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THE WORLD WITHOUT SIGHT. A COMPARATIVE STUDY OF CONCEPT UNDERSTANDING IN POLISH CONGENITALLY TOTALLY BLIND AND SIGHTED CHILDREN

The paper presents the outcome of an experiment on concept understanding in Polish congenitally totally blind and sighted children. A test of free associations was administered to a group of 40 sighted and 24 congenitally totally blind children between the ages of 7 and 9. The research instrument included 25 sample concepts grouped into four categories such as colors, nature phenomena, features of living organisms and physical processes. The collected responses lend support to the fact that there exist many impediments to proper concept understanding due to limited hands-on experience arising out of blindness, visible in the research by the presence of gaps in knowledge or egocentrism-based responses. The data exhibits a blind child's high dependence on contextual clues and a delay in the process of decontextualization, especially if it is not accompanied by sufficient stimulation from the child's environment.

Key words: language development, conceptual knowledge, blind children

Approaches to concept development in a child

The study of the mental lexicon has always been under scholars' close scrutiny (Aitchison, 1987; Bloom, 2001; Miller, 1991; Pinker, 1997 among others). Quite recently, the mental lexicon of people with various cognitive disorders such as blindness has become a topic of extensive analyses in linguistics (Mikołajczak-Matyja, 2008). Following Kurcz (1992, p.106), the mental lexicon is "the intuitive knowledge about the words of a given language or a system of words used by a particular human being." To put it differently, the mental lexicon is the knowledge of semantics, syntax, phonology and orthography, and the knowledge of relations between words: phonological or phonetic relations, syntactic relations, or refer-

ence relations which are beyond the scope of linguistic competence and refer to human knowledge about the world (Kurcz, 1992). As for the internal structure of the mental lexicon, lexical entry, which can be understood as the address of a specific word in the memory, featuring its sound and meaning (Pinker, 1997), a set of morphological, syntactic and semantic information concerning a specific word (Leech, 1987), the representation of semantic, syntactic and phonological attributes of a certain word, independent from sensory modality and different from access representation (Marslen-Wilson, 2002), and also basic information on the lexical item (Murphy, 2003), is considered to constitute its basic framework. The mental lexicon operates on three levels: concepts, lemmas and lexemes. Concepts are configurations of meaning in the conceptual system, lemmas are the parts of lexical items which include the semantic and syntactic information, and lexemes are the parts of lexical items which include the morpho-phonological information. The three levels differ, the concept level is language-independent, the remaining two are language-specific.

The cognitive development of each human being is mainly based on ascribing words to concepts existing as mental images and constructed in the mind. From the moment of early infancy a child combines concepts with their linguistic representations, which for the purpose of clarity are referred to as words. A concept may be regarded as a general idea an individual has about a class of objects or events grouped together on the basis of the things (attributes) they have in common (Child, 2007; Fontana, 1995), or a mental representation and memory of a particular object or event (Gander & Gardiner, 1981). A concept cannot be treated as the synonym of a word. Unlike words, concepts are not created by language but they are a source of language. Language serves a facilitative role to concepts since mental representations that words stand for must be named somehow for the purpose of communication, and a word is used to convey the meaning of a concept. A word is a symbolic, arbitrary and conventional tool that denotes certain aspects of reality, whilst a concept is understood as a mental representation of a tangible and intangible entity. A tangible entity refers to some concrete entities that can be easily assessed by sense modalities, whereas intangible entities are abstract entities such as states or abstract terms. The meaning can be both denotative (reference to concrete objects, actions or ideas) and connotative (reference to emotional associations). It may be contested that a blind person would have more problems with the acquisition of concrete concepts because many of them are perceived solely by sight.

A child masters the meanings of concepts both directly (through exploration and manipulation) and indirectly (through the process of reasoning). Concept development in children proceeds in several phases during specific age ranges which, according to the maturation theory for which Piaget was a forerunner, are hierarchical. The first pattern that may be observed is a transition from simple to more complex concepts grouped in larger classes. Concepts also move from abstract and

general to concepts that are more specific. First concepts are very simple because of the immaturity of the nervous and sensory systems. Complete understanding is gained through accurate perception that is steadily refined to the point where it can be linked with a correct and meaningful symbol (Crow & Crow, 1953). In the process of a child's development, identity concepts and class concepts are created (Gander & Gardiner, 1981). An identity concept is a mental representation of an individual, object, place, event, while a class concept refers to a mental representation of a group of things having something in common. Concepts can also take the form of stereotypes defined as oversimplified concepts (Bartmiński, 2007). Because of their limited experience, children very often use stereotyping in their attempts to organize complex information into narrow definitions. The awareness of concepts is also dependent on the emotional attitude attached to a concept. Concepts that are somehow emotionally loaded are acquired differently than concepts that do not carry any significance. There exist other factors that facilitate the process of concept development, namely the child's attention span and the child's interests, motor coordination and curiosity (Crow & Crow, 1953). The process of concept formation is strongly affected by external conditions. One of the most primary factors accounting for the conceptual differences between individuals is undoubtedly environment. A child's environment that does not provide an appropriate number of stimuli to explore the world by direct contact with objects, hinders the process of concept formation.

