

# Children's conceptions of memory and imagination - from conceptual knowledge to metacognition. Phenomenographical study

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## ABSTRACT

The article presents a research project which applied the methodology of phenomenography to describe children's conceptions of memory and imagination. The comparison of two mental concepts was considered a natural cognitive procedure, conducive to reflection on one's own knowledge concerning the features of thought processes and relationships between them. The graphic and verbal explications developed in the course of the task were used to build a map of children's ways of conceptualizing memory and imagination. A group of 59 nine-year-old children (third grade students of several Polish public schools) participated in the research. The conceptions identified as a result of the phenomenographic analysis (a/ memory and imagination as a mental action; b/ memory and imagination as a mental product, and c/ memory and imagination as the subject's resource) proved to be cumulative and inseparable, i.e. the conceptions with a higher level of complexity and sophistication contained elements of simpler, less mature conceptualizations. The analysis of the collected materials leads to the conclusion that organizing one's own metacognitive knowledge in terms of similarities and differences between cognitive processes can provide an important mechanism for learning, allowing to trigger the meanings' movement between different dimensions of subject's awareness - implicit and explicit, subjective and objective one. The task designed as research tool can be used by teachers as a sort of scaffolding for awakening and supporting children's abilities which are in the zone of proximal development, in the course of intensive development. Conclusions and implications for further research are presented in the summary of the text.

## Introduction

Children's conceptions of thinking have been a fascinating area of research of pedagogy and psychology, which, despite many years of research tradition, still reveals some white spots and unexplained areas of meaning. Despite the fact that the topic has been developing intensively, attracting the attention of many researchers, it also struggles with obstacles and doubts of a methodological nature: How does metacognitive knowledge of a small child develop? To what extent does the pre-conceptual, intuitive understanding of mental activity deserve the term "metacognitive knowledge"? How to construct a task to enable a child to express their knowledge of the mental world? Research indicates that metacognitive reasoning is an important factor shaping the effectiveness of education at the elementary level (Kuhn, Weinstock 2002; Bendixen, Feucht 2010; Lewis 2019). The better the children understand the principles of the

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learning process, the sooner they are able to take conscious control of its course. The better they understand what knowledge is and how it can be organized in the human mind, the more aware they become of their own role in its construction. Metacognitive self-knowledge, what we know about ourselves as a thinker and a knower, seems to be particularly important in this development: "Such self-knowledge can be used not only to inform and support action, but also it underpins our concepts and identity as a thinker and a learner" (Tarrant and Holt, 2016: 1). However, none of these areas of consciousness develop automatically and mechanically - the educational environment can play both a stimulating and blocking role in this process. Although there are empirical grounds to believe that this type of didactic intervention can be effective and beneficial already at the stage of elementary education (Tarrant and Holt 2016; Shilling and Schwartz, 2017; Muncaster, Clarke 2018), in order to effectively support reflection and metacognitive self-knowledge of children it is necessary to understand the core of their development well. The article represents the trend towards explaining the mechanisms of shaping metacognitive knowledge in children, and its main aim is to show a child's ability to compare two mental concepts (using memory and imagination as an example) - explaining the similarities and differences between them. The paper consists of three main parts. The theoretical part presents the concept of metacognitive knowledge and selected models of its development. The second part is devoted to research on the elementary children's understanding of the concepts of memory and imagination. The phenomenographic methodology was applied and the children were invited to construct an inter-semiotic representation of both concepts in the form of a drawing and a verbal explanation. The analysis of the collected statements resulted in the construction of a specific map of children's mental experiences, including various ways of conceptualizing memory and imagination. The summary of the text indicates the implications for further research in this area.

### Conceptual knowledge as an area of metacognition

The origins of metacognition research can be traced back to J.H. Flavell's studies on "thinking about thinking" (1979; 1995). According to his classic definition metacognition is a higher order thinking used to actively monitor and regulate the basic cognitive processes involved in the acquisition of knowledge and skills (Flavell, 1979). The essence of metacognition, therefore, can be defined as any consciously undertaken reflection on the course or effects of one's own thinking, or in a broader sense - the unique ability of the human mind to discover itself (Nęcka et al, 2006: 639), to be aware of the knowledge possessed, its completeness and validity, its sources of origin, possible gaps or uncertain, controversial elements. Although the fuzziness of the metacognition concepts has been often criticized, the basic distinction between the three interconnected components of metacognition seems widely accepted (Flavell 1979; Schneider & Lockl 2002; Tarricone 2011; Misailidi 2010). These are: a/ declarative knowledge of cognition; b/ ability to monitor and regulate the course of one's own cognitive processes, and c/ metacognitive experiences, i.e. a system of personal feelings, assessments and beliefs regarding learning, activated at the time of processing a specific task.

However, the status of metacognitive knowledge in this system is relatively unclear. On the one hand, as many researchers emphasize, there is no direct translation of this knowledge into the ability to consciously control one's own mental processes (even detailed, declarative knowledge of various learning strategies cannot guarantee that the learner will be able to efficiently and effectively manage the course of their own reasoning) (Kanevsky 1995; Veenman et.al 2006; Misailidi 2010; Efklides 2009). On the other hand, it is difficult to imagine mastering the ability to monitor and regulate one's own cognitive processes without at least rudimentary awareness of their distinctive features, or variables essential for their course.

The attempts to resolve this dilemma have led researchers to believe that declarative knowledge of the mind, although extremely important, plays rather an indirect role in the development of the subject's metacognitive abilities (Flavell 1981; Pillow 2008; Kanewsky & Geake 2004). One of the possible explanations was offered by Efklides (2006) who proves that conceptual knowledge of the mental world is subject to strong interactions with affectively charged metacognitive experiences. Metacognitive experiences, specially their emotional parts, i.e. feelings, beliefs, impressions, are sometimes referred to as "online metacognition" (Efklides 2006: 5) or "online awareness" (Tarricone 2011: 172), which suggests that they are not only directly engaged in monitoring metacognitive processes, but also have a reciprocal effect on its course through interaction with more general and static metacognitive knowledge. Therefore, they influence the subject's metacognitive activity - by stimulating the monitoring and strategic regulation of learning, providing feedback on disruptions in the flow of the processing operations, the potential barriers or the level of satisfaction/ dissatisfaction with the pace of work, invested effort or achieved results (Efklides 2006; 2009). In addition, research indicates that metacognitive experiences are strongly involved not only in the regulation of the subject's current cognitive activity, but also in self-regulating behaviors in a long-term perspective, being interrelated to one's self-image as a thinker and learner (Efklides 2006: 8). Metacognitive feelings and beliefs derived from one specific learning situation participate in cause-effect attribution, i.e. assigning responsibility for the quality of the results achieved to internal or external variables (Tarricone 2011: 173). Such attributions shape a child's perceived self-efficacy, defined as a system of personal beliefs and affective reactions, such as doubts or fears, relating to one's ability to organize and implement the actions necessary to achieve the planned level of implementation of a specific task (Zimmerman 2005; Geurten et.al. 2018). Therefore, metacognitive knowledge therefore has a complex, multidimensional character, with general aspects (concerning the cognition and mind's activity in general) interconnected with personal components (concerning the features of the cognizing subject) (see: Tarricone 2011; Proust 2015; Kuhn 2000a; Schneider & Lockl 2002; Veenman et.al 2006; Efklides 2011; Papaleontiou 2019 for extended review)

From a broader perspective, metacognitive knowledge might be seen as just one of the factors contributing to a learning potential of an individual. The study reported by Kanevsky and Geake (2004) offers a three-dimensional model of a learner's intellectual potential where such factors as: metacognitive knowledge, general knowledge base and information processing efficiency simultaneously and mutually interact with each other. Metacognitive knowledge refers to a learner's awareness of his/ her own thinking, skills related to planning, monitoring and strategically managing the learning process (2004: 184). It determines how well information is selected from

the general knowledge base, and how efficiently it is combined and sequenced (which information or skill is retrieved from general knowledge, and how it is applied in a particular task). It provides a form of "executive synthesis" to the learning (2004: 189). At the same time, however, metacognitive knowledge itself is influenced by both, the individual's information processing efficiency (i.e. abilities related to the perception, storage, retrieval, and manipulation of information drawn from general knowledge base), also by a range of nonintellectual factors related to the domain of learning, student's interest, motivation, self-concept, persistence, values etc. In other words, metacognitive knowledge never works in isolation, rather being a part of complex system of intellectual, emotional and social factors creating the learning environment or epistemic climate of the classroom (see also: [Tarricone 2011](#); [Proust 2015](#); [Feucht 2010](#))

