

Verbal definitions of familiar objects in blind children reflect their peculiar perceptual experience

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Abstract

Background The aim of the present study was to examine to what extent the verbal definitions of familiar objects produced by blind children reflect their peculiar perceptual experience and, in consequence, differ from those produced by sighted children.

Methods Ninety-six visually impaired children, aged between 6 and 14 years, and 32 age-matched sighted children had to define 10 words denoting concrete animate or inanimate familiar objects.

Results The blind children evoked the tactile and auditory characteristics of objects and expressed personal perceptual experiences in their definitions. The sighted children relied on visual perception, and produced more visually oriented verbalism. In contrast, no differences were observed between children in their propensity to include functional attributes in their verbal definitions.

Conclusions The results are discussed in line with embodied views of cognition that postulate mandatory perceptuomotor processing of words during access to their meaning.

Keywords

blind children, language, sensorimotor experience, word meaning

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Introduction

Vision provides invaluable information for the construction of the concrete experiences with objects that are needed as a foundation for language learning. To illustrate this point, we need simply think of the contribution of visual experience to the understanding of familiar words such as those denoting a house or a mountain. It is therefore legitimate to ask how children born blind cope with the problem of constructing word meaning. Indeed, one of the major concerns involved in the education of the blind relates to the potentially large extent to which they are dependent on others when learning how to use language. This dependence manifests itself in different ways. For instance, it has been shown that blind children ask more questions than children with low vision or sighted children when talking about household objects (Erin 1986). The mothers of blind children have been found to talk more and use more instructions containing descriptions than the mothers of sighted children or children with low vision (Pérez-Pereira & Resches 2008). The aim of the present study

was to examine whether, despite their dependence on others, language use in blind children reflects their own specific perceptual experiences. We will focus on access to word meaning and limit our investigation to the verbal definitions of familiar objects that blind children are able to elaborate.

Blind children learn to use words that cannot have any sensory basis or concrete referent for them, for example when speaking about the blue colour of a new T-shirt. According to Cutsforth (1932), they frequently use this type of word. Cutsforth (1951) argued that this 'verbalism' reflects vague and disconnected thought because blindness deprives individuals of information that is critical for the construction of a rational world (Nagera & Colonna 1965). Von Tetzchner and Martinsen (1980) reported a higher level of verbalism in blind than in sighted children. This view that the language of blind children testifies to the difficulty they experience in conceptualizing the world is shared by other authors who have highlighted several particularities in their language (Kephart *et al.* 1974; Andersen *et al.* 1984, 1993; Dunlea 1989).

However, a number of studies have challenged the view that language is defective in blind individuals (e.g. Landau & Gleitman 1985; Bigelow 1990; Pérez-Pereira & Conti-Ramsden 1999). Data that are not compatible with the hypothesis that verbalism is specific to the language of blind people have been found (McGinnis 1981). Harley (1963) defined visually oriented verbalism as the use of words referring to the properties of colours or luminance. On the basis of a word definition task, he reported that visually oriented verbalism was relatively rare and did not evolve with age. Rosel and colleagues (2005) found that blind children did not produce a higher level of visually oriented verbalism than sighted children but, in contrast to Harley's study, they noted that this behaviour increased with age in their two groups of children. Demott (1972) failed to report any significant differences in the language used by visually impaired children and sighted children when asked to define concrete words. There are thus clear contradictions in the literature with regard to the production of visually oriented verbalism. This observation deserves further investigation because of the importance of this issue from both the psychological and educational points of view.

