gibsoni contrast with the larger pearlike forms of *B. canis* and *B. vogeli*, the two other *Babesia* species known to infect canines, and *B. mephitis* known from the striped skunk (*Mephitis mephitis*). Lightly staining cytoplasm differentiates *B. gibsoni* from *B. microti* and *B. procyoni*, the other oval *Babesia* in northeastern United States. In addition, our isolate did not parasitize a splenectomized raccoon or rodents, each of which regularly become infected when they are injected intraperitoneally with blood containing parasites of *B. procyoni* and *B. microti*, respectively. Furthermore, previous attempts to infect splenectomized dogs with *B. microti* (*9*) and *B. mephitis* (*10*) were unsuccessful. Serologic tests for identifying *Babesia* species are unavailable (*11*).

Entry of *B. gibsoni* into the United States could have been by way of infected domestic or captive canines or ticks. Although quarantines have been established and ticks have commonly been intercepted at ports of entry (*12*), some ticks have escaped detection and entered the United States (*13*). Both domestic and captive wild canines are allowed entry under federal quarantine restrictions (*14*), but such animals, including those from Asia and Africa, are not routinely examined for babesiasis. At least one pet dog, known to be infected with *B. gibsoni*, was brought into the United States in 1967, prompting the prediction that this parasite might again be introduced here (*15*).

Our report constitutes the first record of this potentially important *Babesia* of canines being transmitted in North America. The primary tick vector of *B. gibsoni* is *Haemaphysalis bispinosa* (*16*); this tick occurs in India, but not in the Americas. *Rhipicephalus sanguineus*, an introduced tick that is common in kennels and houses in North America (*17*), may transmit the organism (*18*), although the evidence is not conclusive (*16*). Other ticks on dogs in New York and New England include *Ixodes cookei*, *I. dammini*, and *Dermacentor variabilis* (*19*), but the tick that transmitted this New England infection remains unknown.

JOHN F. ANDERSON
LOUIS A. MAGNARELLI
Department of Entomology, Connecticut Agricultural Experiment Station, New Haven, Connecticut 06504
CHRISTOPHER S. DONNER
Pleasant Bay Animal Hospital, Inc., East Harwich, Massachusetts 02645
ANDREW SPIELMAN, JOSEPH PIESMAN
Department of Tropical Public Health, Harvard School of Public Health, Boston, Massachusetts 02115

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5. Blood smears were prepared weekly from the raccoon for 10 weeks; from *P. leucopus* for 12 weeks; from the golden hamsters for 5 and 15 weeks; and from the male and female dogs for the first passage, 5 weeks, and for the second passage, for 7 weeks from the male and 10 weeks from the female.
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Laterality of Stereognostic Accuracy of Children for Words, Shapes, and Bigrams: A Sex Difference for Bigrams

Abstract. *Children identified nonsense shapes by touch better with their left hand and words better with their right hand. Bigrams were processed by boys as shapes and by girls as words, which suggests a sexual dimorphism of brain functioning for bigrams. A relative specialization of the hemisphere for stereognostic processing is also suggested, since the accuracy of identification by both hands was greater than chance for all three types of stimuli.*

The right and left sides of the human brain, the two cerebral hemispheres, are joined by the interconnecting (commissural) structure, the corpus callosum. The belief that the left hemisphere plays the dominant role in language functions while the right one does this for processing of spatial stimulation has received strong support from tests of commissurotomized patients, that is, those whose corpus callosum has been cut surgically for sufficient medical reasons. It could be deduced from tests of these adult patients (*1*) that the accuracy of hand stereognosis for linguistic material should be superior by children's right hands and for spatial material superior by their left hands. Of course, one would have to assume that these functions are already sufficiently lateralized in childhood. Indeed, Witelson (*2, 3*) found with a two-handed simultaneous stereognostic test that, if boys felt nonsense shapes with the fingers of their left hand, they recognized them more accurately from a visual display than if they had touched them with the fingers of their right hand. However, although girls were as accurate as boys, girls recognized these same shapes equally well with the fingers of either hand (*3*). Witelson (*2*) also found that boys were equally accurate with both hands in identifying single-letter shapes they had previously felt. This might suggest that linguistic function, as far as stereognostic input is concerned, is not yet lateralized in children.