### Revising the models of metacognitive knowledge development in children

The development of children's metacognitive knowledge has received an enormous amount of attention in research literature, but only few milestone studies will be mentioned here to illustrate important developmental changes in early and middle childhood. One of the most important models was offered by [Kuhn \(2000b\)](#) who in the structure of metacognition distinguished two separate, yet complementary, types of knowledge. She used the term "metacognitive knowing" to refer to explicit, conscious knowledge of the results of the cognition (corresponding to the declarative form), and "metastrategic knowing" which, in contrast, refers to the knowledge of cognitive processes and strategies (corresponding to the procedural form). The former may be specific, situational (concerning a specific domain of knowledge, from a particular field, etc.) or related to knowledge and cognition in general (regardless of their content, field or circumstances of occurrence). This generalized form is referred to by Kuhn as "epistemological knowledge" (2000b: 302) which may take a personalized form, i.e. concerning oneself, one's own knowledge and thought processes, or it may be impersonal, applicable to general cognition, regardless of the subject. Kuhn's conception, although used more often to describe the thinking of adolescents and adults, draws attention to two aspects important for the research presented in this paper. Firstly, the developmental origins of the subject's metacognitive knowledge should be sought in early manifestations of mental abilities known as "naive theories of mind". Two of these manifestations are widely recognized as essential for further development of higher-order thinking ([Kuhn 2000a](#): 178):

- a) the perception of knowledge as a product of human mind is the first and critically important step in the development of epistemological thinking which is metacognitive by nature as it constitutes an internal, silent, non-verbal theory of cognition which the subject uses to explain what we know and how we know;
- b) the awareness of the sources of one's own knowledge, on the other hand, is the onset of the scientific thinking development, as it allows one to distinguish between evidence and guesswork - to understand a proof as something independent from theory, although influencing its final shape. After all, the essence of scientific thinking is to coordinate, reconcile or integrate the existing knowledge with new evidence, resulting in which new understanding is constructed in a highly deliberate, rule-grounded, and strategically controlled process.

Secondly, as emphasized not only by Kuhn, but also by many other researchers, conceptual knowledge of the cognitive activity of the mind is an important link (a kind of developmental bridge) between naive theories of mind and a more mature form of the subject's epistemological awareness defined as understanding the essence and structure of knowledge, as well as perceiving the criteria of its validity and credibility ([Schommer-Aikins 2002](#); [Hofer 2004](#); [Kuhn & Dean 2004](#); [Barzilai & Zohar 2014](#); [Miller 2012](#); [Tarricone 2011](#)).

Both of the assumptions were reflected in the model of metacognitive knowledge proposed by [Alexander and Swananflugel \(1996\)](#), according to which conceptual knowledge of the mind comprises three aspects, organized in terms of decreasing levels of generality:

- A) mental activity concepts: includes information regarding the language of mental activities, the organization of mental activity concepts (or how the concepts are related to each other, an aspect of intentional relations among concepts), and the categorization rules for relating everyday events in the world to these concepts (or extensional relations) - i.e. the knowledge of linguistic terms used to name various forms of cognitive activity of the mind, but also the awareness of the mutual relations and relationships between these concepts and the rules of their "contextual" categorization, i.e. linking specific concepts with the events of the external world / conditions of their actual occurrence. This aspect of metacognitive knowledge, according to the cited scholars, corresponds to children's theories of mind, as it is not necessarily conscious, verbalized knowledge, but rather a "silent" inference system, automatically activated when needed, and thus resembling the "naive theory" (1996: 306);
- B) general declarative metacognitive knowledge of these concepts - regarding how different task and situational variables can affect one's performance in different cognitive areas, i.e. whether and to what extent they condition the level of achievement of a particular form of cognitive activity undertaken by the subject;
- C) strategy-specific metacognitive attributions, i.e. the assessment of the probable effectiveness of a given strategy under specific operating conditions (tasks).

A more complex, general development perspective of interpretation of the metacognitive knowledge components was proposed by [Wellman \(1985\)](#); [Wellman & Hickling 1994](#)) who indicated that the acquisition of this knowledge should be seen as an immanent part of broader cognitive development, subject to the same principles as other areas of cognition. Just like the concepts of numbers, causality and time become fundamental to the children's understanding of the physical world, the concepts in the field of cognition

also become a foundation for understanding the social and personal world (Wellman 1985: 201), i.e. once acquired, they become an internal component of many other concepts, exerting a formative influence on them, and at the same time performing an instrumental function in shaping other areas of cognition. Wellman distinguished five areas of metacognitive knowledge, specifying however, that the listed components do not exhaust the range of developmental opportunities - rather they constitute a specific core or matrix of developmental paths, on the basis of which the subject's metacognitive knowledge is further expanded and differentiated (ibidem: 169):

1. the awareness of the existence of mental phenomena, i.e. the ability to perceive the difference between what is external, observable and material in human behavior, and what constitutes the internal, mental, symbolic entity;
2. occurrence knowledge - the ability to notice the cognitive processes taking place in the mind and differences between them - an important manifestation of understanding the differences between mental processes is, i. a., the perception of their individual, private character (my thinking, knowledge, memory, dreams, forgetting are different from what other people think, know, remember, dream or forget);
3. the knowledge of the variables influencing the course and results of cognitive processes;
4. perceiving that different mental processes and abilities are a manifestation of the same ability of the human mind to process symbolic data;
5. cognitive monitoring - the assessment of one's own cognitive system and application of this knowledge to improve the effectiveness of thinking.

The fact that children perceive mental activities, such as attention, memory, inference, imagination, etc., is recognized as the onset of the development of conscious, explicit metacognitive knowledge, and at the same time a condition for the gradual change from naive theories of mind to intentional reflection on one's own thinking (i.e. moving from reasoning in terms of mental states to reasoning in terms of processes for which mental states constitute the processing content) (Wellman 1985; Pillow 2012).

According to many scholars, an important area of this knowledge is the perception of cognitive variables, i.e. factors influencing the course and effects of information processing. Much of the research in this area comes from the domain of metamemory which is the most widely researched metacognitive concept (see: Tarricone 2011; Schneider & Lockl 2002; Wellman 1985; cf. Flavell 1981 for extended review). Traditionally, three groups of such factors are described (Tarricone 2011): a) those related to the cognitive task (e.g. task complexity, the number of components and their nature - visual or verbal, input data character - perceptual or conceptual; information source; awareness of potential benefits and applications of various metacognitive strategies etc.); b) those related to the person executing the task (e.g. age, education, accurate understanding of one's own abilities, including beliefs of oneself as a mnemonic being/ a learner; the feeling of self-efficacy in learning etc.) and c) those related to the strategy of the task implementation (e.g. knowledge of potential strategies and solutions procedures, such as: learning by heart, revising material, taking notes; proficiency at monitoring and interpreting mnemonic experiences and states, such as: feeling-of-knowing and tip-of-the-tongue knowing how to detect and interpret transient barriers in learning etc.).

The research proves that elementary children have very little knowledge about cognitive variables and tend to put more emphasis on external, perceptual factors rather than psychological values, e.g.:

- Even 3/4-year-old children know that the more elements a task contains, the more difficult it is to remember; also that noise is distracting and interferes with memorizing. Five-year-olds also see the role of such variables as: age (adults remember better), friend's help (sharing a task between two people makes remembering easier), memorizing strategy (recognizing objects is generally easier than recalling information from memory - drawing facilitates remembering), time spent on learning (a longer learning time enhances better remembering) and external cues (a cue helps you recall information) (Wellman 1985: 182);
- Young children know very little about the effectiveness of deliberate memory strategies - preschool children perceive "looking" at the items as more effective memorizing strategy than naming, rehearsing, or categorizing. In contrast, second graders assess rehearsal and categorization as more effective than naming or looking. Later, in middle childhood, children become aware that the choice of appropriate memorizing strategy depends on the material to be learned (Pillow 2008: 301);
- Flavell, Green & Flavell (1995) reported that young children do not understand the stream of consciousness - they tend to perceive people sitting quietly as "doing nothing", having "empty mind" (1995: 80). In contrast, elementary children begin to understand that it is impossible to "turn off" the thinking, and that "some conscious thoughts may occur automatically and be beyond deliberate control" (Pillow 2008: 304);
- Preschoolers have limited understanding of attentional focus and attentional limits (Flavell, Green, Flavell 1995: 81), e.g. they do not understand that if a person is focusing on one subject, he or she cannot be thinking about other things simultaneously. Recognizing the selective nature of attention occurs much later in the development. Schwanenflugel, Fabricius & Alexander (1994: 1559) discovered that 8-years-olds become able to distinguish the sensory modality of attentional input, but are unable to recognize the regulatory aspects of attention (including selection, limited capacity or intermittent sampling). 10-years-olds, in contrast, were sensitive to limited capacity of their own and other's attention but still unable to recognize and appreciate the selection aspect (see also: Pillow 2015).

Evidently, the cognitive variables first noticed by children differ from the model of adult knowledge: they are too general, not very precise, tend to focus on specific, tangible factors, ignoring hidden psychological variables. As a result some over-interpretations or excessive generalizations occur. This is especially the case with the variables acting frequently (in children's interpretations, "often"



can be misinterpreted as "always"). The "number of elements" is an example of the variable, the influence of which on various children's cognitive processes is observed relatively early. Children quickly discover that in many situations "more means more difficult" (Wellman 1985: 184) - more elements to remember, more loads to bear, more problems to solve, more stages to go through, higher hurdles to jump over, etc. Having discovered this principle, children tend to apply it even in the situations where it cannot be applied - meanwhile, as Wellman rightly emphasizes, with reference to cognitive processes and tasks, sometimes "more means easier" (ibidem), e.g. more friends to help, more time to memorize a poem, more practice, etc. Noticing this type of multi-directional impact of certain cognitive variables is much more difficult for children and it appears somewhat later in development.