The most widely recognized theories that try to explain how people build their understanding of concepts include the feature-based model or classical model, Rosh's prototype theory (1978), and Sperber and Wilson's relevance theory (1986). The feature-based model of concept formation, having its roots in classical theories, states that in the process of concept formation an individual compares the salient features of a new stimulus with the features of the concept that were previously acquired. Rosh introduces the term prototype – the representation of the best features of a given concept or the best exemplar of a certain category of concepts. According to Rosh, prototypes denote the items first learned, the items most frequently encountered, and the items which are somehow emotionally charged. The relevance theory explains that people pay attention to information about concepts that is relevant and requires less effort. People all differ in encyclopedic entries for concepts, which are entirely based on experience. An encyclopedic entry includes information about the extension and/or denotation of a given concept – a set of assumptions about the concept. Unlike logical entries, which are constant, small and finite, encyclopedic entries are open-ended; people may add new elements to them and construct new assumptions about the world (Sperber & Wilson, 1986). Hence, blind children will focus on different features of concepts than sighted children, and the features of concepts important to blind children may be of no or little significance to their sighted peers. To summarize these thoughts on concept development and understanding, it may be concluded that:

- Concepts are mental representations of objects or events (their understanding depends on sensory and life experience).
- Concepts are entities with ill-defined or weakly defined boundaries (there is a vast range of different classes of concepts: class and individual concepts, specific and abstract concepts, visual, non-visual or mixed concepts).
- Concepts are created unconsciously.
- Concepts are dependent on culture, language and the environment; sometimes they reflect stereotypes, superstitions or misconceptions etc.
- Concepts are used both extensionally (the meaning of concepts is shared by a community, it is agreed on by convention) and intentionally (the meaning of concepts is unique to each individual).

The study of the mental lexicon and concept understanding is governed by certain instruments that can be separated into quantitative and qualitative instruments. Quantitative methods examine the frequency of word usage. Qualitative methods of mental lexicon study involve the test of free associations (the subject is asked to give associations to a word) and directed associations (the subject is asked to give an association being in a given relation to a word) (Kurcz, 1992).

What is the meaning of blind children's concepts? A few words on existing research.

The role of sight in cognitive development cannot be questioned. It enables people to see the surrounding reality in a quick and detailed fashion, much more careful than through the other senses. The organ of sight exclusively receives stimuli such as colors, contours, shapes from the environment and these are subsequently interpreted by the human brain. It is sight that gives immediate access to the outside world and facilitates communication between human beings. It seems fair to assume that blind children are somehow underprivileged in being totally deprived of experiencing the sensations sight provides.

Language development in a blind child may be delayed at the initial stages (Landau & Gleitman, 1985; Mulford, 1988; Urwin, 1983; Rowland, 1983). According to Landau's reports (1991, 1997), blind infants start uttering their first lexical items at the age of 23 and 26 months, much later than in the case of sighted babies. Norris et al.'s (1957) detailed study indicated that blind subjects used their first words at 15 months (the norm is 11 months), two words at 18 months (the norm is 12 months), and five words at 24 months (the norm is 16 months) (Warren, 1994). In Brambring's estimation (2000), a blind child starts to use their first words that refer to real objects at around 16 months. Some theories note that the early vocabulary of blind children is similar to sighted children's (Bigelow, 1988; Landau & Gleitman, 1985; Miller, 1985; Urwin, 1978). Many incongruous hypotheses have emerged regarding the process of concept development in blind children. This is blamed upon the fact that many studies were conducted among visually impaired and blind subjects of various age ranges; very often the tested group embraced subjects in the period of early childhood and late puberty. In his book for teaching blind children published in 1819, Klein

stated that a blind child has no idea about colors and does not understand concepts that are difficult or impossible to explore with the hands. In his view, blind children lack a characteristic of all sighted children, namely the ability to make a distinction between allocentric realities from egocentric reality (after Walther, 2007). In the same vein, Cutsforth (1932) proposed the theory of verbalism or verbal unreality of words according to which the words produced by blind children are semantically empty. Cutsforth advocated that blind children's language is meaningless because the children do not have access to visual stimuli that play a critical role in understanding. These ideas are criticized, however, by other researchers. Dokecki (1966) argues that experience cannot be treated as the only determinant of language learning. He states that even people who can see do not always master the meanings of concepts by means of direct experience, but rather from verbal descriptions. This is confirmed by Gleitman's syntactic bootstrapping theory (1989) which states that meaning is extracted from syntactic clues. For this particular reason, it is wrong to think that blindness excludes the possibility of deriving the meanings of concepts. Rosel et al. (2005) proved that verbalism is dependent on age – the number of visually based words in the mental lexicon grows with age, and verbalism in blind children is no different from verbalism in sighted children. It is contested by many papers that blind children develop their concept understanding at a slower pace compared to sighted children (Anderson et al. 1984; Preisler, 1995). Boldt (1969) identified ten modes of concept formation in blind children: sensory associative, magical, anthropomorphic, purposive, substantive, dynamic, uncritical functional, analogical, critical functional and casual. He noted that at 10 years of age blind children presented a two-year delay in concept development compared to their sighted peers, but achieved progress by 15 years of age. The results show that blind children's knowledge of concepts depends entirely on learning opportunities and experience. Tobin (2008) conducted an experiment testing blind children's abilities to understand such concepts as mass, weight and volume using a Piagetian-type task and proving how critical information and its reinforcement is in the development of cognitive skills. The study suggests that blind children lack many exposures to concepts. Similarly, delays were found for conservation of substance, liquid, volume, length and weight by Gottesman (1973) and Tobin (1972).

