncertain
– quantitative deduction, quantity constancy, quantitative relations
  – global quantity recognition, incomplete or is developing
  – quantity constancy is not recognised or is developing
  – misinterprets the quantitative relation
  – confusion in the interpretation or identification of symbols related to a relation

  - misinterpretation of the spatial arrangement of a relation
  - confusion in the use of relation-related symbols
- numeric-digit matching
  - incorrect transcoding between numeric and digit
  - incorrect writing of digits in the square grid
  - incorrect numeric writing
  - incorrect number writing, even mirror writing
- place value concept
  - regular mixing of place value and sign-value notation
  - interpretation of place value undeveloped
  - lack of attention to place value during mathematical activity
- number memory
  - acoustic error in pronouncing numerals
  - numerical order incomplete
- operation performance
  - difficulty in moving between the four levels of abstraction (action, display, drawing, symbol) during the performance of the operation, often only solving the task by acting it out
  - device use or finger use for low numbers
  - difficulty in writing down or reading the operation
  - difficult recognition or appropriate application of analogies
  - errors in seriality
  - incorrect or very slow understanding or execution of the operation performance method
  - incorrect operation performance due to spatial orientation or laterality error
  - lack of transparency in the relationships arising during the operation performance
  - incorrect application of approximate calculation (estimation)
- measurement conversion
  - difficulty in determining approximate quantity
  - measurement conversion is extremely slow or not practicable
  - difficult interpretation and application of relationships
- textual task
  - incomplete mathematical interpretation of the text, emphasis on the point and the necessary data
  - incapability of translating the text into the language of mathematics
  - incapability of finding the right operation for the mathematical problem formulated in the text, incorrect strategy selection
  - incapability for formulating the answer

The complex appearance of the symptoms of several detectable indications listed here may be a sign among kindergarten teachers (number concept, counting with low numbers) and among elementary school teachers. Post-recognition screening can also be performed by teaching professionals, for which the Dyscalculine survey sheets developed by Ottilia Szabó for five different numbers are suitable. In the following, the diagnostic examination is performed by experts in special education in a professional team, using the Dyscalculia Pedagogical Examination (DPV) examination tool developed by the Dyscalculia Research Group for different age groups.

Focal points to support students with dyscalculia

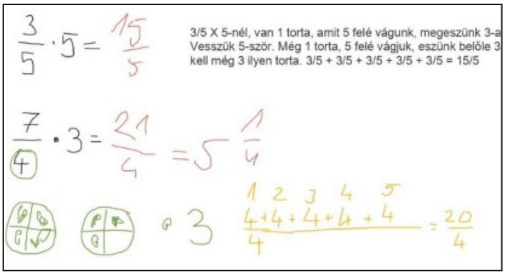
The presence of dyscalculia in mathematical performance can already be safely recognised in the lower grades of elementary school. In accordance with Mesterházi (2004), the primary goal of post-recognition development work is to determine and individually apply the results, time, and tools of the development process in accordance with the identified individual abilities and gaps in order to eliminate the negative learning spiral. Schlegel (2007) describes the negative learning spiral as *Teufelkreis*, which can be transformed into a positive learning spiral by the special education teacher in collaboration with the educator. The professionals need to work with all three pillars of this spiral for the achievement of success. These pillars include the child's personality, performance, and environment. Development alone is not enough if it is not supported by personality development and the creation of a collaborative atmosphere in the environment that is consistent with a holistic approach to special education therapeutic work.

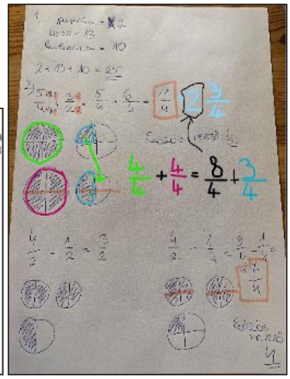
It is necessary to motivate the student and create a safe environment during the therapeutic and integrated cooperation. For children, contextual work can be applied during therapy, by placing them in a motivating story for them, so mathematical challenges are endowed with situational interpretation. To this end, in addition to the usual school methods, the two individual and project method options detailed below are considered good practices.

Cooperation with individual work in an online space

Online individual or small group development work can be integrated well into the digital curriculum. In the case of the present practice, after acquaintance, we agreed on the different activities and the communication channels assigned therein. During our joint online work, we wrote the tasks on a Jamborad interface where we had the opportunity to create, explain, interpret, and correct simultaneously. I sent short videos to the student to interpret and analyse certain topics. After interpretation, the student completed the homework in classic paper-pencil form and photographed it, which I corrected with an image editing drawing program. I strengthened the practice by allocating a small number of regular tasks and different online games surrounding the topic. In addition to regularity, it was important to think in a small number of tasks, as in the case of dyscalculia therapy it is essential to get to know the thinking strategy, the method and means of performing the operation, breaking it down into small elements, mastering these step-by-step, strengthening the abstraction at a lower level, and then building upon this.

Images 1 and 2
Correction of the homework with an image editor, joint work performed on Jamboard





Project work in an online space

Beyond the usual framework of the school, the online project method and story-embedded development can be applied, which I continued as an ancillary activity to the research described in the doctoral dissertation prepared in 2018. For the primary school children participating in the research, I compiled a project consisting of individual and group tasks. In a participatory manner, the participants could choose a topic from a questionnaire with easy-to-understand communication[1], which, based on the votes, became the restaurant. In order to develop a partner and support role, the protagonist of the story is Mogyi, who opens a restaurant and asks for help from the children involved in the project.

I built the project on my own website, for which it was possible to upload the contents to a Drive interface and create joint projects there.

Image 3
Image of the project website.

[2] Easy-to-understand communication: Easy-to-understand communication is the display of important information content elements in the common language, or the development of independent information content in a simple and clear form that aides the correct understanding of the information. The reworking/elaboration of the information with easy-to-understand communication is aided by the adequate use of images and illustrations in compliance with the content and formal rules of adaptation. Available on the Easy-to-understand communication – easy-to-understand life website: http://konnyenertheto.gonczirita.hu/ismeret/fogalom/ (05.03.2021)

The participants did not know each other at the start of the joint task, and after they started the project, they could only contact each other or me online. The online project method included structured, overlapping tasks, which are presented in detail in Table 3.

Table 3
Application elements of the online project method in the topic of the Mogyi restaurant advertising campaign (pursuant to Farkasné Gönczi, 2018, p. 184)

Project method process	Topic	Targeted skills areas	Task
Preparation	Restaurant placement	spatial orientation, laterality, connection insight	Map drawing based on ppt story.
Topic selection	Planning an advertising campaign for Mogyi's restaurant	decision	Based on the maps made by the participants, an advertising campaign must be created according to the ppt notice made in Mogyi's name. The task is to independently explore the advertising campaign forms, and to determine the location of the campaign based on the information.
Planning	Team workflows	cooperation, planning, sequencing	The groups created based on the campaign's intended location choose their own advertising company name. They develop their work form and get acquainted with the online form of presentations. They divide the tasks among themselves. The decisions are recorded online and a plan is made.
Execution	Restaurant menu and poster designs	estimation	Teams gather information about restaurant prices and poster ads. Based on the information, they create their own menu and ad poster.
Restaurant opening	Presentation of menus and posters	presentation	The works created by the advertising company teams are posted on the online presentation interface.
Crisis communication	participants in decision-making	chart reading, sequence creation, opinion formation, decision-making, reasoning, transcoding, performing basic operations	As a result of the campaigns the restaurant is booming. A chart arrives at the advertising companies advising that the worst performing product will be removed from the menu. Teams need to learn how to read the chart, for which a description with easy-to-understand communication is available on the online interface. It is their job to make the decision regarding the recalling of the product. Part of the task was to perform tasks involving basic operations and transcoding (Farkasné Gönczi, 2014, p. 27)

Children's party	testing fun tasks for the event	more or less, quantity constancy, digit-numeric image matching, quantitative decision in the case of numerals and digits	According to the story, Mogyi's restaurant undertakes to organise a children's party. The games need to be tested, a step done by the participants.
Farewell	writing a farewell letter to Mogyi	wording, summary	The closing element of the project, where the children process the completion of the joint work.

In order to maintain motivation for remaining in the project, I developed a multi-channel support strategy found below.

- Providing story-based tasks that can be interpreted by children.
- Involving children in the story, i.e., in addition to solving the task, incorporating their decision into the project, shaping the story together.
- Creating individual and virtual teamwork.
- Immediate display of finished products in the Products menu, increasing the motivation associated with own featuring.
- Immediate feedback on responses to tasks and questionnaires.
- Diverse presentation format: description, image, PowerPoint projection, video, audio material.
- Provision of a variety of task solving situations. (Farkasné Gönczi, 2018, p. 185).

In parallel with the application of the project method, the participating children performed mathematical skills development tasks on the topic of everyday restaurant-related topics. Based on the evaluated submitted responses, we received a more accurate picture of the mathematical performance of the individual and their lack of knowledge and ability. Based on the responses received, the project method was also suitable for process detection at individual level with targeted tasks. The tasks and workbook developed from the project are currently available on the protected page, http://www.dyscalculiaport.gonczirita.hu/dyscalculiaportmese/.

Summary

The first actors in the recognition of dyscalculia are the parent and the teacher, who observe more from the list of symptoms in the article than the given child. As the exploration progresses, the educator clarifies the complex symptoms from a pedagogical point of view by performing a screening procedure, after which the child is directed to the territorially competent expert examination. Here, in cooperation with a team of specialists, the special education teacher assesses the changes in the structure of mathematical abilities and skills, then makes therapeutic aspect and support proposals adapted to the findings. In the first half of this article, in addition to the definition of dyscalculia, the complex structure of the mathematical ability and skill structure is shown together with the list of symptoms adapted to it, the combined presence of several elements of which indicates the presence of dyscalculia. The second half of the article features two online good practices that can be applied when working with children with dyscalculia. In addition to the series of discussions, short videos and online games which can be applied during the course of online therapy and integrated education, by using the project method in an online context, the educator can imagine himself or herself in a situation that corresponds with interests of the children beyond that offered by the therapeutic framework. It is likewise possible to make decisions and shape the story while developing motivation and the ability to cooperate in an indirect way.

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Development of upper limb functions and self-assessment in students with cerebral palsy in inclusive education

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Upper limb movements are essential from a very early age in children's learning processes, and play an important role in school tasks such as handwriting. In cerebral palsy (CP), the functions of upper limbs are often impaired, a factor that affects children's learning success. The aim of this paper is to briefly present the results of research that has been carried out in recent years at the Eötvös Loránd University's Bárczi Gusztáv Faculty of Special Needs Education, investigating the upper limb movements of students with CP and their self-assessment of function. Standardized hand function tests (MACS, QUEST, JHFT, Abilhand-Kids specific to CP) were used to assess upper limb function, and the International Classification of Functioning, Disability, and Health core sets for CP (ICF core set for CP) was used to self-assess functioning of students. The results suggest that CP pupils in inclusive education have a high level of upper limb function in general; they do not generally report serious problems with their own function and their environment, but they rate themselves lower than their peers in special education. Changes during the school year were poorly detectable. The ICF-based self-assessment also highlighted problems that other outcome measure methods cannot detect but may affect school life.

Keywords: cerebral palsy, upper limb motion, self-assessment of functions, school life, somatopedagogy

Introduction

Movement behavior is an integral part of cognitive and social development. Upper limb movements are essential from a very early age in children's learning processes, in becoming familiarised with the outside world, attaining self-sufficiency, and also in compulsory and leisure activities later in kindergarten and school. Fundamental movements develop between the ages of one and seven. Among other things, school-age children are able to perform basic manipulative movements. In elementary school, the child learns to practice natural movements in a changing and increasingly complex environment. During this period, two important factors influence participation and performance: one is the development of the accuracy of spatial and temporal coordination, the other concerns tasks related to manipulation skills, as well as the intensive development of reaction time and movement speed (Sugden et al., 2013; Boronyai et al., 2015).

Primary school teachers seek to take advantage of these maturation processes as they teach students more and more precise and increasingly complex forms of movement. To mention just one, the acquisition and skill level of handwriting is a particularly important area because it can influence children's psychosocial development and is related to learning outcomes (Feder & Majnemer, 2007; Cahill, 2009). In cerebral palsy (CP), the functions of one or both upper limbs are often impaired, a factor that affects children's learning success. The effectiveness of learning and successful participation in school life can have a stronger effect on the co-education of children at school (including their social inclusion) compared to a state of impeded movement (Zgur, 2012). All of these circumstances have repercussions on the child's self-esteem.

The aim of the current study is to present the results of a pilot research project we have carried out in recent years among the cerebral paretic students of Eötvös Loránd University's Bárczi Gusztáv Faculty of Special Needs Education (ELTE BGGYK). Our studies focused on upper limb movements and the self-assessment of their functionality for students with CP in inclusive education.

The effect of cerebral palsy on a child's development and learning processes

According to a national definition in 2007, "Cerebral palsy (CP) describes a group of permanent disorders of the development of movement and posture, causing activity limitation, that are attributed to nonprogressive disturbances that occurred in the developing fetal or infant brain. The motor disorders of cerebral palsy are often accompanied by disturbances of sensation, perception, cognition, communication, and behaviour, by epilepsy, and by secondary musculoskeletal problems" (Rosenbaum et al., 2007, p. 9). Its importance is demonstrated by the fact that CP comprises the most common and costly chronic damage to the neuromuscular system in children and adolescents (Blohm, 2012; Richards & Malouin, 2013; Hurley et al., 2015; Miller & Bachrach 2017). Depending on the location of the brain damage, the subsequent movement disorder may affect one or the other half of the body or the whole body.

For children with CP, their development is characterised by abnormal sensorimotor development. Other forms of developmental disorder can also emerge in perception, posture, postural control, locomotor, and fine motor skills (Vekerdy & Nagy, 2017). An essential consequence of atypically evolving movement is that it limits the ability to adapt to everyday, changing movement tasks, thus actual participation in everyday activities is impacted (Sugden et al., 2013). It follows that in the case of a child with CP, the pedagogical goals and tasks associated with each age stage are often determined primarily by the tendency of the impairment and severity of the condition (Benczúr, 2017). In terms of hand functions, for example, a typically developing child can grab a hoop lying on the ground at the age of two to six months, shift objects from one hand to the other at the age of four to eight months, build a tower of toy blocks at the age of nine to eleven months, and copy a circle at the age of twenty-four to forty months. (Sugden et al., 2013, p. 271). In contrast, in the case of CP, grasping objects by hand may not evolve or can only be accomplished in adapted form (Richards & Malouin, 2013). Another consequence is that these difficulties in complex movement influence learning processes (Fótiné et al., 2011; Szenczi et al., 2016). This may be associated with various comorbid conditions, including already extant and consequently evolving perceptual, cognitive, communication and behavioural disorders (Vekerdy & Nagy, 2017).

When examining the hand functions, intellectual abilities, and handwriting development of CP students with unilateral involvement, Tükel Kavak and Eliasson (2011) found the following. Children with CP perform worse in terms of visuo-motor coordination, speed, dexterity, kinesthesia, and graphesthesia compared to their peers displaying typical motor development (TDC). Deficiencies in movement planning also make the movements of the unaffected hand slower and less effective. Although progress can also be seen in these students' performance, the process of learning how to write takes longer. While IQ and age are good predictors for the expected quality of handwriting, these factors do not indicate speed. Another study that also examined environmental conditions additionally found a difference in handwriting between CP students and TDC control individuals (Tükel Kavak & Bumin, 2009).

Sentenac et al. (2013) examined the school education of CP students between the ages of eight and twelve in nine European regions. It was hypothesised that their participation in different types of schools would depend on the child's individual abilities, motor, and intellectual abilities. A total of 818 CP students participated in their study. All of the studied regions used the same definition and classification system for cerebral palsy (*Surveillance of Cerebral Palsy in Europe*). In their research, they recorded children's data (age, gender, major motor functions, intellectual impairment, vision, seizures during previous years, and communication) based on interviews with parents and recorded the particular type of school in which the child is studying. In addition, the Strengths and Difficulties Questionnaire was used to examine students' behavior and emotional well-being. In their research, they found that the most significant determinants of enrollment in certain school types comprised the age and types of impairments (motor skills, intellectual abilities, seizures, and communication) while emotional and behavioural problems were not factored at all. As a result, they found that, depending on the region where they live, two children with the same impairment may have different chances for entering traditional education (Sentenac et al., 2013).

The concept of special educational needs and inclusive education in public education

In the Hungarian education system, regarding to the 2011 CXC Act. a cerebral paretic child is a special need student. Based on the classification according to need, this disorder figures among those children with physical disabilities (based on the Guidelines related to the 2020 National Core Curriculum). The 2011 CXC. Act on National Public Education is a new summary concept of children or pupils in need of special treatment. One subgroup of this is the group of children or students with special educational needs (SEN) (Papp, 2019). In the Hungarian language, integration/inclusion also function as synonyms for a form of co-education. Integration has been used as a type of social integration for people with disabilities from the beginning; the term of 'co-education with non-disabled peers' has emerged as the interpretation has evolved (Papp, 2012). Within the international context, it can be generally said that the use of these terms and their definitions are still not clear or uniform (Papp, 2012).

Renowned theorists of inclusive education have repeatedly pointed out that the most important thing is for professionals to define exactly what they assign to the concept of inclusion. School inclusion aims to create an environment that all children can use equally well. That is, it seeks to accommodate not only children with special educational needs, but all children. It always strives to support current underperformers after finding the reasons for poorer results (Kron, 2009; Ainscow et al., 2012). This is why it is important to conduct a thorough examination and evaluation of the factors underlying a student's academic performance. Kókay formulates the concept of inclusive education as the following: "In the terminology of the Hungarian school system, it means ensuring the participation of children with disabilities. In a pedagogical sense, it indicates that the school accepts students with different educational needs" (Kókayné, 2019, p. 552). Inclusive education furthermore takes individual differences into account.

The education of students with cerebral palsy in Hungary

Children with cerebral palsy are able to study at special or mainstream schools in inclusion. An European study conducted between 2004 and 2005 has shown that in certain countries the participation of children with CP in mainstream schools fluctuates between 20 and 93% (Michelsen et al., 2009). In Norway and Portugal, full inclusion is the most significant: in Hungary the two types of schools exist in parallel. It is therefore difficult to estimate the schooling of students with cerebral palsy because little CP-specific population-level data is available (Gillies et al., 2017). The national educational data are usually applied to students with special needs or to subgroups of different types of disabilities. Sixty-eight per cent of special educational needs (SEN) students attend a mainstream school. Most of these students have only one disability in a specific area (e.g., a physical disability) and the disability is typically mild in severity. Seventy-nine per cent of the students with (only) physical disabilities study at a mainstream school and 21% attend a special school (Márkus, 2019a).

Hungary's system of unified special education and conductive education methodology centres are supposed to support inclusion, including to assure the system of support SEN teachers and conductors (conductive education teachers). In Hungary, two pedagogical disciplines address the education and development of pupils with CP: conductive pedagogy and somatopedagogy

(Márkus, 2019a). Since the CP students examined in this study are served by support SEN teachers who specialise in educating students with physical disabilities, it is important to introduce this discipline, which is admittedly familiar to Hungary, but also somewhat known abroad.