Other studies have highlighted the impact of the unique perceptual experience of blind people on their verbal productions (Anderson & Olson 1981). Anderson (1984) analysed the type of attributes that 10 congenitally blind and sighted children aged 3–9 years associated, from memory, with familiar manipulable objects. In a verbal task, the blind children tended to describe a larger number of functional attributes than the sighted children who, in turn, reported more perceptual attributes than the blind participants. The blind children mentioned more attributes related to their own personal experience than the sighted children. However, as pointed out by the author himself, this study included only a small number of children, thus limiting the potential validity of the results. Furthermore, most of the reported differences did not reach significance. Moreover, there have been few systematic analyses of the word definitions produced by blind children across different categories of words. Despite this, the literature has revealed far-reaching and complex interactions between word-learning and conceptual organization during development (e.g. Markman 1989; Landau 1994; Barsalou *et al.* 2008). Furthermore, no study has undertaken a systematic comparison of blind children, children with low vision and sighted children involving a detailed analysis of how they define concrete familiar words, in order to assess the impact that low residual vision can have on children's language.

If, as embodied views of language usage would suggest (e.g. Barsalou 1999), bodily experience helps ground word mean-

ings, the verbal definitions of familiar objects provided by children who have no vision should reflect their own perceptual experience and should therefore differ from those produced by sighted children. A recent study has shown that language and drawing in the blind can indeed be understood in terms of embodiment theory (Sanchez *et al.* 2011). As blind people primarily use the haptic and auditory systems to acquire information about an object (Hatwell *et al.* 2000; Hatwell 2003), they should refer more to the tactile and auditory characteristics of objects than sighted children who, for their part, should primarily refer to their visual components. With regard to the issue of visually oriented verbalism, sighted children should use more visual terms (references to colours, brightness or transparency) than blind children, in keeping with the idea that language is, at least in part, perceptually and bodily grounded. In line with Anderson's (1984) observations, we expected blind children to introduce more personal references into their verbal definitions than sighted children. Finally, in order to examine whether these perceptually based differences could be detrimental to other aspects of language, we analysed the frequency of functional definitions of objects, without expecting to observe any significant differences between the three groups of children in terms of their references to the functional aspects of the objects.

Method

Participants

Ninety-six visually impaired children, aged between 6 and 14 years, participated in the study. Forty-four of them were congenitally blind children (best corrected visual acuity below 1/60) and 20 children presented low vision (best corrected visual acuity of below 3/18). None of these children had associated disorders, in particular language or cognitive disorders. Because of the low incidence of total blindness without associated disorders in France, children from other French-speaking regions and countries (Quebec, Belgium, Switzerland) were included in the study in order to assemble an acceptable number of children of different ages. The children were divided into four age groups (6–7 years, 8–9 years, 10–11 years and 12–14 years), as shown in Table 1. In addition, 32 sighted children were matched on chronological age with the children presenting a visual handicap. There was little point forming a larger control group of sighted children because significant differences between the sighted and the visually impaired children emerged rapidly. These children were neither academically precocious nor retarded and they had normal vision. All the children lived at home and both of their parents spoke French. Informed written

Table 1. Characteristics of the blind, sighted children and children with low vision

Age group	Number	Mean age (years, months)	Standard deviation (months)	Sex	Blindness WHO category	Country (number)
(a) Blind children						
6–7 years	8	7;2	6	4 girls 4 boys	Cat. 5: <i>n</i> = 3 Cat. 4: <i>n</i> = 5	France (6) Belgium (1) Quebec (1)
8–9 years	13	8;8	7	8 girls 5 boys	Cat. 5: <i>n</i> = 6 Cat. 4: <i>n</i> = 7	France (6) Belgium (4) Quebec (3)
10–11 years	9	10;1	6	6 girls 3 boys	Cat. 5: <i>n</i> = 4 Cat. 4: <i>n</i> = 5	France (5) Quebec (2) Switzerland (2)
12–14 years	14	12;11	10	8 girls 6 boys	Cat. 5: <i>n</i> = 8 Cat. 4: <i>n</i> = 6	France (10) Belgium (1) Quebec (1) Switzerland (2)
(b) Children with low vision						
6–7 years	10	7;3	4	5 girls 5 boys	Cat. 3: <i>n</i> = 4 Cat. 2: <i>n</i> = 4 Cat. 1: <i>n</i> = 2	France (6) Belgium (4)
8–9 years	11	8;7	8	6 girls 5 boys	Cat. 3: <i>n</i> = 7 Cat. 2: <i>n</i> = 2 Cat. 1: <i>n</i> = 2	France (8) Belgium (1) Switzerland (2)
10–11 years	15	10;6	5	6 girls 9 boys	Cat. 3: <i>n</i> = 6 Cat. 2: <i>n</i> = 4 Cat. 1: <i>n</i> = 5	France (12) Belgium (2) Quebec (1)
12–14 years	16	13;4	8	11 girls 5 boys	Cat. 3: <i>n</i> = 8 Cat. 2: <i>n</i> = 7 Cat. 1: <i>n</i> = 1	France (12) Quebec (2) Belgium (2)
(c) Sighted children						
6–7 years	8	7;2	3	3 girls 5 boys		France
8–9 years	8	8;10	6	5 girls 3 boys		France
10–11 years	8	11;2	2	3 girls 5 boys		France
12–14 years	8	13;3	6	6 girls 2 boys		France