The awareness of the complex, multifaceted relationships between cognitive processes, as well as the simultaneous impact of various variables influencing cognition, is a fragment of a larger picture - a manifestation of understanding human mind as a complex information processing system. It is the perception of the mental world integrity, its functional coherence, mutual connections and interdependencies between cognitive processes that the majority of researchers consider to be the core of the mature, constructivist conception of mind (Flavell et al. 1995; Carpendale & Chandler 1996; Misailidi 2010; Kuhn & Dean 2004; Hofer & Bendixen 2012).

Extended research in that area was provided by Schwanenflugel and her team (Schwanenflugel, Fabricius & Alexander 1994; Fabricius, Schwanenflugel, Kyllonen et al. 1989; Schwanenflugel, Henderson & Fabricius 1998). Fabricius et al. (1989: 1287-1288) argue that the main developmental changes occurring between middle childhood and adolescence are related to how children integrate and differentiate mental activities involved in knowing. First signs of understanding the interrelations between mental concepts can be observed in children older than 8 years. Both, children and adults, tend to spontaneously organize the concepts in terms of memory involvement - with memory being a central point around which other mental processes are organized. Young children generally do not perceive an active role of memory in input functions e.g. 8-years-olds perceive comprehension as simply hearing or seeing something (sensorial input), whereas 10-years olds interpret comprehension as involving memory (constructive processing), e.g. they understand that "a) it is possible to interpret/ explain something in variety of ways because of the contents of one's memory, and b) how one understands something will determine what is remembered" (Schwanenflugel, Henderson, Fabricius 1998: 521-522). This observation led the researchers to the conclusion that "growing awareness of the active role of memory in input functions may signal children's developing understanding of the many ways that the mind manipulates and transforms information from input to output" (1998: 521) - which eventually leads the children to recognize the constructivist nature of human mind.

Another important dimension in organizing the mental concepts observed by Schwanenflugel, Henderson & Fabricius (1998) was the degree of certainty versus uncertainty. With age children tend to appreciate the relevance of cognitive certainty and uncertainty as being a natural part of everyday cognitive activities - they not only realize that some activities are less certain than others (due to the inferential type of information or relatively little data available), but also perceive the importance of activities which help to manage the cognitive uncertainty, such as: estimating, guessing, reasoning, thinking, questioning. Further research confirmed that pre-adolescents are only beginning to understand the constructivist nature of active mental processes, that "knowledge can be more or less certain, that feelings of uncertainty are important in evaluating information, that things can have multiple meanings, and that these meanings can arise solely from differences in interpretive mental processes" (Schwanenflugel, Fabricius, & Noyes, 1996: 288). Constructivist conception of mind based on an understanding of the selective, interpretive, and uncertain nature of active mental processes develops mainly between the ages of 10 and 12 years. Most young adolescents were able to see and explain that interpretative cognitive processing based on such activities as: selective attention, comprehension, comparison, and inference, could lead to different cognitive outcomes even when the initial input was the same. Weimer, Parault Dowds, Fabricius, Schwanenflugel & Woon Suh (2017) convince that such understanding is important not only in academic performance, but also in social reasoning about conflict situations.

Recognizing the uncertainty of some information processing can be also seen as a prerequisite for future rationality development in thinking. As Moshman (2007) explains, in development children move from automatic, elementary and ubiquitous inference to thinking and reasoning. "Thinking - including problem solving, decision making, judgement, planning, and argumentation - is here defined as the deliberate application and coordination of one's inferences to serve one's purposes. Reasoning, in turn, is epistemologically self-constrained thinking in which the application and coordination of inferences is guided by a metacognitive commitment to what are deemed to be justifiable inferential norms" (Moshman 2004: 221; see also: Kuhn, Dean 2004).

Integrity of mind as a key component of metacognitive knowledge is also emphasized by Pillow (2008) who builds upon Schwanenflugel's conceptions to construe more general developmental path. He also indicates the "occurrence knowledge" as a starting point in the development of children's knowledge of cognition, i.e. the awareness of existence of various cognitive processes, their functions and features, which appears in an elementary form during the transition period between early and middle childhood (between 5 and 7 years of age). Initially, however, children perceive various forms of mental activity as isolated, independent and autonomous from one another. When a child's knowledge becomes sufficiently thorough and detailed, the ability to consciously reflect on the complexity and multidimensional nature of human cognitive functioning appears - children begin to organize their knowledge in terms of similarities and differences between mental actions. The so-called "organizational knowledge" is gradually shaped (Pillow 2008: 299). The following qualities of cognition are applied as the main categories of the organization of this knowledge, prevailing in the subject's consciousness: reception of input/ output data; source of information; feelings of certainty or uncertainty of results; role of memory, attention or inference; the level of conscious effort spent on processing information (feeling of effort or difficulty), emotions associated with the activity of one's own mind and cognitive effort put into solving a specific task (2008: 305). As children's metacognitive knowledge is transformed into an increasingly organized, structured and conscious form, a new, more abstract conception of mind begins to form - "As children develop an understanding of thinking, they come to view cognitive acts as organized, systematic, and purposeful, rather than as separate occurrences of specific activities. Viewing thought in terms of deliberately related cognitive acts implies knowledge of the mind as an organized processor of information" (Pillow 2008: 307) - in this way a child moves from

conceptual knowledge, i.e. the awareness of how the mind works, to understanding that the actions of one's own mind can be consciously and strategically controlled to achieve a desired result. It was Pillow's studies and his concept of "organizational knowledge" that inspired the research presented in this article.

## Design and methodology

### Method

The main aim of the research was to describe a child's ability to undertake metacognitive reflection while making comparisons between two mental concepts, i.e. noticing and explaining the key differences between them. Pillow (2008; 2012) defines this ability as "organizational knowledge", arguing that it constitutes a developmental bridge between early theories of mind and more mature epistemological thinking. The concept of "organizational knowledge" is strongly empirically confirmed in linguistics, especially in cognitive linguistics which assumes that "language directly reflects the cognitive processes taking place in the human mind and therefore is an inherent element of human cognition" (Borowiec 2014: 70). As Langacker (2001) emphasizes, we can understand the meaning of a given language form only in connection with other cognitive structures, regardless of whether they have their exponents in the language or not. If this assumption is applied to mental concepts, the meaning of a particular mental concept can be explicated only in context - through and in relation to another mental concept. In this approach, contrasting two mental concepts with each other is a natural cognitive procedure, a manifestation of the human ability of abstract thinking based on categorization of things, phenomena, ideas or events. A still more crucial role of comparing concepts is emphasized by E. Clark's theory of lexical contrasts, according to which children acquire linguistic terms - including those relating to the world of mind - as pairs of contrastive concepts (after: Borowiec 2014: 43). However, the acquisition of words is preceded by the acquisition of concepts which are their cognitive counterpart: "in the course of development, both systems condition each other - new concepts stimulate the search for new words, in turn new words lead to mastering new concepts" (ibidem).

The following research problems were formulated: 1/ What is the children's conception of memory and imagination? 2/ What features of these mental concepts do children consider crucial, i.e. are able to indicate, name and explain? 3/ To what extent can they see mutual relationships and interconnections in the course of these mental processes?

### Collecting and analysing data

To collect empirical material, the phenomenographic interview was used, preceded by a comparative drawing. The children were asked to create a graphic representation of the indicated terms in the form of a book cover: "I would like to ask you for help - I'm writing a book for children about memory and imagination. And I have no idea how a cover for this book should look. Think about the differences between these two concepts: memory and imagination. What should the cover show so that everyone notices the difference immediately? Try to design and draw such a cover". Having finished the drawing, the children were asked to explain their understanding during individual interviews: What does your drawing show? What do the words "memory" and "imagination" mean? How would you explain to a mate how memory differs from imagination?