The definition of somatopedagogy and its role in the education of CP students

Somatopedagogy (i.e., special needs education for physical disabilities) is one of the specialties of special education and addresses the complex rehabilitation of persons primarily with physical disabilities and secondarily with additional types of disabilities. "Somatopedagogy is a complex system, in which the effects of medical, psychological and pedagogical methods, procedures and tools are achieved in harmony with the individual with physical disability and his/her environment" (Benczúr, 2011, p. 110). Accordingly, it is not a method, but the application of purposfully compiled combination of methods. Based on the results of a complex evaluation, the SEN teachers for students with physical disabilities are supposed to support children and adults (without age limit) in the adaptation of needs-oriented and individualised combination of methods, as a member of the rehabilitation team. Mostly they work in the public education system but may be found in healthcare and social institutions (Márkus, 2019b).

Complex somatopedagogical rehabilitation is based on a complex evaluation and includes movement education, the improvement of communicational skills, cognitive activities, and socialisation. Movement education is the complex of effects that impacts the musculoskeletal system and combines therapeutic and pedagogical methods (Márkus, 2019b). In cooperation with inclusive schools, support SEN teachers for students with physical disabilities provide CP pupils with individual or small-group development while supporting the work of other teachers and offering advice to the school's educators. SEN teachers specialising in somatopedagogy can often work with other professionals in the rehabilitation of CP children. In addition to others, physiotherapists and conductors with partly similar activities.

International Classification of Functioning, Disability and Health as a self-assessment instrument

Approved by the World Health Organisation (WHO) in 2001, the International Classification of Functioning, Disability, and Health (ICF) is an international standard for framing, recording, and measuring functioning and disability. One of the purposes of ICF is to "establish a common language for describing health and health-related states in order to improbe communication between different users, such as health care workers, researchers, policy-makers and the public, including people with disabilities" (EV, 2004; WHO, 2007, p. 5). The question may be raised of why a rehabilitation model and evaluation tool appears in the context of inclusive education. The answer to this question lies in the fact that, by means of its "common language", this classification not only enables health care workers but also teachers and students to understand their own or other's functional status. This explanation is best shown by the fact that ICF has enjoyed considerable use for many years in non-medical fields (Kullmann, 2012).

Visualisation of the respective experience is not mentioned among the original possibilities of the adaptation of ICF. However, this demand has been present among rehabilitation participants for a long while (Ueda & Okawa, 2003). The use of ICF for this purpose is not yet widespread. It is well known in rehabilitation, that observance of patients' opinion may have an effect on their participation and the efficiency of the rehabilitation. On the other hand, these patients' opinions serve such substantial information, which might not be shown with other appraisal methods (Kullmann & Kullmann, 2018). It is worth to follow up this occurrence in inclusive education to inspect children with cerebral palsy and assess changes while also framing the development plan.

A few words about the structure and use of ICF

ICF analyses the functional status of an individual in their actual environment, in three dimensions: from the perspective of the body, the individual and society. These categories are arranged in two main subdivisions (Functioning and Disability, Contextual Factors). Each part has more components: body functions (b) and body structures (s), activities and participation (d), and environmental factors (e).

The smallest units of ICF, called categories, are specified with letter-number coding (e.g., d170 Writing). This code continues with the qualifier number, separated by a point. The quality of functional abilities in each category may be assessed on a scale from zero to four, depending on the magnitude of an impairment. When zero (.0) is coded, this value denotes 'no impairment', while four (.4) denotes 'complete impairment'. The rating of the environmental factors is possible on a nine-point scale because all domains are coded as a barrier or a facilitator on a four-point scale. A rating of ".4" denotes 'complete barrier', meanwhile the + sign denotes a facilitator, accordingly "+4" code denotes 'complete facilitator', and "0" denotes 'no barrier, no facilitator' environmental factors (WHO, 2007).

The original ICF was published by WHO in 2001; the full version of ICF provides classification at four levels of detail. The short version of ICF is a two-level system that includes all the domains (WHO, 2007, p. 8). To make the application of ICF easier, faster, and more applicable to everyday use, beyond the aforementioned, two-level system, many developing, ICF Core Sets have been created for specific health conditions. The typically occuring ICF categories that belong to a specific health condition are included in these core sets (Kullmann, 2012). At present, specific core sets for eighty-three conditions are available, out of which fifteen have been adapted to three prominent NDDs – typically diagnosed in childhood – such as CP, autism and ADHD, which have a severe effect on kindergarten or school attendance (Schiariti et al., 2018; https://icf-core-sets.org/en/page1.php).

Schiariti et al. (2018) first studied the practical use of ICF-CY-CP in clinical practice in different countries in the world: this comparison was conducted using descriptive and cross-sectional analyses. The adaptation of ICF Core sets proved a helpful tool for the purpose of selecting appropriate services and provisions. Their experience has shown that in the course of research and clinical practice they would be open to using the ICF-based approach, but the question of how to do so during the examination is a remarkable challenge. To overcome this barrier, in 2017 Schriariti et al published a toolbox with the following title: *Toolbox of Multiple-Item Measures Aligning with the ICF Core Sets for Children and Youth with Cerebral Palsy*. Their study aimed to identify valid and reliable measures while creating a toolbox that would cover the content of each ICF Core Set for children and youths with cerebral palsy. Their result is a guide for professionals worldwide, to seek appropriate measures for their research and clinical work (Schiariti et al., 2017).

The examination of self-assessment of functioning in CP children

Teplin, Howard and O'Connor (1981) examined the self-esteem of fifteen (aged between four and eight years) children with cerebral palsy and compared the study participants to their age-matched control group. They established that the self-esteem of the group was corresponding, however, the self-esteem of children with cerebral palsy was lower with a consequent trend. Russo et al (2008) investigated the self-esteem and quality of life in children with hempiplegic cerebral palsy. Eighty-six pupils (ages three to sixteen years) participated in their study, and their results were compared to an age and sex-matched group. Self-esteem was measured using the Self-Perception Profile for Children and the Pictorial Scale of Perceived Competence and Social Acceptance for Young Children. Quality of life was measured with the Pediatric Quality of Life Inventory. According to their findings, the level of quality of life is poorer and the self-esteem is lower in children with cerebral palsy. Although, in favour of the children with cerebral palsy, significant difference was found in maternal acceptance.

Oliveira et al. (2016) described the application of the ICF Core Sets for Children and Youth with cerebral palsy (from zero to eighteen years) on a nine-year-old child. For the items that could not be described by standardised methods, they asked the patient and his family. According to their findings, by applying the ICF-CY-CP, any patient's functionality can be described objectively and thereby enable a better evaluation of the patient's evolution in the follow-up with rehabilitation. The use of ICF-CY allows the evaluation to be expressed in a language that will allow comparison and preparation of report with administrative and clinical purpose.

In the research literature, few examples exist of using ICF to analyse self-assessment: in recent years, however, interest has grown in conducting standardised evaluation in different health conditions covering ICF categories (Farzad et al., 2014; Leissner et al., 2014; Fox et al., 2015). Similar research has been done with children with cerebral palsy. Andrade et al (2012) assessed seventy-six children with CP using an ICF-based instrument while also interviewing their parents. The results were compared to the participants' socioeconomic status and type of cerebral palsy. Fontana et al. (2016) used ICF-CY-based questionnaires for very low birthweight children and the longitudinal change was tested. The questionnaires were completed by the parents and a member of the follow-up team. As far as we know, this is the first time that an ICF-based instrument has been used for the self-assessment of functioning for students with cerebral palsy (Lénárt et al., 2018).

Our own study among cerebral paretic children in inclusive education

Examination of upper limb movements and self-assessment of functioning in students with CP in special school

Our first studies were conducted in the 2015/2016 school year at a special school with a larger CP sample (forty-six individuals). At the time, our examinations were still taking place at a special school, an important starting point for our subsequent assessment. Therefore, the purpose of this research is only to describe the most essential details. As very few similar studies have been performed in Hungary, our purpose was to find and test the research methods known in the international literature, which can be used freely but are still little known in Hungary. As a control group, we included a mainstream school's non-CP students from primary and secondary schools (twenty-nine students with typical development and twenty-one students with speech and language disorders). Since the hand function tests would have been too easy for the control groups, they did not perform these taks, but only answered the questions of the International Classification of Functioning, Disability, and Health core set for CP. We performed the same instrumental motion analysis with them as we did with the CP students (Lénárt & Szemenyei, 2015; Lénárt et al., 2017, 2018). Motion analysis clearly showed differences between the two groups.

The differences were also seen in the self-assessment of functionality (b2 Sensory functions, b7 Neuromusculoskeletal and movement-related functions, d4 Mobility, d5 Self-care. Out of the changes recorded during the school year, in this study we only draw attention to the fact that CP students observed significant improvement precisely in those areas where they had previously reported a greater problem compared to members of the two control groups. However, it has also been noted that students in non-special schools (especially those with special needs) often judged their own status more severely than students in special schools. It was this phenomenon that prompted us to compare the self-esteem and upper limb functions of CP students in special schools versus inclusive education.

The comparison of the functions of upper extremities and assessment of functionality-based on self-assessment – in CP children in inclusive and special education

In the 2016/17 school year, we examined eight cerebral paretic students participating in inclusive education. The study areas included gross motor function (GMFCS), functional level of upper limb movements (MACS), degree of difficulty of daily self-sufficient movements (Abilhand-Kids specific to CP), and self-assessment of functionality (ICF core set for CP). (The methods are presented in Chapter 7.3.) The study results were compared with the gender- and age-matched members of the original sample of CP students in special education.

CP students studying in inclusive education performed significantly better in the areas of gross motor function and self-sufficient movements. In short, they solved tasks that required ordinary hand movements significantly better. Although the functional level of upper limb movements (MACS) also showed better results among those cerebral paretic students who attended in inclusive education, the difference was not significant. Thus, based on expert evaluation, the mobility status of these CP students proved better than the mobility status of the fitted control group in a special institution.

A comparative analysis of the ICF categories showed that in most categories, functional states are assessed similarly by members of the two study groups. It is also common to find that, broken down by individuals, both the pupil in inclusive education and the pupil in a special education institution rate their condition more negatively, but no trend can be detected.

In some categories (b164 higher-level cognitive functions, b710 mobility of joint functions, d230 carrying out daily routine, d415 maintaining a body position), students in inclusive education rated their functional status more negatively. This may be because they compare themselves to their non-disabled schoolmates and found their functional status more limited in this comparison. In the category of 'Looking after one's health' (d570), we found that pupils in inclusive institutions say that maintaining their health is more problematic and not as important compared to students attending a special education school. While inclusive school's CP students have an average of two to three hours of personalised adaptive physical activities per week, students at a special education institution receive five personalised adaptive physical activities lessons per week. The swimming pool in the special school and the various optional sports activities also contribute to their healthy lifestyle. In the canteen, children can choose from several menus, including a diet one. In the case of mainstream school CP students, they found it less important and possible to pay attention to their health due to the lack of or less opportunity for daily physical education, school sports, and health-related activities.

Students in inclusive schools found their extended family (e315) and products and technology for education (e130) less supportive compared to students at a special education institution. The reason for the difference between the latter may be that the special education institution is extremely well-equipped:

students can receive personalised teaching aids, for example. Meanwhile, based on our observations and interviews, students attending inclusive education receive minimal help and study under nearly the same conditions as their typically developing peers (Hegedüs, 2018). Our examination of CP students in inclusive education was repeated six months later. Minor changes were also detected in all areas, which generally indicated improvement, yet these changes were not significant in either area (Hegedüs & Lénárt, 2018).

Six-month follow-up of development in upper limb movements in CP students in inclusive education on the grounds of professional assessment and self-assessment

After the presented pilot research, we performed examinations utilising the tested measuring methods on an extended sample and with the aim of exploring:

– the global movement condition of pupils with CP in inclusive education, with special regard to the functions of the upper limb
– how they asses their own functional status,
– what connection can be found between the measurable characteristics of the upper extremities and the self-assessment, as well as
– how the measured characteristics change after six months based on the assessment of the professionals and the participants' own self-assessment

Following previous agreement and provision of research ethics[1], the research started in May 2019 and its follow-up finished in November 2019. With the assistancs of some inclusive schools of Budapest, we were able to examine pupils in their own conventional environment.

Methods

Sample

We aimed to involve every pupil with CP who is provided an support teacher (specialised in somatopedagogy) by the system of special education and attends the aforementioned special school: Mozgásjavító' Kindergarten, Elementary and Specialized Secondary School, Unified Special Education Methodology Centre and Students' Residence in Budapest. Altogether we selected fifteen pupils in the pattern, and thirteen (eight boys and five girls; aged between seven and eighteen years with the average age of 11.5 years) students participated in the follow-up study. The enrollment criteria were the following: normal intellect, diagnosis of cerebral palsy, and perceptible functional limitation in at least one of the upper extremities.

Research methodology

The set-up was based on the experiences of the previous pilot studies and can be described as follows. The students' SEN teachers classified the global

[1] All participants received a written research briefing. The consent form had been signed by the parents of children and participants aged 16 or above. Participation was voluntary.

functional level of their locomotion (Gross Motor Function Classification System – GMFCS) and upper limb functions (Manual Ability Classification System – MACS). To assess the upper extremities skills, we applied three tests: the Quality of Upper Extremity Skills Test (QUEST), the Abilhand-Kids Scale, and the Jebsen Hand Function Test (JHFT). For the self-assessment, the ICF Core Set for children and youth with CP was used. We tried to assess every student in one sitting, which took about forty-five minutes. In every case, the first methods comprised the tests for measuring upper limb functions, followed by questions from the ICF core set. At the end of the session, we recorded the classification into the GMFCS and MACS categories. Below contains an elaboration of the methods and the examination process.

Self-assessment of functions

In the study, we applied two relevant age-related ICF core sets (6-14 and 14-18) developed by Schiariti et al (2015). We used these two core sets as one contracted 42-category brief set, which was complemented with d445 Hand and arm use category. Every student was examined face-to-face, in a separate room. Firstly, we explained their task: they would hear statements which they have to assess by themselves. Afterward, the ICF categories were read to the participants. If it was necessary, with their explanations and inclusions and/or exclusions of the given categories of the two-level system. In the case of uncertainty, they had the opportunity to ask questions, and clarifications were provided. We encouraged students to express their opinions, especially if they were not able to decide easily between the level of qualifiers. Hence, the level of qualifiers was frequently asked first in a narrative form, and secondly by making the explicit qualifier. If the statements of the student were not corresponsive, additional clarifying questions were asked. The final word always remained with the pupils.

In the course of the assessment of functional abilities, the students were able to qualify their functional state between 0 and 4. 0 denoted 'no impairment', 1 denoted 'mild problem'; 2 denoted 'moderate problem'; 3 denoted 'severe problem' and 4 denoted 'complete problem'. Qualifying the environmental was based on a positive and negative interval scale between .4 and +4. Although the meaning of the numbers is similar to the use of the previous qualifiers, the lack of sign indicated which environmental factor acts as a facilitator (+) or a barrier (-) (WHO, 2007). The time for filling in the assessment was variable in each case and ranged from those who required little explanation, whose responses generally took fifteen minutes. The timeframe increased proportionally with the number of added clarifying questions and examples.

Ordinal Scales

A recognised classification tool in CP, the Gross Motor Function Classification System (GMFCS) is based on the self-initiated movement and use of assistive devices (Palisano et al., 2007; Vekerdy & Nagy, 2017). It is a five-level system to describe the following gross motor function: sitting, walking, and use of mobility devices. The Manual Ability Classification System (MACS) was developed for children with cerebral palsy, aged between four and eighteen years (Eliasson et al., 2006). MACS describes five levels, which are based on the pupil's self-initiated abilty to handle objects in everyday life. Children with minor limitations are placed on Level I and children with severe functional limitations are usually found at Level V. The children's functional state has been established by their SEN teachers, based on these two ordinal scales.

Examination of upper extremities
ABILHAND-Kids specific to cerebral palsy children scale is a measure of manual ability to manage daily activities. It consisted of twenty-one bimanual tasks and is rated according to difficulty: impossible, difficult, easy, or not attempted in the last three months. According to the authors' experience, rating by parents is the most reliable (Arnould et al., 2004). Basilio et al (2016) confirmed that the use of ABILHAND as a questionnaire in adult chronic stroke patients is appropriate. Based on the positive experiences garnered in our previous research with CP children, we also decided to ask the children themselves.

The Jebsen Hand Function Test (JHFT) assesses fine motor skills during the performance of daily activities and consists of seven items: writing a short sentence; turning over cards; picking up small common objects; simulated feeding; stacking checkers; picking up large light cans; picking up large heavy cans. The testing always began with the non-dominant hand (Jebsen et al., 1969).

Total score is the sum of time taken for each item. Officially one item can not last longer than two minutes, but since in Hungary these evaluation methods have not been used in children with CP, we did not interrupt the assessment after two minutes. The longest time required almost four minutes more for students to complete the item regarding 'writing a short sentence' with the non-dominant hand. It took approximately twenty minutes to complete the JHFT.

Contrary to the rest of the assessment tools, JHFT is not freely accessible. In Hungary, ELTE BGGYK was the first institution to buy the test kit for a target population that includes patients with hand disabilities or hand dysfunctions. It is subsequently appropriate for the examination of children and youth with CP. The first test of JHFT in Hungary – with the participation of stroke patients – was conducted by the academics and students of our faculty (Földi et al., 2018). As far as is known, our team was the first to attempt the same on an individual with CP.

The Quality of Upper Extremity Skills Test (QUEST; Dematteo, et al., 1992) consists of four domains: A - dissociated movement (independent finger movement; shoulder items, elbow items, wrist items; grasps); B – grasp; C – weight bearing; D – protective extension (protective arm reaction); and 33 activity items separated among the domains. The children had to be in a predetermined position and we demonstrated each task. During the examination of dissociated movement and gasp domains, the children had to sit on a chair and we examined the weight bearing and protective extension domains on a polifoam floor mat. In the course of assessment, both hands are scored separately and the scores are totaled at the end of each domain. The total testing time was approximately twelve to fifteen minutes.

The results are displayed based on a narrative data analysis and descriptive statistical methods. The changes and correlation between the different results were analysed using Wilcoxon test, Spearman correlation and paired sample t-test (corresponding to the level of the measurement level of scales). P values of less than 0.05 were considered as statistically significant.

Results

Measured characteristics of participants and changes during the semester

Based on the rank scales, most of the CP students enrolled in the study (eleven individuals) moved around independently, without any aids (GMFCS Level 1). Some required minor assistance or aids to relocate (GMFCS 2, 3). Based on MACS scores, the majority (eight individuals) used objects easily and successfully and manipulated them well. The rest required less help with everyday manipulation activities (MACS, 1, 2, 3). Nor were there any major obstacles to judging day-to-day self-sufficiency activities. Most of the activities listed in the Abilhand-Kids checklist were considered easy by the students. Difficulties were indicated in some cases, but none of the activities were considered impossible. The total scores of the QUEST upper limb functional assessment also showed a value close to the maximum 100 (mean 89.3, standard deviation: 19.43), but significantly different values (27.64) were also received. In the ICF-based assessment most of the students did not report a problem (0), but some pupils reported more serious difficulties in some areas than others.

Out of the Jebsen Hand Function Test subtests, the *Writing* and *Simulated feeding* tasks proved the most difficult. All tasks were performed faster with the dominant hand, but the performance of the two hands correlated with one another ($r = 0.5$-0.95, $p < 0.05$). This means that the student who performed the tasks faster with the dominant hand also performed faster with the non-dominant hand.

We started our control studies six months after the first one. During the re-admission of *Abilhand-Kids*, we found that there was a minimal decrease in the number of activities deemed easy and revealed a proportional increase in the number of activities that were difficult to perform. Based on an analysis completed with the Wilcoxon test, no significant change was observed.