WHO, World Health Organization. Cat. 5: no light perception; Cat. 4: light perception; Cat. 3: visual acuity between 1/60 and 3/60; Cat. 2: between 3/60 and 6/60; Cat. 1: between 6/60 and 6/18.

consent was obtained from the parents. The experiment was conducted in accordance with the principles of the World Medical Association Declaration of Helsinki on Ethical Principles for Medical Research Involving Human Subjects.

Procedure

The experimenter told the children that they would have to define words denoting objects that they were familiar with. She first named the object to be defined, and then asked the children to imagine the object before defining it in order to make their representation as complete as possible. The experimenter then systematically asked three questions in a random order: one about the object's identity: 'For you, what is a . . . (tree, for

example)?', one about its specific features: 'how do you think a . . . is made?', and one about its distinguishable features: 'How can you recognize a . . .?'. The 12 familiar objects were selected so that they (1) contained animate and inanimate objects; (2) evoked, as a set, most of the perceptual modalities; and (3) differed in the way children can interact with them through touch. The objects were: man; dog, fish and bird (animals); tree, house and bed (tangible but non-manipulable objects); toothbrush, glass and banana (tangible objects that can be held in the hand); sun and rain (not solid but highly contact-sensitive objects). The order in which the definitions were requested was randomized for each child. If the child provided a reply such as 'I don't know', the experimenter moved on to the next question. The entire sequence was recorded and then transcribed off-line

for coding. Two raters who were unaware of the purpose of the experiment worked independently and coded the variables defined below. Their mean percentage agreement was 84%. Disagreements were settled before analysis.

Data coding

The presence or absence of each of the following variables in the definitions given by the children for each of the 12 objects was coded and mean proportions were computed across the 12 definitions:

- Reference to tactile ('Toothbrush bristles are rough'), visual ('Glass is transparent'), auditory ('I like listening to the rain falling outside'), olfactory ('Fish does not smell good') or gustatory ('A banana is sweet') perception. A more global variable labelled 'explicit reference to perception' was built by considering all the cases in which at least one of these perceptual dimensions was evoked in the definitions.
- Specific references to colours and light or luminance properties, as in 'a banana is yellow', 'the sun is bright'. It should be noted that these references were always appropriate in the children's definitions.
- Use of visual verbs in the definitions: 'if you look . . . see . . .'. Again, it is worth noting that this usage was always appropriate.
- Intrusion of personal experience in the definitions: as for example in the following definition of dog 'sometimes dogs are not nice; my dog pees everywhere and my mum is not happy' or fish 'once my dad brought a fish, it was quite sticky' . . .
- Reference to the function of the object, as in the following examples: 'A toothbrush is made for brushing teeth', 'A dog helps protect us from bad people' . . .

Results

The frequencies of no-responses were low (less than 7%) and did not differ significantly as a function of visual status, $F(2, 115) = 1.44, P > 0.15$. This showed that the blind children succeeded in this spontaneous verbal recall task just as well as the sighted children. ANOVAS were carried out on each dependent variable listed above with Visual Status (three: BC: blind children; LVC: children with low vision; SC: sighted children) and Age (four: 6–7, 8–9, 10–11, 12–14 years) as between-subject factors, and Category (five: man, animals, non-manipulable objects, manipulable objects, non-solid contact-sensitive objects) as a within-subject factor.