Phenomenography is an empirical study which aims to investigate the qualitatively different ways in which people understand, experience and conceptualize a particular phenomenon or an aspect of the world around them (Marton 1981). These "different ways of understanding" or conceptions are the basic units of description in phenomenographic research. As Marton explains "a conception can be characterised as composed of both a referential aspect - i.e. a particular meaning of an individual object (anything delimited and attended to by subjects) - and a structural aspect - i.e. the combination of features discerned and focused upon the subject. These two aspects, though different, are intertwined in nature" (Marton & Pong 2005: 366). Following Marton's guidelines, a two-stage analysis, based on inductive approach, was applied to empirical data (Marton & Pong 2005: 337): (a) the first stage was focused on identifying and describing children's conceptions of memory and imagination in terms of their overall meaning. This was done by identifying and marking themes in interviews' transcripts (searching for "what" was expressed); and (b) the second stage focused on identifying the structural aspects of each conception expressed by subjects (searching for "how" it was expressed). The analysis was guided by holistic approach - both, the verbal explanations (interviews) and graphical representations (drawings) were considered as an integral whole. The comparative drawing played a crucial role in the process of inspiring metacognitive reflection, on the one hand providing the children with time for reflection, and on the other hand, offering inter-semiotic tools of expression facilitating the grasping and formulating complex meanings, transferring the intuitive understanding of phenomena to a more conscious level which allows their verbalization. As a result, the drawing co-creates and complements the verbalized meanings. This research approach is based on the belief that "phenomenographers do not ask about the subject's extraordinary abilities to observe the world, about the competence to describe their own experiences. Furthermore, they do not draw a demarcation line between pre-reflective experience and conceptual thinking (...), the researcher can find the structure and meaning of the experienced phenomenon in both of them. The important thing is not what the world is, but what kind of world appears to us in direct experience" (Jurgiel 2009: 99). The drawing was therefore intended to provide substitute, inter-semiotic tools for describing the parts of the experience which are admittedly available to consciousness, but in an unfinished, pre-conceptual form, for which the subject has not yet found sufficiently precise words. Graphic symbols and verbal explanations accompanying them were treated as complementary to each other.

The phenomenographic study must be subjected to a rigorous procedure, ensuring an appropriate level of its accuracy and credibility. The credibility of presented findings was assured by a peer-debriefing process (Denzin & Lincoln, 2000). Two independent researchers were involved in the cross-checking process of all interviews to establish inter-rater reliability. Their responsibility was to

elicit categories of description and search for quotes exemplifying each category. Then the categories were compared and discussed to reach common understanding. As a result, a map of different conceptions of memory and imagination was created, including structural aspects and variations in the way these aspects were experienced and described by children (Table 1).

### Research group

A group of 59 nine-year-old children, from three different schools in a large city in southern Poland, participated in the study. First, the ethical dimension of the research was handled: a consent to conduct the research was obtained from the school management, the parents were informed about the purpose and nature of the research, their written consent was obtained for the child's participation in the study, as well as for the use of the children's drawings for academic purposes. Taking into consideration the sensitivity of children at this age, care was also taken to ensure that the research was conducted by their class tutors and constituted part of the natural course of school activities, so as to enable the children to focus on the task and not generate additional stress or anxiety caused by the presence of third parties. Only the drawings whose authors agreed to make them available to the researcher were used for the final analysis, (not all children agreed to this, several students decided to take the drawing home and show it to their parents). In this context, obtaining the children's consent to use their work was considered complementary and equally important as obtaining parental consent.

## Results

Three concepts of memory and imagination emerged during the analysis, differing in the degree of internal complexity, the number of details described as well as the perception of the relationships between various spheres of the activity of the mind. The differences between the analyzed concepts described by the children concerned both the course of mental processes, the type of information used, and the results obtained. A thorough description of these conceptions is presented below.

### Memory and imagination as mental action

The first conception is understanding memory and imagination as mental actions. Both from the linguistic and cognitive point of view, it is the simplest definition strategy, consisting in transforming a particular abstract noun (memory, imagination) into a continuous verbal form (doing something). In this approach, memory means remembering, storing data in memory (but also: recalling, not forgetting), and imagination means imagining - making up, inventing, fantasizing, e.g. *thinking about things we don't see* (girl); *inventing things that are not in the world* (boy); *creating something, creating unreal worlds* (boy). In both cases, children clearly emphasize that it concerns a mental activity related to the work of the brain. A signal of this awareness is a symbolic presentation of both concepts in the drawing by means of: a/ a speech bubble above the human head (examples of the remembered content are drawn inside the bubble - Fig. 1) or b/ an image of the human brain, in which the children clearly marked two different, separated areas, often explaining *this brown line is memory and this yellow dot is imagination* (Fig. 2). Thus, according to the children, both memory and imagination "reside" in the brain, but different areas (centers) are responsible for their operation.

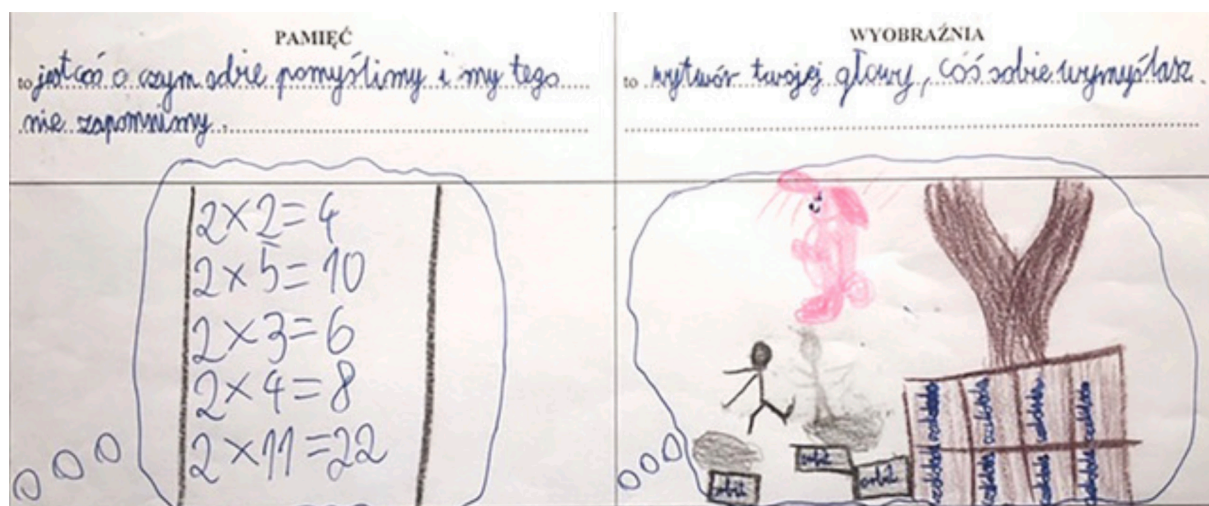
The key difference between memory and imagination in this conception seemed to be the nature of the outputs, and their connection with reality. Memory as memorization concerns objective, realistic information, directly useful in everyday life, e.g. *Memory is remembering words, places, order and many other things* (boy); *Memory is remembering what we have to do or what the teacher asks you to do as homework* (girl); *Memory is not forgetting, for example, you remember some holidays, birthdays, and so on. I always remember my father's and mother's birthdays* (girl). Two features of memory - or rather a lack of them in the children's statements - seem to be constitutive to this conception:

- lack of a time perspective - children do not distinguish between remembering past and current events (i.e. retrospective and prospective memory), they seem to perceive memory as on ongoing activity (not forgetting the things happening at present, here and right now);

