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Information Processing Speed and Academic Success: A Qualitative Inquiry Into the Perception of Teachers and Parents by Students

Szybkość przetwarzania informacji a sukcesy szkolne. Jakościowe badanie postrzegania uczniów przez nauczycieli i rodziców

KEYWORDS

mental speed, motor speed, school performance, school performace, cognitive abilities

ABSTRACT

In the article, the construct of mental speed is analysed as a biologically predetermined basic cognitive skill. It presents the results of research aimed to investigate the relationship between motor/mental speed and students' school performance from the point of view of teachers and parents. Applying procedures of the qualitative research paradigm, the central method of data collection was a semi-structured interview with 17 teachers and 10 parents of students with extreme (both high and low) values of mental and motor pace. The analysis of the interviews with the teachers provides information on stereotyping pupils with a higher mental and motor pace. In their teaching practice, teachers do not reflect enough on students' different mental and motor pace. There are almost no modifications of the curriculum, levels of task difficulty, differentiation of assignments e.g. according to cognitive demands of assignments. Also, a connection was revealed between both teachers and parents' self-perceived temperament types and their attitude towards children with a low mental pace.

SŁOWA KLUCZE

szybkość mentalna, szybkość motoryczna, wyniki szkolne, zdolności poznawcze

ABSTRAKT

W artykule analizowany jest konstrukt szybkości mentalnej jako biologicznie uwarunkowanej podstawowej zdolności poznawczej. Przedstawiono wyniki badań dotyczących związku między szybkością motoryczną i mentalną a wynikami uczniów w szkole z perspektywy nauczycieli i rodziców. Wykorzystując procedury jakościowego paradygmatu badawczego, podstawową metodą zbierania danych był półustrukturyzowany wywiad przeprowadzony z 17 nauczycielami oraz 10 rodzicami uczniów o skrajnych (zarówno wysokich, jak i niskich) wartościach tempa mentalnego i motorycznego. Analiza wywiadów z nauczycielami dostarcza informacji na temat stereotypizacji uczniów o wyższym tempie mentalnym i motorycznym. W praktyce dydaktycznej nauczyciele nie uwzględniają w wystarczającym stopniu różnic w tempie mentalnym i motorycznym uczniów. Niemal nie dokonuje się modyfikacji programu nauczania, poziomu trudności zadań ani różnicowania poleceń np. pod względem wymagań poznawczych. Ponadto ujawniono związek między samoocenianym typem temperamentu nauczycieli i rodziców a ich podejściem do dzieci o niskim tempie mentalnym.

Introduction

When defining both the construct of intelligence and the structure of a person's cognitive abilities, fundamental constructs are often considered. In older sources of psychological literature a large number of studies can be found focused on investigation of biological foundations of human intelligence. Basic cognitive mechanisms are perceived as more fundamental than other elementary mechanisms of cognition. According to Roberts & Stankov (1999), these biologically predetermined constructs include the concept of mental speed, also referred to in professional literature as information processing speed. More recent studies of cognitive performance speed perceive it as a phenomenon causing differences in a person's other cognitive characteristics. Extensive research focused on mental/cognitive speed has been carried out in many different countries. In the current literature, there are a substantial number of empirical studies investigating the relationship between a person's mental speed and cognitive abilities. McAuley & White's (2011) research results show that information processing speed, inhibition and working memory are separable abilities and the extent of this separability is stable during development. In other words, it cannot be automatically expected that a "slower" person with lower information processing speed inevitably has a lower level of other executive and cognitive processes. Nuño et al. (2021) examined mental speed in a clinical population of patients with depression.

Neurological correlates of information processing speed were a subject of research by Silva et al. (2019). Andersen et al. (2023) analysed influences of digital technologies on changes in a person's mental speed. Experimental interventions to increase mental speed have also been explored: e.g. Moore et al. (2023) assessed the impact of the ReadRx reading intervention on cognition including information processing speed. Tsai et al. (2019) studied the connection between motor competence and muscular fitness with information processing speed in preschool children.