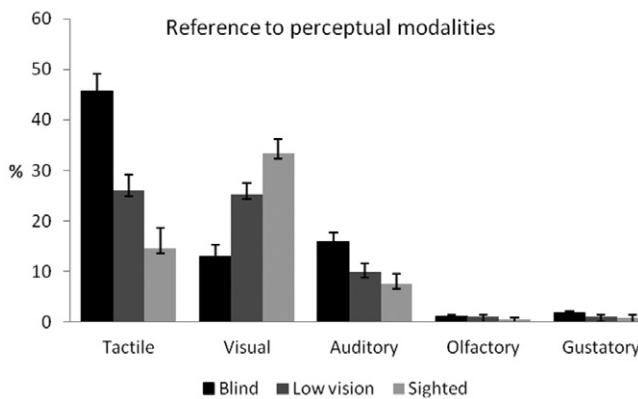


Figure 1. Percentages of explicit references to different perceptual modalities in children's definitions as a function of visual status.

Explicit references to perceptual attributes in the object definitions depended on the child's visual status, $F(2, 115) = 3.2, P < 0.05$. Duncan multiple comparison tests showed that BC referred to perceptual dimensions ($M = 61.9\%$) more often than SC ($M = 48.2\%$), $P < 0.05$, with the VIC presenting an intermediate level ($M = 54.8\%$). A marginally significant interaction between Age and Visual Status, $F(6, 115) = 2.04, P = 0.06$, indicated that the differences between BC and SC tended to increase with age. As Fig. 1 illustrates, BC produced more references to the tactile characteristics of the objects than LVC or SC regardless of age, $F(2, 115) = 19, P < 0.01$. Similarly, their definitions included auditory dimensions significantly more often than those produced by the LVC or SC, $F(2, 115) = 5.8, P < 0.01$. In contrast, visual dimensions were referred to more often by the SC than the LVC or BC, $F(2, 115) = 16.1, P < 0.01$. It should be noted that the low level of reference to olfactory and gustatory perception may be due in part to our sample of objects. What is of interest, however, is the fact that, irrespective of visual status, the children did not differ in their tendency to include the olfactory and gustatory characteristics of objects in their definitions, $F < 1$.

As far as tactile information is concerned (Fig. 2a), the differences between BC and SC were particularly great for the definition of manipulable objects, with the BC mentioning tactile properties in 60.3% of cases, while this percentage fell to 34% in the LVC and 9.4% in the SC, $F(8, 460) = 2.85, P < 0.01$. Figure 2b shows that it was mostly when defining animals (dog and bird) and non-solid contact-sensitive objects (rain) that the BC cited auditory characteristics more often than the SC did, $F(8, 460) = 2.68, P < 0.01$. The superiority of SC over BC when referring to visual characteristics (Fig. 2c) was observed irrespective of object category.