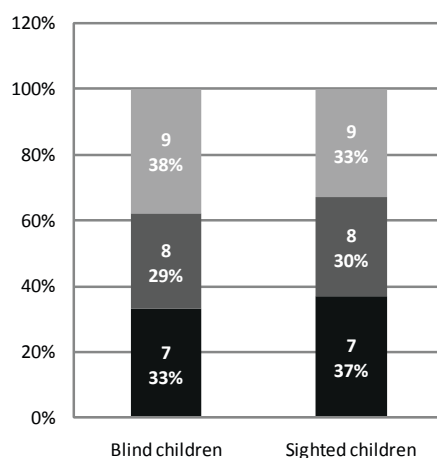
As far as the classification of concepts is concerned, no delays were observed in blind children. Higgins (1973) carried out experiments on classification abilities proving that blind children did not exhibit any lags. Gottesman (1973), by comparing Piaget's scale of development, stated that vision is not vital for the performance of haptic perception. Stephens and Grube (1982) examined blind children's performance on conservation, classification, logic, mental imagery, spatial relationships and formal operations tasks and noted that blind children presented delays of as much as 8 years between them and sighted children. The children performed well in concrete reasoning but worse in logical thought entailing visual imagery and spatial perspective. The bulk of studies (Miller, 1985; Stephens & Grube, 1982)

shows that blind children acquire some concepts only at the symbolic level and have difficulties in problem-solving situations; concrete reasoning is not very different from sighted children and mental images must be attained through direct experience (Scholl, 1986).

Demott (1972) holds that there are no differences between the meaning of words of blind and sighted children. In the same vein, the experiments of Millar (1994) and Piskorska (2008) do not show any anomalies in the understanding of concepts in the group of blind children. Millar noted that blind children did not make more mistakes in the task of recognizing colors than their sighted counterparts. The blind subjects responded even faster to auditory, spatial and visual responses. Piskorska assessed the aesthetic judgments of blind children and confirmed that blind children understand visual concepts without major problems. Many research papers have been devoted to the study of text comprehension by blind children (Rosel et al. 2005; Sękowska, 1984). They show that blind children have a very rich and extended vocabulary range, and they use sight bound expressions in similar ways as their sighted counterparts. Caton (1977) states that blind children learn the meanings of concepts even faster than sighted children do. Landau and Gleitman (1985) found that the children in their study represented a vast knowledge of colors; for instance, the children who differentiated colors were able to name objects and their colors. This finding is supported by Perez-Pereira and Conti-Ramsden (1999). Sękowska (1974) undertook research into blind children's abilities to recognize common objects and their features. She concluded that blind children had better abilities to think in an abstract way than sighted children, and their vocabulary was very rich.

Landau and Gleitman (1985), however, propose that although blind children do not use meaningless vision-based terms, their understanding of such terms may differ from the understanding of their sighted peers. These researchers observed such a pattern in blind children's usage of the words "look" and "see." The blind children attached a different meaning to such words. To these children both concepts meant to "explore something with one's hands" rather than to perceive with the eyes. Differences in meanings of words in the blind child's lexicon originate from the lack of visual information, which is a source of meaning. Blind children may know and use concepts but the real understanding of them may not be proper or may be highly individual. Furthermore, many scholars note certain peculiarities of blind children's comprehension of concepts, such as a longer process of attaching meanings to words (Burlingham, 1965; Harley, 1963), parroting or repetition of some phrases and words (Warren, 1994), language egocentrism understood as a blind child's tendency to describe concepts through his or her own activities, experiences etc., and stereotypical speech which denotes a propensity to use previously heard utterances, mainly the utterances expressed by the child's caregivers (Perez-Pereira & Conti-Ramsden, 1999). In a nutshell, it may be acknowledged that a blind child moves from the egocentric perspective to the allocentric perspective of reasoning at a slower pace than a sighted child (Dunlea, 1989). Limited experience may

Figure 1. The number of children in the study



sometimes lead to gaps in knowledge. Blind children may not understand certain concepts or have problems with their identification. This is confirmed by Walther (2007), Marek (2005) and Dale and Salt (2008), to mention but a few studies.

The presented observations support Tobin's ideas (2008); he claims that blind children display different concept understanding because they lack reinforcement of delivered information rather than due to any abnormalities in development. To use any concept correctly and successfully it must be reinforced through constant exposure. Undoubtedly, sight is an indispensable guide in such processes. In the face of no reference to visual perception, blind children adopt compensatory measures such as compensation through senses other than sight (Grzegorzewska, 1964; Hulek, 1969; Sękowska 1974, 1984 and others) and verbal compensation (Majewski, 1983; Sękowska, 1974; and others).