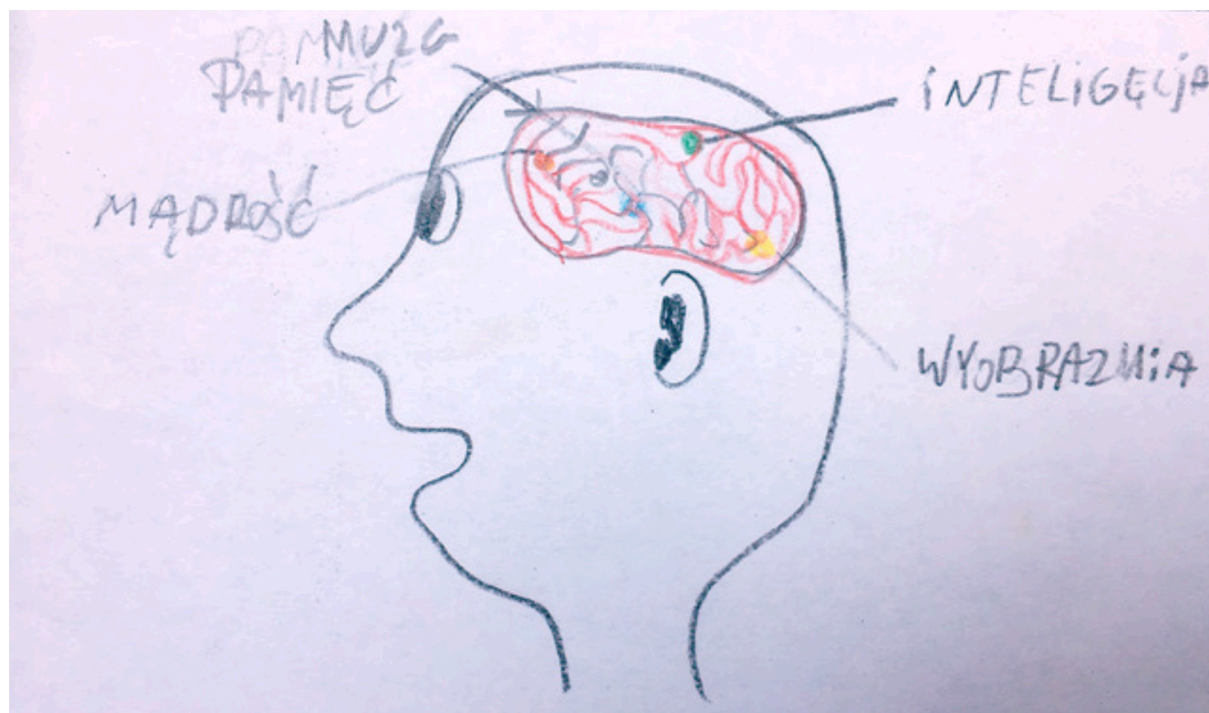
**Table 1**

Categories of description of the results obtained in the research

Structural aspects of conceptions	Features elicited - variations
<b>1. Nature of the phenomenon</b>	mental action (activity), product of action, resource (skill) of a person
<b>2. Type of the processed content</b>	a/relation to reality: objective, real versus subjective, unreal content b/modality - figurative, behavioral, semantic and symbolic code
<b>3. Nature of the results</b>	visual - diversified dynamic versus static ordered versus disorganized
<b>4. Intentionality of the action/mental process</b>	a/automatic process (impulsive, activated without awareness) versus activated consciously, for a specific purpose b/susceptible to managing the course versus independent of the will of the subject
<b>5. Context of the mental action</b>	a/utility versus play b/concerning curriculum versus extracurricular / professional
<b>6. Relationships between the mental processes</b>	present (processes related, influencing each other) versus lack of relationship (processes isolated, independent of each other)



**Fig. 1.** Presenting memory and imagination as mental phenomena with a symbolic dialogue bubble (Memory is something we will think and we will never forget it. In other words, memory is remembering. For example, I remember everything from a lesson. And imagination is a product of your head, something you imagine. For example, I can imagine a chocolate river. I mean, imagination is making things up- the drawing shows a chocolate river, a pink flying rabbit of supernatural size and people who "orbit", jumping from one cloud to another).



**Fig. 2.** Memory and imagination presented as two different areas of the human brain ("This brown stripe is memory, and that yellow dot is imagination" (girl). Source: own research.

- lack of awareness of the mechanisms of selection or evaluation of remembered information - good memory is a capacious one, it can fit everything.

On the other hand, imagination as a mental activity concerns fantastic entities and worlds: *Imagination is making up various things, for example my sister imagines a lion with a mouse's head (boy); Imagining impossible objects, for example the car of the future (girl), Imagination is inventing things that do not exist in the world, fantasizing (boy); Imagination means that someone imagines another world, for example I imagine being in the World of Lego Star Wars (boy).* Interestingly, children notice that the process of imagining can take place



consciously, while being awake, e.g. when playing, or unconsciously, in a dream (*Imagination means seeing something in a dream – girl*), and they use terms like: "making things up", "a fantasy", "dreaming while asleep", "daydream" or "reverie" - to define the essence of imagination.

### Memory and imagination as a mental product

The second of the distinguished conceptions of memory and imagination proved to be related to the results of these processes. Therefore, memory is defined as "the things we remember", e.g. *Memory is something that we will think and not forget, for example I remember everything from the lesson (boy); Memory are the things we once learned and will remember for the rest of our lives (boy); These are thoughts and things that the brain remembers (girl); Memories of old times. It is needed because we remember what was in the lesson or what we learned (boy); Something that goes into your head and stays in the brain (boy)*. The distinctive features of this conception are:

- distinguishing a time perspective - memory can be retrospective, related to memories from the past events, or it may have an ongoing character - remembering current tasks and duties, e.g. *Memory means that something was long ago and you still remember it, have kept it. If you get some homework, you also have to remember it. Remembering, in other words, is keeping a thought (Fig. 3)*;
- the lack of awareness of information selection mechanisms. Memory is valued by the children in terms of capacity or storage limits (how much I can remember) and durability (how long I can remember things), e.g. *Not forgetting everything is very good memory - boy; My grandma's memory is very short - boy*;
- clear connection with the functional context – the children emphasize that memory is needed/ necessary at school to learn, for example, memorizing the difficult spellings or multiplication tables. Apart from school, memory is useful for everyday functioning, such as remembering your duties, birthdays or shopping lists. In both cases, the use of memory is accompanied by a feeling of compulsion - we must/ should remember something, as well as the often stressed need to exercise it: memory has to be practiced, and the basic method of exercising is repeating something many times. In order to remember something you have to repeat it, e.g. *I don't like to memorize things (boy), You must remember your duties (girl), Exercise your memory!* (this phrase appeared in children's statements repeatedly).

On the other hand, imagination is associated with something that we invent, for example: *Imagination is our representation of unusual things: floating houses and talking airplanes (girl); Something made up in the head that doesn't exist (boy); A thought that is possible and sometimes impossible (boy)*. In this conception, the children recognize the nature of the results produced as a basic difference between the analyzed mental concepts. When defining the imagination the children mainly emphasized its pictorial, representational character. Unlike memory, which can involve a variety of experiences or information processed (figural, semantic, behavioral or symbolic information, e.g. words, spelling rules, mathematical operations, dates, historical facts or events), imagination means visual thinking, e.g. *imagination is: An image in my brain, it reminds me of things, people and so on (boy), It's like a person reads a book and then imagines it. It is like a movie, a sort of screen in your head (boy), There are small pictures in my head that show impossible things, for example, I once imagined*

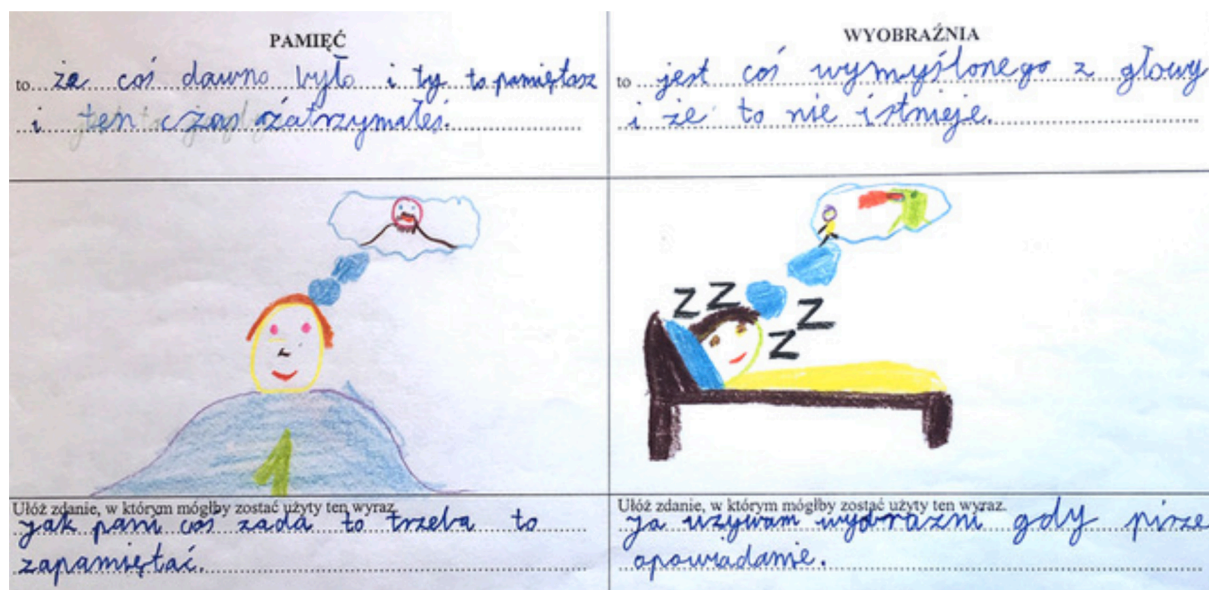


Fig. 3. Time perspective - memory as retrospective and on-going (current). The author explains: *Memory is that something happened a long time ago and you remember it and you keep this time in your memory. And when the teacher gives you homework, you have to remember. In other words, memory is a stored thought. Imagination is something made in your head and it doesn't exist. I use my imagination while writing a story. Imagination means thinking about something that doesn't exist (boy).*



myself being invisible. I mean - imagination is a picture (girl).

Interestingly, children intuitively perceive the causal relationship between imagination and the sense of sight as the basic source of data which are then processed in the mind - intuitively, because this relationship was expressed rather in the form of a drawing than verbalized (Fig. 4). Only sporadically there were attempts to explain this relationship with words, for example, *Imagination is as if you might have seen something* (boy); *Imagination, in other words, visualizes, pictures something but it is not true* (boy) - it is easy to notice that although the quoted boy intuitively feels that his imagination uses the data collected earlier with the sense of sight, he lacks the words and grammatical structures necessary to explain this knowledge.