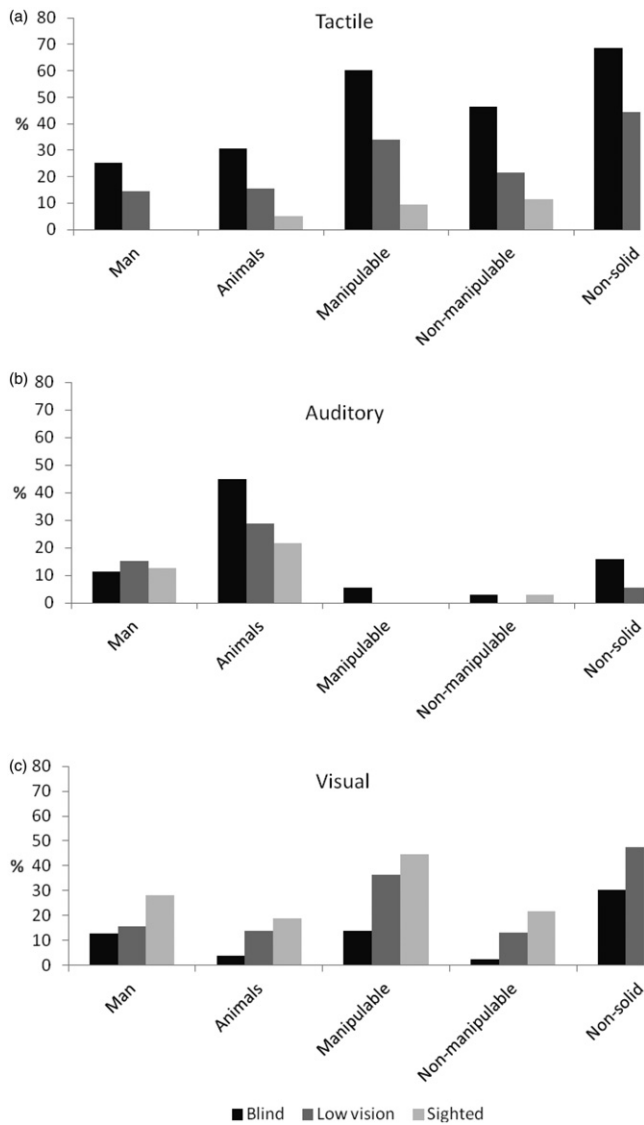


Figure 2. Percentages of references to the tactile (a), auditory (b) and visual (c) perceptual modality in children's definitions of different object categories as a function of visual status.

We coded the number of times the children evoked colours or luminance-related properties in their definitions. These visual characteristics were mentioned more often by the SC ($M = 23.6\%$) than the LVC ($M = 15.7\%$) or BC ($M = 7.9\%$), $F(2, 115) = 12.6$, $P < 0.01$. Age did not significantly affect these productions in either the BC, $F(3, 43) = 1.75$, $P = 0.17$, or SC, $F(3, 31) = 1.5$, $P = 0.22$. The tendency of SC to mention colour or brightness was observed mainly in response to the non-solid contact-sensitive objects (colour and brightness for the sun, transparency for rain) and the manipulable objects (colour for the banana and toothbrush, transparency for glass), whereas the

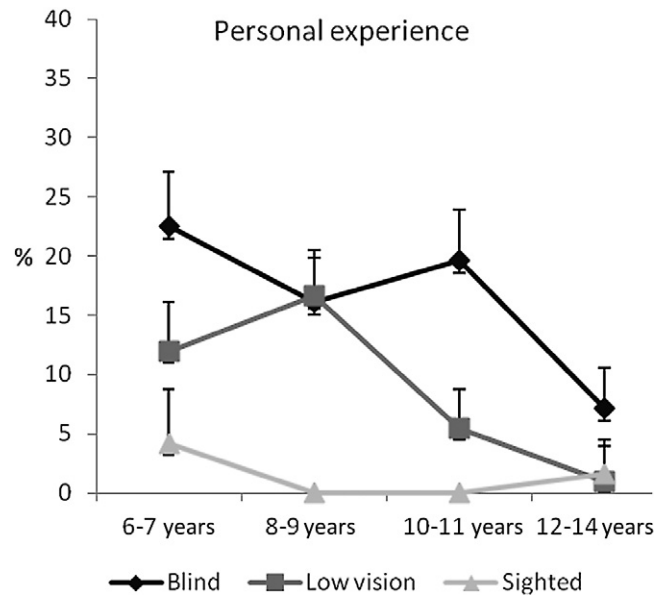


Figure 3. Percentages of references to personal experience in children's definitions of different object categories as a function of visual status.

differences between the three groups were smaller for the other categories of objects, $F(8, 460) = 3.2$, $P < 0.01$.