Method

Participants

The perspectives on blindness and numerous theories of concept acquisition presented above encouraged the author to examine congenitally blind children's understanding of concepts in more detail. The study was undertaken with expectations as to how congenital total blindness would be likely to affect the memory and understanding of concepts, and whether congenitally blind children would exhibit a different manner of concept understanding compared to their sighted peers. The study was conducted in a group of sighted and blind respondents between the ages of 7 and 9. The total number of participants was 64, 24 Polish congenitally totally blind and 40 sighted subjects (see Figure 1). In the initial pre-test, the subjects were

carefully selected through a process of interviews with teachers and psychologists employed at a particular school. Only congenitally totally blind respondents with no additional accompanying disorders such as cognitive, sensory or physical ones were chosen for the study. The congenitally totally blind subjects were all blind from birth and had no light perception, neither pattern nor light vision. Obviously, the blind children did not have any previous experience with visual stimuli. The causes of blindness were optic atrophy, retrolental fibroplasia, and agnesia corticalis. All the children attended special schools for visually impaired and blind students and were labeled by their teachers as average developing children. A group of 40 sighted children was gathered for comparison. The sighted children were matched by age and school level to their blind counterparts.

Materials and procedure

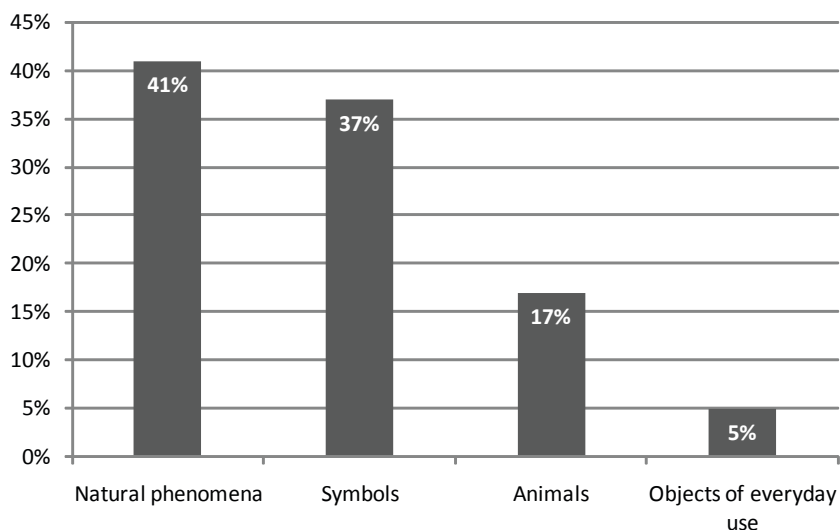
25 sample concepts of the following categories were chosen: colors (*black, white, red, yellow, gray, blue, green*), natural phenomena (*rainbow, cloud, star, sky, sun, wind, leaves, dew, fog, storm*), features of living organisms (*blood, vein, wrinkles, skin, fur*) and physical processes (*dust, rust, mold*). The concepts included ones which could be labeled as purely visual (for example colors, some natural phenomena such as rainbow or star, or features of living organisms such as vein), other than visual (wind and storm), and concepts involving no well-defined sense domination (wrinkles, leaves, dust, mold, cloud, sun, blood, skin, fur, rust). Most concepts that human beings use have no well-established sense domination, and their understanding depends completely on individual experience. Naturally, it seems that blind people should more eagerly engage senses other than sight in the process of concept understanding. In addition, people affected by blindness would refer to linguistic cues provided by the context to infer about the concept meaning; hence, it was hypothesized that their vocabulary would be abundant in idioms, collocations and general statements not necessarily acquired by direct contact. Conversely, sighted people would exploit sight to perceive the surroundings as this sense modality delivers data in a quick and detailed manner, contrary to other senses. In the present study, it was of interest to check whether there would be any differences between the children's responses due to blindness.

The method used in the experiment was a free association instrument conducted in Polish. Prior to the experiment, each child was individually instructed on the method used in the experiment. The children's responses were recorded and later transcribed and analyzed. The children were interviewed face to face and one by one. The examiner uttered a certain concept, and each child responded with a particular answer or in other words the association to a certain concept.

Results in the group of sighted children

In the colors task, the sighted children provided 280 answers (see Figure 2). The range of answers included **the names of natural phenomena** (115 answers), for

Figure 2. The sighted children's responses to colors



example blue – sky, water, lake; yellow – sun, sand, lemon, bee, barley; green – grass, trees, forest; black – earth, soil, night, cloud, coal; white – snow, day, ice, cloud; red – apple, cherry, flower, rose, heart; gray – hair, cloud, **symbols or connotations** (102 answers), for example black – anger, evil, pain; white – angels, purity; red – love; blue – heaven, happiness, bliss; gray – unhappiness, **the names of animals** (48 answers), for example black – raven, cat, crow; gray – cat, mouse, and **the names of objects of everyday use** (15 answers), for example black – the wheels of a car; green – blackboard; white – paper, chalk. The examples given above clearly illustrate that sighted children focus on visual impressions, enumerating items that are typical of each color. It is also quite characteristic that the children are able to list such items, which entails careful observation of the concept and a detailed dissection of its elements, for instance barley for yellow, coal for black. The second category of responses reflects the children's knowledge that concepts, especially colors, stand for other items and serve the role of their representations as symbols, and that many concepts have meanings profoundly ingrained in culture. Similar findings were collected in the task of providing associations to other purely visual concepts (Figure 3), namely rainbow, star and vein (the total number of responses was 120). When characterizing these concepts the sighted children enumerated a great number of **vision-based responses**, in most cases colors (67 answers), for example rainbow – colors; star – golden, silver, shining, sparkling; vein – blue, violet, greenish. Apart from vision-based responses, the children provided many

