INTRASENSORY AND INTERSENSORY DISCRIMINATION OF FORM

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ABSTRACT

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Intrasensory and intersensory discrimination of form was investigated with children, 9.47 years of age. The intersensory procedure consisted of presenting a standard stimulus (visually) to Ss repeatedly until habituation occurred during the first Habituation Period. Subjects were divided into two groups for the second period: (a) one group of Ss received repeated presentations of the same stimulus as in Habituation Period One (haptically); (b) the other group of Ss received repeated presentations of a different stimulus from the one used in Habituation Period One (haptically). Results lent support to the generalization of Sokolov's theory to intersensory functioning. Subjects required more trials to habituate to the different stimulus presented in Habituation Period Two than Ss who received repeated presentations of the same stimulus. In addition, GSR frequency and amplitude habituated more consistently than fixation and touching dependent measures. The results were discussed in light of their implications for present hypotheses concerning the nature of intersensory integration and suggestions for future research.

INTRASENSORY AND INTERSENSORY DISCRIMINATION OF FORM

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INTRODUCTION

The orienting reflex (OR) is a general organismic response to change in stimulation (Sokolov, 1963), and includes both somatic and autonomic components. Moreover, the gradual disappearance of the organism's OR to repeatedly presented stimuli (habituation) has been extensively used as a reliable dependent variable. For example, habituation of various components of the OR has been demonstrated with infants (Saayman, Ames, & Moffet, 1964; McCall & Kagan, 1967; Schaffer & Parry, 1969), children (Lewis, Goldberg, & Rausch, 1967; Cantor & Cantor, 1964a, 1964b), and adults (Berlyne, 1958; Berlyne, Craw, Salapatek, & Lewis, 1963; Kimmel & Goldstein, 1967). OR components in these studies have included heart rate (HR), visual fixation, and/or skin resistance (SR).

Other investigators have demonstrated OR habituation to auditory (Bartoshuk, 1962; Corah & Stern, 1963; Koepke & Pribram, 1966), olfactory (Engen & Lipsitt, 1965), tactile (Grossman & Greenberg, 1957) and gustatory stimuli (Fisher & Fisher, 1969). These studies have in common the demonstration that rate of habituation may be influenced by various stimulus factors such as intensity, duration and complexity as well as interstimulus interval.

Perceptual research has suggested that children six-years of age and older transfer the perception of form across sensory modalities, while children less than six-years of age do not evidence intersensory transfer of form (Pick, Pick, & Klein, 1967). Several theories have been advanced to account for the intersensory integration of sensory input. For example, Piaget and Inhelder (1956) have proposed a cognitive process theory of intersensory integration while Connolly and Jones (1970) have proposed an information systems theory of intersensory integration. A question of special interest for the present study concerned the extension of Sokolov's neural model theory of habituation as a potential explanation of intersensory integration.

Sokolov (1963) has theorized that a central neural process mediates habituation and dishabituation of the OR. According to this theory, incoming stimuli leave traces of their characteristics (neural models) primarily in the cortex. Excitation arising from an incoming stimulus is transmitted to the cortex which in turn is presumed to act as an analyzing center comparing the incoming stimulus with the established neural model. If the incoming stimulus matches an existing model, the cortex directs impulses to the reticular formation to inhibit or block the organism's OR to the incoming stimulus. If, on the other hand, the incoming stimulus does not match the neural model, the cortex is assumed to direct impulses to the reticular formation to elicit an OR. The rate of response habituation has been suggested as indicative of the rate of model formation of that stimulus (Lewis & Goldberg, 1969; Dodd & Lewis, 1969; McCall, 1969).

The present study was designed to investigate the effects on habituation rate or dishabituation when a form presented in one sensory modality (visual) is followed by the presentation of the same form or a different form in another sensory modality (haptic). Consistent with Sokolov's theory and perceptual research it was predicted that visual presentation of a form followed by haptic presentation of the same form would result in more rapid habituation than would occur if a visually presented form were followed by a haptically presented form.

Method

Subjects

A total of 30 boys and 30 girls ranging in age from eight-years to eleven-years (Mean = 9.47 years, SD = 1.01) served as Ss. Twenty Ss (10 boys, 10 girls) were randomly assigned to each of three experimental groups: Visual-haptic (VH), Visual-visual (VV), and Haptic-haptic (HH).