Visual verbs such as 'to look' or 'to see' were used only infrequently (on average, in 4–5 responses out of the total of 36) and this level of usage did not differ between BC ($M = 13.2\%$) and LVC ($M = 15.5\%$) or SC ($M = 14.7\%$), $F < 1$. However, it declined significantly as a function of age in SC [from 38.3% at 6–7 years of age to 3.3% at 12–14 years of age, $F(3, 31) = 5.2$, $P < 0.01$] and in BC [from 16.6% to 6.6%, $F(3, 43) = 3.4$, $P < 0.05$], but not in LVC (from 13% to 11.6%, $F < 1$).

The BC ($M = 16.3\%$) reported personal experiences in their object definitions more frequently than the LVC ($M = 8.8\%$) and SC ($M = 1.4\%$), $F(2, 115) = 11.7$, $P < 0.01$. As shown in Fig. 3, this tendency decreased significantly with age in BC, as it also did in LVC, whereas SC produced such references only rarely at all ages, $F(3, 115) = 3.2$, $P < 0.05$. In consequence, the differences between the three groups of children with regard to this behaviour were small at 12–14 years of age.

Finally, the number of function-based definitions increased significantly with age in the three groups of children, $F(3, 115) = 2.8$, $P < 0.05$. The visual status factor as well as the interaction between age and visual status failed to reach significance (BC: $M = 23.1\%$; LVC: $M = 23.3\%$; SC: $M = 23.7\%$), $F < 1$. Regardless of visual status, the animate objects (animals and man) were rarely defined functionally, in contrast to the inanimate objects, $F(4, 460) = 195$, $P < 0.01$.

Discussion

The aim of this research was to examine the extent to which the verbal definitions of familiar objects produced by blind children reflect their perceptual experience and therefore differ from those produced by sighted children. Our results showed that the blind children evoked the tactile and auditory characteristics of objects significantly more often than the sighted children. For their part, the sighted children, and especially the younger among them, relied more on visual perception to define the objects and referred to the properties of colour, brightness and transparency more frequently than the blind children did. Coherently, Schlaegel (1953) reported that the more the visual acuity of blind adolescents is reduced, the less their mental images integrate visual dimensions and the more they integrate auditory dimensions. Visually oriented verbalism, which is quite infrequent in blind children as pointed out by McGinnis (1981), did not develop significantly with age in our study, thus confirming Harley's (1963) findings.

These results provide evidence that the meanings of words designating familiar objects are imbued with the particular experience of each group of children. This finding is consistent with embodied cognition theory, which postulates that the definition of word meanings inescapably requires their perceptuo-motor processing (e.g. Barsalou 1999; Wilson 2002; Ansonge *et al.* 2010). Kiefer and colleagues (2008), for instance, have shown that the processing of words denoting sound-producing objects activates the same auditory cortical areas as when listening to real sounds and have suggested that access to word meaning might depend partly on a simulation of brain activity during perception and action. In our task, this type of situated simulation might have been elicited by the instruction to imagine the object before defining it. This could explain why it was when they were asked to describe manipulable objects that the blind children generally included more tactile dimensions in their definitions than their sighted counterparts. Because haptic perception (i.e. active touch) is bodily anchored, it is conceivable that this process of grounding meaning in sensorimotor representations is particularly acute in the blind. This would explain why, when all the perceptual modalities are considered together, blind children older than 6–7 years of age made more explicit references to the perceptual attributes of the objects than the sighted children.

Blind children referred more often to their personal experiences than sighted children when evoking familiar objects, a finding that confirms the observations reported by Anderson (1984). This could be due to the fact that episodic memory, which, alongside perception, is important for the grounding of

meaning in sensorimotor representations (Barsalou 1999), is particularly activated in blind children because of the predominance of bodily centred perception such as active touch. It could also relate to the predominance of egocentric thought that has also been observed in the field of spatial understanding (Millar 1983, 1994; Coluccia *et al.* 2009; Ruggiero *et al.* 2009). The decrease after the age of 10–11 years in this tendency to mention personal experiences could possibly be due to the simultaneous progress in conceptual development, which makes the abstract properties of objects more salient.