After repeated examinations of the *Jebsen Hand Function Test* tasks, we found a significant improvement only during the "Large, heavy objects" subtest (dominant hand $t = 2.575$, $p < 0.024$; non-dominant hand $t = 2.317$, $p < 0.039$). In general, however, for most tasks both the dominant and non-dominant hand activities took less time to complete, the most spectacular result was shown in writing, card turning, simulated feeding, and moving light objects.

An exception to this is the "Checkers" subtest, in which seven out of thirteen students took longer to complete the task during the second time with the non-dominant hand; for the dominant hand, five participants needed more time during the control study.

In a second assessment of the *Quality of Upper Extremity Skills Test*, we found a positive change in three students, one outright, while no or a negative change was observed in the other students. The changes were not significant in any of the subtest cases. We will now review the results of *ICF-CY for CP* follow-up study according to the ICF chapters. We mention only those categories in which we were able to detect changes within six months.

Body functions

Within the *mental functions (b1)* chapter, the motivation category has been found more problematic by almost the half of the students. In the sleep functions (b134), six students reported changes in the positive direction, while out of them one prominently improved. Higher-level cognitive functions (b164) exhibited change in nine students with seven out of the nine changing in a positive direction. In total it is revealing that, in most cases, the functions were assessed better or worse only with one qualifier.

In the *sensory functions and pain (b2: b210, b280)* chapter the quality and quantity of the changes were negligible based on our observations. The *Neuromusculoskeletal and movement-related functions (b7)* chapter includes the mobility of joint functions (b710), muscle tone functions (b735), and control of voluntary movement functions (b760). In every category, almost half of the students exhibited a change: the distribution of the changes in positive and negative direction is also approximately 50/50.

Activities and participation

Learning and applying knowledge (d1) includes solving problems (d175). The results of the control study in this category were similar to the original study, but two students denoted 'no difficulty (0)' instead of 'severe difficulty (3)'. One pupil indicated larger impairment: instead of 'no difficulty (0)', he indicated 'severe difficulty (3)'.

The *General tasks and demands (d2)* chapter includes the following categories: carrying out daily routine (d230) and managing one's own behaviour (d250). In both categories, at least half of the children perceived changes. The ratio was fifty-fifty in both, referring to negative and positive directions. Almost in all cases the pupils gave higher or lower qualifiers with two levels.

Conversation (d350) belongs to the *communication (d3)* chapter: only one student indicated any change. During the control study he indicated 'mild difficulty (2)' instead of 'no difficulty (0)'. In all categories for the *mobility (d4)* chapter, nearly half of the pupils perceived changes. We found outstanding deviation on the following chapters. In the fine hand use (d440) category 11 students reported change, two out of eleven were larger: one of the students gave a better qualifier with two levels, and one student gave a worse qualifier with three levels. In maintaining the category referring to body position (d415), we observed changes in two students: one noted larger difficulty with three levels and one reported a smaller difficulty with two levels. We did not note remarkable changes in the categories of hand and arm use (d445) and moving around (d455). The *Self-care (d5)* chapter includes the next categories: toileting (d530) and eating (d550). We did not experience outstanding changes in toilet usage and eating, but in the case of d550, more students indicated larger difficulty in the control study. The third category in this chapter is looking after one's health (d570): nine children perceived changes, two of them denoted larger difficulty, but none of them was significant. In the categories of *interpersonal interactions and relationships (d7)* chapter we did not observe any remarkable change. The *Major life areas (d8)* chapter includes the following categories: school education (d820), acquiring, keeping and terminating a job, recreation and leisure (d920). We did not find outstanding change in these areas.

Environmental factors

We experienced change in the products and technology for personal use in the daily-living (e115) category of the *Products and technology (e1)* chapter. Nine pupils perceived changes: those who perceived change in a positive direction gave better qualifiers with two levels; two of the students denoted noticable change in a negative direction.

In the *Products and technology for personal indoor and outdoor mobility and transportation* category we found changes in seven students. In four cases out of seven, we were not able to get an appraisable answer during the original study, but in the follow-up all of them denoted 'complete facilitator (+4)' or 'substantial facilitator (+3)'. In one case we perceived remarkable deterioration. In the *Products and technology for education* (e130) category we discovered changes in nine students with three out of the nine displaying a remarkable alteration in a positive direction.

In the *Products and technology for culture, recreation and sport* (e140) category, we found change in two cases, out of which only one was remarkable: 'no facilitator (0)' changed to 'complete facilitator (+4)'.

In the category of *Design, construction, and building products and technology of buildings for public use* (e150) we noticed change in five cases; four out of five moved in a positive direction with one out of these four displaying remarkable change: he indicated 'complete facilitator (+4)' instead of 'no facilitator (0)'. Changes were found in the *Support and relationships (e3)* chapter. In the *Immediate family* (e310) category, five students perceived change, one of them noticeably as he recorded 'complete facilitator (+4)' instead of 'mild facilitator (+3)'.

In the *Friends* (e320) category, we found change in five cases: three students moved in a positive direction, with one demonstrating remarkable change in that she gave 'substantial facilitator (+3)' qualifier instead of 'mild facilitator (+1)'. The changes that occurred in a negative direction were remarkable: one student denoted a 'complete barrier (4)' qualifier instead of 'complete facilitator (+4)'. In the *Personal care providers and personal assistants* (e340) category, we found changes in five cases. All of these moved in a negative direction, with two showing marked change: these students indicated a larger extent of impairment with two and four levels ($Z=-2.060$, $p<0.05$). In the *Individual attitudes of friends*, in the *attitudes (e4)* chapter, we denoted changes in seven pupils. Four cases displayed remarkable impairment: two children denoted lower qualifiers with two levels, and two with three levels. Even though the change did not achieve significance, a trend ($Z=-1.848$, $p=0.065$) did emerge.

In the *Societal attitudes* (e4619 category, we found changes in six students: in two cases this alteration occurred in a positive direction. Both were remarkable in that they denoted improvement mounting to two levels. In four cases where we perceived impairment, the qualifier was lower by two and three levels. In the *Services, systems and policies (e5)* chapter we were able to collect more data during the follow-up study. In general, we did not experience any remarkable change within the categories, but in many cases, we were still able to observe improvement.

Although we could measure significant changes only in two categories, we may deduce – by the changes of the quailifiers – that there still is a trend for improvement in the following categories: higher-level cognitive function (b164), solving problems (b175), fine hand use (d440), hand and arm use (d445), looking after one's health (d570), products and technology for person use in daily living (e115), products and technology for personal indoor, and outdoor mobility and transportation (e120). We could meanwhile observe noticable impairment in two categories: personal care providers and personal assistants (e340), individual attitudes of friends (e420).

In conclusion, as regards the changes that may have occurred within six months, we did not observe significant improvement in the results of ABILHAND-Kids and QUEST. Relative to the outcome of JHFT, one subtest showed significant improvement, however, in other subtests we observed discernible changes in positive direction. During the assessment of the ICF categories, we did not find relevant difference between the two measurements. In general, we experienced improvement in more cases or nearly consistent results; whilst impairment was observable in fewer cases, but it was more tendentious.

Relation between the results of different examination techniques

We have investigated the correlation between the results of upper limb and relocation movements both at the first and the second measurement process. We have also compared the test results with those specific FNO-categories related to upper limb functionalities or relocations, (b735 Muscle tone functions, b760 Control of voluntary movement functions, d440 Fine hand use, d445 Hand and arm use, d460- Moving around in different locations) as well as all the ICF chapters. Previously, we used chapter-based comparison (Fontana et al., 2016) which enabled us to evaluate the students not only by categories, but by chapters, too. We have measured a significant correlation between the two rating systems, GMFCS and MACS ($r=0.753$, $p<0.01$). This means that, as the upper limb functionality deteriorates, larger movements start to become more and more hampered.

The *Gross Motor Function Classification System* showed measurable significant correlation with the following IFC categories: in the first measurement period, the d 465 Moving around using equipment (r=0.603, p<0.05), in the second measurement period b760 Control of voluntary movement functions (r=0.670, p<0.05), d460- Moving around in different locations (r=0.713, p<0.01) and trend-like correlation with the category d440 Fine hand use (r=0.525, p=0.065).

The bigger, merged categories showed significant correlation in the second measurement period with the following categories: b7 Neuromusculoskeletal and movement-related functions (r=0.625, p<0.05), d4 Mobility (r=0.561, p<0.05), and a trend level with the a d7 Interpersonal interactions and relationships (r=-0.533, p=0.061). The strength of these significant correlations are viewed as moderate.

The *Manual Ability Classification System* was correlated with the ICF categories b760 Control of voluntary movement functions (r=0.631, p<0.05) and b7 Neuromusculoskeletal and movement-related functions (r=0.729, p<0.005) during the second measurement period. The results show that the evaluation of the specialists on the upper limb functionality are similar to students evaluating their own relocation capabilities. These also display moderate correlations.

The *Quality of Upper Extremity Skills Test* showed strongly significant correlation with the e5 Services, systems and policies merged ICF category at the first measurement period. Here, despite the measured high values, the results should be rather trend-like as the number of measurements taken were rather small. The results suggest the higher the measured upper limb score given by the disabled people, the worse score was given by them for the surrounding services, systems and regulations. In the second measurement period, the QUEST shows significant correlation with the following ICF categories: d445 Hand and arm use (r=0.629, p<0.05), merged category of d2 General tasks and demands (r=0.582, p<0.05), and trend-like correlation with the Self-care (r=0.531, p=0.062). The strength of all the measured correlations is either weak or moderate. In every case correlation between variables was positive which suggests – based on the scale interpretation of the tests – that the higher the score the specialists gave for an upper limb functional state, the more troublesome rating was given for these functions by the disabled people.

The evaluation of the *Abilhand-Kids* did not show any significant correlation with either of the examined categories in the first measurment period. There was, however, significant negative correlation with the categories of chapter of *Learning and applying knowledge* (r=0.669, p<0.01) and positive correlation with the categories of chapter *Self-care* (r=-0.544, p<0.05). This means that disabled people tend to rate their functions of studying and application of knowledge worse but give better ratings for self-sufficiency as better practical upper limb functions appear. The measured correlations display moderate strength in both cases.

The *Jebsen Hand Function Test* showed correlation with the other results in several cases. The classification scales (i.e: GMFCS, MACS) and JHFT showed correlation in two sub-tests, the Picking up small, common objects and the

Moving large empty cans subtest (r=0.7, p<0.01). In case of the QUEST, the *Page turning* subtest of JHFT showed correlation with the subtest of QUEST B (Grasp and release) QUEST D (Protective Extension) and JHFT construction of a disc tower task with QUEST A subtest (Dissociated movements) (r=0.5, p<0.05). We found multiple correlations with the categories of FNO-based functional self-assessment (e.g. b117 Intellectual functions, b710 Mobility of joint functions, d175 Solving problems, d570 Looking after one's health, d710 Basic interpersonal interactions). However, there was no correlation between everyday activity list of Abilhand-Kids and the JHFT test.

On the whole, it can be stated that the two assessment periods produced multiple correlations between self-assessment of students and upper limb functionality measured by specialists. These correlations can usually be found between subtests and categories.

Discussion

Summary of the results of previous research

Based on the results of our research, we have observed the following findings.

- The examined participants – students with cerebral palsy in inclusive schools of Budapest – do not have serious impairments in their upper limb function and gross motor function while their results approach physiological standards. The children's movement are usually on a higher funcional level than their peers' in special school. This phenomenon is in accordance with the published educational data of the antecedents in literature, which affirmed that students in inclusive education mostly fall within only one major disability category and the cases are less severe (Márkus, 2019a). The significance of the tests is that they are able to draw attention to smaller deflections and specific areas for improvement.
- Based on the ICF Core sets, the students did not indicate outstanding problems, but in general they assessed their own funcionality and their environment – acting as a facilitator – lower than their peers attending special schools. Daniel and King (2010) studied the effects of students' placement versus non-placement in an inclusion classrom. Among the examined students, teachers and parents also participated and the data collection process consisted of gathering information from various locations and individuals, which involved the students' self-reported self-esteem analyses. According to their findings, the results showed that students placed in inclusion classes tend to have lower self-esteem compared to students in non-inclusion classrooms.
- It has been determined that the changes within a half-year period are not remarkable. This result may be explained by the following: the short interval between the original and follow-up studies and the fact that the students reached high scores during the first examination. At the same time, one (picking up large heavy cans) of the subtests of JHFT showed significant improvement. This type of task did not appear in the other tests and this

function may be related to the the smaler children's physical development. This fact also confirms the necessity for multifaceted measurement.

In conclusion, the ICF-based self-assessment did not show significant changes, but large individual differences were noticeable. Some surprisingly large changes also occured. In such cases, the possible presence of a mistake resulting from the mode of questioning and data recording must be taken into consideration. Yet we also have to consider that the ICF always reflects the actual state. This is why it is not improbable that a youngster – going through many emotional and physical changes – assesses his/her friends as a 'complete facilitator (+4)' in May, and six months later, during the follow-up study, the student qualified the same category as a 'complete barrier (.4)'. If taken out of context, the example typically refers to an area in which we are able to collect information only from the children and which indirectly affects their school performance.

When evaluation the changes, our results can hardly be in accordance with the antecedents in literature, since the examination of hand function on individuals with CP is a little investigated area (Klevberg, 2017). In themselves, these outcomes are not definitively appraisable, yet still calls for teachers who are working in practice to focus on which partial area should be improved or altered.

– A comparison of the different results shows that the subtests which measure the similar scope of activities and functions correlated to one another. The results which show the connection between the movement ability classification tests and the – at first sight outlandish – categories of ICF may be even more interesting. For example, the negative correlation between the interpersonal interactions and relationships (d7) and GMFCS shows the better functional level of the locomotions, the worse the quality of interpersonal interactions is assessed. Similar correspondence appeared also with the categories of *Services, systems and policies* (e5). Accordingly, individuals with mild disabilities are more critical with the individuals in their milieu. Other correlation results imply that the assessment of the activities related to movements and self-sufficiency are similar in the professionals' and students' opinion.

Observations of methodology

We did not have the possibility to assess all the tests in one sitting with every student. The children's tempo, the severity of involvement proved determining, and the age of the students also impacted the needed time. Younger pupils were more motivated, viewed the tests as more entertaining, while for the juveniles it was just a 'mandatory task'.

During the assessment of ABILHAND-Kids it occured in some cases that students considered an activity to be easy that was not necessarily justified by their state of motion. In such cases, we requested the opinion of their SEN teacher responsible for providing their adaptive physical activities. It has been observed many times, that we did not presume, for example, that zipping up a zipper is an easily doable task. Even so, the participants had independently developed special adaptive techniques that enabled them to complete this kind of task at nearly the similar tempo and level of quality as their peers displaying typical development.

During the assessment of JHFT, the most important aspect was the positioning: every child had to sit properly while everything was placed in front of them according to their height. Younger students considered this test as 'the most entertaining' and were exceptionally motivated. This circumstance meant that it was more often necessary to warn them to start the subtests only after the signal. We consider as a limitation of the method, that the youngest participant was eight years old, while the oldest was twenty years old, yet, despite differences in age and body size, they had to use the same tools. This aspect was specially notable in grasping and lifting with the hands, during the picking up large light and heavy cans subtests. However, the test contains items of stock size that must not be changed.

With the use of ICF Core sets, we aimed to gather the concerned individuals' opinions about their own state of motion, attitudes, relationships, and social status. The assessment of the questionnaire in the first period took a very long time, and even lasted almost an hour. However, as we became more accomplished at questioning, the needed time decreased. For the fluent using of the questionnaire, practice is required, but it is available to everyone, if used regularly. The learning tools are accessible on the WHO website (https://icf.ideaday.de/en). It is worthwhile to provide explanations and demonstrations for better understanding of those questions which are more abstruse, especially for younger children.

Based on our findings, the students gladly discussed these questions since the questions were related to specific areas that are important to them. We observed that – mainly for the younger students – it was harder to answer some questions about services, systems and policies or societal attitudes. In most cases, this difference arose from their age or living space because they had not had any actual experience in the given area.

During the assessment of the questionnaire, the experience emerged that it is worthwhile to have conversations face-to-face only with the students, without their teachers' presence, since in this way, the children are able to give their opinion without any control, which can be different from their teachers' opinion. It also happened that the children asked us to talk with them privately and not to show their answers to the teachers. These aspects do not mean that the teachers can not participate in the questioning. Instead, it is important that they not act as a supervising entity: they should be there as a helper and questioner to ensure the atmosphere and conditions that make it possible for the students' own opinion to be recorded, without any influence. This may cause differences between their opinions, but after discussion and interpretation, it may lead to closer cooperation, confidence, and more precise goal setting. This approach is in accordance with the ICF ethical principals.

Conclusion

The presented studies were based on expert and self-assessment of upper limb functionality in children with cerebral palsy attending inclusive education. The aim of our studies is to ensure the development of an appropriate measurement protocol for special educators/somatopedagers involved in inclusive education. The basic condition for successful development is a correct, thorough, and regular condition assessment. Although methodological publications for the inclusive education of children with cerebral palsy have been published from time to time (Sárközi, 2010; Péntek & -Dózsa, 2020), they rarely go into sufficient detail on test procedures. The methods we use and recommend can be mastered by other professionals.

To detect individual differences and small changes, it is important to rely on multiple data sources. Moreover, if the assessment conditions for a test are not strictly fixed, it is worthwhile to utilise several approaches within the cases in question. For example, in the case of a self-completion checklist, it is also important to ask the child's parents or teachers or check the implementation of the given task. It is definitely worthwhile to involve the students themselves in the studies in order to reveal and take into account their opinions, experiences, and intentions. This is actually possible with children of any age: it is merely necessary for the researcher to pose the right questions.

We intend to repeat the studies, performed on a larger sample and allowing for the development of age subsamples. Indeed, some of our results so far may be related to age characteristics. We consider it important to involve other participants in future ICF-based studies, such as parents and teachers, and special education teachers, so that we can compare different opinions.

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The population features of visually impaired children aged between 0 and 14 in Hungary

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This paper focuses on the crucial features of the healthcare and pedagogical services provided for 1,432 visually impaired (VI) children aged 0–14 who participated in an exploratory research project conducted between 2014 and 2019. In order to explore the population characteristics of visually impaired children in Hungary, the paper relies on two major data sources: the census data of the Hungarian Central Statistical Office between 1990-2016, and the examination documents of the Corps of Pedagogical Services of Visually Impaired Children from 2009 to 2013. The following data were analysed: the ratio of blind and low vision children in the various phases of special and majority educational institutions; the frequency of premature birth among blind and low vision children in relation to gestational weeks; the frequency of ophthalmologist diagnoses among groups of VI children; the frequency of ophthalmologist diagnoses among groups of VI children; associated disabilities of VI children. The results suggest that the population of visually impaired children is under transformation: visually impaired groups based on the classical interpretation of visual performance are being replaced by new groups governed by needs.