Several studies (*4–6*), however, show that both boys and girls of the ages tested by Witelson have a right ear superiority for processing linguistic material presented in dichotic listening tests. Moreover, while there is no clear superiority in children's right visual field for processing single Hebrew letters, such has been shown for two-letter Hebrew words (*7*). These results (*4–7*) can be interpreted to mean that even in young children the left (dominant) hemisphere is specialized for linguistic function for stimulus presentation in either the auditory or the visual modalities. Whether Witelson's (*2, 3*)

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negative stereognostic results for letter shapes with boys, and nonsense shapes with girls, are the result of the specific sample of children she tested, her testing techniques, the specific stimuli she used, the ages at which these functions become lateralized for stereognosis, or some combination of these, is not clear. In this study we replicate and extend parts of the investigations reported by her.

We studied 56 boys and 56 girls ranging in age from 78 to 176 months who tested at or above average in the Short Form Test of Academic Aptitude (*8*) and attended a suburban school (*9*).

Our stereognostic test material was of three types: (i) paired nonsense shapes, copied from Witelson (*2*); (ii) paired words—TO, IT; WE, BE; IN, ON; NO, OR; and AN, AT; and (iii) paired consonant bigrams—CM, HC; SV, VL; JK, ZJ; XD, SD; and ZX, XH (*10*).

During each test the child was seated before a visual shielding enclosure similar to that used by Witelson (*2*). The child made contact with the stimuli by simultaneously lowering the previously raised index and middle fingers of each hand respectively onto the right and left member of the presented pair. Finger movements only were permitted. The time allowed for contact was 10 seconds.

Each of the three types of stimulus material was also represented by a separate visual-display-response panel upon which ten duplicate stimuli of the test were arranged in a fixed spatial random array. After each tactile contact of a pair of test stimuli ended, the relevant panel, previously held out of view, was shown to the child. The child then indicated by pointing with each hand respectively to the shape thought to be felt with that hand on that given test trial. There was no time restriction for this response, and the children were encouraged to guess if they were doubtful about a stimulus.

Each child was individually tested on each of the three stimulus types. One week elapsed between each test. The ordering of the test type was equalized among the children. During a test, the children were each given ten test trials consisting of the five paired stimuli shown above, one of the pair being presented to each hand. After the left-right reversal of the members of each pair, each pair was presented again. At the beginning of each test, instructions were read to the children that stressed "show me what you felt" for the shapes and bigrams and "show me what you read" for the words.

Before proceeding, we gave analogous, nontest, stimulus and response practice materials to each child. This assured us that the child understood the tests and followed the instructions. A response had to be entirely correct to be counted.

As can be seen in Fig. 1, the children correctly identified all three types of stimuli felt with both hands more frequently than they would have had their responses been completely random. Such guessing would produce an average of 1.0 correct responses for each hand for each type of stimulus.

A split-plot factorial design analysis of variance, dividing the children into the three age groups indicated in Fig. 1, shows that age is a significant variable ($F = 53.48$, $d.f. = 2, 108$, $P < .01$). The numbers of correctly identified stimuli increase with age independently of the tested hand and the type of stimuli palpated. Witelson (*3*) found this for shapes; our result extends this to all three types of stimuli. Stimulus type varied in difficulty as well, since it too was a significant variable ($F = 17.64$, d.f. = 2, 108, $P < .01$). Overall, words proved to be the easiest for the children to identify, while shapes were the most difficult.