Figure 3. The sighted children's responses to star, rainbow and vein

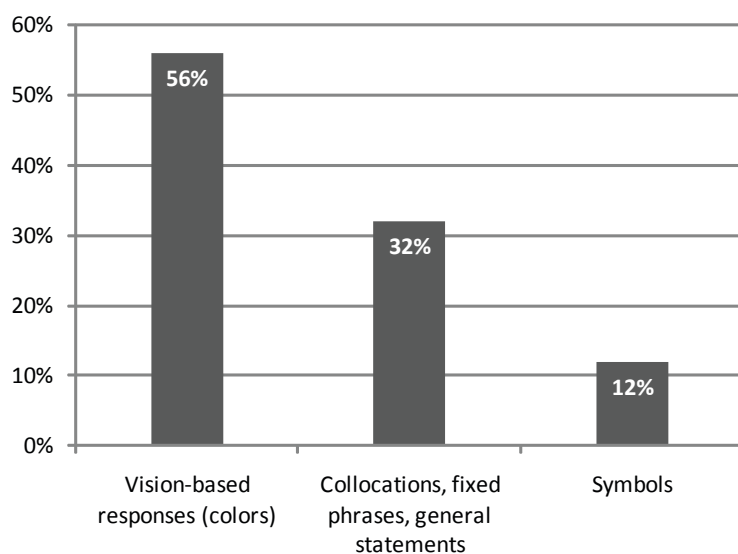


Figure 4. The sighted children's responses to wind and storm

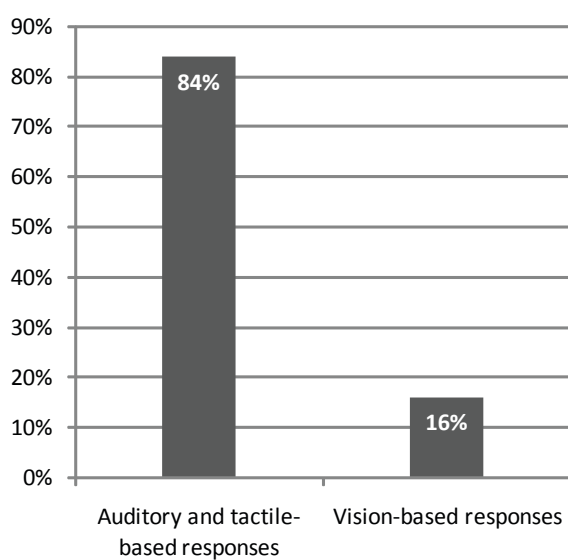
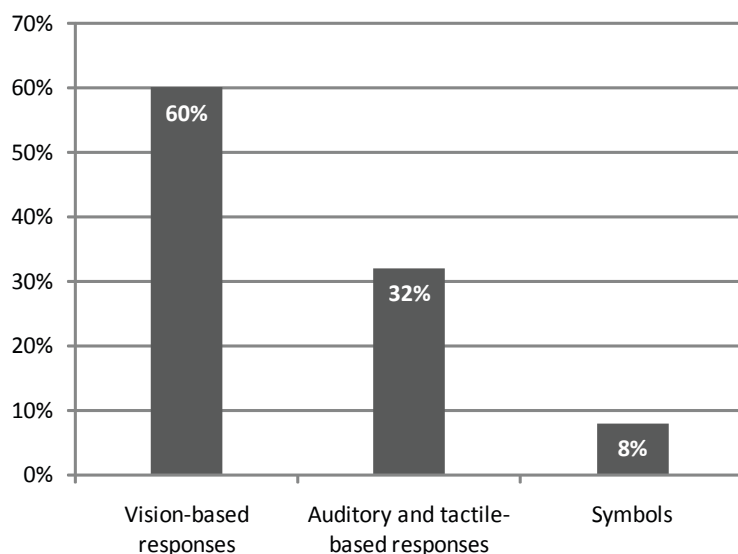