Keywords: visual impaired children, age-related prevalence of VI children in Hungary, ophthalmologist diagnoses, chronic diseases among blind and low vision children, associated disabilities of VI children

Introduction

In 2018, vision impairment (VI) was classified by the International Classification of Diseases 11 (WHO, 2020) into two groups: distance and near presenting vision impairment. Distance vision impairment comprises four sub-groups, such as (1) Mild – presenting visual acuity worse than 6/12; (2) Moderate – presenting visual acuity worse than 6/18; (3) Severe – presenting visual acuity worse than 6/60; (4) Blindness – presenting visual acuity worse than 3/60. Presenting near visual acuity worse than N6 or M.08 with existing correction. Near vision impairment: Near visual acuity worse than N6 or M.08 at 40cm. (WHO, 2021) “A person’s experience of vision impairment varies depending upon many different factors. This includes for example, the availability of prevention and treatment interventions, access to vision rehabilitation (including assistive products such as glasses or white canes), and whether the person experiences problems with inaccessible buildings, transport and information." (WHO, 2020). At present at least 2.2 billion people around the world have vision impairment, out of whom at least one billion have a vision impairment that could have been prevented or is yet to be addressed (WHO, 2020). Globally, among adults the leading causes of vision impairment are uncorrected refractive errors, cataracts, age-related macular degeneration, glaucoma, diabetic retinopathy, corneal opacity, and trachoma. Little information exists about childhood vision impairment. According to the statistics of WHO, among children the causes of vision impairment vary considerably across countries. For example, in low-income countries congenital cataracts is a leading cause, whereas in middle-income countries retinopathy of prematurity is more prevalent (WHO, 2020). Globally, ninety million children under the age of fifteen years are visually impaired. Among them, two million children are blind, thirty million children experience moderate to severe vision loss. Fifty-eight million children have mild vision impairment (IAPB, 2021).

Objective

In Hungary, surveys about the visually impaired children's population have been conducted based upon medical (Németh et al., 2005; Nagy et al., 2017), *pedagogical-psychological* (Prónay, 2004; Paraszkay, 2007), and *sociological* (KSH, 2014, 2018) approaches. While medical and pedagogical-psychological studies mostly aim to describe the quality features of the population (age, type of illness, the severity of the visual impairment, type of pedagogical and medical care, educational, pedagogical, examining and developing methods specific of the visual impairment specific), sociological studies focus on the number of cases or the frequency of occurrence. Certain aspects of the population features appear as fragmented or incomplete: the qualitative features of visually impaired children are very often linked to an educational institute, a group of visually impaired children, or illnesses (Paraszkay, 2007; Krähling, 2017).

The age group prevalence of visually impaired children has not been identified in Hungary, which hinders comparison with international data. As the authors of this study are practising special education teachers while one is a former employee of the national special pedagogical diagnostical centre (the Centre of Pedagogical Services – Board for Special Education, Early Intervention of Visually Impaired Children, in short: the Centre of Pedagogical Services), we learned that the Centre has a documentary collection regarding the qualitative and quantitative features of the tested visually impaired children and their parents. The documents in question have been collected for several decades and contain otherwise incompletely accessible, but — from the pedagogical, medical, and social care perspective — relevant and very sensitive data for a very high number of children. Processing the data for the more than a thousand cases contained in this collection has not been carried out before this study.

Theme

The focus of the examination are the visually impaired children, who from the pedagogical perspective qualify as children with *sensory special educational needs* or visually impaired if they have an impairment of visual functioning even after treatment and/or standard refractive correction, and have a visual acuity of 0–0.33 (0–33%), or a visual field of less than ten degrees from the point of fixation in either direction, that is twenty degrees altogether [OH, 2020]. Whether or not a child has visual impairment in the pedagogical sense *(Sensory Special Educational Needs)* is determined by the Centre of Pedagogical Services that provides pedagogical diagnosis and rehabilitation services for children.

From a (special) pedagogical perspective, not all children with an ophthalmologic diagnosis are visually impaired, but all children who are categorized as visually impaired from a pedagogical perspective have an ophthalmologic or neurological diagnosis stating that their visuality is modified to the extent that an optical aid may not prevent them from experiencing a considerable limitation in gaining knowledge and having proper orientation (Kiss & Pajor, 2020, p. 296). From a pedagogical-educational perspective, visually impaired children may be categorized as blind children, children with *severe visual impairment*, and *children with moderate visual impairment* (OH, 2020). The category of *severe visual impairment* has become less frequently used in the pedagogical praxis (Kiss & Pajor, 2020, p. 295). Gilbert and Ellwein (2008) suggest that the occurrence of childhood visual impairment may be estimated based on the level of social and economic development and the mortality below the age of 5 (Gilbert & Ellwein, 2008). Accordingly, in countries with low income and a high mortality rate below the age of 5, the average blindness rate for 1000 children is 1.5. This rate *in developed countries is only 0.3.* Research by Philip and Dutton (2014) points out that in developing countries the rate of visually impaired children below the age of 16 is 40 children/10000 live-births, whereas *in developed countries this rate is only 10-22 children/10000 live-births* (Philip & Dutton, 2014). Based on the above, WHO estimates that all around the world there are about 1.4 million blind children, the two-third of whom live in the poorest regions of Africa and Asia. The number of children with moderate or severe visual impairment is estimated to be 18 million (Philip & Dutton, 2014). In Hungary the *2011* census (carried out by KSH) registers *all together 2591 persons as visually impaired children aged between 0 and 14,* from whom 247 children were categorized as blind and 2344 children were categorized as children with moderate visual impairment (KSH, 2001). *This is the 0.026% of the total population, and 0.18% of the population within the same age group.*

The goals of this fact-finding research are:

- Determining the quantitative features *(sample size, rate, prevalence)* of visually impaired children aged between 0 and 14 in an organizing manner on a representative sample.
- Fact-finding data-collecting and data processing of the qualitative features *(pedagogical, psychological, medical and demographic classification)* of

visually impaired children aged between 0 and 14 based on the diagnostical data of the Corps VI.

During the research we aim at answering research questions that are of exploratory nature. During this process we do not apply an examination suitable for testing a hypothesis; therefore, we pose the following research questions, which relate to the exploratory examination of the population features of visually impaired children and their parents:

1. What is the age-related prevalence of visual impairment in Hungary like compared to the international data?
2. What features may be revealed from the data of the Corps VI?

Method

The methodology of the research relies on two comprehensive quantitative analytical methods:

Method I.: filtering and analysing the data from The Hungarian Central Statistical Office [KSH 2001, 2011, 2016] referring to the visually impaired children aged between 0 and 14.

Method II.: Large sample, complex data collecting with document analysis about the demographic, medical, and pedagogical features of children with sensory special educational needs (and their parents) based on the examination documents from 2009-2013 of the Corps VI archives. The *analytical sample* contains only data of children aged between 0 and 14 in the cases of whom the medical and pedagogical diagnostic process unambiguously confirmed the fact of vision impairment (sensory SEN). The sample size of the analytical sample is 1432 persons, which means that the so called ‘examination file’ (on paper) of 1432 visually impaired children aged between 0 and 14 were analysed. During collecting data, we managed to collect categorical data from the anamnesis reports, medical reports, birth discharge summaries and the recapitulatory pedagogical-psychological discharge summaries; then by further analysing these data we determined the occurrence frequencies. Due to limited access to the data, only handwritten notes not including personal data that could have made identification possible were allowed to be prepared based on the paper documents. At the moment there is no clear principle or administrative/public educational protocol regulating the research on the continuously growing number of documents, stored in the various institutes dealing with the pedagogical diagnostics of the national or county pedagogical special services. Giving out and sharing these very sensitive data fall under the full responsibility of the head of the institute or the head of the educational district. Despite its large sample size, the analytical sample may not be considered representative of the whole population, because not all children who may be suspected to have visual impairment get in touch with the Corps VI. However, there is no other institute or data base that would have reliable data concerning children with *sensory special educational needs* with such a large sample size. The study discusses in detail the background of the visually impaired children who stay outside the pedagogical diagnostic system.

Results

Results I.

Based on the data tables of The Hungarian Central Statistical Office (KSH 1990, 2001) the occurrence rates of visually impaired children aged 0 and 14 were determined and summarized in table format *(Table 1)* within the whole population and in their age-group.

More accurate methodological and conceptual establishment of principles (KSH 2014, 2018) are connected to the samples of the *2011 Census and the 2016 Microcensus* (KSH 2011, 2016), therefore prevalence values were determined more emphatically in these two samples. Based on the aggregated data, the prevalence of childhood visual impairment is 0.26‰ in 2011 and 0.22‰ in 2016 in the entire population. *This means that in every ten thousand people 2.6 adult and 2.1 children are visually impaired.* The age group prevalence is 1.8‰ in 2011 and 1.5‰ in 2016, that is, *from ten thousand children of the same age group (aged between 0 and 14) 18 are visually impaired in 2011 and 15 are visually impaired in 2016.*

Table 1.
The number of disabled people, visually impaired people, and visually impaired people below the age of 14, and their rate within the entire population and within the population aged between 0 and 14. (Census data)

	Popula-tion	entire population		in the population aged bw. 0 and 14		
		disabled	VI	number	disabled	VI
Census 1990	10 374 823	368 270 *3.55%**	51 400 *0.50%**	2 130 549 *20.5%**	33 485 *1.57%*** *0.32%**	4135 *0.19%***, *0.040%**
Census 2001	10 198 315	577 006 *5.66%**	64 558 *0.63%**	1 694 936 *16.6%**	28 803 *1.70%***, *0.28%**	3065 *0.18%***, *0.030%**
Census 2011	9 937 628	490 578 *4.94%**	82 484 *0.83%**	1 447 659 *14.6%**	23 190 *1.60%***, *0.23%**	2591 *0.18%***, *0.026%**
Microcensus 2016	9 803 837	408 021 *4.16%**	69 747 *0.71%**	1 421 937 *14.5%**	22 857 *1.61%***, *0.23%**	2137 *0.15%***, *0.022%**

* rate in the entire population, ** rate in the population aged between 0 and 14

The collected data of the visually impaired population aged between 0 and 14 recorded in all four surveyed periods were further categorized into *low vision* and *blind categories (Table 2),* and we completed these categories with individual visual impairment categories that vary according to the surveys (*blind in one eye, deafblind).*

Table 2
Categories of visually impaired children aged between 0 and 14 based on Census data

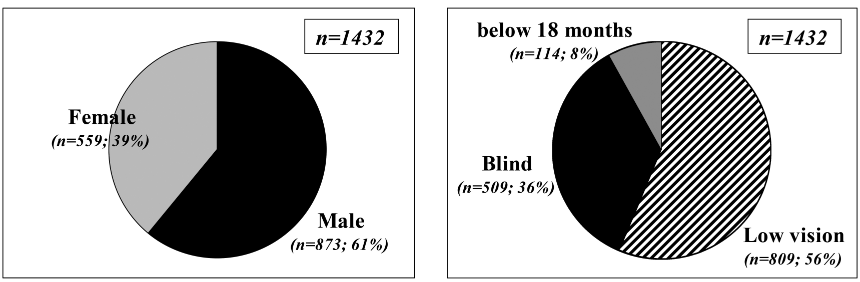
	Blind	Low vision	All VI	Blind in one eye	Deafblind
Census 1990	1020	3115	4135	635	no data
Census 2001	334	2731	3065	438	no data
Census 2011	247	2344	2591	no data	124
Microcensus 2016	335	1802	2137	no data	75

Due to the evident signs of condition for blindness, international literature (Gilbert & Ellwein, 2008) determines prevalence value only for the blind population, so using the 2011 age-group population number (1 447 659), *the age-group prevalence value for blindness is 0.17‰.* Using the 2016 data, *the age-group prevalence value for blindness is 0.23 ‰.* Thus in 2011 from 10 000 children below the age of 14 1.7 persons were found blind; in 2016 this value is 2.3 persons.

Results II.

Figures 1 and 2 show the gender ratio and the visual impairment ratio of the analytical sample of the Corps VI.

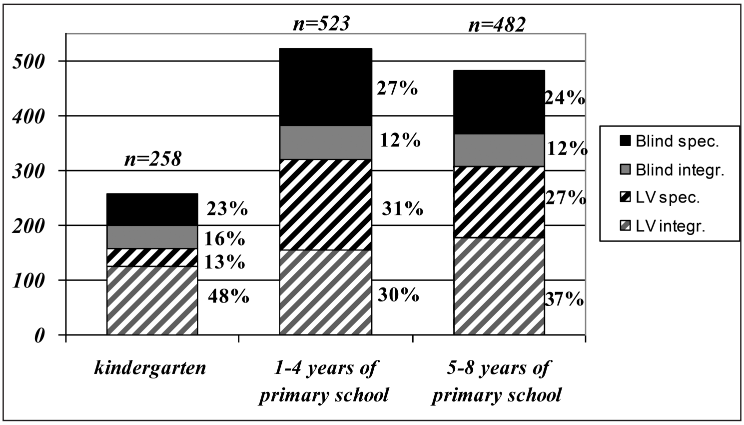
Figures 1 and 2
The composition of the analytical sample based on the gender ratio and the visual impairment categories



8 percent (114 persons) of the sample is made up of babies and toddlers below the age of 18 months who may not be categorized with certainty as blind or low vision but need early intervention due to their condition signs and/or their ophthalmologic or neurologic diagnosis.

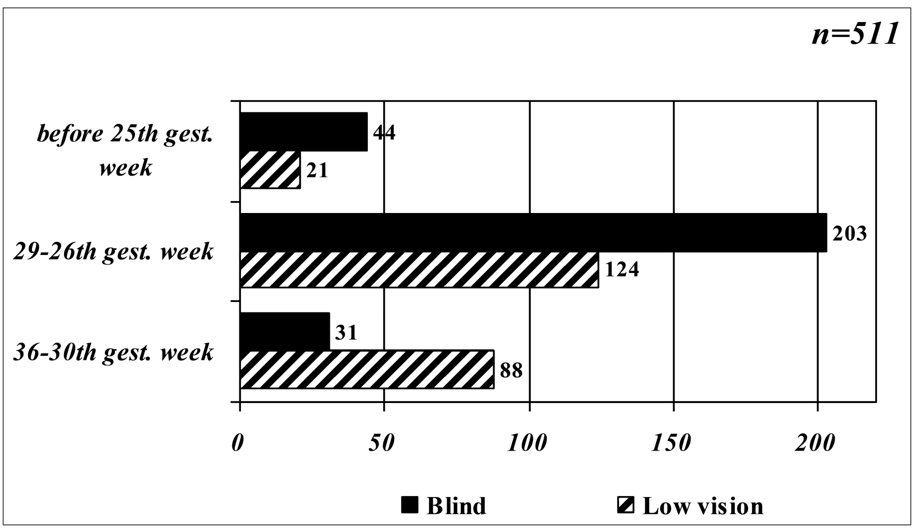
Features of institutional care: *11.8% (169 persons)* of the analytical sample *received early intervention, 18% attended kindergarten, 36.5 % attended one of the 1-4 years of primary school and 33.7% attended one of the 5-8 years of primary school* as of their last examination report. The ratio of blind and low vision children attending kindergarten and primary school is demonstrated in Figure 3, indicating within that the ratio of majority institutional care and the special pedagogical care.

Figure 3
The ratio of blind and low vision children in the various phases of special and majority educational institutions



Features of preterm birth: 35.6% of the sample (511 children) were prematurely born. This ratio is 54.6% among blind children and 28.8% among children with low vision. Figure 4 shows that pre-term babies who become visually impaired are born on the 26-29 gestational week.

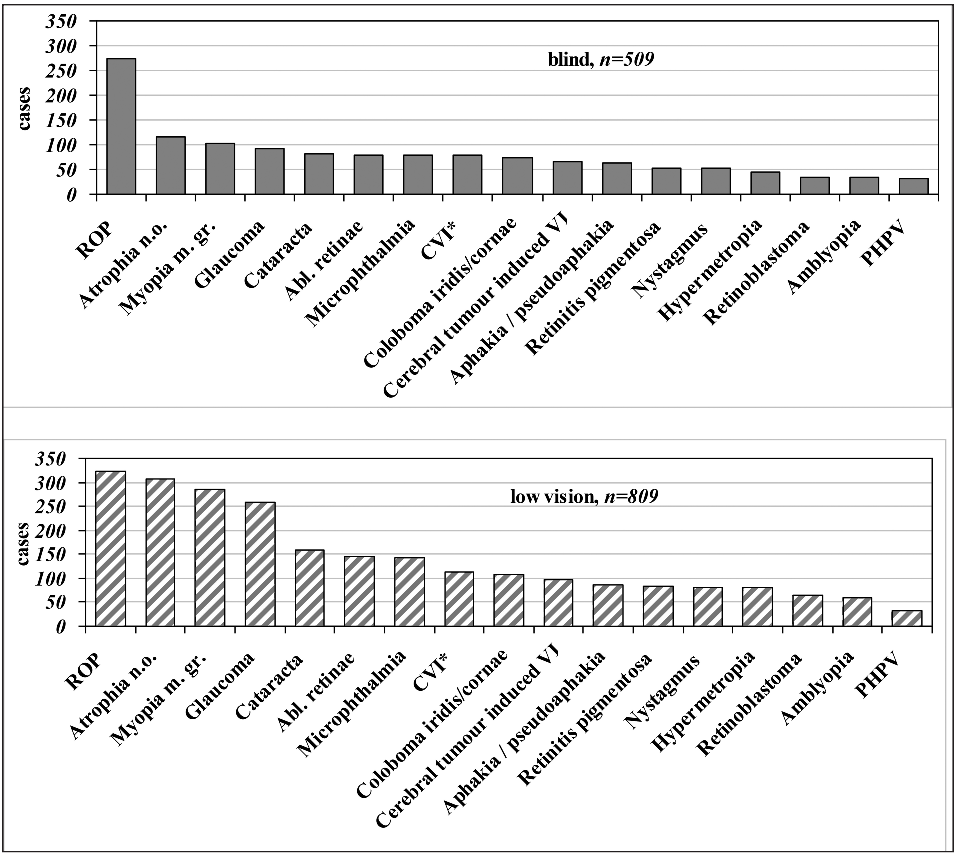
Figure 4
The frequency of premature birth among blind and low vision children in relation to gestational weeks



Features of ophthalmologist diagnoses: 932 of the 1432 children (65%) received their diagnosis before the age of 6, while 500 (35%) after the age of 6. After detailed analysis it is to be highlighted that from the perspective of the correctability and early rehabilitation it is a positive result that half of the children (50.9 % – 467 children) were properly diagnosed before the age of 1 and 18% of the children (262 children) were already diagnosed at birth. The frequency of ophthalmologist diagnoses among the groups of blind and low vision children is shown in *Figure 5*:

Figure 5

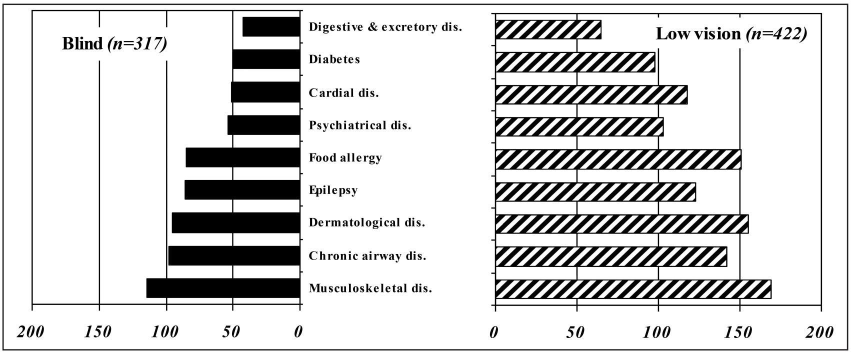
The frequency of ophthalmologist diagnoses in the groups of blind and low vision children (ROP, Atrophia nervi optici, Myopia majus gradis, Glaucoma, Cataracta, Ablatio retinae, Microphthalmia, CVI, Coloboma iridis/cornae, Cerebral tumour induced VI, Aphakia/pseudoaphakia, Retinitis pigmentosa, Nystagmus, Hypermetrophia, Retinoblastoma, Amblyopia, PHPV



Features of chronic diseases *(Figure 6):* 62.2% of blind children and 52.2% of low vision children have chronic diseases, many of them have 2-3 diseases.