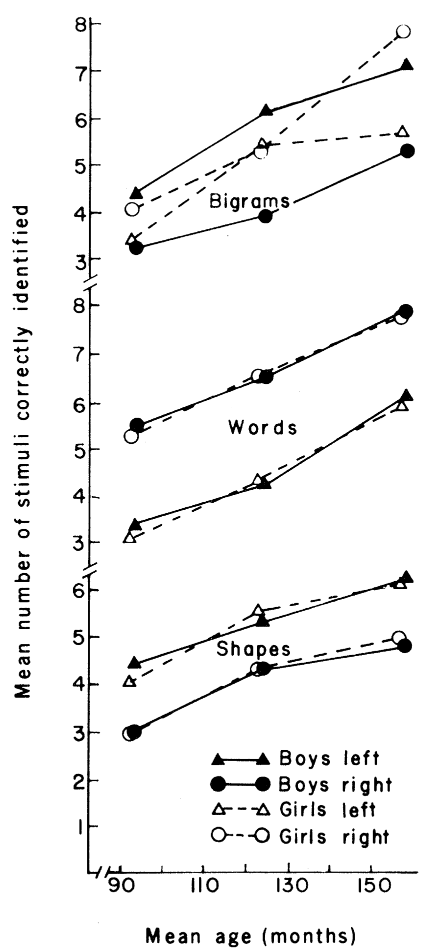

Fig. 1. Accuracy of finger stereognostic identification of shapes, words, and bigrams of children grouped at three ages. The mean age of the boys and girls in each group differs by 1 month. The chance level of correct response for each stimulus type and hand is 1.0. The standard errors of the plotted values ranged from a low of 0.24, which equals the size of the data point symbols, to a high of 0.51.

Sex by itself as a variable was not significant, which means that the girls and boys were equal in their ability to identify correctly the test stimuli. However, sex as a variable entered into two significant interactions: sex × hand ($F = 29.99$, d.f. = 1, 108, $P < .01$) and stimuli × sex × hand ($F = 27.39$, d.f. = 2, 216, $P < .01$) (*11*).

We found that boys ($t = 6.19$, d.f. = 54, $P < .001$) and girls ($t = 5.71$, d.f. = 54, $P < .001$) (*12*) were able to identify correctly more of the nonsense shapes that they felt with their left hand, whereas they could identify correctly more words if they felt them with their right hand (for boys, $t = 9.90$, d.f. = 54, $P < .001$; for girls, $t = 9.90$, d.f. = 54, $P < .001$). Comparisons between sexes of hand performance on the shape and word tests showed no significant differences. However, boys correctly recognized more of the bigrams felt with their left hand, while the reverse was true of girls. The differences between the scores for the left hand and the right hand of both sexes on the bigram test were also significant ($t = 7.53$, d.f. = 110, $P < .001$ for the left-hand comparison and $t = 11.4$, d.f. = 110, $P < .001$) for the right-hand comparison (*13*).

Our study confirms Witelson's (*2, 3*) observation of the superior stereognostic discrimination of the shapes felt by boys' left hands. In contrast to her work, however, we found that girls performed no differently on this task than did boys (*14*). We further failed to confirm Witelson's observations (*2*) that boys identify linguistic stimili (single letters) equally well with both hands. If such stereognostic linguistic stimuli consist of two-letter words, not only do boys better identify those touched with their right hand, but so do girls. Thus, for this modality, a single letter appears not necessarily to be an adequate linguistic stimulus for children. This also has been observed with Hebrew-speaking children tested by means of the visual modality (*7*). But then, neither are two letters necessarily an adequate linguistic stimulus, since the boys in our study processed the bigrams as if they were spatial stimuli. For children, the two letters must, when presented by means of the tactile modality, form a word in order to be an unequivocal linguistic stimulus. A similar effect appears to have been found in the study with Hebrew-speaking children (*7*).

We conclude that the respective superiority of each lateral stereognostic sensory field derives from its anatomical relationship to the specialized contralateral cerebral hemisphere by means of the decussating afferent input to that hemisphere. The logic of this conclusion follows that used either explicitly or implicitly by others [for example (*4, 6, 7*)].

Since the accuracy of the minor system (the nonspecialized sensory field and minor hemisphere) for the processing of linguistic materials is above that of chance, the specialization of the dominant hemisphere system for stereognosis in children may be a relative one, with the difference between the functioning of the two being one of degree. Some accurate processing of linguistic material by the minor hemisphere (system) has been shown in adult commissurotomized patients (*15*). Our results appear to generalize the principle of relative specialization of a hemisphere to a function for which the minor system is the more specialized, namely for stereognosis of spatial stimuli. It is also generalized to children. However, since the corpus callosums of our subjects were presumably functioning normally, our experiment does not preclude the possibility that the greater-than-chance stereognostic processing of the different stimuli by the nonspecialized system was effected in the specialized hemisphere by means of this commissure.

While our results do not confirm the sexual dimorphism for the nonsense forms found by Witelson (*3*), we note that the differential processing of the bigrams by the girls and boys of our study is entirely consistent with her conclusion that the "brains of girls and boys may be differentially organized for the cognitive processes involved in reading" (*3*, p. 426). If accepted, however, such a conclusion must be qualified because first, both the girls and boys in this study processed the two-letter words in almost identical fashion, and second because a minority of girls processed the bigrams as most boys did and vice versa.

