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NOTE

WITELSON'S DICHHAPTIC TASK AS A MEASURE OF HEMISPHERIC ASYMMETRY IN DEAF AND HEARING POPULATIONS

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Abstract—Specialization of the right hemisphere for spatial processing was examined in adults and in hearing and deaf children using Witelson's dichhaptic task. Right- and left-hand performance did not differ for any of the groups although a significant age difference in overall performance of hearing subjects was found. The former result calls into question the validity of Witelson's task.

HEMISPHERIC specialization of function in the normal adult brain has been well documented. One of the experimental paradigms developed to index right hemisphere specialization is WITELSON's [1, 2] dichhaptic task. The present study employed this paradigm to index hemispheric specialization in specific populations.

Witelson's dichhaptic task requires bilateral simultaneous tactual exploration of pairs of nonsense shapes, followed by subsequent visual recognition of the two shapes. WITELSON [2] argued that such a task would produce competition in the neural system such that any superiority of the right hemisphere for the required cognitive processing would be reflected in superior perception of the contralateral (left) hand stimuli. She found that right-handed boys demonstrated a left-hand superiority—indicative of right-hemisphere specialization—as early as age 6 yr. Girls, on the other hand, were still showing equal performance across hands at 13 yr. On the basis of these findings Witelson argued for differential education of boys and girls.

LA BRECHE, MANNING, GOBLE and MARKMAN [3] employed Witelson's task to investigate hemispheric specialization in congenitally deaf children. On the basis of Witelson's result it was expected that the comparison group of 17-yr-old hearing children would display a left-hand superiority. It could also have been argued on the basis of other findings [4, 5] that the 15-yr-old deaf children would show either a left-hand superiority or equal performance on both hands. Instead, the hearing group showed a significant right-hand advantage—opposite to Witelson's findings—and deaf children tended to perform similarly, although the difference in performance between hands was not significant for these children.

The present study attempted to clarify the issue as to whether performance on Witelson's dichhaptic task is a valid measure of right-hemisphere specialization. The task was employed in two separate experiments with two different samples: in Experiment 1, with normal hearing adults, and in Experiment 2, with hearing and deaf children falling within the age range of the children studied by WITELSON [2].

EXPERIMENT 1

Method

Subjects. Twenty-seven first-year psychology students volunteered for the experiment as part of a course requirement. Each subject had previously completed a revised form of the Edinburgh Handedness Inventory [6] during a class session. Twenty-one were predominantly right-handed (scored 75–90), the remaining six were left-handed or ambidextrous (scored 18–74). Mean age of the eight right-handed males was 26.63 (S.D. = 13.69), and of the 13 females was 23.62 (S.D. = 11.54); mean age of the non-right handers was 30.83 yr (S.D. = 13.88).

Stimuli and apparatus. Two sets of 10.4 × 4 × 0.5 cm perspex shapes, identical to those used by Witelson, were mounted in pairs of 18 × 25.5 cm masonite boards. Two holes at the bottom of a high screen allowed the subject to place his hands over the unseen stimuli presented by the experimenter.

Procedure. In each trial the subject was required to actively touch simultaneously two different unseen stimuli for 10 sec, each one with the index and middle fingers of one hand. The subject then attempted to

identify the two shapes in a display of six shapes, by pointing to the recognized shapes with their left hand. A maximum of 24 practice trials were given, followed by 10 test trials. Scores are the number of left- and right-hand objects correctly chosen. The range of possible scores was thus from 0 to 10 for each field.

Results

Mean left- and right-hand scores for right-handed male and female subjects are presented in Table 1. Although both groups tended to show a right-hand superiority, an analysis of variance indicated that none of these differences were significant: Field effect, $F(1, 19) = 3.21$, $P > 0.05$; Sex × Field, $F(1, 19) = 0.36$, $P > 0.05$. These results tend to support the findings of LA BRECHE *et al.* [3], rather than WITELSON [2]. The slight right-hand superiority of the non-right-handed adults (see Table 1) was not significant, $t(10) = 1.07$, $P > 0.05$.

Table 1. Mean correct left and right tactual field scores for each group in Experiment 1

Group	Left	Right
RH males	7.38(2.13)	7.88(1.64)
RH females	6.15(1.72)	7.15(1.28)
LH all	6.17(1.47)	6.83(0.41)

Note: Standard deviations appear in parentheses.
RH = Right handed, LH = Left handed.

EXPERIMENT 2

Method

Subjects. The subjects' biodata are shown in Table 2. All groups contained equal numbers of boys and girls with the exception of the older deaf group which contained one additional female. The main group of 19 subjects demonstrated a right-hand preference for handwriting; three extra left-handed subjects were also tested. All deaf children (with the exception of one boy with one blind eye) suffered no physical or mental disability other than that associated with their severe to profound deafness (average loss of 75 dB and above).

Table 2. Numbers and mean age of children in each right-handed group

Group		Age	Number
Hearing children	Older	11.40(0.52)	10
	Younger	7.00(0.00)	10
Deaf children	Older	12.55(0.52)	11
	Younger	9.12(0.64)	8

Note: Standard deviations appear in parentheses.

Materials and procedure. The stimuli and apparatus were the same as those employed in Experiment 1. The only difference in the procedure was the method of instruction to the deaf children—this was achieved through a routine of finger-spelling, gesture and written instruction.