The research by McEachern (2017) has shown that slow information processing in students is often misinterpreted as laziness, which can negatively affect their self-esteem and school success. The authors identified a significant relationship between processing speed, working memory and mathematics performance, considering these factors as predictors of numerical intelligence. In contrast, Malone and colleagues (2022) highlight the relationship between motor skills and executive functions as elements of school readiness. Although they are related, the researchers emphasise their partial independence. The strongest correlations between these abilities are observed in early childhood (Kim et al., 2018; Floyer-Lea & Matthews, 2004), supporting Anderson's (2007) concept of shared brain areas involved in different cognitive tasks. The research by Roebers et al. (2014) and Pitchford et al. (2016) indicate that executive functions are more important for school achievement than motor skills – particularly in reading, writing and mathematics.

In our article, the subject of analysis is students' mental speed as a determinant of school performance. The construct is examined from the point of view of parents and teachers.

Research Problem

The data presented in this article is a part of a more complex research focused on the relationship between mental speed, cognitive flexibility and school performance (Kovalčiková & Miecznik-Warda, 2022). The research also includes questions of a descriptive nature: How do teachers evaluate performance of students with different mental speed during class? How do teachers take into account students' mental pace during the education process? How do parents think about their children's mental pace in relation to their academic results?

Methodology of Research

Participants. The research was carried out at a randomly selected elementary school in Sosnowiec (Province of Silesia), Poland. The sampling frame was the online search

engine for schools and educational institutions on the website of the Ministry of Education and Science of the Republic of Poland. Three schools were included in the research by lottery from the database of schools in the Province of Silesia. The basic selection criterion for the school to be chosen was the school management willing to participate in the research activities. The study included students, teachers and parents of children from the 3rd, 4th and 5th grades of the primary school. The research was carried out in 2022–2023. Phase 1 included 100 students of the 3rd, 4th and 5th grades, diagnosed with tools measuring mental and motor speed (hereinafter MeMoS). In the relational research investigating relationships between MeMoS and school performance (Kovalčiková & Miecznik-Warda, 2022), pupils with extreme (both low and high) MeMoS values measured with D-KEFS TMT (Delis et al., 2001) and the test "Pętelkowanie" ["Looping"] (Bogdanowicz et al., 2008) were identified. The first test belongs to the D-KEFS group of tests to measure the level of executive functioning of children and adults aged 8–89 years. It was developed by Dean Delis, Edith Kaplan and Joel Kramer and published in 2001. The Road Test – D-KEFS (TMT – Test of Test Taking) focuses on cognitive flexibility, visual attention, mental and motor speed. It consists of 5 subtests: visual research, number layout, letter layout, alternating letters and numbers – cognitive flexibility and mental speed as well as motor speed. In the study in question, a subtest examining motor and mental speed was used to select the group. Another test aimed to select the research group is the "Looping" test. This is a subtest of the "group of methods for diagnosing the causes of pupils' school failure" (Bogdanowicz et al., 2008). It assesses the level of fine motor skills, hand mobility (exercised activity), hand dominance and eye coordination. A respondent draws loops in one minute. By comparing the test results with the standardised performance, we also get information about the person's motor speed.

Teachers and parents of those children, who were diverse in personality, both calm and reflective and energetic and socially active, were then included in the study.

Thus, the interviewed participants were intentionally selected based on results of the previous phase of research. Seventeen teachers participated in the study, including 12 women and 5 men, with professional experience ranging from 9 to 22 years. They represented various specialisations: four Polish language teachers, three mathematics teachers, five early childhood education teachers, two natural science teachers, one history teacher, and two art teachers. The majority were nominated teachers (N = 9), while the remainder were chartered teachers (N = 8).

Ten parents also took part; all of them were mothers of the pupils (six mothers of boys and four mothers of girls). The mothers' socio-cultural status was assessed using three indicators: level of education, occupation and place of residence. The analysis showed that six of the mothers held a higher-education degree, and four had completed secondary education. In terms of employment, some worked in the service and

trade sector, some in specialised professions, and the rest as administrative/clerical staff or self-employed business owners. Most lived in medium-sized and large cities (N = 8), while two respondents came from rural areas. The collected data indicate that these mothers can be classified as having a moderate to high socio-cultural status.