A characteristic feature of the concept of imagination as a mental product is the awareness that pictures created by imagination may be related to reality in many different ways. They can be:

- A. real, reflecting (or mirroring) reality - this area includes both: daydreams (e.g. *I imagine myself in 10 years' time* - boy; *I imagine that I have a dog and walk it* - girl), as well as anticipation of future events, the consequences of your own actions, e.g. *Imagination is the things we want to exist or not. Sometimes I imagine what a lesson will be like. Imagination, in my opinion, means predicting situations* (girl),
- B. unreal, breaking the existing rules and schemes. And the children consider this imaginary fabrication, fantasizing, creating non-existent, unreal worlds to be the most important, most needed aspect of their imagination, e.g. *Imagination is thoughts that exceed real possibilities, for example chirping dogs or flying people* (boy); *Imagination is something that a person thinks and is usually unreal. It's like a movie, something re-created in your head* (girl); *Imagination is a product made in your head, you make it up, I can, for example, imagine a chocolate river* (Fig. 1); *Imagination is images that don't exist in the real world, such as blue heads or some place we are supposed to visit. Impossible worlds* (boy).

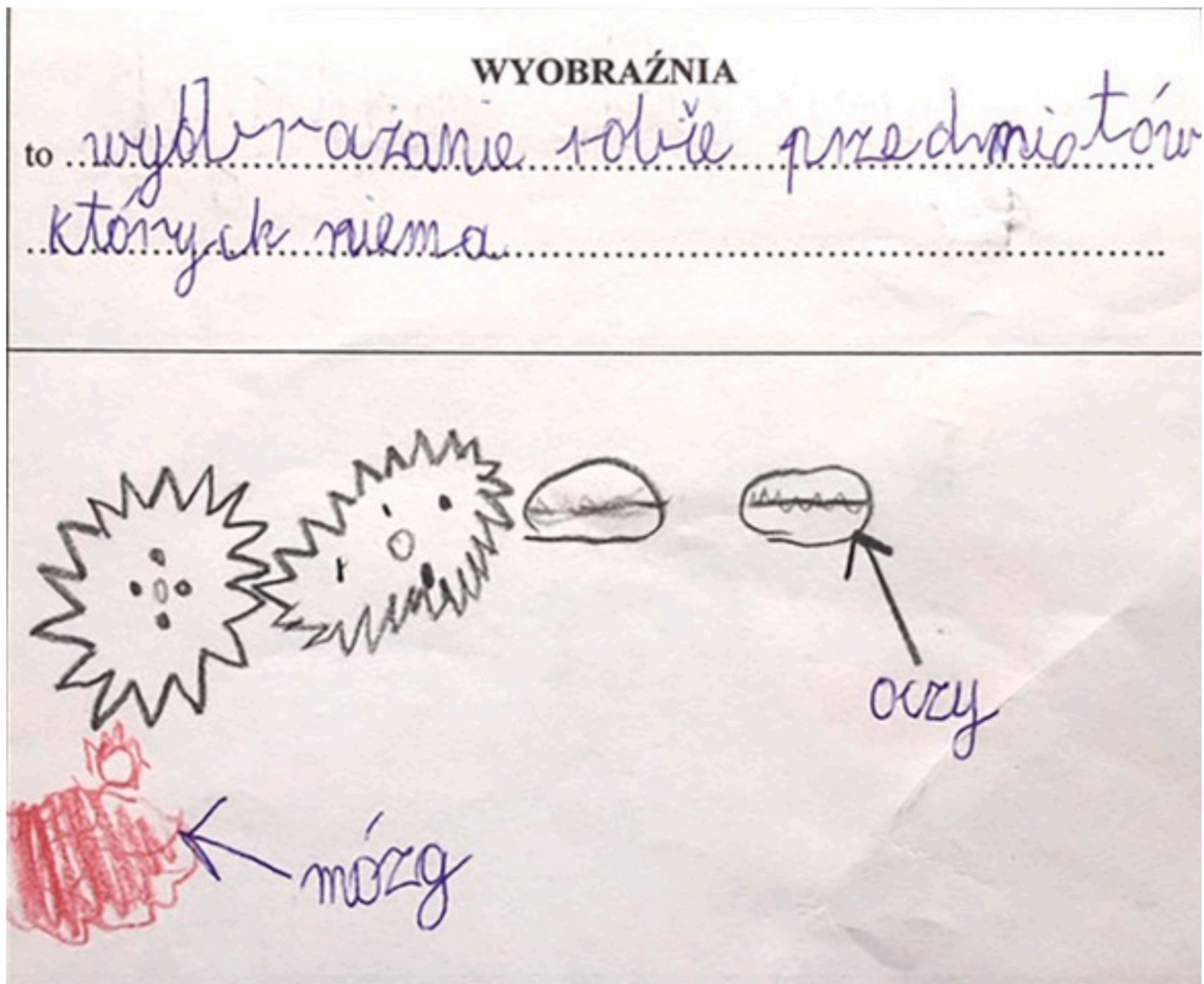
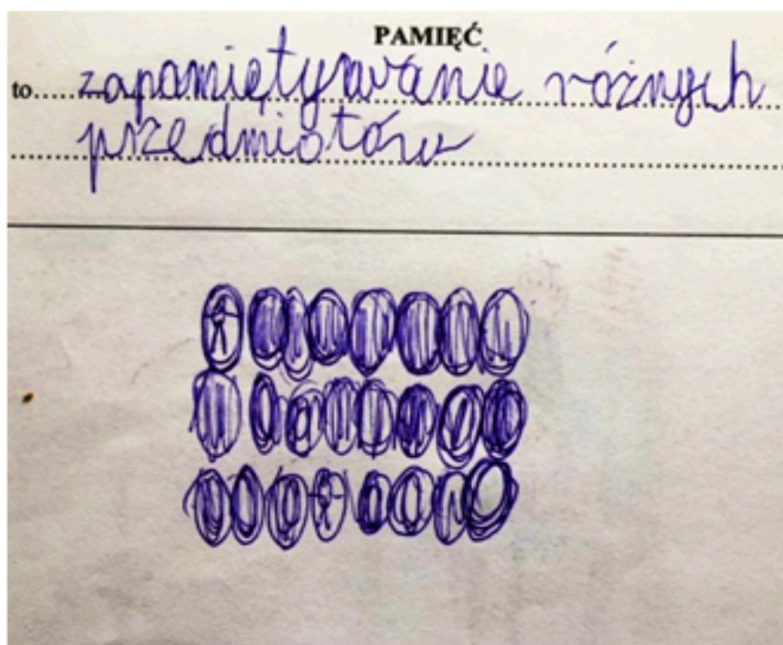
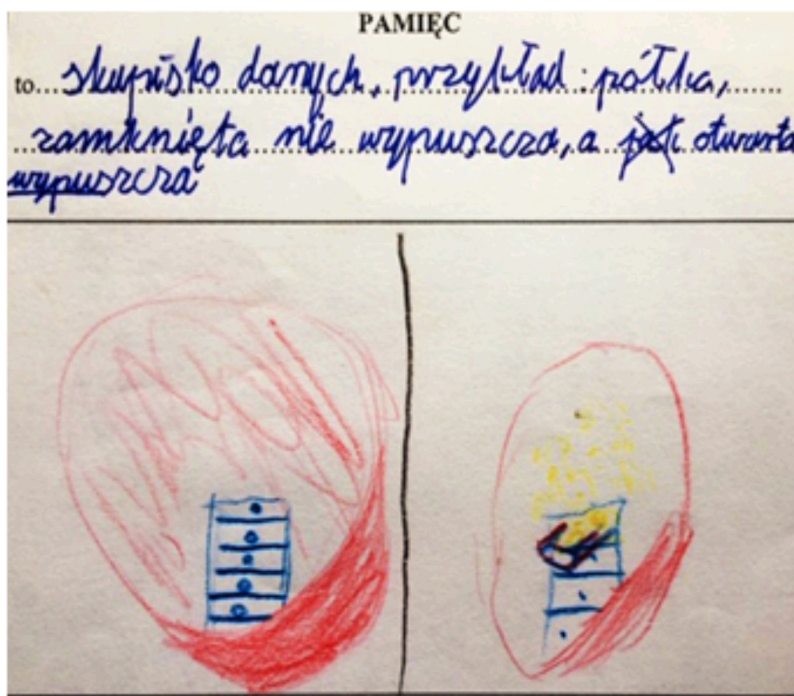


Fig. 4. Symbolic representation of the relationship between imagination and the sense of sight. The author explains: *Imagination is making up the things that don't exist* (boy). In the lower left-hand corner of the picture we can see a red human brain, with two star-shaped creatures, symbolizing information processing or the process of creating images, heading towards a pair of closed eyes.

In this conception the connection with the enjoyment context seems to be a very interesting distinctive feature of imagination. Unlike memory, which the children perceive as a practical skill, closely related to the process of education, the ability to imagine unreal worlds is perceived as a form of escape from everyday life, rarely needed at school, belonging to children rather than adults, e.g. *Imagination is our world of fun, it's a wonderful thing* (girl); *Imagination is very much needed by a child* (girl); *Imagination is a different world seen by children* (boy).