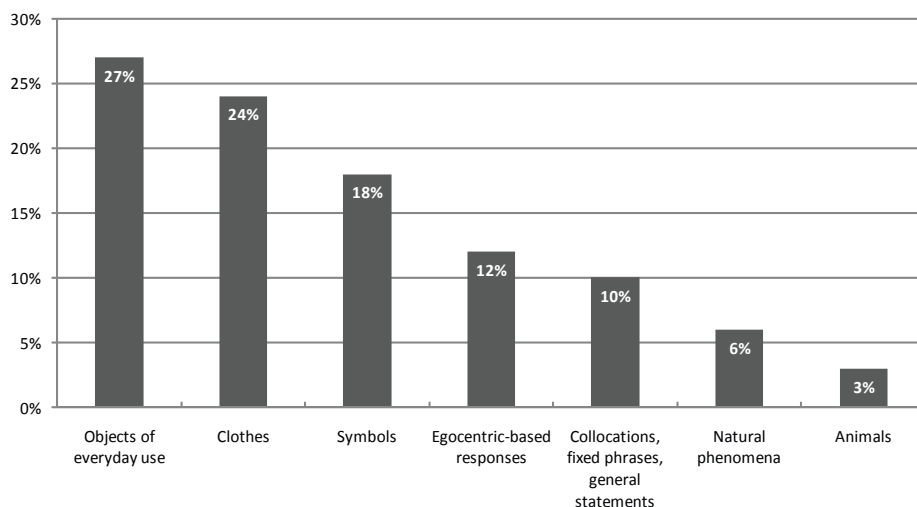
Figure 5. The sighted children's responses to wrinkles, leaves, dust, mold, cloud, sun, blood, skin, fur, rust



collocations, general statements or stereotypes and folk beliefs (38 answers), for example star – falling star, star brings luck, movie star; vein – blood examination. There are also some responses (15 answers) of **symbolic connotations**, for example star – happiness, luck; vein – pain; rainbow – peace. The next group of concepts embraces two concepts – storm and wind (Figure 4). These two concepts, unlike the concepts in the group just described, are based on something other than visual perceptions simply because they can neither be perceived by the eyes nor described by any visual elements such as colors alone. Both wind and storm are phenomena that evoke predominantly senses other than sight; in the case of wind it will probably be tactile perception, and in the case of storm – auditory perception. The sighted children provided 80 answers in the task with two categories of responses: **other-than-sight responses – tactile and auditory-based responses** (67 answers) and **vision-based responses** (13 answers). Other-than-sight responses include wind – blows, cold, chilling; storm – thunder, and visual responses: wind – trees swaying in the wind, leaves are falling; storm – lightning, dark clouds, dark sky.

Finally, the last group of concepts includes a mixed category of concepts with no dominant sense modality (Figure 5). The total number of the sighted children's responses is 480 answers with three basic classes of response: **vision-based responses** (287 answers), for example mold – green, white; dust – gray, gray powder; rust – orange, wrinkles – lines on the face, sun – yellow; leaves – green; fur – different colors in different animals; skin – black, dark, pale, **other-than-sight sense-based**

Figure 6. The blind children's responses to colors

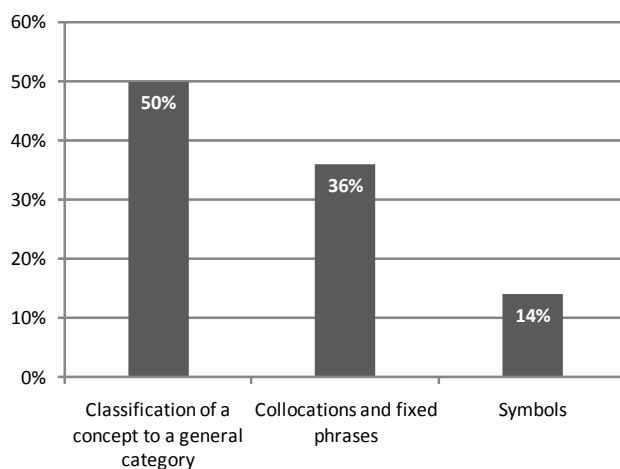


responses (155 answers), for example sun – hot; mold – smelly; wrinkles – rough skin; fur – short, spiky, warm, soft, and **symbols** (38 answers), for example wrinkles – old age, leaves – spring; sun – holiday.

Results in the group of congenitally totally blind children

The answers given by blind children are more diversified. For the first task of providing associations to colors, all the responses (168 answers) can be divided into 7 different classes (Figure 6), which at first sight suggests how incongruent and individual the understanding of concepts is in blind children. The dominant category in all the responses is the category of **names of everyday objects** (45 answers) and **the names of clothes** (40 answers). Other responses include **symbols** (31 answers), **egocentric-based responses** (20 answers), **collocations and fixed phrases** (17 answers), **natural phenomena** (10 answers) and **the names of animals** (only 5 answers). The blind children's responses relate mostly to clothes (white shoes, wedding gown, yellow trousers, blue trousers) and objects of everyday use (a red colored pencil, a gray tablecloth, a green colored pencil, light). The research documents that blind children use symbolic and emotive connotations in their vocabularies. Furthermore, the children in the study display a tendency to refer to egocentric-based responses or under-extension errors (narrow denotations of concepts) very often marked by possessive pronouns. If the child lacks experience, they stick to the original context in which they learned the concept. The sighted