Tools and Procedures

The basic method of data collection was a semi-structured interview. Questions posed to teachers concerned their self-assessment of temperament traits, knowledge of pupils' cognitive characteristics, diagnostic practices in the educational process, and their approaches to working with students exhibiting different MeMoS. They were as follows:

- Which temperament type do you identify with? Are you more impulsive and fast-paced, or rather slower, calm, and reflective?
- How do your students differ from one another? With which students is it easier for you to work: those who are more impulsive and quicker, or those who are calmer, slower, and more reflective? Why?
- In your work, can you recognise students with low mental processing speed? How do they function in class? Do they encounter difficulties? What kind? How do they cope?
- Similarly, can you recognise students with high mental processing speed? How do they function in class? Do they encounter difficulties? What kind? How do they cope?
- What test results do students with high processing speed achieve? And those with low processing speed?
- Do you notice differences in test outcomes between these two groups? What academic results do they attain?
- Do you believe that students' academic outcomes are related to their mental processing speed?
- How do you individualise your instruction for these students? Which forms and methods do you use?
- With which type of student is it easier for you to work with? Why? What are the advantages of working with each type of students and how do you leverage them?
- What challenges arise when working with a student who has low mental processing speed? How do you address them?
- In your opinion, how do children with low mental processing speed function within the school environment?

- In light of our conversation, what kinds of support measures do you think would be helpful for these students?
- Questions posed to parents concerned their self-assessment of temperament dispositions, their children's school achievements from the parents' perspective, and their children's study habits at home:
- How would you describe your child? What temperament type do they exhibit? Are they slow and calm, or quick and impulsive?
- How do you assess your child's level of knowledge and skills?
- Does your child enjoy going to school? Do they enjoy studying?
- What academic results does your child achieve? Are they satisfied with them? How about you?
- Does your child experience difficulties in learning? If so, what kind of difficulties?
- Are these difficulties primarily school-based or related to homework? How does your child cope with them?
- Do you think these learning difficulties are related to your child's temperament traits?
- If your child has difficulties at school, what form of support does the school provide? Do teachers respond to these difficulties? How?
- If there are no difficulties, do you believe this is related to your child's temperament or their work habits in class?
- How does your child handle homework at home? How much time do they spend studying? Do they work slowly or quickly? Do these traits help or hinder their work?
- Is your child independent in their studies? Do you assist them? To what extent? Does your child expect your help?
- What is the atmosphere like during home study sessions?
- In your opinion, how does your child function academically both at school and at home? How do they cope with assigned tasks?
- Considering our entire discussion, what recommendations would you make regarding the education of students like yours?

Data Analysis

Recorded interviews with parents and teachers were transcripted. Categories of the data were formed ad hoc from the empirical material. The analysed categories represented a generalisation based on the level of specific relationships between acquired pieces of information. The study was conducted using Reflexive Thematic Analysis in accordance with Braun and Clarke's (2022) guidelines. Semi-structured interviews

with teachers and parents of pupils displaying varying processing speeds (MeMoS) were subjected to a six-phase thematic analysis:

1. Familiarisation with the data: Interview transcripts were read repeatedly, with initial observations and potential areas of interest noted.
2. Coding: Based on excerpts from the participants' accounts, codes were generated, including: difficulties copying from the board; accuracy versus speed; catch-up strategies during breaks; experienced stress and frustration; impulsivity of faster students. Each code reflected a specific strategy, problem, or emotional aspect described by the respondents.
3. Generating initial themes: Codes were grouped into four primary thematic threads: perceptions of slower and faster pace (codes: graphomotor difficulties; perceived ability), Coping strategies (codes: breaks; borrowing notebooks; additional tasks), Emotional and social consequences (codes: stress; diminished motivation; peer relationships), Educational recommendations (codes: time individualisation; task adaptation; parental expectations)
4. Developing and reviewing themes: Themes underwent iterative review; some codes were merged (e.g., "stress" with "frustration"), others separated (e.g., "strategy of hiding unfinished work" from "working during breaks"), to better capture the diversity of the participants' experiences.
5. Refining, defining, and naming themes: Each theme was assigned a descriptive label reflecting its essence: Slower and Faster Pace – Classroom Perceptions; Pupils' and Teachers' Coping Methods; Emotional and Social Effects of Pace Differences; Expectations and Recommendations for the Education System.
6. Writing up: Findings were presented alongside illustrative quotations from teachers and parents.

This analytic approach provides an in-depth understanding of how differences in processing speed influence students' academic success and identifies strategies and recommendations to improve instructional practice.

