Hand schema in children¹

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Abstract

When a young child, eyes closed, localizes a finger which has been tactually stimulated, he uses a visual schema of the hand. When this image conflicts with the then inverted posture of the hand, localization worsens. It improves again, except for the congenitally blind, on trials when the hand is returned to its original position.

Problem

When visual and tactual cues are conflicting in the perception of a geometric form, subjects respond predominantly to the visual cues, even though errors of judgment result (Rock & Victor, 1964). The present studies demonstrate that, for young children, a similar process is involved with regard to one aspect of the body image, namely the hand schema. It can be shown that, given a task of finger localization, the child utilizes a hand schema, or mental image, which is predominantly visual, although elicited by a tactual stimulus. He makes most errors when this visual image conflicts with the actual postural position of the hand.

Method

The procedure for the finger localization test, adapted from Benton (1959), was as follows: For one series (A), the child was asked to close his eyes and place his right hand, palm up, before him on the table. The experimenter then touched one finger lightly with a pencil and 3 sec. later asked the child to point to the finger which had been touched, while keeping his eyes closed. Under a second condition (B), the subject was asked to turn his hand over (palm down) after his finger had been stimulated. After 3 sec. he was asked to point to the correct finger with his hand in this altered position, again keeping his eyes closed. A third condition (C) was given in which the subject was asked to turn his hand over, but then to turn it back to its original position during the 3-sec. interval before responding. Again he was asked to keep his eyes closed. Each child was given 10 trials under each condition and the order of the presentation of conditions was systematically varied.

Results

The results for five age groups are presented in Table 1. Although errors decreased with increasing age for all three conditions, the younger children (ages 4, 5, and 6) made significantly more errors under condition B than under conditions A ($t = 3.68$; $P < .01$) or C ($t = 2.65$; $P < .01$). Many of these errors were of the "opposite" variety, i. e., pointing to the thumb after the smallest finger had been stimulated, or indicating the fourth finger in place of the second. The errors of the older subjects (ages 7 and 8) did not follow this pattern, but were too few to indicate any differences between the conditions.

Table 1. Mean errors in finger localization when the hand remains stationary (A), is inverted (B), and is inverted but then returned to its original position (C). Figures in parentheses are number of subjects.

		Conditions		
Ages		A	B	C
4	(15)	1.47	3.47	2.20
5	(20)	1.40	2.85	1.50
6	(17)	.59	1.15	.53
7	(16)	.25	.44	.69
8	(15)	.33	.27	.40

These data suggest that a visual image of the hand was elicited when the finger was stimulated tactually. When this image conflicted with the new position of the hand (condition B), the young child made more errors than when the image was consonant with the position of the hand when he responded (conditions A and C). It is clear that the increase in errors in condition B cannot be explained on the basis of intervening motor activity, since in condition C the child turned his hand both over and back again and yet made fewer errors than in condition B. Nor can the time lapse be the cause of the differences, since there was a 3-sec. interval for all three conditions.

If the visual image interpretation is correct, congenitally, totally blind children, who have no visual image of the hand, should not make more errors in condition B and in condition C. Data for a small group of such subjects support this notion. Of nine blind children tested, only 2 (22%) made more errors under condition B than under condition C, while 30 of the 52 non-blind children (58%) had followed this pattern. Figure 1 indicates that while most errors for sighted children occurred under condition B, for blind children condition C elicited most errors. It is hypothesized here that the significant increase of errors from A to C ($t = 1.75$; $P < .05$, one-tailed test) for the blind children is the result of a decay of the tactual impression with increased intervening motor activity. In other words, with no visual image to aid them, they rely on a tactual-kinesthetic sensation which is more likely than a visual image to be disturbed by intervening tactual and kinesthetic stimulation resulting from turning the hand.

Discussion

These data have theoretical relevance with regard to the importance of the various sensory modalities on the body image. Clearly the young child's hand schema, is

Fig. 1. Mean localization errors for blind children, aged, four, five, and six years, and a seeing control group. Figures in parentheses are number of subjects.

a predominantly visual image. Whether this is true for other parts of the body or for older subjects is an open question. One wonders whether the change in the response pattern for the 7- and 8-yr.-olds reflects a shift in the importance and dominance of visual imagery, or merely a masking of any real difference on a task that was too simple under all three conditions for this age group. An analogous task, more suitable for their age level is necessary to answer this question.

The data on the congenitally blind stress the im-

portance of tactual sensations for that group. Worchel (1951) found that sighted subjects were superior to blind subjects in tactual form perception and spatial orientation and related this superiority to an ability to translate tactual and kinesthetic cues into visual images. The present studies demonstrate a similar translation with respect to one aspect of the body image.

Finally, it should be made clear that the use of congenitally blind as a control group, rested on the assumption that they do not have tactual spatial schema, analogous to the visual schema in the sighted. If they did possess such a schema for their hand, for example, one would expect the results of the two groups to be similar. However, in line with the findings of von Senden (1960), these data suggest that the blind are relying on tactual sensory cues, which do not form a simultaneous spatial schema analogous to the visual schema of the sighted, and which degenerate with succeeding tactual and kinesthetic impressions.

References

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Note

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