Figure 6

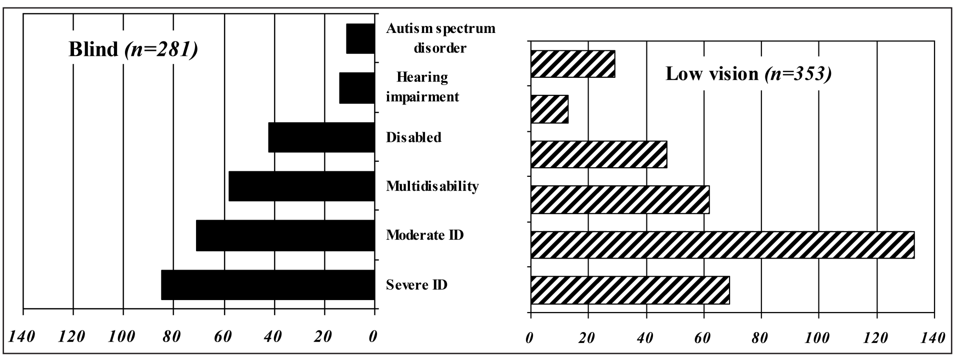
Frequently occurring chronic diseases among blind and low vision children (Digestive & excretory system diseases, Diabetes, Cardial diseases, Psychiatrical diseases, Food allergy, Epilepsy, Dermatological diseases, Chronic airway diseases, Musculoskeletal diseases)



Disabilities which can be revealed by special pedagogical and psychological tools and are associated with impaired vision *(Figure 7)* (autism spectrum disorder, hearing impairment, disability, multiple disabilities, moderate intellectual disability, severe intellectual disability) were identified in 634 cases, that is, 44.2% of the sample.

Figure 7

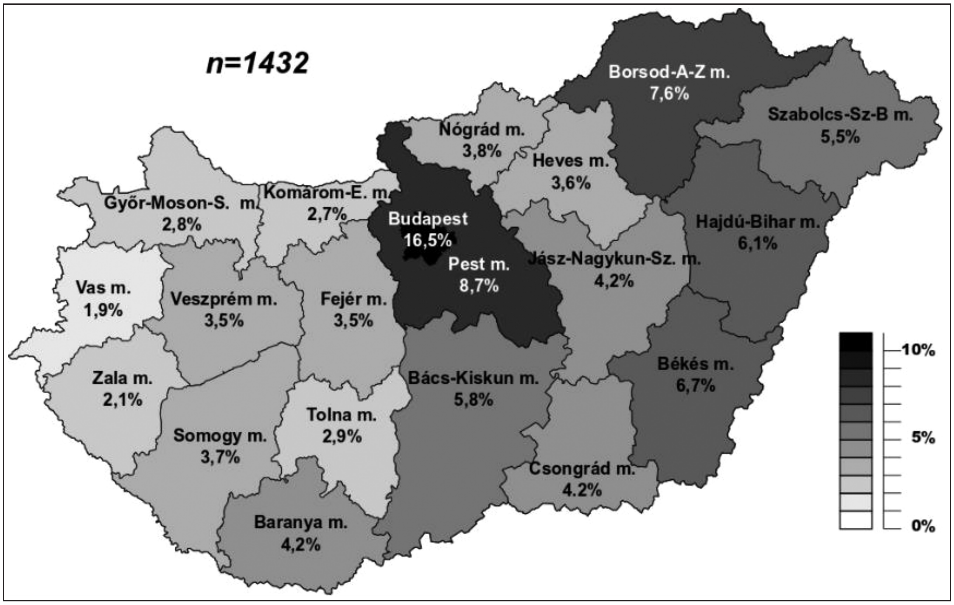
Associated disabilities of blind and low vision children



In both groups a separate category was created for those with *multiple disabilities*. There are 58 (20.6%) such children in the *blind group* and 62 (17.6%) in the low vision group. This category shows the ratio of children who have *severe and multiple disabilities* and receive medical and pedagogical care within the framework of special needs education, often in social and healthcare institutions.

The *demographic features* of the sample showed that the most children with visual impairment come to the pedagogical diagnostic examination from Budapest, Pest county and Borsod-Abaúj-Zemplén county. *Figure 8* shows the county distribution of the children who attended the examination according to their and their primary caregivers' registered address.

Figure 8
County distribution according to registered address



Fewer children arrived from the Transdanubian counties than from the Danube-Tisza Interfluve and Eastern Hungary. The exceptions are Baranya, Nógrád and Heves counties. Most children arrived from cities with county rights (33%), fewer came from small towns and large villages (29.6%). The ratio of those living in smaller villages was 20.9% and Budapest residents made up 16.5% of the sample.

Conclusions and implications

The following conclusions in connection with the results were received during the exploratory analyses. Based on the data of the 2011 census (considered representative) and the 2016 microcensus (both conducted by KSH) (KSH 2011, 2016) the age group prevalence of the Hungarian visually impaired children aged between 0 and 14 years does not exceed the values estimated for developed countries (Table 3). When using the data of the 2016 microcensus, we must take it into consideration that it was conducted with a sampling fraction of 10% of the population. Therefore, the data are to be regarded as highly reliable estimates, but in the case of smaller populations, such as the group of visually impaired children, the reliability may somewhat decrease. When using these data, it is important to emphasize that they are based on estimation and accordingly, the statistical power of the possible conclusion is limited.

Table 3
Age group prevalence of visually impaired children

	Philip and Dutton (2014)	**Gilbert and Ellwein (2008)**
out of 10 000 0-16 year old children	10-22 visually impaired	3 blind
	Kiss and Pajor (2020) based on 2011 census (KSH)	
out of 10 000 0-14 year old children	18 visually impaired	1.7 blind
	Kiss and Pajor (2020) based on 2016 microcensus (KSH)	
out of 10 000 0-14 year old children	15 visually impaired	2.3 blind

In the analytical sample, among both *blind and low vision* children there is a high rate of associated disabilities and chronic diseases. It can be established that the more severe the visual impairment is, the more disabilities and chronic diseases are associated with it. The rate of preterm birth among blind children is 54.6% (among low vision children this rate is only 28.8%). These results are in accord with those in neonatology, according to which *retinopathia prematurorum, bronchopulmonary dysplasia, intraventricular haemorrhage and periventricular leukomalatia* are the most frequent chronic neonatal morbidities which have a fundamental impact on the children's quality of life (Balla & Szabó, 2013, p. 1499–1503). Visually impaired children with complex handicaps or multiple disabilities need differential medical and pedagogical diagnosis, aftercare and therapeutic attitude. The actors of the medical and pedagogical care system must differentiate between the services they offer and the methodologies they apply: they must change the methods of examination and treatment, and they must apply therapies tailored to the needs of the individuals, they must incorporate alternative communications, strategies in the care system and they must ensure accessibility to the environment of the care system's facilities.

It is a priority to provide visual impairment specific training and continued professional support for the experts working in early intervention and inclusive education.

Steps must be taken in order to ensure the broader knowledge of the characteristics of low vision especially in state administration. Awareness-raising and publicity campaigns and programmes are recommended.

It would be beneficial to work out a directive that regulates the researchability of the sensitive and crucial data of the pedagogical assistance services.

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Virtual reality therapy in special needs education

From therapy to inclusion

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The Virtual Reality (VR) technology has become a part of our everyday lives. The VR systems allow the users to be directly involved in human-computer interaction. The Virtual Environment provides artificial sensory information, while Virtual Tools allow direct interaction from the users side. Virtual devices such as computers, smartphones, and interactive whiteboards often appear both in general and special education. Education and rehabilitation professionals also use VR systems in various fields. The aim of the study is to summarise the wide range of VR system applications in diversified areas of special education. Our literature review focuses on special education and rehabilitation, moving towards the context of inclusion. Based on the numerous research, applying VR tools to the educational field has been increasing year by year. In the early '90s, researchers began using virtual learning environments and they demonstrated that the application of virtual methods can be extended to behavioral therapies (relate anxiety), physical therapies (e.g. wheelchair simulators), and to develop cognitive performance (to develop attention) or social skills (learning to navigate community literacy). VR systems allow the possibility of providing continuous feedback and the opportunity for interactive learning and skill development. In the practice of special needs education, VR systems are useful in intervention, as well as monitoring, and evaluation. By using VR systems, users from any age group can be motivated. Furthermore, these systems apply their own natural semantics and can be used without spoken language or other conventional symbols. VR can promote education more accessible and differentiated for children with disabilities. This is one of the conditions for the effectiveness of co-education. The VR systems make no distinction between the users, on the other hand, users with special needs may require more adaptation or support in using VR. Hungarian professionals in the field of special needs education are also using VR tools, which offer opportunities to develop skills for independent living.

Keywords: virtual reality, special needs education, rehabilitation, inclusion

Virtual Reality and Virtual Environment

The development of Virtual Reality technology has come a long way since the 1960s when the first computer notepad, Sketchpad, was released. Its general application for common use has evolved since the 1990s and virtual reality has become a part of our everyday lives. All Virtual Reality systems are based on the same elements: environment, computer, user, sensory systems simulation, interaction, immersion experience, and presence (Bamodu, 2013). Numerous research reports that virtual games are gaining more and more ground, especially among young people. First, it is important to distinguish between two key phenomena in the field, Virtual Reality (VR) and Virtual Environment (VE) (Mintaze et al., 2014).

"Virtual Reality can be interpreted as an improved form of human-computer interaction that allows the user to be a part of and interact with the computer-generated environment. Reconstructed reality requires an active presence on the part of the user. The Virtual Environment provides artificial sensory information and allows the user to acquire real experiences" (Mintaze et al., 2014, p. 279). Moreover, Virtual Tools represent the tangible aspect of the system and allow direct interaction from the user side. For example, in a virtual tennis match against the computer Wii controller represents the tennis racket.

Virtual Reality systems

Virtual Reality therapy is now an existing concept (Massie, 2010). During the last decades, interest in the VR devices developed by multinational companies has been increasingly growing in the field of education and rehabilitation. Primarily, the devices mentioned above were developed for entertainment purposes. Parallel with this process, more and more professionals began to use them for teaching, development, and rehabilitation purposes. Initially, the therapeutic environment was adapted for applying VR tools, but nowadays VR systems are evolving according to rehabilitation needs.

Virtual devices can be categorized according to the purpose of the activity performed by them, as follows in Table 1.

Table 1
Fields of application of the most common virtual devices

GAME	LEARNING/STUDY	REHABILITATION
Nintendo Wii; Nintendo Wii Fit; Nintendo Wii Fit U	Nintendo Wii	Nintendo Wii; Nintendo Wii Fit; Nintendo Wii Fit U
Sony Eye Toy		
Sony PlayStation VR	Sony PlayStation VR	Sony PlayStation VR
		Pediatric Intensive Therapy System (PITS)
Xbox; Xbox Kinect	Xbox; Xbox Kinect	Xbox Kinect
		Interactive Rehabilitation Exercise System (IREX)

Virtual devices such as computers, smartphones, and interactive whiteboards often appear both in general and special education. Exergames, or active video game systems, have become an integral part of everyday education. "Exergaming is the combination of exercise and video games" (Bogost, 2007, cited in Di Tore, 2012). These systems allow the whole body to be involved in human-computer interaction and the possibility of providing continuous feedback and opportunity for interactive learning and skill development (DiTore, 2016).

VR systems exert their influence on body and mind. Education and rehabilitation professionals operate VR systems in various fields for improving movements and cognition. The classification, based on the affected field proposed by Galvin and Levac (2014) is shown in the following:

- Systems that require a straight posture;
- Systems that focus on whole body movements, as well as movement of lower and upper limbs;
- Systems that focus on the quality of movement and
- Systems that affect cognitive and motor relationships.

Games require a high degree of concentration, as the user observes a quasi-projection of real life on the screen. Users learn and improve skills by interacting with the virtual environment. This phenomenon applies to the use of all Virtual Reality systems. Learning in a virtual environment is based on both direct and indirect experiences. Here, direct individual learning is combined with the learning from others' actions and their consequences. The latter is called observational learning and is a form of learning that is not based on the direct experience of an individual (Burke, 2010).

With direct and indirect experiences, VR provides an opportunity for variable practice and learning complex skills. Skills acquired in a virtual environment (VE) may be further applied in the real environment. During this process, previously learned skills promote performance in novel settings, a phenomenon called positive transfer (Anderson, 2000). Regarding motor learning, this process refers to the general application of practiced, learned movements in multiple situations (Censor, 2013). For example, the transfer of balancing skills acquired on the Wii Fit Balance Board to keep equilibrium during walking. While in the field of motor learning there are a number of methods to track transfer effects (Berencsi et al., 2016; Vámos et al., 2018), it is still complicated to assess how effectively we can transfer the variety of acquired skills to real-life settings (Levac, 2019).

Virtual Reality in special education

Virtual Reality systems have been used in special education for decades. The first Virtual Reality and Persons with Disabilities Conference was held as early as 1992. At this conference, people with disabilities and professionals from a wide range of disciplines were present. The aim of the conference was to share ideas and develop concepts on how Virtual Reality systems can be applied to special education (JEFFS, 2009).

In the early ’90s, researchers began using virtual learning environments to teach children with physical disabilities how to navigate a wheelchair (Inman, 1994, cited in Jeffs, 2009). From this time on, more and more researchers have become interested in the study of virtual learning environment in the field of rehabilitation. The first wheelchair simulators were designed as early as 1998 by Desbonnet, Cox, and Rahman, and then by Niniss and Nadif in the early 2000s (Jeffs, 2009). In these early stages of application in the field of rehabilitation, the thought that there is a need for Virtual Reality systems to focus on strengths already appeared (McCommas et al., 1998).

As early as 1998, North demonstrated that the application of virtual methods can be extended to behavioral therapies, such as those related to resolving anxiety. Virtual imagination and manipulation of the environment helped to solve certain phobias such as anxiety in a crowd, claustrophobia and fear of flight or height (Sik Lányi, 2006). By the late 20th century, professionals predicted that the Virtual Learning Environment would be common in classrooms and was expected to assist the building of the educational environment, promote research, development, and the use of creative applications (Jeffs, 2009). Decades later, we have witnessed the realization of this previously predicted process as educators are increasingly integrating virtual learning environments into classrooms by using more and more widgets and different games in education.

Application methods of VR in special education

The amount of research in the international literature that examines the relationship between Virtual Systems and special education is increasing. The categorisation of the systems is created according to areas of use, types of disabilities, and possible users. In most cases, unique human-computer interfaces are presented and these interfaces display reactive, animated models (Sik Lányi, 2006). According to proposals made by Sik Lányi (2006), Laufer (2011) and Jeffs (2009), we can briefly categorise the possible fields of application based on the type of disability, as can be seen in the following summary.

Sensory impairments: In a Virtual Environment, it is possible to support or reduce or remove some stimuli, e.g. visual or auditory information. An example is the AudioChile, which is a virtually-created environment developed for visually impaired or blind children for the purpose of exploring the city. Another similar program is MathsignerTM, a 3D-animated program for learning math or sign language.

Autism spectrum disorders (ASD) and mental disorders: In most cases, VR systems are used to practice social interaction and facilitate the use of social skills. Developed by Kellems et al (2020), the iAnimate Live project can facilitate the acquiring and usage of these critical skills. Their results show that the use of VE and virtual characters (avatars) is more cost-effective than traditional methods and suitable for the acquisition of social skills. Furthermore, it affects the quality of life.

Verbal and nonverbal communication, cognitive skills, and impulse control can also be developed in VR. Lorenzo (2013) used Immersive VR to develop social competencies and executive functions in ASD. Within the framework of the Autism Spectrum project, the users practiced social interactions such that of boarding a crowded bus. In the context of ASD, Parsons (2016) highlighted the use of VR in the field of measurement and evaluation. Furthermore, VR can facilitate learning and the generalisation of skills in the real world. Stone et al (2019) investigated the effect of online multiplayer games on social interactions. Their results showed that playing online games supports social interaction through speech, writing, and gestures.

Communication impairment and social disorders: For children with speech impairments, VR systems may help them practice communication situations via the augmentation or alternative usage of images and sounds. Some projects help to improve the social interaction of children with Down syndrome (Sik Lányi, 2006). For example, as a means of promoting active social interactions, an online environment has been created where anyone from the world can participate.

Attention deficit hyperactivity disorder and learning difficulties: In a recent study by Cheng and Lai (2020), the application of VR systems in education has been rated as fundamentally successful among this population. Here, the goals are to use these devices is to aid adaptation to the learning environment and improve learning performance. Different learning problems may require the use of distinct systems and technical solutions. An example is the Adjustable Virtual Classroom, in which teachers and students are presented virtually (in the form of avatars). This virtual environment models a classroom or a crowded room where the user can practice public speaking.

Multiple/severe disabilities: In this context, the distinguished components of using VR systems are fair usage flexibility and simplicity. In general, these programs are intuitive, have a high tolerance for mistakes, and require less physical effort. They are often used to develop social skills and learning to navigate community literacy (e.g., the comprehension of printed brand names on products). Additionally, the learning process is controllable and users have the option of repetition.

Intellectual disabilities: Among this diverse population, VR is basically used in the learning of three main areas: social skills, cognitive performance, and independent living. The limitation may be that these learned skills do not necessarily transfer to other areas. However, a number of studies have proven that individulas with intellectual disabilities are able to transfer the learned skills to real life (Standen, 2005). VR is also suitable for monitoring the learning process. In the case of intellectual disabilities, VR is convenient for practicing skills because no others are present as a pressurising or frustrating factor while learning a new skill. The other advantage is that users can make mistakes without experiencing any real consequences (Standen, 2005; Cheng & Lai, 2020).

Standen et al (2005) and later Sik Lányi et al (2006) present opportunities to develop skills for independent living, including a shopping simulation, food preparation, orientation, and road safety. However, understanding the use of devices could present some difficulties. Furthermore, handling these devices can be demanding due to oft-associated, fine motor difficulties.

Physical disabilities: Limited movement and limitation in the exploration of the environment may in turn affect spatial perception and orientation in children with physical disabilities. Since the '90s, these functions could be facilitated by wheelchair simulators. A lab environment in which the users practice with a joystick is another possiblility. In the field of motion development, the use of exergame systems is the most popular. Cooper and Williams (2017) authored six studies that appropriately documented the use of the Nintendo Wii in the education of children with cerebral palsy (CP) and basically concluded that this tool is suitable for balance training, although in their opinion long-term studies would be necessary to confirm this finding. In our research with paraplegic children, we also worked with Nintendo Wii Fit and the Wii Balance Board. During the daily therapy classes, we evaluated the effect of Wii games on balance. Based on the results, we found the tool potentially good for balance development in this population (Ardai & Vámos, 2016).

Other professionals applying similar tools also underscored the aforementioned positive results. In Ojeda-Castelo's research (2018), Kinect sensors were used since these are already validated development tools. They wanted to develop a game-like system that could be easily applied in special needs education for different disabilities. The goal was to develop an algorithm that recognizes the user and excludes the outside world. The algorithm with sensors is able to detect the user's skeletal system and joint position. Its forms of application in learning are very diverse. After a preliminary assessment, it recommends a program tailored to user needs (e.g. learning numbers or letters). The tool provides a new opportunity for interaction specifically for children with special educational needs. In terms of rehabilitation, the main advantage of this system is its availability for home training. It is also based on Microsoft Kinect and the application focuses on three main areas: physical difficulties with motion; posture (keeping the correct pose); balance and coordination. (Ojeda-Castelo, 2018).