A.



B.

**Fig. 5.** Presenting memory as an ordered set - A/ bits or clusters of data, B/ a chest of drawers (The child explains: *Memory is a group of data, for example, a closed shelf does not release information, and an open shelf releases it...* - boy). Source: own archive.



### Memory and imagination as a resource

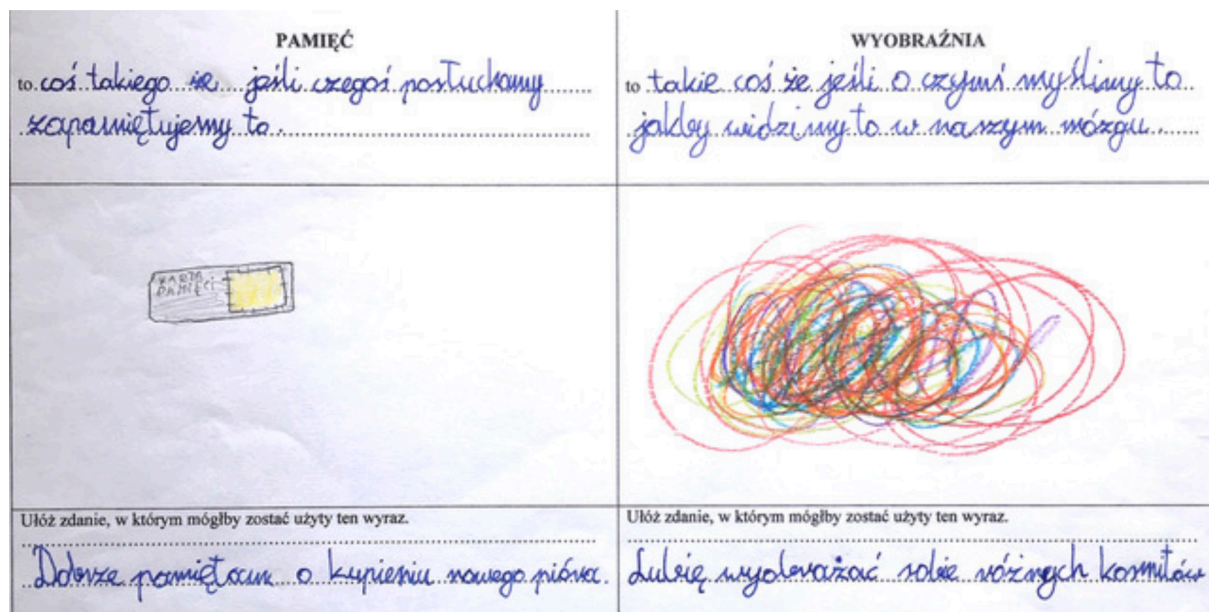
The last conception was understanding memory and imagination as a resource - interestingly, however, children seem to perceive memory as a resource of the mind/ human brain (everyone has memory, although not everyone has a good memory), while imagination is seen rather as a specific person's resource (not everyone has imagination, although some were lucky to have been endowed with unique, vivid imagination).

When defining memory, the children described it rather in static terms - as a special place or organ in the head used for storing information, e.g. *memory is an organ that remembers all adventures that happened a year, two, three, four years ago, it's the second human brain* (girl); *Memory is a place in the brain that enables you to remember the things we have learned on a certain day* (girl); *Memory is a human hard drive, because all our experiences and memories are uploaded there* (boy); *Memory is a thought with which you want to keep something in your head, an image preserved in your head* (boy). A significant enrichment of this conception of memory is the intuitive feeling of the existence of mechanisms for selection and categorization of information - children expressed the belief that human brain not only selects data (categorizes them into important/ valuable or unimportant/ worthless), but also arranges them, organizes information searching for important relations between their content. This is evidenced by the statements: *Memory is a data cluster* (boy); *Memory is accumulated knowledge* (girl).

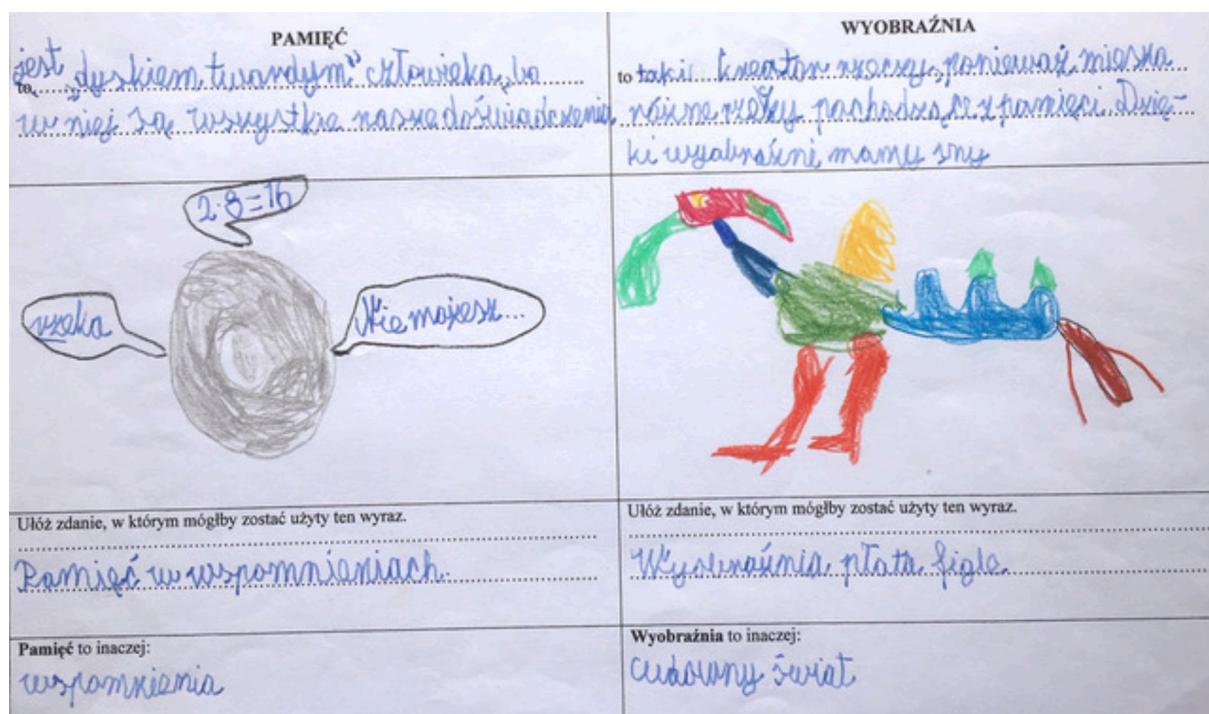
Conversely, the imagination was described rather in dynamic terms - as a form of thinking or a ability, e.g. *Imagination is a part of the sense of thinking with which we make up incredible things* (boy); *Imagination is the brain's skill, because we imagine all sorts of crazy things* (boy). It can be concluded that while memory is perceived by children in terms of a hard drive, imagination is defined rather as a kind of specific operating system, i.e. software.

The dimension "stability and order versus dynamics, changeability and disorder" was clearly reflected in the drawing representations of memory and imagination. The pictures representing imagination were often accompanied by the chaos of the topsy-turvy world, tangled, multicolored, saturated with vividness, not ordered in any logical way, as in Fig. 6. In turn, symbolic images of memory were usually confined and ordered, which at the same time referred to popular associations with a computer (RAM memory, hard drive or floppy disc, chest of drawers, etc.) - Fig. 5.

An important distinctive feature of this conception is also the growing awareness of the mutual relationships between memory and imagination (Fig. 7), e.g. *Imagination is a sort of creator of things because it combines various things from memory. We dream thanks to our imagination* (boy); *In other words, imagination is memory with which we imagine non-existent worlds* (boy); *Imagination is the images that show up in our minds* (boy). As it is clearly seen from the quoted statements, the children still lack the linguistic skills necessary to precisely explain this relationship, but they intuitively sense that the remembered information and images provide material for the work of imagination which selects the necessary elements from memory, "combines" and transforms them into the unlikely. The third-graders are aware of the creative nature of this process, and the fact that this area of thinking requires mental effort and conscious intention or motivation to be activated. At the same time, however, they perceive imagination as a gift or talent which only few people possess, for example: *My memory is poor. I don't know if I have imagination* (boy). Apart from children, writers are also endowed with this



**Fig. 6. Imagination visualized as colorful chaos.** The author explains: *Memory is something that when we listen to something, we remember it. For example, I remember very well that I must buy a new pen. And imagination is such a thing that when we think about something, it is as if we see it in our brain. I like to imagine different aliens* (boy). The drawing presents memory as a computer flash drive, whereas imagination is seen as a jumble of tangled colorful lines. Source: own archive.