Interviews With Teachers

Perceiving slower vs. faster pupils. Teachers describe pupils with slower MeMoS as less successful, as weaker and having trouble keeping up with peers. Their problems are related to writing off the blackboard within the specified time, slower performance of written exercises, failure to fulfil assigned tasks in class, and failure to finish both tests and written work. Art teachers report that such pupils usually fail to finish art and technical works. They believe that the "slowness" of performance is most likely related to students' less developed fine motor skills. Elementary teachers think that the child, who writes slowly, writes misshapen letters usually of different sizes, does

not follow the line, and has problems with graphomotorics. Some teachers report that students work slowly because they care too much about the quality of their handwriting. Their work is precise and handwriting neat, but they are not able to finish work within the specified time.

Pupils of higher grades try to cope with the problems of keeping up with the work pace on their own. Teachers report that students work during breaks, borrow exercise books from school mates, take photos of the blackboard (with the teacher's permission) and finish school tasks at home. One teacher notes that these pupils' problems are related to stress due to their inability to keep up with others, resulting in decreased achievement motivation. Teachers also observe that if students fail to finish tasks, they often try to hide the unfinished work to prevent working during breaks or they ask for the option to finish the work at home. Their exercise books often contain gaps, empty lines and unfinished tasks. One teacher pointed out that *"these students get stressed by the fact that the others have finished and they have not; (…) they get tired of the task because it takes them longer than the others, and they get frustrated quicker with what is happening during the lesson"*.

According to teachers, pupils with high MeMoS write fast, perform manual, art, technical and manipulation works fast. They learn well and cause no problems in class. Some teachers note that pupils with high MeMoS are often imprecise, the handwriting of pupils who write fast is not neat, and they often make spelling and punctuation mistakes, omit letters or change their shapes. According to teachers, the mistakes are the result of impulsive behaviour and a lack of concentration. Art teachers note that the work of such pupils is superficial and lacking in detail.

According to most respondents, slow MeMoS students achieve considerably lower academic results than their peers working faster in class.

Assessing pupils' mental speed. All teachers report to be able to recognise differences in their pupils' mental speed even without specific diagnostic means. The above behaviours reported by teachers can be summarised as follows: low MeMoS pupils are passive, do not respond to stimuli and orders, solve tasks slowly and have fewer ideas for solution of problem tasks than their faster-thinking peers. They are unlikely to finish a test within the specified time. The biggest problem is "to keep up" with other pupils when working together in class. This leads to the need for an individual approach to the student and additional instructions. Slow pupils require repeated reminders of work instructions and frequent guidance on specific tasks. Based on teachers' observations, such pupils are perceived by their peers as weaker and less helpful in class. Most teachers treat them as unable to cope with school demands.

According to teachers, high MeMoS students are the most visible in class. They have many task-solving ideas, they are active, always first to respond, they always finish tests in advance, they are first in math calculations and with ideas for solving

problems. Teachers add that such pupils are usually over-impulsive in their reactions; they think fast and respond fast, sometimes without thinking. They often work in the "trial/error" scheme. The speed with which they react means that they sometimes loose attention or the ability to notice details and think in terms of the requirements of the tasks they are performing. They may be superficial. Respondents also notice that some high MeMoS pupils can overwhelm the teacher with their presence, "rush" others with their work pace, are impatient and less tolerant towards slower students. Having solved their tasks, they often disturb others. Such experience, however, does not influence the general opinion of most respondents that pupils with high mental speed are perceived as more talented and skilful than their peers.

Educational procedures. Interviewed teachers say that they try to implement various ways and methods of work with pupils with extremely different paces. All report that they take into account differences in such students' activities in class. All interviewed teachers unanimously report that, according to their observations, pupils with lower mental speed, i.e. slow thinkers, write and also perform various practical activities at a slow pace. Thus, respondents perceive the connections between the mental speed. Teachers report various ways and methods of work with pupils with different MeMoS. For high MeMoS pupils, they prepare additional tasks, worksheets, workbooks for development of cognitive processes, (e.g. analytical thinking, visual perception), use classroom libraries – work with encyclopaedias, read books, delegate looking up concepts relating to the subject matter in encyclopaedias and presenting them to the class after completion of tasks by all pupils, create classroom rules for subsequent activities after finishing work (tidy up one's place, help a school mate, read an interesting fact from the presented envelope and inform others about it, pick another task from the "task box" and complete it).