Special considerations for use in special education

The previously mentioned devices (like Nintendo Wii or Xbox Kinect) play a prominent role in this field. These Active Video Game Systems are easily integrated into pedagogy and are suitable for teaching purposes (Cooper & Williams, 2017). Several research groups (Cagiltay et al., 2019; Cooper & Williams, 2017; Ojeda-Castelo, 2018; Kavanagh, 2017; López-Serrano, 2017) consider VR technologies to be potentially adequate in special education because they provide alternative interaction, fast response, advanced graphics, communication, and collaboration support. VR is also an appropriate choice in the case of learning difficulties as it helps to deal with associated challenges, such as a short attention span, low memory performance, the need for many repetitions, and frequent feedback.

Cagiltay et al (2019) demonstrates that VR systems may build bridges between school and at home application in multiple fields, such as (1) video games that help movement, kinaesthesia, (2) tablet and interactive whiteboard for practice (e.g., letters, numbers), and (3) smart devices that help in storytelling and communication. VR systems are also useful in intervention, monitoring, and evaluation and can be more manipulated than reality. Furthermore, these systems apply their own natural semantics and can be used without spoken language or other conventional symbols (Standen, 2005; Chadwick & Wesson, 2016).

Motivational factors

The alleged emotional impact of virtual reality (VR) and active video game systems (AVG) is a key marketing strategy. One aspect of the application of such systems in rehabilitation and education is the motivational factor (Rorhrbach, 2019). Computer games and smart devices have been popular below the age of 18 since the '90s. Sáringer (2010) reported that one third of boys and one fifth of girls between the ages of 10 and 18 have some virtual device. The proportion of children playing games on their smartphones increased to 61% among the age range of 8-17 years, a figure that shows how these activities have become integrated into everyday activities according to IPSOS survey in Hungary. Researchers hypothesise several reasons underlying the phenomenon of high incidence of virtual games usage. One reason may be the sense of security provided by a virtual world containing real elements but without real stakes, a situation that provides an opportunity to experience subjective conflicts (Standen, 2005).

Several studies emphasise the motivating power of VR systems in the educational process (Ojeda-Castelo, 2018; Kavanagh, 2017). Some of these systems are designed to improve customisation. Tasks are game-oriented and help to control attention and motivation.

Interactive whiteboards are already being widely for different tasks in the educational environment (Cagiltay, 2019). Kinect is one of the most suitable tools for developing digital competencies and cognitive and physical skills. Kinect, like other devices such as Wii or smartphones, are also cheap and easy to use. (Ojeda-Castelo, 2018). Furthermore, the natural interactions generated by these tools can be defined as communication between human and computer. The aforementioned interaction has a develompental and motivating factor and can therefore be successfully applied to the diversified field of special education (Cagiltay, 2019; Torres-Carrión, 2018; Kavanagh, 2017; Panzavolta, 2018). Altogether, VR tools provide a cheap, easily adaptable and effective alternative in the learning process.

From teachers' perspectives

Despite some difficulties, the use of VR systems in education is becoming increasingly popular among teachers. In their study in 2019, Cagiltay et al examined the relationship between educational technologies (including a wide array of teaching- and learning-related software and hardware, such as computers, interactive whiteboards, multimedia, VR devices) and special education. They primarily focused on teachers 'perceptions. Their goal was to understand what opportunities, experiences, and perceptions teachers have regarding Educational Technologies. A questionnaire was used to assess what teachers thought about the new technical solutions offered by VR. The results showed that the teachers use these options less because of the absence of infrastructure and instructions. The attitude of teachers was positive and open. Their opinion was that the application of technology improves school performance and job satisfaction, but it would be necessary for them to learn how to apply the technologies as well. They preferred to use devices that can be applied from an early age. According to them, the application of VR makes students more motivated to learn and raises the quality of learning, as it is a completely different educational method compared to traditional solutions. Furthermore, it allows more interactions among teachers and students and promotes the engagement of students with interactive, common tasks (Kavanagh, 2017).

Virtual Reality for inclusion

The structure of education and its adjacent areas are fields that constantly evolve to adjust to the needs and demands of the students. Either individualised or system-centered procedures can be encountered in situations that enable the inclusion of groups of minorities or individuals with disabilities (Papp, 2012). VR can promote this process by providing a tool for inclusion in which the quality of education rather than the environment is emphasised. Making education accessible and differentiated for children with disabilities is one of the conditions for the effectiveness of co-education (Papp, 2007). In many cases, it is emphasised that the aim of the application of VR in education is to increase independence, social and community involvement, and to reduce individual differences. Co-education has a similar goal system in which the categories of self-development, autonomy, and social participation also appear (Papp, 2012).

Digital communication is now accepted by the majority of the world's population. "However, it may be difficult to distinguish between the digital and the real world. Digital inclusion is an increasingly important social issue, reflecting human rights and includes equity. It enables social participation, community, and civil participation. Instead of classical linguistic elements and conventional symbols, it also provides alternative opportunities for communication for people with disabilities" (Chadwick & Wesson, 2016, p. 19).

In the virtual world, everyone has a chance to try various things that may not be available or possible in real life. In this world, anyone can be included: the game does not make any distinction between individuals with or without disabilities. Kavanagh et al. (2017) studied VR systems in terms of accessibility for participation, users' experiences, and interactivity before categorizing them according to areas of use:

- Simulation: The importance of being able to actively participate in interactions. Simulation increases opportunities in areas where there would be, for example, financial barriers to access (e.g., walking in the Pantheon virtually).
- Training: This aspect provides an opportunity to engage in activities that individuals would not be able to do in a real environment. An example is a VR Classroom, where children with ADHD, or who are afraid of public speaking, can practice appearances in front of a crowd.
- Access to Limited Resources: Lists cases where VE is used, for example, to simulate laboratory practice, or a virtual walk in a museum that a financial budget would not otherwise allow.
- Distance learning: In this context, they emphasised that VR helps access the learning environment. It helps prevent isolation and makes learning more real. They mentioned tools (especially for the home training for children with CP) to practice physiotherapy tasks and continue rehabilitation at home.
- Motivation: The virtual learning environment (VLE) was compared to traditional education. The result was that students learn better and are more motivated than when in a traditional learning environment.

For people with physical disabilities, environmental or physical accessibility is one of the most important factors in terms of participation. In the case of this population, getting to school can be one of the greatest challenges (Pivik et al., 2002). Accordingly, VR can be a new device for distance learning and the engagement in the learning process from home can help inclusion. The point is not only to be able to study at school, but also to take learning out of it (Sik Lányi, 2006).

In 2018, Gómez made a workshop summary for people with disabilities, professionals, and all VR users. The subject of the summary was about the entertainment applications which can be a part of the learning process and the use of VR devices promotes the inclusion of people with disabilities and reduces the gap between male and female players. They foster researchers, people with disabilities, designers, and users to form a community that supports and helps with this. The use of exergames systems is becoming increasingly popular in special education. In this context, inclusion is akin to the last stage in the process of diagnosis, education, and self-realization in which the goal is inclusion (Gómez, 2018).

In spite of its facilitating nature, a systematic review by Torres-Carión (2018) emphasises that the literature on the relationship between VR and inclusion is still scarce. Just thinking about the example of trying out a wheelchair simulator can be a sensitising experience for intact peers, which can increase acceptance, inclusion (Pivik et al., 2002).

Conclusion

In the present literature review we summarised the increasing use of VR systems in special needs education. The successful application of VR and

VE highlighted elements are immersion, presence, interaction, transduction, and cost-effectiveness (Panzavolta, 2018). In terms of its limitations, the inexperience and incomplete knowledge of teachers could be a challenge. At the same time, the openness of teachers and children indicates that VR systems can be successfully integrated into education.

In the 21st century, VR systems are part of the everyday lives of the rising generations and provide a means of connecting to young people through the field of their interest. VR sysytems could help with learning, development and, last but not least, establishing social relations and inclusion. Therefore, it is worth considering the use of VR systems in special needs education as well as taking active part in the amelioration of such systems for diagnostic, monitoring, and developmental purposes in the support for individuals with special needs.

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Health-related quality of life of Hungarian children and adolescents with disabilities

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This study presents a comparative analysis of the HRQOL (health related quality of life) of Hungarian children and adolescents with disabilities. This empirical research was carried out during the academic years of 2016/2017, 2017/2018, and 2018/2019. Gathered via the KIDSCREEN-27 questionnaire, the data provide information on the HRQOL of 2,631 children with typical development (TD) (1,411 boys and 1,220 girls, mean age 14.88±2.68 yrs) and 1,056 children with a disability (diagnosed with special educational needs – SEN) (702 boys and 354 girls, mean age 15.72±2.6 yrs). QOL was examined from various aspects. Results in the various subsamples were first compared to Hungarian reference data. Then, an analysis of variance (ANOVA) was performed to detect differences between the subsamples in the five dimensions of QOL. When comparing the QOL of Hungarian children with SEN to Hungarian reference data, we found that only children within an autism spectrum disorder (ASD) had low HRQOL in the dimension of social support and peers. The comparison of the T-values characterising the HRQOL of the subsamples showed that children with other psychological developmental disorders (OPDD), those with ASD, and children with hearing impairment (HI) experience significantly poorer HRQOL T-values in several dimensions compared to children with TD or other disabilities. The physical well-being of children with OPDD is lower than that of students with TD or a mild intellectual disability (MID). In addition, children with OPDD show significantly lower levels of QOL in the school environment dimension compared to other subsamples (children with physical disabilities /PD/, with MID, or with low vision /LV/). Students with HI or ASD showed lower rates of QOL compared to other subsamples in the dimensions of autonomy and parent relations, social support and peers, and school environment. The lower QOL found in the different dimensions will help experts plan and determine the foci of intervention.

Keywords: Health-related Quality of Life (HQOL), children and adolescents with disabilities, children and adolescents with special educational needs, KIDSCREEN-27

Introduction

The definition and importance of Health Related Quality of Life

The concept of Health-related Quality of Life (HRQOL) has been used in science since the 1950s (Kullmann, 2010), when the social goal of developed countries shifted from a primary focus on economic growth to increasing the well-being and QOL of citizens. The fields of medical/health sciences, psychology, and social sciences started investigating QOL approximately at the same time (Kovács, 2007; Ercsey, 2010). Consequently, there is no unified definition of QOL (Kullmann, 1993; Kovács, 2007). Sociology characteristically investigates QOL by measuring life satisfaction and happiness (Utasi, 2007) and analyses the social, economic, cultural, and environmental factors that determine QOL (Kovács, 2007). In psychological research, QOL equals happiness. WHO defines Quality of Life as 'individuals' perception of their position in life in the context of the culture and value systems in which they live and in relation to their goals, expectations, standards and concerns. It is a broad ranging concept affected in a complex way by the person's physical health, psychological state, level of independence, social relationships, personal beliefs and their relationship to salient features of their environment' (WHO, 1997, p. 1).

As the above definition shows, QOL is not related merely to health status: it is also determined by social participation and life satisfaction. It is therefore important and informative to examine QOL among individuals with disabilities (Kullmann, 2010). Schalock's QOL model and definition are widely applied with reference to individuals with disabilities. According to the definition, QOL is a multi-dimensional phenomenon, which includes eight core domains (emotional well-being, physical well-being, material well-being, social inclusion, interpersonal relations, self-determination, rights, personal development), which are all influenced by personal and environmental factors. The various dimensions are assessed by means of culture-sensitive indicators and form the basis for providing personalised support (Schalock et al., 2002, 2011; 2011).

There are several reasons why measuring the QOL of children and adolescents experiencing chronic diseases is important (EISER, 1997), and the same reasons underline the significance of evaluating QOL among children with disabilities. Making health-related decisions may be supported by quantifying the impact of the medical intervention (e.g., that of an amputation versus limb salvage procedures) on the child's QOL. Together with survival statistics, date on QOL may support clinical trials and intervention development. QOL helps reveal children's difficulties and identify children who may need some kind of support (Eiser, 1997).

HRQOL is a subcategory of QOL, used for measuring self-perceived health. It is often applied in effectiveness studies that measure its impact on health (Gu & Chang, 2016) because it not only maps bodily changes, but also self-perceptions related to all physical, psychological, social, and functional changes (Papp et al., 2016).

Assessing quality of life

A large variety of QOL tools are used by different sciences. There are *three main types of QOL measures: questionnaires, visual analogue rating scales, and observation.* Questionnaires are the most widely used QOL evaluation method (Kullmann, 2010). Some questionnaires survey the factors which influence QOL and therefore help in profiling different problems (QOL profiling). Other instruments determined QOL with aggregate data (QOL index). There are generic questionnaires which are valid in terms of the whole or the majority of the population and specific questionnaires designed for specific smaller populations (Kullmann, 2010).

Medicine, psychology and sociology use different QOL definitions and methods. WHO (World Health Organisation) has developed various generic and specific QOL assessments (e.g. WHOQOL, 100; WHOQOL, BREF; WHOQOL-5; WHOQOL – DIS etc.) (Kullmann, 2012). There are numerous QOL evaluations for children as well (Collier et al., 2000; Eiser & Morse, 2000; Wallander et al., 2001; Solans et al., 2008). The majority of these HRQOL questionnaires were developed for children with TD or chronic diseases. Although there are questionnaires adapted for specific populations of children with disabilities, these are mostly available in the language of the countries they were developed in and were adapted and validated for a particular disability group (e.g., Gómez et al., 2016). DISABKIDS is a QOL questionnaire which emerged out of a collaboration among seven European countries and designed for assessing the QOL of children and adolescents with chronic diseases (epilepsy, diabetes, asthma, etc.) and that of with CP (Baars et al., 2005). Since Hungary was not involved in either the development project or the validation of the questionnaire, this evaluation tool is not available in Hungarian. In a systematic review, Solans et al. (2008) found that KIDSCREEN is the only assessment tool that sets HRQOL reference data for children and adolescents from more than ten different countries and was validated for the languages of all these countries.

The QOL of children and adolescents with disabilities

Although weighing QOL is obviously important, few studies focus on the QOL of children and adolescents, let alone with a specific focus upon those with disabilities. Moreover, all of these studies are rather different in that they concentrate upon different samples of children and adolescents with different kinds of disabilities, different ages and genders while the research tools are also varied. The comparison of the QOL of different samples of children with disabilities is therefore impossible. Most studies compare the QOL of kids with a particular disability to that of the QOL of their peers with TD. The majority of studies find the QOL of children with disabilities lower, while the factors responsible for this lower QOL vary by disability.

Various studies account for the lower QOL of children with ASD in comparison to those with TD or chronic diseases. In a study carried out with KIDSCREEN-52, Clark et al. (2015) found that the QOL mean scores of adolescents with ASD were lower than the reference data. These results were additionally supported by those received in the parental questionnaire (Clark et al., 2015). De Vries and Geurts (2015) found similar results (i.e., a lower QOL compared to the TD children) in their research of physical, psychological, social well-being, and school subdomains of QOL. While IQ and language did not influence QOL, autistic traits and a lower level of executive functions had an obvious negative impact on it. Children who had social communication difficulties and problems in motivation exhibited lower QOL in the physical dimension, while lower levels of social motivation, poorer cognitive flexibility, and emotional control led to lower scores in the emotional dimensions. In the dimension of school, lower QOL was associated with poorer working memory, and weaker planning and organisation skills (De Vries & Geurts, 2015).

Data collected with the parent version of the KIDSCREEN-27 questionnaire found below average T-values in the dimensions of physical well-being, psychological well-being and social support and peers for children and *adolescents with ASD or MID*, the dimension of social support peers being the lowest of all. Lower ratings for of well-being were predicted by challenging behaviors, autism, age, and speech as the primary mode of communication (Biggs & Carter, 2016). Although various studies point out the poorer QOL of children with ASD, some argue that this lower QOL is not a result of the autism spectrum disorder as a single cause but rather emerges due to other factors: cognitive functions (Chiang & Wineman, 2014) or the level of support need are also influential (Renty & Roeyers, 2006). Arias et al. (2018) investigated the QOL of 1,060 children displaying varying degrees of intellectual disability, a quarter of whom were also diagnosed with ASD. The subjects who had both intellectual disabilities and ASD achieved lower results only in interpersonal relations, social inclusion, and physical well-being. Similar to former studies carried out with adults, Arias et al. (2018) found that both intellectual disabilities and the level of support need had an impact on various QOL dimensions. As for social inclusion, girls showed lower indicators than boys.

The subjective QOL of *children with ID* is poorly investigated (White-Koning et al., 2005). Although various studies explored the QOL of adults with ID (Nota et al., 2007) and that of families raising children with ID (Jin-Ding et al. 2009; Hu et al., 2012), further research is needed to attain a comprehensive understanding of their situation. The few studies related to this population focus primarily on the subjective perception of pain, emotional and behavioral problems, fears, and anxiety (Renwick et al., 2003) and survey children and adolescents with ID and additional disabilities (Arias et al., 2018; Ncube et al., 2018). Sabaz et al. (2001) explored the QOL of children with epilepsy, some of whom were also diagnosed with ID. Their results showed that epilepsy had a negative impact on QOL in both subsamples, but an intellectual disability alone (without epilepsy) also had a negative effect on QOL.

Various international studies focus on attention deficit hyperactivity disorder (ADHD), most of which find that ADHD has a similar impact on QOL compared to that related to other mental and physical disorders. An increase in the severity of the disorder causes a parallel decrease of QOL.

Some studies show that *children with HI* have a lower QOL compared to children with TD in some dimensions. In a systematic literature review and metaanalysis of 41 journal articles, Roland et al. (2016) found that the QOL of children with HI was significantly poorer compared to that of their peers with TD, especially in the social dimensions and the school dimension of QOL. In a longitudinal research, an equal QOL of children with HI and TD was found for the ages of four and eleven in the emotional and physical domains. However, the QOL of children who attended segregated schools and that of children who switched from segregated to mainstream education proved to be lower in the social and school dimensions compared to the QOL of children with TD and their peers with HI who continuously participated in mainstream education. Parallel to getting older, the QOL of both children with HI and TD continuously decreased in the dimension of school environment. This research found no influence stemming from language skills or the severity of HI on the social dimension of QOL (van der Straaten et al., 2020).

Oliveira et al. (2018) surveyed *children and adolescents with VI* and their parents with the KIDSCREEN-52 questionnaire and found high QOL in the dimensions of psychological well-being and parent relations and home life, while low levels of QOL were detected in the domains of social acceptance (bullying) and moods and emotions. The QOL of low-vision children was higher in all dimensions than that forof blind children. Researchers found higher QOL of children with LV than those of blind children in all QOL dimensions; however, differences were statistically not significant. Parents assessed the QOL of their children be lower than the children themselves.

Studies revealing the QOL of c*hildren and adolescents with PD and multiple disabilities (MD)* account for lower levels of QOL compared to that displayed among TD children. Calley et al. (2012) compared the QOL of children with cerebral palsy (CP) (spastic diplegia) aged 5-12 years to the QOL of children with TD of the same age. The children's QOL was assessed with the parent version of Cerebral Palsy Quality of Life questionnaire (CP-QoL). The research found greater QOL of children with TD in the domains of functioning, and participation and physical health. Lower levels of QOL of children with PD were found by Wojtkowski et al (2017) as well. The parent questionnaires detected lower QOL of children with motor disabilities compared to TD controls, both in terms of physical and psychosocial health. According to the study, the ability to achieve independent walking correlates with psychological functions, general behaviour, and mental health.