JOSEPH CIOFFI
GILLRAY L. KANDEL
Department of Psychology,
Rensselaer Polytechnic Institute,
Troy, New York 12181

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10. Witelson's (*2*) nonsense shapes comprise ten irregular forms each measuring approximately 37 by 37 by 15 mm. Ours were cut from styrofoam 15 mm thick. We paired the shapes as she did. Our words and bigrams consisted of upper case letters used for bulletin boards (Kwik Sign Polystyrene Letters, Western Speciality Manufacturing Corp., Cheyenne). They measure 20 by 18 by 3 mm per letter with a stroke width of 4 mm. The stroke has distinctly palpable edges.
11. Other significant interactions were age × stimuli ($F = 3.04$, d.f. = 4, 216, $P < .05$), and stimuli × hand ($F = 137.97$, d.f. = 2, 216, $P < .01$).
12. To protect against a type I error, we adopted an alpha level of .001 for all planned comparisons.
13. Subsidiary experiments using smaller groups of children showed that the results with the word and bigram tests of this study could not be attributed to the different instructions given the children, namely, to "show me what you read" for the words and "what you felt" for the bigrams.
14. A comparable effect, that is, more accurate identification of faces presented in the left sensory field (tachistoscopically), has been found for both boys and girls by A. Young and H. Ellis, *Neuropsychologia* **14**, 495 (1976).
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Cholinergic Neuronotrophic Factors: Intraocular Distribution of Trophic Activity for Ciliary Neurons

Abstract. *Chick ciliary ganglionic neurons require an interaction with their peripheral targets for survival during a critical period of their embryonic development in vivo. It has recently been shown that survival of these neurons in dissociated cell cultures is supported by extract from whole chick embryo. In this study, an assay system based on microwell cultures of ciliary ganglionic neurons was used to demonstrate that a very rich source of trophic factor for them is the intraocular target tissues they innervate. Out of 8000 trophic units present in a 12-day embryo, 2500 were contained in the eye. A subdissection of the eye showed its activity to be localized in a fraction containing the ciliary body and choroid coat, with a specific activity almost 20-fold higher than that of the whole embryo. This selective intraocular distribution at a time when survival or death of ciliary ganglionic neurons is decided in vivo suggests that this soluble factor may be involved in the normal development of the ciliary ganglion.*

Neuronal cell death is a widespread phenomenon in the normal development of the nervous system (*1*). In the chick ciliary ganglion, half of the neurons present at embryonic day 8 die before embryonic day 14 (*2*). This cell death occurs at the time when ciliary ganglionic (CG) neurons are connecting with their target tissues, the ciliary body and choroid coat of the eye. Prior removal of an eye results in the complete loss of CG neurons in the ipsilateral ganglion, at the very time when cell death occurs during normal development (*3*). Conversely, neuronal death can be reduced by implanting an additional eye primordium, which increases the amount of target tissue available to the CG neurons (*4*). Neurons have been hypothesized to compete for a limited trophic supply from the tissues they innervate (*1*). Excess neurons fail to receive sufficient trophic support and do not survive.

In monolayer cultures, CG neurons seem to require special trophic support, which can be provided by coculture with skeletal muscle cells (*5*) or by medium conditioned over heart cells or supplemented with extract of chick embryos (*6, 7*). The presence, in extract of embryonic tissues, of a soluble material capable of supporting CG neurons, all of which are cholinergic, suggests that such extracts can be profitable sources for the isolation and identification of possible cholinergic neuronotrophic factors. We report here that (i) the highest concentration of trophic activity for CG neurons was found in the tissues that are their physiological targets and (ii) the active agent in these tissues exists in amounts sufficiently high to make its purification feasible.

Tissues to be assayed for trophic activity were homogenized in 6 ml of distilled water per gram of wet weight of the sample, with 20 strokes of a homogenizer (Potter-Elvehjem). The crude homogenates were spun at 108,000*g* at 0° to 4°C for 2 hours. Supernatant fractions from these spins were collected and assayed for protein concentration (*8*). To determine the amount of trophic activity in an extract, a dilution series was tested with a microwell bioassay, which we developed by modifying and scaling down

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