Low MeMoS pupils are adjusted the number of tasks in tests, extended time for tests – allowed to finish tests during breaks; reduced the amount of text to write off from the blackboard, allowed to take photos of the blackboard, notes from schoolmates; teachers themselves decide which pupil will answer the question (to eliminate "pupil hand raising").

Interviewed teachers report these advantages of working with higher MeMoS pupils: dynamic work in class, progress by curriculum, possible use of other attractive forms and methods of work in result of the created time space. In the education process, teachers prefer to work with higher MeMoS pupils.

Interviews With Parents

Description of pupils' situation at school. Analysis of statements of parents of children diagnosed (in a previous phase of our research) with a lower level of MeMoS shows

a general tendency in the opinions that these children have problems at school. Most respondents confirm that their children, despite their willingness to go to school, do not want to learn. It is difficult for them to fulfil school duties and study. Their performance at school is often assessed as below average. Parents report that the children do not seem to be less intelligent; their problems with learning are rather caused by their slow work pace, problems with concentration, and insufficient time to complete assignments. Their greatest difficulties are caused by tests, because the children are unable to complete them on time. Moreover, such children experience stress in every lesson, because they have problems to write off the blackboard, complete the assignment in the time limit and keep up with their school mates. Then, at home, they have to ask their friends what is for homework because they did not have time to write it down in exercise books. Parents are aware of children's under-achievement at school. They have to try hard to help their children catch up on what they missed at school. However, they report that the extent of the child's problems depends on the teacher's ways of working. Some parents are aware of their children's slow pace of work, but they know that their teachers prefer the children to finish the task in the common room during breaks. In general, parents appreciate teachers' work because teachers often spend their free time during breaks helping their children.

Interviews with parents show that another problem of low MeMoS pupils is relationships with peers. Such children, especially in higher grades, are considered slow thinkers; there are situations when they are laughed at by their peers for their "slowness", inability to "keep up" with the class, as well as for slow movement reactions in physical education class. One mother described her child's difficulties with peer relationships in the classroom as follows: *"She's in a pretty dynamic class and she's quieter; she has different interests than her peers. They found a sort of weaker link in her (...); unfortunately she began to function in the classroom as the class fool who can be laughed at and who will not react. (…) After that, she had a blockage because they were laughing at her. The same at PE. She excels in individual sports, but in team sports she cannot keep up with her colleagues, her friends. There's a problem because she didn't run that fast, she didn't catch the ball. Well, so they are laughing at her".*

Opinions of parents of high MeMoS children are different. Such children like school. Respondents say that teachers talk positively about these pupils, they appreciate that they are active, respond promptly and fulfil instructions fast. The children have no problems in relationships with peers. However, parents notice some problems, especially during tests and exams. "Fast" children are often inattentive; they do not read instructions till the end and misinterpret them. Respondents think that it is caused by the desire to finish the task quickly, "to be the first", and by the reluctance to sit at the desk for a long time. Parents of younger pupils note that, if in a hurry, these children's handwriting is illegible, their descriptions of things in a creative assignment

are too brief, and they use short sentences instead of complex clauses. Parents report that some teachers ask those students to correct their work while other teachers do not require it. Most parents say that they are not satisfied if teachers do not require corrections of fast but imperfect performance. Parents agree that not all teachers adjust teaching methods and procedures to pupils with a different work pace. As a standard, teachers work with the whole class at a uniform pace without differentiating tasks and time demands. They require the same and at the same time from all pupils. Parents try to help their children with homework giving some tips, advice, and even clocks to watch the time, or send them to special courses helping them to concentrate.

Description of students' situation at home. Mothers of slow MeMoS pupils describe how much time their children spend on homework. Such children require constant care and supervision. They work, write, learn and think at a slow pace. Mothers attribute it either to children's bad concentration or calm nature. As one interviewee stated, *"my son's favourite expression is 'I don't know'. And it's 'I don't know' not because he doesn't know; it's because he probably doesn't want to think. I have to pour out my frustration on him sometimes to make him want to think"*. These mothers admit that the atmosphere at home while working is unfortunately not positive. In some homes, there are even conflicts and tensions between a child and a parent. Mothers often used to say that their children would then retreat into themselves, and no longer give anything of themselves and give up.