Surveying special populations with generic QOL questionnaires is also the focus of some research studies. Tompke and Ferro (2021) found that the KIDSCREEN questionnaire was valid for usage among children with mental disorders. Young et al. (2007) tested the KIDSCREEN questionnaire's validity among twenty-eight children with CP and found that factors relevant to the life of the population were well-reflected by the questionnaire. In many instances the children's priorities directly corresponded to the dimensions and concepts contained within KIDSCREEN. There are however various domains of everyday life which are relevant for children with PD and have an impact on their QOL but are not included in the questionnaire. These comprise for example relationships with family members other than parents; inclusion and fairness; home life and neighbourhood; pain and discomfort; environmental accommodation of needs; and recreational resources other than finances, and time (Young et al., 2007). When analysing the relevant results of the questionnaire, the above weaknesses must be taken into consideration.

In Hungary, the KIDSCREEN questionnaire was used for assessing the QOL of children with chronic diseases (Papp et al., 2016). When reviewing the literature, we found no Hungarian study that examines the QOL of children with disabilities. Furthermore, we found no international research that provides a comprehensive assessment of the QOL of children and adolescent populations with different disabilities using the same assessment tool.

Aim of the research

The aim of our research is to examine the HQOL of Hungarian children and adolescents with TD and disabilities, including children with

- mild intellectual disability (MID),
- other psychological developmental disorder (OPDD), which in Hungary includes a severe learning disability, attention deficit disorder and behavioural dysregulation
- autism spectrum disorder (ASD),
- visual impairment (VI, include blindness /B/ and low vision /LV/),
- hearing impairment (HI) and
- physical disability (PD).

Our aim was to compare the results to Hungarian reference data (The Kidscreen Group Europe, 2016) and detect differences between subsamples in each dimension of HQOL. The overall goal of the research is to reveal whether any population with a particular disability requires special attention due to a low QOL in any dimension.

Materials and methods

Study sample

Our research was carried out in two phases. During the spring of the academic year of 2016/17 and autumn of 2017/18, 1,124 students with SEN (MID, APD, ASD, VI, HI, PD) in 42 schools were examined within the framework of the project, EFOP-3.2.8-16-2016-00001. In spring 2018/2019, 2,651 children with TD were surveyed in 44 schools as a part of the project, EFOP-3.2.10-16-2016-0000, in a randomised, regionally and nationally representative sample of age, gender, and type of school. Similar to children with TD, the sampling of their peers with MID and children with other psychological developmental disorder was randomised and the sample was representative nationally, regionally, and based upon school type. Students with other disabilities were examined in their respective segregated institutions.

Participation was voluntary. In the case of minors, a parental consent form was signed. Students had the right to refrain from participation at any time during the assessment procedure.

Participation was limited to students who were diagnosed with a specific disability, had no additional disabilities, and were officially claimed to be students with SEN.

Only fully complete questionnaires were included in the research. Finally, 2,631 children with TD (1,411 boys and 1,220 girls, mean age 14.88±2.68 yrs) and 1,056 children with SEN (702 boys and 354 girls, mean age: 15.72±2.6 yrs) filled in the questionnaire. A detailed description of the sample can be found in *Table 1.*

Table 1
Description of the study sample

total		Sample			Decimal age (year, Mean±SD)		
		Boys	girls	total	boys	girls	
SEN	MID	429	277	152	15.75±2.75	15.82±2.82	15.6±2.62
	OPDD	440	301	139	15.7±2.44	15.88±2.4	15.31±2.48
	ASD	33	30	3	15.09±2.84	15.06±2.92	15.35±2.35
	VI	55	31	24	14.96±2.51	15.26±2.55	14.58±2.46
	VI-B	29	17	12	16.14±2.63	16.27±2.73	15.95±2.58
	VI-LV	26	14	12	13.65±1.59	14.04±1.7	13.2±1.37
	HI	56	35	21	18.16±2.38	18.21±2.31	18.08±2.55
	PD	43	28	15	13.51±2.07	14.05±2.12	12.5±1.6
	All	1056	702	354	15.72±2.67	15.84±2.67	15.43±2.66
TDC		2631	1411	1220	14.88±2.68	15.02±2.68	14.72±2.68

SEN = special educational needs MID = mild intellectual disability, OPDD = other psychological developmental disorder, ASD = autism spectrum disorder, VI= visual impairment VI-B = Blindness, VI-LV = low vision, HI = Hearing impairment, PD = physical disability TDC = typically developing children

Methods

In the research, the HRQOL of children was evaluated with the KIDSCREEN-27 questionnaire (Kidscreen Group Europe, 2016). A generic health-related QOL questionnaire, KIDSCREEN has been validated both for healthy children and children ages eight to eighteen with chronic diseases. It was developed as part of a collaboration among thirteen European countries (Hungary included), therefore results may be interpreted in line with national and international standards.

KIDSCREEN-27 assesses five HRQOL dimensions: physical well-being, psychological well-being, autonomy and parent relations, social support and peers, and school environment.

- The *dimension of physical well-being* investigates the child's physical activity, energy, and fitness and examines whether the child feels unwell, and to what extent he or she complains of poor health. Low QOL in this

dimension may refer to physical exhaustion, poor physical fitness or low energy levels. High QOL in this dimension shows that the child or adolescent is full of energy, active, and characterised by proper health and physical fitness.
- The *dimension of psychological well-being* maps the level of positive feelings and life satisfaction, and those of loneliness and sadness. Low QOL in this dimension displays low levels of life satisfaction and points to sadness or low self-esteem. High QOL in this dimension demonstrates happiness, high life satisfaction, and positive feelings.
- The *dimension of autonomy and parent relations* investigates the interactions of the child or adolescent with his or her parents (caretaker/s), and examines how much the child or adolescent feels to be loved and supported by the family. This dimension also detects the level of autonomy the child feels to have and perceived financial opportunities. Low QOL in this dimension refers to the child's feelings of being limited, lacking in attention, and appreciation, and the feeling that life is determined by finances. High QOL in this dimension indicates good child-parent relations, a feeling of age-appropriate liberty, and a feeling of financial safety.
- The *dimension of social support and peers* explores peer relations, the quality of interactions, and perceived levels of being supported. Low QOL in this dimension indicates that the child or adolescent feels to be segregated and not accepted by his or her peers. On the contrary, high QOL in this dimension shows that the child feels accepted and included.
- The *dimension of school environment* focuses on cognitive skills, learning, and concentration and explores feelings related to school and teachers. Low QOL in this dimension signals that the child does not like school, while high QOL in this dimension refers to positive feelings.

Respondents filled in a paper and pencil questionnaire anonymously and autonomously. When necessary, children or adolescents with MID or ASD received support in understanding the statements. For blind children, the questionnaire was read aloud and filled in by the researcher in a two-person situation.

The data were analysed in accordance with the instructions found in the KIDSCREEN manual (Kidscreen Group Europe, 2016) and by means of the IBM SPSS 26 statistical software. Raw QOL in this dimension of the different dimensions were converted into T-values. The T-values of each dimension were analysed. The T-values of the subsamples were compared to the T-values of Hungarian reference data. Data were also analysed for gender. The Kidscreen Group Europe recommends that data within a half-standard deviation from the mean T-values be regarded as average; lower values should be taken as low, higher values as high Quality of Life with respect to the given dimension. Then, mean T-values characterising the QOL of each subsample were compared with ANOVA.

Results

Testing the indicators of reliability (internal consistency) of KIDSCREEN-27

Since KIDSCREEN was developed for assessing the HQOL of children and adolescents with chronic diseases and not for that of respondents with disabilities, indicators of reliability were tested for each subsample and the internal consistency of groups of questions was calculated before data analysis. Cronbach's Alpha scores for each subsample and group of questions and the number of respondents by subsample are shown in *Table 2.*

Table 2
Cronbach's Alpha scores showing internal consistency for each subsample and group of questions

Sub-jects	QOL dimensions									
	Physical well-being		Psychological well-being		Autonomy & parent relations		Social support & peers		School environment	
	Cr-α	N	Cr-α	N	Cr-α	N	Cr-α	N	Cr-α	N
TDC	0.816	2428	0.831	2361	0.790	2370	0. 828	2411	0.796	2398
MID	0.734	329	0.700	314	0.774	323	0.770	325	0.704	319
OPDD	0.748	370	0.788	354	0.792	364	0.820	366	0.751	364
ASD	0.888	25	0.751	27	0.848	26	0.889	26	0.874	28
B	0.737	20	0.715	21	0.767	20	0.303	21	0.499	21
LV	0.747	26	0.778	25	0.518	25	0.835	26	0.801	26
HI	0.686	28	0.673	28	0.688	28	0.865	28	0.809	28
PD	0.601	30	0.768	31	0.713	31	0.807	31	0.713	29

Cr-α = Cronbach's Alpha, TDC = typically developing children, MID = mild intellectual disability, OPDD = other psychological developmental disorder, ASD = autism spectrum disorder, B = Blindness, LV = low vision, HI = Hearing impairment, PD = physical disability

Cronbach's-α displays good internal consistency in the case of children and adolescents with MID, OPDD, and ASD (Cronbach's-α ≥ 0.,700) which means that the reliability of the questionnaire is high in all dimensions of HQOL. In the following cases, however, Cronbach's-α scores were low (Cronbach's-α ≥ 0.700):

- children and adolescents with HI in the dimension of physical well-being (Cronbach's-α=0.686), psychological well-being (Cronbach's-α=0.673) and autonomy and parent relations (Cronbach's-α=0.688);
- children with PD in the dimesnion of physical well-being (Cronbach's-α=0.601);
- children and adolescents with LV in the dimension of autonomy and parent relations (Cronbach's-α=0.518);

– blind children in the dimension of social support and peers (Cronbach's-α =0,303), and school environment (Cronbach's-α=0.499). Due to low Cronbach's-α values, the reliability of the results in the dimensions listed above may be questionable.

The QOL of children and adolescents with disabilities compared to Hungarian reference data

When comparing the T-values of each dimension to the Hungarian reference data (see *Table 3*) while using aggregate results of boys and girls (*Figure 1*), only the subsample of *children with ASD in the dimension of social support and peers had low QOL*. Blind children had slightly higher T-values compared to the average reference data in the dimension of social support and peers. Children with LV displayed slightly higher T-values while *children with PD had much higher T-values compared to reference data (thereby had high QOL) in the dimension of school environment*. Respondents with TD performed average in every dimension of QOL, compared to the Hungarian reference data.

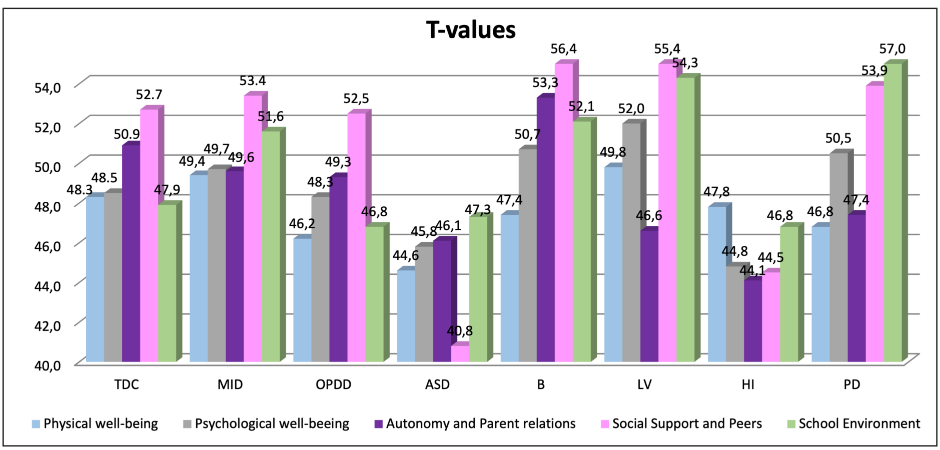
Table 3

T-values meaning average HQOL by dimensions based on Hungarian reference data (The Kidscreen Group Europe 2016)

	Physical well-being	Psycho-logical well-beeing	Autonomy & Parent relations	social sup-port & peers	School Envi-ronment
T-value (means of Hungarian children)	42.37 – 51.77	42.84 – 53.22	43.,15 – 53.90	45.7 – 56.32	42.92 – 53.48

Figure 1

T-values of QOL dimensions in the subsamples



TDC = Typically developing children MID = mild intellectual disability, OPDD = other psychological developmental disorder, ASD = autism spectrum disorder, B = Blindness, LV = low vision, HI = Hearing impairment, PD = physical disability

Characteristics of the QOL of boys and girls in the subsamples, comparison with Hungarian reference data

When comparing the answers of boys and girls separately (see *Table 4 and 5*), the HQOL of both genders with TD is average in comparison with reference data. The ranking of T-values in the different QOL dimensions is almost the same as that found in the ranking of the reference data.

No low QOL were found in the results of children and adolescents with MID. The lowest T-values were found for boys with MID in the dimension of autonomy and parent relations, for girls with MID in the dimension of physical well-being. Boys and girls with MID and with OPDD (like their peers with TD) scored highest QOL in the dimension of social support and peers. For both boys and girls with OPDD, the lowest T-values were found in the dimension of physical well-being, but all *QOL indicators of children with OPDD are average compared to Hungarian reference data.*

As regards boys with ASD, QOL were low in the dimension of social support and peers. T-values in the dimension of school environment were the highest. Although the sample of *girls* (N=3) was too small for drawing comprehensive conclusions, it is worth noting that they had low QOL in the dimension of physical well-being and their *T-values were above average in the dimension of autonomy and parent relations compared to reference data*.

As for *blind subjects, boys' T-values were above average in the dimension of social support and peers while girls exhibited high QOL in autonomy and parent relations*. Boys' T-values were lowest in psychological well-being compared to girls' lowest T-values in physical well-being, while their T-values in both cases appeared in the average zone.

Children with LV (both boys and girls) performed above average QOL T-values in the dimension of school environment, while T-values of boys were even higher in the social support and peers dimension. Boys and girls had their lowest T-values in autonomy and parent relations, but these were still in the average zone.

Boys and girls with HI had low QOL in two dimensions: boys in autonomy and parent relations and social support and peers, girls in social support and peers and in school environment. Boys scored the highest T-values in the dimension of school environment, while girls in physical well-being. However, even these higher values belonged in the average zone.

The *QOL of boys and girls with PD* was equally high in the *school environment dimension, and their QOL in this dimension was above average. Above average values were found in the dimension of social support and peers for boys with PD.* While for both boys and girls, T-values were lowest in the dimension of physical well-being, these values were however average.

Table 4
T-values meaning average HQOL by dimensions and by genders based on Hungarian reference data (The Kidscreen Group Europe. 2016)

Hungarian reference data (Kidscreen Group Europe)	Hungarian boys (T-values)	Hungarian girls (T-values)
Physical well-being	44.08 – 53.68	41.26 – 50.32
Psychological well-being	43.96 – 54.52	42.09 – 52.24
Autonomy & parent relations	44.37 – 54.97	42.36 – 53.14
Social Support & Peers	44.76 – 55.91	46,37 – 56.56
School Environment	42.13 – 52.87	43.50 – 53.91

Table 5
T-values of the subsamples in the different dimensions of QOL, and their discrepancy with Hungarian reference data

		TDC	MID	OPDD	ASD	B	LV	HI	PD
Physical well-being	Boys	49.,5	50.5	47.3	45.1	50.7	49.5	47.1	48.5
	Girls	46.9	47.6	44.0	40.5	42.5	50.2	49.3	43.4
Psychological well-beeing	Boys	50.0	50.6	50.2	46.0	50.4	54.1	43.9	53.2
	Girls	46.8	48.1	44.4	44.8	51.3	49.6	46.5	44.9
Autonomy & Parent relations	Boys	51.9	49.9	50.4	44.5	50.9	47.6	42.6	48.9
	Girls	49.9	49.1	47.2	59.0	57.0	45.5	47.3	44.3
Social support & peers	Boys	52.6	53.8	52.7	39.8	57.1	56,9	44.2	56.1
	Girls	52.8	52.8	52.1	48.3	55.3	53.7	45.1	49.3
School Environment	Boys	48.0	51.3	47.4	46.7	51.2	54.5	48.5	56.7
	Girls	47.8	52.2	45.6	53.1	53.5	54.1	43.2	57.6

TDC= tipically developing children MID= mild intellectual disability, OPDD=other psychological developmental disorder, ASD= autism spectrum disorder, B=Blindness, LV= low vision, HI= Hearing impairement, PD= physical disability; high shadow cell = low QOL compered to Hungarian reference data, dark shadow cell = high QOL compered to Hungarian reference data

Differences in HQOL of children and adolescents with TD and with different disabilities based on ANOVA, differences between means of T-values

When comparing the average T-values of children with disability in all the dimensions to the T-values of children with TD, *psychological well-being was* *the only dimension in which ANOVA detected no differences in any subsample of children with disabilities and children with TD.*

In comparison to children with TD, *children with OPDD achieved lower values in the dimension of physical well-being* (p=0,002), *children with HI in the dimensions of autonomy and parent relations* (p=0,004) *and social support and peers* (p=0,002), *and children with ASD in the dimension of social support and peers* (p<0,001).

In the *dimension of school environment, children with MID* (p<0,001), *low-vision* (p=0,018) *and PD* (p<0,001) *achieved higher QOL based on T-values compared to subjects with TD.*

Differences in HQOL of children and adolescents with different disabilities based on ANOVA, differences between means of T-values

Comparing the T-values of children with different disabilities in the different dimensions of QOL, *the T-values of children with OPDD in the dimension of physical well-being are significantly lower than those of children with MID* (p<0,01). Although the post-hoc tests of ANOVA showed no significant differences among the subsamples in the dimension of physical well-being, the low T-values of children with HI and the high T-values of low-vision subjects must be noted.

Similarly to psychological well-being, children with HI had the lowest QOL among the subsamples in the dimension of autonomy and parent relations (T-value =44.1) as well. Blind subjects achieved the highest T-value (53.3) in this dimension. The difference of the two subsamples in this dimension was significant (p=0.022).

Children with ASD and their peers with HI achieved significantly lower QOL T-values in the dimension of social support and peers than all other subsamples (see *Table* 6).

Table 6

Differences of average T-values in the dimensions of social support and peers. Results of the post-hoc test of ANOVA

Kind of disability					95% Confidence Interval	
1	2	Mean Difference	Std. Error	Sig.	Lower Bound	Upper Bound
ASD	MID	-12.60022*	2.22249	0.000	-19.3408	-5.8597
	OPDD	-11.66612*	2.21325	0.000	-18.,3786	-4.9536
	B	-15.,60128*	3.19938	0.000	-25.,3046	-5.8979
	LV	-14.,59347*	3.02442	0.,000	-23.7662	-5.4208
	HI	-3.70689	2.96992	0.917	-12,.7143	5.3005
	PD	-13.11003*	2.89990	0.000	-21.9051	-4.3150

HI	MID	-8.89333*	2.14773	0.001	-15.4071	-2.3795
	OPDD	-7.95923*	2.13817	0.005	-14.4440	-1.4744
	ASD	3.70689	2.96992	0.917	-5.3005	12.7143
	B	-11.89439*	3.14792	0.004	-21.4416	-2.3471
	LV	-10.88658*	2.96992	0.,006	-19.8940	-1.8792
	PD	-9.40314*	2.84302	0.021	-18.0257	-0.7806

In the dimension of school environment, children and adolescents with PD were found to have significantly higher QOL not only than children with TD (p<0,01), but also their peers with OPDD (p<0,01), and children with HI (p=0,02). In this dimension, lowest T-values were found among children with OPDD and children with HI (T-value =46,8 in both subsamples). QOL T-values of children with OPDD were significantly lower than those of children with PD (p<0,001), MID (p<0,001) and LV (p=0,004). In the dimension of school environment, the QOL of children with HI was significantly different only compared to the QOL of children with PD (p=0,002).