Figure 7. The blind children's responses to rainbow, star and vein



subjects seem to have a fully developed allocentric perspective and the ability to distinguish an exemplary thing from the group of things, the one performing the role of a prototype, which is supported by the lack of egocentric-like responses. Blind children, on the other hand, develop this ability later. This observation shows that blind children may have problems with an allocentric way of thinking, and the ability to extend from the egocentric to the allocentric mode of thinking may proceed more slowly in blind children than is the case with sighted children. A large number of context-bound words suggests that the process of decontextualization from the original context is hampered by the lack of sight. Some egocentric-based responses include: black – the screen of my computer when it is broken, black music, the defeat in chess, the defense in chess (an association provided by a boy who was an avid chess player), my grandmother's cat, a box for glasses; white – cane, the attack in chess; red – my car, the book *The Paul Street Boys*, my lunchbox, Elmo from *Sesame Street*; yellow – my mug, a cassette, the duckling from the fairy tale; green – grass for my hamster. Collocations and fixed phrases occupy an important place in the children's language. Some examples include white – sausage, chocolate; red – red borsch; yellow – yellow river from the Beatles song; gray – *szarość dnia* [the gray of day] from a song by Budka Suflera (a popular Polish band); mold (*pleśń*) – *ser pleśniowy* ['moldy' i.e. blue cheese]; dust – allergy to dust; vein (*żyła*) – *żyłka handlowa*, *żyłka do interesów* [both idioms for 'a flair for business'].

In the task of rainbow, star and vein (Figure 7) the blind children provided 72 answers with the categories of a **general classification to a class of concepts** (36 answers), for example star – phenomenon, **collocation and fixed phrases** (26 answers) and **symbols** (10 answers). In the same vein, with the concepts of wind and

Figure 8. The blind children's responses to wind and storm

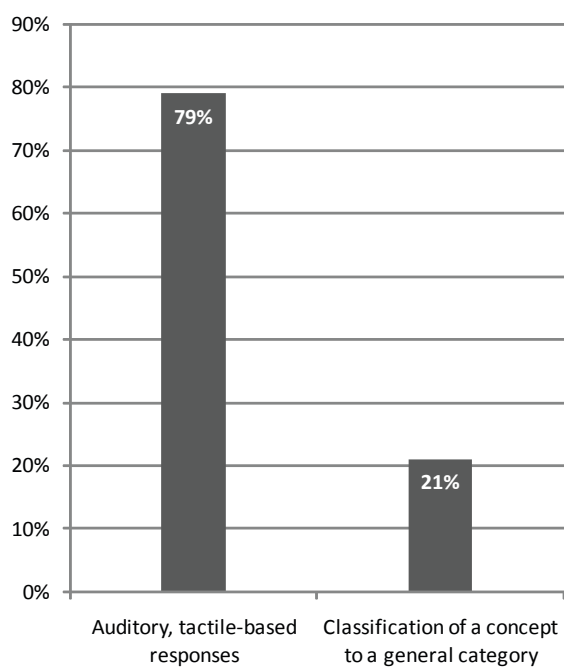
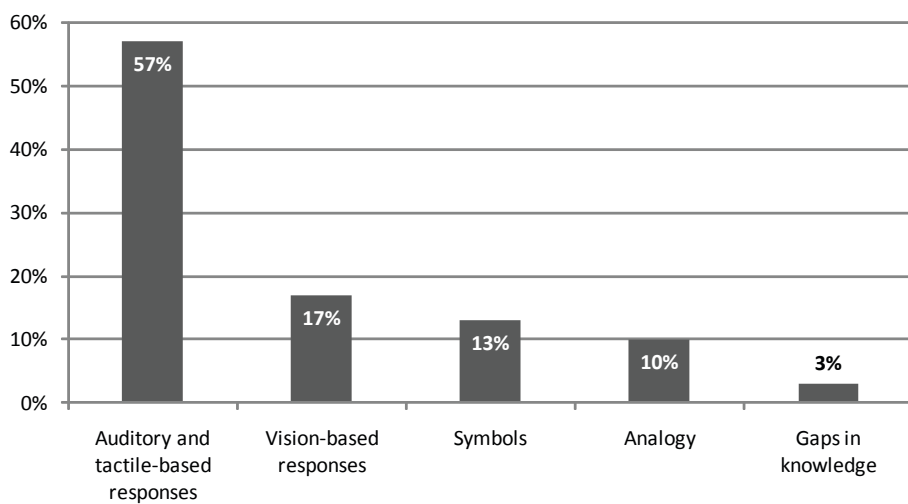


Figure 9. The blind children's responses to wrinkles, leaves, dust, mold, cloud, sun, blood, skin, fur, rust



storm (48 answers) there are **other-than-sight sense elements** (38 answers) and **classification of a concept to a category** (10 answers) (Figure 8). In both tasks, the blind children prefer to classify a certain concept to a broad class of concepts, for instance rainbow – phenomenon; wind – natural phenomenon, rather than provide a description.