**Fig. 7. Memory and imagination as a resource.** The author explains: *Memory is a human hard drive because it contains all our experiences. I mean, memory is things from the past. And imagination is a kind of creator of things because it combines different pieces of information from memory. We have dreams thanks to our imagination. Imagination means a wonderful world*". The drawing shows memory as a black disc, with speech bubbles containing: "river",  $2 \times 8 = 16$ , "You cannot ...". Imagination, on the other hand, was represented by a colorful creature resembling a combination of a bird and a dinosaur, a note *Imagination plays tricks* is added. Source: own archive.

**Table 2**

Conceptions of memory and imagination elicited during research

**A. Memory and imagination as a mental action/event:**

- perceiving memory and imagination as mental events, isolated - not related to each other and happening here and now (continuous verb forms emphasizing the present context of events);
- failure to perceive human ability to manage processes (both memory and imagination are treated as events triggered automatically or by a stimulus external to the child);
- noticing the differences in the nature of the processed content (memory applies to useful, real content, whereas imagination applies to fantastic, incredible content)
- lack of time perspective and mechanisms of selection or evaluation of the processed information

**B. Memory and imagination as a mental product/result**

- defining memory and imagination in terms of mental products (memory is recollections, remembered information, and imagination is depiction, mental images);
- differentiating the nature of the results produced and the nature of the information processed (memory uses various types of information - figural, semantic, behavioral or symbolic; whereas imagination is pictorial - it creates visual output, primarily uses the sense of sight)
- emergence of time perspective (memory is recollections and remembering what needs to be done in the future; imagination is fantastic worlds of the past or future, as well as dreams of the future);
- intuitive sense of intentionality of both processes (especially strong in the case of memory, which is additionally combined with a compulsion / obligation to remember something)
- in the concept of imagination there is an intuitive sense of relationship with the senses (imagination does not work in isolation)

**C. Memory and imagination as a mental resource of the thinking subject:**

- noticing connections and relationships between processes (defining imagination by referring to memory and vice versa);
- perceiving human role in activating both processes and managing their course, while emphasizing the different scope of their controllability (both processes require conscious mental effort, but everyone has memory and should exercise it consciously, whereas imagination is a gift given to the few, talented ones);
- differentiation of memory and imagination in terms of dynamics and organizing the results of their actions (memory means order and static nature; and imagination is movement, dynamics, joyful chaos);
- differentiating the context in which these processes are most often needed (memory in a functional or educational context, whereas imagination in the context of play or artistic work)

aptitude, especially the creators of fairy tales and comic books, e.g. *Imagination is something that allows you to create non-existent things and games, various fairy tales, it's needed to write books* (boy). In this way, in children's understanding imagination becomes associated with creative professions. Contrary to memory, children do not see the possibility of exercising, developing or improving their imagination - but express the belief that it can and must be consciously controlled, activated when needed (almost turned on and off as if with a mysterious button), e.g. *Activate your imagination! Stretch your imagination! Use your imagination!*

## Summary

Contrasting two mental concepts in the form of graphic-verbal representation with inter-semiotic means of expression proved to be an effective methodological procedure. The children found the task interesting, though difficult at the same time. First, they concentrated hard on their work, searching for effective ways to visualize the concepts (in several cases the children abandoned the original idea, asked for a new worksheet and started the task from the beginning - with more precise or accurate idea). Then, after finishing their own work, the children looked at and commented on their classmates' drawings with great interest. In this way, the task became not only an inspiration for conscious reflection on how the mind works, verbalization of one's own beliefs and intuitions, i.e. starting the processes of externalization in the sense given to this concept by J. Bruner (2006). It also provided an opportunity to construct self-knowledge. As numerous studies show, "self-knowledge is the core of metacognition" – it is a combination or link between consciously undertaken reflection, aimed at learning about one's own cognitive processes, and introspection, i.e. insight into one's own thoughts and feelings (more on this topic: [Tarricone 2011](#): 46). Constructing self-knowledge always occurs in the context of a specific task, in this case it was in the course of solving a complex problem how to present relationships between the particular mental concepts and how to explain one's own understanding to others. The comments of the surveyed children confirm that it was a new, unusual and intriguing challenge for them. [Table 2](#) summarizes the concepts of memory and imagination identified during the research.

## Discussion and conclusions

The map of the children's ways of understanding memory and imagination based on the results of the research does not claim the right to describe the developmental trajectory, although the conceptions distinguished in it have been organized from the least detailed to the richer, more sophisticated ones. However, the map is not a description of changes in the awareness of one child, it rather reflects a specific "collective mind" ([Marton 1981](#)). The conceptions or ways of experiencing the mental phenomena which were identified in the study are rather cumulative than separable, i.e. the more mature and advanced conceptions contain elements of simpler reasoning, as if the knowledge gained at less advanced stages of development did not disappear, but was transformed, reinterpreted, enriched with essential details and subtle distinctions at the next stages. As a result, in the statement of a particular child the elements of different conceptions are intertwined with one another, as if the child's reasoning was just undergoing intense developmental changes, new forms of knowledge were shaping and emerging.

Phenomenography offers a valuable insight into the processes of gradual crystallization of children's metacognitive knowledge. Two observations seem particularly important for drawing conclusions from the presented research. Firstly, in the children's statements two areas of understanding, which in traditional metacognition studies are usually examined and analyzed separately, are intertwined with each other: the subjective dimension, including attributions and beliefs related to oneself as a thinker, and objective dimension, constituting a form of generalization of phenomenological experiences and concerning cognition in general. Meanwhile, as phenomenographers have proved, these two areas of human experience cannot be separated - the way of experiencing the world is "a subset of the different aspects together constituting that what is experienced. An experience of an object is thus not just a subjective shadow of the real object but a part of the whole that is both subjective and objective at the same time" ([Marton, Booth 1997](#): 538). Our consciousness gives shape to these experiences, organizes them by pushing some important and well-shaped elements towards the center, and placing the others in the background before they assume a more mature, perceptible, verbalizable form. "Although you are aware of innumerable things at the same time it would be wrong to imagine that you are aware of everything in the same way. Your awareness has a structure to it. Certain things come to the fore - they are figural, thematized - while other things recede to the ground - they are tacit and unthematized. And there again, there are not two categories of awareness - figure and ground, thematized and unthematized, or explicit and implicit. There are rather different degrees of how figural, thematized, or explicit things or aspects are in your awareness" ([Marton, Booth 1997](#): 539). Phenomenography, through studying the collective mind, allows us to grasp this internal dynamics of consciousness - it allows us to describe how a child's awareness of mental concepts dynamically extends between what is "silent" in their experience and what is open, shaped and captured in linguistic forms. The transition of meanings, their organization into coherent, increasingly overt structures is the essence of the process of shaping a child's metacognitive knowledge.

Secondly, one of the observations made in the present study clearly contradicts the findings of other researchers. Flavell suggests that preschoolers tend to view thinking in terms of mental products rather than processes leading to their formation: "That is, they tend to identify thinking with the answer, solution, or stimulus selection eventually arrived at rather than with the mental efforts and activities that led up to them" ([Flavell, Green, Flavell 1995](#): 82). In other words, in the process of development reasoning in terms of mental products appears earlier than thinking in terms of processes and activities. However, in the presented research, the perception of memory and imagination as mental products proved to be a more advanced way of conceptualization - not only due to the degree of saturation of this concept with details, but primarily due to the intuitive perception of the potential causes of their formation. This is particularly evident in the case of imagination where children clearly emphasized that the creation of imaginary, unreal mental images may result from a previously read book, a film watched, or something previously seen that triggered their imagination. Therefore, this



conception is accompanied by reasoning in terms of cause and effect, which is missing in the perception of memory and imagination as a mental action (where action is experienced as an isolated, somewhat mysterious event, without a clear time perspective, which actually occurs in the human head, but somehow automatically, without the explicit participation of one's will and intention). The above observation should be treated as a hypothesis which requires confirmation in subsequent studies.

The presented study does not claim the right to formulate generalizations - the inclusion of a single age group limits the ability to draw conclusions about developmental change (further research with different age groups is needed). The purpose of the presentation was rather to make the readers aware that the qualitatively important changes occur in the epistemological thinking of elementary children, new areas of sensitivity and reflection emerge which the teacher should notice and support. Short-term transitions in children's thinking, though they might have been triggered by participating in the study, can be perceived as an important form of learning resembling the mechanism described by L.S. Vygotsky as "zone of proximal development" (1978: 84). Although, according to the developmental trajectory described by Kuhn & Dean (2004), their reasoning is still deeply rooted in the absolutist perception of knowledge, children become aware of the role of various mental processes in constructing and interpreting knowledge - thinking, attention, memory, understanding, etc. Under the influence of educational expectations, there appears a need to understand these processes and subject them to conscious control. The reflection on the structure and course of these processes arises spontaneously, the awareness is formed that these processes do not take place in isolation, on the contrary they form a complex chain of mutual interactions. However, in understanding the characteristics and the relationships between the operations involved in the processes of thinking and learning, a child needs help from the teacher - a scaffolding to reach the abilities which are in the zone of proximal development.

### Availability of data and materials

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

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### Competing interests

The author declares that she has no competing interests.

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