With regard to the debate on the construction of word meaning in blind children (e.g. Dunlea 1989; Landau 1997), it is important to point out that showing that specific sensorial content permeates word meaning in these children does not necessarily mean that sensory experience is the only path by which they can construct word meaning, or that language in the former is defective. Our results revealed that it was not possible to discriminate between blind and sighted children on the basis of their use of visual verbs, a verbal behaviour that tended to disappear with age in both groups. Language itself is another important source of information for the acquisition of the conventional meanings of words such as those corresponding to visual verbs (Pérez-Pereira & Conti-Ramsden 1999). Blind children adapt to the language spoken in their surroundings, and this is probably why the developmental trajectory of the use of visual verbs seems to be similar in both blind and sighted children. Our results also showed that, contrary to the arguments put forward by Kephart and colleagues (1974), the blind children in our study possessed as much functional knowledge of objects as the sighted children. Functional definitions of objects also became more frequent with age in both groups. This shows that language also plays an important role in the construction of knowledge and can partially compensate for the absence of visual experience in blind children during conceptual development (Landau & Gleitman 1985).

Finally, our results showed that the characteristics of the language produced by the children with low vision generally either occupied an intermediate position between those observed in the language of the blind and the sighted children, or were closer to those of the latter. This result echoes much of the data obtained in the field of spatial cognition (Dekker 1993; Blanco & Travieso 2003; Heller *et al.* 2003). Language in these children with low vision thus reflects the importance that residual vision, even when as rudimentary as blurred grey images, can have in the construction of word meaning. The attention that they probably devote to their residual vision may explain why these children still continue to use visual verbs at 12–14 years of age, in contrast to the other groups of children.

In conclusion, the present study provides evidence that the language developed by blind children is specific in the sense that it reflects their particular sensorimotor experience, in exactly the same way as it does in sighted children. Language in the blind appears to be suitably grounded in concrete experience. The grounding of meaning in sensorimotor experience does not prevent conceptual functional aspects of word definitions from developing similarly in blind and sighted children. These findings contradict the view that language in blind children is disconnected from the children's own sensory experience (Cutforth 1951). However, the present study focused on a limited and narrow aspect of language. It would now seem to be important to investigate other dimensions of language in blind children in order to test the more generalized validity of our findings.

This notwithstanding, what are the potential implications of this type of result in terms of the support given to visually impaired children? The present study points to the importance of organizing the environment of blind children so that they can interact with objects through a number of sensorimotor channels. For example, the observation that blind children did not refer to olfactory and gustatory perception more often than the sighted children, even though these perceptual modalities might go some way to compensating for their lack of vision in object recognition, indicates that intervention programmes that train them to use these perceptual modalities could be useful. Facilitating and reinforcing perceptuomotor experience in these children, accompanied by the provision of labels and verbal descriptions, would undoubtedly help them ground word meanings in their perceptual and bodily experience, thus reducing their dependence on other people for language acquisition. Second, the fact that the blind children's language was not characterized by visually oriented verbalism suggests that parents and caregivers should employ visual terms in their verbal interactions with blind children in the same way as they would with sighted children. Such an approach would help improve communication between blind and sighted people as language itself makes a large contribution to knowledge acquisition in blind children. Finally, our results highlight the importance of autobiographical memory in the way young blind children understand the world. These results therefore clearly have many implications. For instance, they may suggest that such children are easily disturbed by any unexpected change in their environment and that caregivers consequently need to pay special attention to this. They may also imply that young blind children naturally encode more context-specific attributes of objects or events than age-matched sighted children. If this is indeed the case then it may have consequences for the assessment of young blind children's development.

Key messages

- Blind children referred to perceptual dimensions (tactile, auditory) more often than sighted children when defining familiar objects.
- Visually oriented verbalism was infrequent in blind children who mentioned colour or luminance properties less often than sighted children.
- More conceptual aspects of language did not differentiate the groups of children as regards their visual status.
- The results are in line with embodied views of cognition that postulate the mandatory perceptuomotor processing of words when accessing their meaning.

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