The last group of concepts with 288 answers (Figure 9) includes **auditory and tactile-based responses** (166), **vision-based responses** (48 answers), **symbols** (37 answers), **analogy** (28 answers), and **gaps in knowledge** (9 answers). In the last task, the dominant group of responses are tactile and auditory responses. The blind children's answers show how important senses other than sight are in the process of cognition. The responses include mold – sticky, slippery, soft, warm; blood – warm, sticky; wrinkles – hollows in the skin, jowls, folds of skin; dust – powder; rust – crusts inside; leaves – rough, oblong, flat, stem, soft; skin – tender; fur – fluffy, short. Some children had evident problems with explaining the features of concepts or provided inaccurate descriptions. This category of responses can be put under the label of gaps in knowledge, and it implies that the children have not mastered the meanings of the concepts thoroughly, or the explanations given by parents or teachers were not plain enough. Without a doubt, blind children cannot experience visual concepts themselves and in the majority of cases they use other people's accounts. Verbal compensation is very often the one and only possibility for the child to understand a certain concept. Finally, blind children's answers are characterized by the presence of analogy, for example rainbow – colorful sticks, colorful carpet, mist – a kind of curtain, blood – sticky but not as sticky as juice, dust – sand, vein – snake-like, star – a kind of lamp, skin – as hard as leather. The ability to infer about the features of concepts based on other concepts is a mechanism that facilitates and enhances proper understanding.

Discussion

The statistical analysis was conducted with the chi-square test in all the categories to check the hypothesis whether the lack of sight (congenital total blindness) impacts and diversifies the responses obtained from the study. In all categories the p-value is <0.00005 , which signifies that blindness affects the differences between the understanding of concepts in blind and sighted children, and that it has a considerable influence on the responses the children provided (see Tables 1, 2, 3, 4 and chi-square ratio).

The sighted children's answers are dominated by vision-based and symbolic responses. Gaps in knowledge, improper understanding of concepts were not observed. In the case of the blind children, the results confirmed the existence of obstacles to concept understanding resulting from the lack of or insufficient experience. Some problems appeared with concepts rarely used in everyday speech and concepts the child had little or no contact with. The blind children presented egocentrism in lan-

Table 1. The children's responses to colors

	Sighted	Blind	Total	Chi-square ratio	
Natural phenomena	115	10	125	chi	239.9883
Symbols	102	31	133	alfa	0.05
Animals	48	5	53	df	6
Objects of everyday use	15	45	60	crit	12.5916
Egocentrism-based responses	0	20	20	p	0.0000
Collocations and set phrases	0	17	17		
Clothes	0	40	40		
Total	280	168	448		

Table 2. The children's responses to natural phenomena

	Sighted	Blind	Total	Chi-square ratio	
Vision-based responses	67	0	67	chi	100.5333
Collocations and set phrases	38	26	64	alfa	0.05
Symbols	15	10	25	df	3
Classification of a concept to a general category	0	36	36	crit	7.8147
				p	0.0000
Total	120	72	192		

Table 3. The children's responses to features of living organisms

	Sighted	Blind	Total	Chi-square ratio	
Other than vision-based responses	67	38	105	chi	24.5435
Vision-based responses	13	0	13	alfa	0.05
Classification of a concept to a general category	0	10	10	df	2
				crit	5.9915
Total	80	48	128	p	0.0000

Table 4. The children's responses to physical processes

	Sighted	Blind	Total	Chi-square ratio	
Vision-based responses	287	48	335	chi	170.5608
Other-than-sight senses	155	166	321	alfa	0.05
Symbols	38	37	75	df	4
Analogy	0	28	28	crit	9.4877
Gaps in knowledge	0	9	9	p	0.0000
Total	480	288	768		

guage referring to their personal experience (likes, hobbies), which proves that some of the children did not have enough stimulation, or that the process of decentering the meanings of concepts proceeds more slowly than in sighted children. The stress should be put on overextensions of concepts to avoid egocentric meanings of words. The awareness of visual elements in concepts reveals the great role of verbalism as a key compensation mechanism in blind children's cognition. The blind children showed knowledge of symbolic meanings attached to concepts and vast knowledge of stock phrases existing in their native language. With the concepts most difficult to explore, the children engaged in analogical reasoning seeking similarities between concepts and constructing their explanations of such concepts. The absence of sight forced the children to apply other senses to explore the objects' attributes. In sum, it seems obvious from the results outlined above that language acquisition and understanding is dependent on speech- and context-bound clues. Senses other than sight play a supportive role by strengthening the information obtained through discourse. That is why blind children may struggle, especially in the early years of their lives, with ascribing meanings to words and extending lexical usage to new referents. With time, however, they learn how to use compensating strategies such as sensory substitution and language clues to arrive at a meaning. The understanding of concepts is strictly intertwined with language (syntactic clues). The information about concepts and their attributes that the senses deliver is strengthened by the language a person is exposed to at the level of communication. Blind children use this advantage to arrive at the meanings of concepts, especially concepts difficult to access by senses other than sight. Although, as the study shows, blind children's understanding of concepts differs in some respects, and concept development may be slower at the initial stage (egocentrism and gaps in knowledge), the mental lexicon of blind children is not poor or void of any meaning. The children's responses clearly indicate that blind children's development is not retarded. The study shows that blind children possess a full range of cognitive abilities necessary to think, make judgments about the world and its phenomena as well as to understand concepts. Furthermore, the children's mental lexicon is very rich and includes visual perceptions, stereotypes, symbolic and emotive associations, metaphors and the incorporation of other senses.

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