Mothers describing themselves as energetic cannot understand why their children need so much time to finish tasks. They attribute this condition to laziness or bad concentration. One mother describes her son as follows: *"I must admit that my son is completely different from me. He is much calmer, even phlegmatic, which drives me mad. I guess he does not know what I think inside, because I do everything for him and I do not want him to feel it. I try not to hurry him, not to stress him, but it is a challenge"*. Mothers describing themselves as calm and rather reflective try to create enough time for their children to do homework and seek professional advice to help them. They say that it is no great frustration or problem for them; they understand their children's needs.

According to their parents, high MeMoS pupils do homework quickly and efficiently, but often inconsistently. The time they spend on learning is too short. Parents say that their children are energetic, active and bright. Teachers endorse parents' opinions. Homework is done in a positive atmosphere at home. Parents report that their children do not like to correct their mistakes when pointed out, do not like to return to the work done, do not like to check the completed assignment. As a result, according to parents, although the children complete tasks quickly, they often make mistakes due to inattention.

Parents demand teachers to pay more attention to slow MeMoS pupils, to use methods allowing all pupils to understand the subject matter. Parents express the

opinion that teachers should adjust the amount and type of homework to children's work pace, and that it is not right if most teachers adjust the pace of work to the fastest pupils in class.

Discussion

Professional discussion on students' cognitive characteristics provides space for reflection on methods of working with pupils with different educational needs. Research in the cognitive construct of mental speed allows perceiving information processing speed as a determinant of such individual behaviours that are considered constituents of "intelligence" or cognitive abilities. However, manifestations and contexts of cognitive abilities predetermined by mental speed in the school context are not a frequent subject of research. The finding of the present descriptive investigation is that there is a connection between the teacher's and the parent's (self)perceived temperament type and the relationship between assessing and respecting differences in children's mental speed. In the opinion of teachers describing themselves as energetic and temperamentally strong, low MeMoS pupils are passive and academically weaker. Such assessment of low MeMoS pupils exerts a significant influence on the evaluation of their performance at school and their school achievement manifested in the classification grade. Teachers describing themselves as temperamentally balanced and introverted believe that the speed of work does not influence academic results if pupils have enough time to complete tasks. Interviews show that these teachers individualise instruction more.

In general, teachers claim to recognise pupils with different MeMoS without problems. Low MeMoS pupils write slowly and think slowly. Interviews with teachers provide information about positive stereotyping of higher MeMoS pupils. All interviewed teachers perceive them as bright and quick thinkers, active and creative ones. Paradoxically, however, teachers also report that their literary or art works often lack precision, are rather brief and without details. Some of such students are also superficial and imprecise. Their responses are influenced by impulsiveness – they are not always well thought out and right. Yet, fast MeMoS pupils, especially if they are also talkative, are considered more intelligent, and they are easier to work with in class. Some teachers seek educational solutions in individualised instruction. They prepare supplementary tasks and worksheets for high MeMoS pupils. On the other hand, they give more time to low MeMoS pupils to complete assignments, but often at the expense of breaks. They even reduce the number of tasks in tests. Respondents' answers show that there are almost no modifications of the curriculum, levels of task difficulty, assignment differentiations, e.g. by cognitive requirements. In this context, it is appropriate to state that while higher mental speed is in general associated with better academic performance, it is only one of many factors contributing to pupils'

academic success. Other cognitive abilities, such as working memory, attention control, motivation and metacognition, also play a significant role (Md Hassan & Rahman, 2017; Prokhoroy et al., 2015). Pupils with lower mental speed may show other cognitive strengths contributing to their academic success and ability to learn. Their strengths may include e.g. the quality and depth of thinking, level of analytical thinking – although they need more time to analyse information, this may lead to a deeper understanding and critical evaluation of concepts. Such pupils often excel in social science subjects requiring thoughtful reflection. Slower information processing allows pupils to create unique ideas and approaches to problems. We are of the opinion that current teacher training should include applied knowledge about the pupil cognitive equipment as the basis for effective individualised education also of slower, but perhaps more analytically thinking, students.

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