Results

The mean left- and right-hand scores for the various right-handed groups are presented in Table 3. Analyses of variance indicated once again that there were no significant differences between the left- and right-hand scores of any of the groups. Only one group, the younger deaf children, showed a larger (but insignificant) left-hand score.

With respect to the left-handers, an older hearing girl was tested and showed a substantial left-hand advantage (nine correct as compared to only three for the right hand). The two remaining left-handed deaf

Table 3. Mean correct left and right tactual field scores for each group in Experiment 2

Group		Left	Right
Hearing children	Older	7.00(1.58)	7.00(2.17)
	Younger	4.80(1.87)	5.60(1.51)
	All	5.90(1.89)	6.30(1.75)
Deaf children	Older	6.82(1.66)	7.36(1.63)
	Younger	6.75(2.12)	5.38(1.77)
	All	6.79(1.81)	6.53(1.93)

Note: Standard deviations appear in parentheses.

children showed very slight tendencies in opposite directions: an older girl scored seven correct on the left, and six on the right; a younger boy scored six on the left, and seven on the right.

Combining the data of the right-handed hearing groups from the two experiments, a significant increase in correct responses with age was found, $F(2, 38) = 8.28, P < 0.002$. Further tests revealed that the difference between the adult and older hearing children groups was not significant, $F(1, 29) = 0.002, P > 0.05$. All other comparisons were significant: Adult vs younger children, $F(1, 29) = 14.10, P < 0.002$; younger children vs older children, $F(1, 18) = 14.88, P < 0.002$.

DISCUSSION

The results of this study indicate that for all groups tested there were no significant differences between left- and right-tactual fields in accuracy of perception of nonsense shapes, although for most groups a trend toward right-hand superiority was evident. These findings are contrary to WITELSON's [1, 2] report of superior left-tactual field recognition and are more consistent with LA BRECHE *et al.*'s [3] findings with both deaf and hearing children.

A possible explanation of the results from the first experiment alone may lie in the notion of increased proportional use of the preferred hand with age. During school years the preferred hand for writing is used extensively which could result in greater right-handed behaviour for adults than for young children in their first years of schooling. Perceptual-motor mechanisms may thus become more oriented toward the right hand such that in Witelson's task situation any hemispheric-specialization-based tendency for greater perceptual ability in the left field is masked by the biased perceptual-motor orientation toward the right hand.

One would expect, then, that younger children would display a left-field superiority and that during the middle school years the direction of this superiority would change, so that eventually a right-field advantage is evident in adults. Such a developmental change should have been reflected in a significant age by tactual field interaction. However, this interaction was not significant and the younger hearing children, in particular, did not show any left-field advantage.

The trend toward left-field superiority in the younger deaf children was not expected and is not easily explained. Within the group, boys showed a substantial left-field advantage while the girls performed equally well in both left and right fields. The differences within the deaf groups may lie in the possibly heterogeneous sample of deaf children. A major problem encountered during the second experiment was the selection of an adequate number of deaf children within the age range and with the required characteristics—that is, no significant handicap other than deafness, a severe to profound level of deafness (preferably sensori-neural), a reasonable level of communication and average class achievement. Other factors known to be relevant to brain lateralization in the deaf, such as the subject's primary mode of communication [5] were noted, but could not be controlled or manipulated in this experimental situation.

In conclusion, the findings of the present study were not consistent with those reported by Witelson. She found left-hand superiority for the task in normal, hearing children. LA BRECHE *et al.* [3] found right-hand superiority for hearing children and no significant differences for deaf children. The present study found no significant field differences for either hearing adults, hearing children or deaf children. Thus Witelson's paradigm for indexing right-hemisphere specialization for spatial processing appears to be rather fragile. The differences in the nature of the samples used in this study and in hers may somehow account for the contradictory results, and further investigation is needed before any firm conclusions can be made. Factors such as strategies used by subjects to remember and identify the shapes, the nature of the distractors used in the six-shape visual displays, and the period of time available for touching the shapes may also have a

significant impact on performance on the task. These need to be investigated. Such doubts about the validity of Witelson's findings do, however, bring into question her somewhat extreme suggestions as to the desirability of differential schooling for the sexes that she derived from her results.

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Résumé :

On a examiné chez des adultes et des enfants entendants et sourds la spécialisation de l'hémisphère droit pour le traitement spatial au moyen de l'épreuve dichaptique de Witelson. Les performances des mains droite et gauche n'étaient pas différentes pour aucun des groupes bien qu'on ait constaté une différence significative d'après l'âge dans le niveau général des performances des sujets entendants. Ces premiers résultats mettent en question la validité de l'épreuve de Witelson.

Zusammenfassung

Spezialisierung der rechten Hemisphäre für die Verarbeitung räumlicher Gegebenheiten wurde mit der im Titel genannten Aufgabe bei Erwachsenen und bei hörenden und tauben Kindern untersucht. Die Leistungen der rechten und der linken Hand unterschieden sich in keiner der Gruppen, jedoch fand sich ein signifikanter Einfluß des Lebensalters auf die Gesamtleistung hörender Personen. Das erste Ergebnis läßt die Validität von Witelsons Aufgabe fragwürdig erscheinen.