Discussion and conclusions

As a result of our study, we have data regarding the HQOL of 1,056 Hungarian children and adolescents with disabilities and 2,631 children and adolescents with TD. Results for each dimension were compared to the Hungarian reference data (The Kidscreen Group Europe, 2016) and mean T-values of the subsamples by dimensions were also compared with ANOVA.

The results of this QOL assessment partially confirm the results of other research in this field, thereby indicating that the QOL of children and youth with disabilities is lower than that of their peers with TD (Sabaz et al., 2001, Calley et al., 2012; De Vries & Geurts, 2015; Clark et al., 2015; Biggs & Carter, 2016; Wojtkowski et al., 2017).

When comparing the QOL of children with a disability to the Hungarian reference data, only respondents with ASD exhibited low QOL in the dimension of social support and peers. This result contradicts the findings of several studies that found a lower quality of life in children with autism spectrum disorder in several dimensions (De Vries & Geurts, 2015; Biggs & Carter, 2016). Our findings underscore that the respondents with *ASD feel segregated and do not feel accepted by their peers*. As for *blind children, a slightly high QOL appeared in the dimension of social support and peers. In the dimension of school environment, children with LV and PD displayed high QOL based on T-values compered with Hungarian reference data.* (Values of children with LV was only slightly higher than the reference values). Contrary to the research findings of Calley et al. (2012) and Wojtkowsi et al. (2017), children with PD are not characterised by low QOL in any dimension based on the results of our research.

When analysing data for boys and girls separately, below average QOL was detected among children with ASD and those with HI. *QOL of Boys with ASD* *was low in the dimension of social support and peers, while QOL of girls with ASD was low in the dimension of physical well-being. Boys with HI has low QOL in dimensions of autonomy and parent relations and social support and peers. Girls with HI exhibited low QOL in social support and peers and school environment dimensions.* These findings regarding HI girls were confirmed by Roland et al. (2016). In all other subsamples the QOL was mostly the same as the Hungarian reference data, above average QOL was found in the following dimensions:

– Girls with ASD in autonomy and parent relations;
– Blind boys in social support and peers, blind girls in autonomy and parent relations;
– Low-vision boys in social support and peers and school environment, girls in school environment;
– Boys with PD in social support and peers and school environment, girls with PD in school environment.

Comparing the average of T-values of the subsamples with ANOVA, we find that children with OPDD, ASD and HI show significantly lower QOL in various dimensions compared to subjects with TD or other disabilities. The physical well-being of children with OPDD is lower than that of children with TD and MID. This result may refer to the subjective feeling of physical exhaustion and low energy levels of the subsample. Participation in proper amounts and quality of physical activity is an important factor in the QOL of these children. When *comparing children with OPDD to other subsamples (children with PD, MID, LV), we found significantly lower T-values in the dimension of school environment*. Low QOL in this dimension shows that the child does not like school and has negative feelings about it. The result is not surprising, since the majority of the subjects in this subsample were diagnosed with specific learning disorders or ADHD. If they are not taught with proper methods, the children often face failure in learning, meaning that *prevention of negative school experiences is crucial in improving their QOL*.

Children with HI and ASD achieved significantly lower T-values than their peers in various dimensions (autonomy and parent relations, social support and peers, school environment). Low QOL values in the dimension of social support and peers have to be highlighted, because both of the aforementioned subsamples (HI, ASD) had significantly lower T-values compared to all other subsamples. Among this group of children, these results refer to feelings of isolation and the perception of not being accepted. *The real social inclusion of children and adolescents with HI and ASD is therefore crucial in improving their overall QOL.* When we compare subsamples with disabilities to children with TD, *in the dimension of autonomy and parent relations only children with HI achieved significantly lower QOL T-values*. Results show that *in the families of children with HI, complex and comprehensive interventions are necessary in particular*.

The psychological well-being dimension of QOL was the only dimension in which no differences were detected between the subsamples based upon the results of ANOVA. This shows that *children and youth with disability and their peers with TD experience equal levels of happiness and life satisfaction, sadness and loneliness are not characteristic in either subsample.*

We can conclude that not all subsamples of children with disabilities experience lower levels of QOL than their peers. HRQOL of children with MID, VI (blind or low-vision), and PD are equal to that of their TD peers in every dimensions. Children with PDD, ASD and HI are characterised by lower QOL in various dimensions. These particular results may guide the planning and implementation of intervention and find the foci of it.

Limitations

Sampling was representative (national, regional, type of school) only for children and adolescents with TD, MID, and OPDD. In the other subsamples, sampling was randomised and students attended mostly segregated educational institutions. The use of different sampling methods may influence final findings. In some subsamples (especially when data were analysed with respect to gender and age) the number of respondents was low. KIDSCREEN-27 was not validated for different populations of children with disabilities, but its usability with individuals with disability was proven by various international research studies and the internal consistency of the questionnaire was carried out in this research, too.

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The emotional and relational impact of starting kindergarten for non-native speaking children: a case study of a three-year-old child

Toth, Angelika

This paper presents a case study and some results of a longitudinal study conducted from 2013 to 2018 in preschools in Hungary and Switzerland. This study has been prepared as part of the author's PhD research at the University of Geneva (Toth, 2018). The objective of this research was to reveal the relational and emotional experience of entering kindergarten/ school1 for non-native speaking children, i.e., children who do not speak and understand the language spoken at kindergarten or school. (In this case study, the chosen child did not speak Hungarian when she started kindergarten). To capture the complexity of the emotional experience, a special observation form has been chosen called the Esther Bick method (Bick, 1964; Franchi & Toth, 2014), which has been developed in the training of child psychotherapists in the Tavistock Clinic in London. Through the unconscious, projective, and transferential movements captured by the observations and completed by other mainly qualitative tools, I could reveal the internal movements that go through the children and approach their fears and their anxieties.

Keywords: emotional experience, anxieties, starting kindergarten, non-native speaking

Introduction

The preliminary hypothesis was to consider that the transition to kindergarten is in itself an emotionally intense period. For non-native speaking children who enter the compulsory schooling system, this transition might be even more challenging. The reason for this not only lies in the language barrier but also in the difficulties of their families linked with the fact that they are foreigners (migrants or asylum seekers) and living in physical and/or emotional insecurity (for example, they can be afraid of being forced to leave and return to their country at any time). These uncertain conditions represent the reality of many young non-native speaking children in kindergartens and schools throughout Europe.

[1] In Hungary, compulsory education starts with kindergarten for three-year-old children whereas in Switzerland children start school at the age of four and preschool is not obligatory. In this paper, we will focus on the Hungarian kindergarten context.

The study focuses on factors that influence children's emotional states, their evolving relationships with adults and peers, and their capacity to communicate and share experiences regarding their first year in kindergarten. This doctoral research draws upon different research fields and areas, such as educational sciences, intercultural education, child psychoanalysis and observational studies (Tavistock Clinic – Kleinian model), developmental psychology, and the psychology of immigration. For data collection, one Swiss primary school and one Hungarian kindergarten with a high-concentration of immigrant scholars have been chosen, with non-native children in each class. This case study is based on observations realised between 2013 and 2014 in a kindergarten in the eighth district of Budapest with a high concentration of Chinese, Vietnamese, Mongolian, and Iraqi children.

A case study of Ivett

Ivett is a Vietnamese, three-year-old girl. She has a younger sister who stays at home with their nanny while Ivett is at kindergarten. Her parents work at one of the Asian markets of the city. Her mother only appeared on the first days of kindergarten: from this point on, the nanny accompanies her to the kindergarten every morning. Ivett was born in Hungary a few years after her parents moved to the country. Before starting kindergarten, she went to nursery. Physically she is of medium height and looks somewhat babyish because her chest is tilted back and her stomach is pushed forward. She has white skin, black hair, and slanting eyes. Her steps are unstable especially during the first days, like babies who have just learned how to walk. She usually wears two pigtails, a style that lends her a friendly and cheerful appearance. Most of the time she wears nice dresses with colourful tights. Despite her neat appearance, she seems to be emotionally neglected. She is capable of settling down and handling her anxiety on her own. She easily establishes contact with the observer. When she arrives at kindergarten and the observer is already there, Ivett takes her hand and puts her head in her chest. She seeks the observer's physical proximity, gaze, and attention, but does not try to interact with her. Sometimes the way she connects is abrupt, unexpected, and intrusive. For example, she can suddenly jump on the observer and try to sit on her knees.

The experience of separation from the parents

On the first day of kindergarten, Ivett explores the room under the gaze of her mother. They look at each other with love and tenderness. Ivett seems to have a secure and strong attachment to her mother. From the third day of school, her nanny brings Ivett to kindergarten. Her behaviour with the nanny is very different to what she exhibits when with mother: she is distant with her and does not say goodbye when she leaves. Unlike some of the children who cling to their parents and cry desperately, Ivett walks among the tables and explores the classroom without showing any anxiety. However, her uncertain steps and her disharmonious movements seem to reflect her unstable internal state. After several weeks of preschool, when she arrives at the classroom, she freezes, does not move, and walks awkwardly among the tables. She gives the impression of being caught in a state of 'in-between state': she is not in her family area anymore, but she has not yet arrived at kindergarten. This 'in between' state has been observed in most of the non-native speaking children, particularly in moments when the routine changes, for example before breakfast, before going to the playground or after nap time. All changes and unexpected situations seemed to cause fear and anxiety in these children. The following excerpts were taken from an observation made by the author for her doctoral research.

> The children line up for breakfast then they sit down to eat. Ivett, looks very unstable as she stands in the queue and then walks to the table. I worry that she might fall on top of the other children any time. I have the impression that I'm observing a baby who just learned how to walk.
> (Excerpt of observation of Ivett in the second week of kindergarten)

Throughout the first few weeks at kindergarten, after entering the classroom, she sits down at the table where she spent the first days with her mother. Even if she is alone, she seems to be in connection with a loving person.

> After entering the classroom, Ivett spends minutes standing between the drawing board and the door. She watches the children, then she looks at herself in the mirror and gently caresses her face with both hands. She then caresses the drawings on her tights while she looks through the window. It seems like she is in contact with something or someone outside the class.
> (Excerpt of morning observation of Ivett in the fourth week of kindergarten)

Forming relationships

During observations, Ivett interacts almost exclusively with the observer, especially in the beginning of the year. Their non-verbal communication contains a lot of tenderness and affection. She shows the observer the games she has discovered. It seems to be important for her to share her experience and gain recognition from a unique person.

> She tells me "Szia" (Hello) and gives me the wooden booklet she is playing with. She asks: "Kérsz?" (You want some?) [...] She gives me the booklet again and asks "Szép?" (Beautiful?).
> *(*Excerpt of morning observation of Ivett in the first week of kindergarten)

Her first contacts with teachers and classmates are flat and rare. She observes them but does not go towards them. She establishes contact with her teachers about a month after the beginning of the school year. Little by little, Ivett accepts the teachers' invitation to participate in activities. With help and under the gaze of the teachers, her movements are increasingly fluid and steady, but as soon as she is left alone, her movements become disorganised and discontinuous again. It looks as if her body is held by the gaze and the attention of an adult.

> The teacher calls her to the painting activity. Ivett joins her immediately. The teacher helps her to get on a chair, then she puts her hand on Ivett's hand and shows her the movements of painting with a brush: repetitively up and down. The continuous movement enfolds me and puts me in a state of calm. The teacher leaves Ivett to help other children. Alone, her painting movement becomes increasingly jerky, rough, and she stops the up and down move and paints dots. The teacher comes back to her and shows her again what to do. [...]
> I lean back on my chair and feel peaceful.
> (Excerpt of morning observation of Ivett after one month of kindergarten)

After about two months of kindergarten, she begins to have 'crises' (*krízisek* is the Hungarian term for outbursts that is used by her teachers): she screams, slaps, and cries when her classmates approach her. During these moments of distress, Ivett asks her teachers for some consolation. After she receives their help, she regularly goes to them and invites them in various playing activities. With her teachers, Ivett is calm and reassured.

> A little girl presses so hard on her hair clip that Ivett jumps up, makes a high-pitched sound and starts to cry. She runs in the direction of the door with her hand on her head and a sad face. The teacher bends down and Ivett falls into her arms. She puts her face in the crook of his neck and the teacher cradles her like a baby, speaking to her very softly. Ivett looks at the girls while keeping her face half-hidden. The teacher continues to cradle her back and tells her that everything will be fine.
> (Excerpt of morning observation of Ivett after 2.5 months of kindergarten)

During the first month of kindergarten, Ivett is not interested in her classmates. She does not try to interact with them, avoids proximity, and retreats to an isolated corner during group time. She only looks at them when there is a new situation and she is trying to figure out what is going on and what she should do. About a month-and-a-half after the beginning of kindergarten, Ivett starts to interact with older girls. She lets them play with her like a doll: they do her hair and hold her. The teachers call them Ivett's 'new girlfriends'. They sometimes qualify their exchanges as 'violent and aggressive'.

> This morning, two older girls (5- to 6-year-olds) welcome Ivett by hugging her on both sides. Ivett smiles tenderly. The girls pull, push, stroke her as if she were a doll. She does not interact with the girls, does not look at them but lets them manipulate her like an object. She continues to smile as she caresses the 'Hello Kitty' on her T-shirt as if she were trying to calm herself.
> (Excerpt of morning observation of Ivett after 1.5 months of kindergarten)

She does not seem to know how to protect herself from the aggression and the harshness of interactions with her classmates. At the beginning of the school year, she often bumps her feet and her chest and drops toys accidentally. She proceeds the same way with her classmates: she puts herself in dangerous situations, she does not defend herself when the contact is too intense, then she becomes overwhelmed and dissolves into a ‘crisis’ by crying or yelling at her classmates. She does not seem to know how to regulate contact with others. Conflicts with her classmates are more and more frequent. Before the Christmas holidays, her reactions to the slightest interactions are very fragile and sensitive.

> The teacher calls for tidying up. A boy asks Ivett to tidy up. He takes pieces of the puzzle she is playing with and tries to put them in a box, but Ivett protects her game: she lays on the table and covers the game with her arms. She shouts very loudly which scares the little boy who walks away from her. Ivett continues to yell at him in a very aggressive way: her face is red, and her facial expressions are tight.
> (Excerpt of morning observation of Ivett after two months of kindergarten)

At other times, when her classmates are playing next to her, she looks at them as if she wanted to join their game but does not know how to participate. In spring, after six months of school, Ivett is more and more tolerant with her classmates. Towards the end of the year, she is comfortable during group times and tolerates the closeness of her classmates. She has friends and seems to be proud of the relationships she constructed with some of her classmates.

> Ivett touches Ana’s nose while looking at me. She points at her and tells me the girl’s name, looking at me with a big smile. I have the impression that she wants to introduce me to her new friend.
> (Excerpt of morning observation of Ivett after eight months of kindergarten)

Ivett’s verbal and non-verbal communication and the lack of communication

As was mentioned earlier, Ivett communicated with the observer from the first days of kindergarten and sought the adults’ attention and consent.

> Ivett completely colours in a tiny area on her sheet of paper, then she raises it in the air and gives it to the teacher, who congratulates her and shows her where to continue. In the next few minutes, this scene is repeated several times. She raises the sheet after each stroke she makes and seems to need the teacher to give her a positive response.
> (Excerpt of morning observation of Ivett after two months of kindergarten)

Her ‘crises’ decrease as she gains growing confidence in speaking Hungarian. The more she understands and the better she is understood, the less she seems to struggle, and her crises disappear. Even if she does not yet speak fluently in Hungarian at the end of the year, she seems to be more comfortable and calmer in her verbal and non-verbal communication. She does not need to scream, hit or cry in order to express when something bothers her. Also, the confidence and reassurance that the teachers give her help Ivett tolerate when she is not understood by words since she feels to be understood emotionally.

> Ivett looks at the teacher from time to time. I notice that there are a lot moments of silence which are very calming and soothing. There is a good atmosphere and a lot of kindness between Ivett and the teacher. When the teacher gives her full attention Ivett calms down and seems to be contained.
> (Excerpt of morning observation of Ivett after three months of kindergarten)

Discussion

The excerpts taken from observations of Ivett have highlighted the complexity and the fragility of the experience of being a non-native child starting kindergarten. Regarding the separation experience, Ivett and also the majority of the nine children observed in classrooms (Toth, 2018) stayed for a long time in an *'in-between', frozen state* when they entered the classroom. They also froze in unexpected transition situations. We can imagine how disturbing it might be not to understand what is going on. Fortunately, children found strategies to reassure themselves. Some of them leaned on loving internal relations while others found support from adults or peers in their new environment.

Ivett chose the observer as the person to lean on emotionally. After three months of kindergarten, when she was less worried and more confident, she could gradually open up to others. We can imagine that the observer's presence remained her *early experiences of a fusional "one-on-one' relationship* with her mother. She perhaps needed to be in contact with this unique relationship before opening up to collective experience. Knowing this, the questions remains of what is needed to establish a relationship between children and teacher.

The teachers' openness to children, their trustful behaviour and sensitivity to the children's unspoken signals promote confidence and help children contain their anxieties. On the other side, the ability of teachers to connect with children's fears is also influenced by their apprehension of being able to understand them (Franchi, 2014a). This ability to understand is not only due to language skills but also *to the cultural similarities or differences* they consider with children (Franchi, 2014b; Payet et al., 2011; Rosenbaum, 2010). Sometimes, cultural factors can interfere in these evolving relationships, and it becomes difficult for teachers to see the child behind his/her slanting eyes, the different smell of his/her clothes or his/her strange behaviour.

Children's reactions to a language barrier can be numerous. Some of them respond with anger to the feeling of not being understood. As was mentioned above, Ivett initially responded with indifference when her classmates did not understand her. She let them manipulate her like a doll. Then she reacted violently by screaming, slapping, and crying. Her aggressive behaviour changed when she began to feel that her teachers understood her. She was then more able to tolerate the missing words and started to use non-verbal language to express herself. At this point, the teachers' ability to recognise how difficult it was for her not to be understood helped Ivett feel better. The teachers' willingness and ability to interact with non-native speakers can reduce children's anxieties regarding the unspeakable and untalkable experience they were having (Rosenbaum, 2010).

To conclude, the language barrier for non-native children can not only render the children more fragile but also threaten their emerging relationships with teachers and peers. Being separated from their parents and finding their place in kindergarten is in itself full of fears and struggles. The way teachers and peers consider communication difficulties and cultural differences with non-native children can strengthen their fears and struggles. This is why it is essential with all children and with non-native speakers in particular, that teachers stay emotionally available to children's needs and manage their own needs elsewhere. This is also one the main challenges of being a teacher.

This paper shows only a tiny part of the findings highlighted by the PhD study. The whole study was based on 82 classroom observations of nine children conducted in Geneva and Budapest, with dozens of interviews, surveys and other tools (e.g., relationship scales). Other findings and case-studies will be presented in future publications. Last but not least, it would be worthwhile to mention again the originality of the Esther Bick (1964) observation method used as a tool in Educational Studies. The observer's conscious and unconscious attention and the emotional turbulences he/she identified and tolerated in classrooms allowed the observer to gain an insight into the internal states and the emotional experiences of children. This psychoanalytical orientation is ground-breaking in educational research.

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