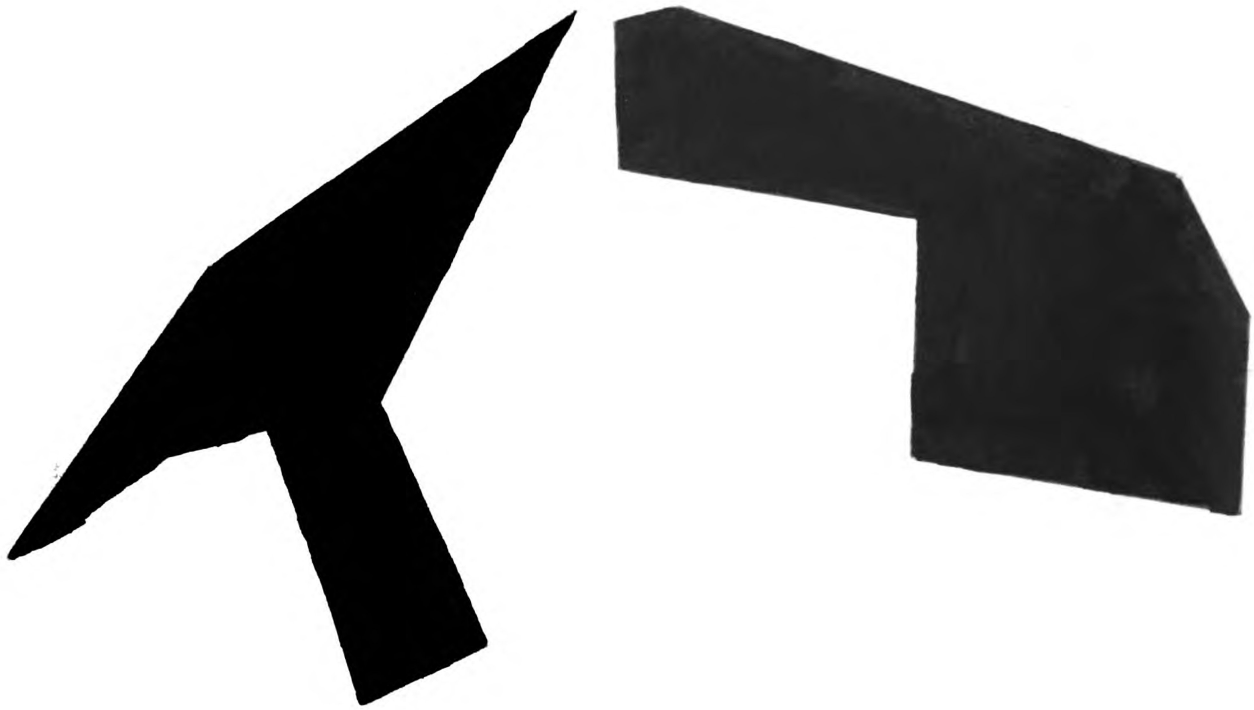
Apparatus

Visual stimuli. As indicated in Figure 1, the visual stimuli were photographic slides of two eight-sided random-shaped forms. Random shape 1 had a perimeter of 14 inches and random shape 2 had a perimeter of 16 inches. Both forms were black and were presented on a white background.

The visual presentation apparatus consisted of a 24" x 24" translucent plate glass screen mounted in a three-inch frame positioned between two 12" x 30" panels. Located in the center of each panel was a 1" x 3" observation hole covered with one-way viewing glass. Subjects were enclosed on their right and left side by olive green felt covered frame walls. Subject to viewing screen distance was 24 inches. A Carousel slide projector, mounted behind the stimulus presentation apparatus, projected the slides onto the glass screen.

Haptic stimuli. The haptic stimuli were a corresponding set of forms constructed from 1/4-inch thick masonite. These smooth-surfaced forms were mounted on a 16" x 16" piece of masonite and were raised 1/4-inch above the surface of the masonite.

Haptic stimuli were mounted in a 16" x 32" frame and presented in the same horizontal and vertical plane as the visual stimuli. The haptic presentation apparatus was located directly in front of S during



Stimulus 1 Stimulus 2

Figure 1. A representation of stimulus 1, a 14-inch perimeter form, and stimulus 2, a 16-inch perimeter form.

haptic stimulus presentation. During visual stimulus presentation the apparatus was removed. When haptic stimuli were presented, a visor—attached to a frame bordering S's head—was lowered to block S's vision. This same visor was raised when visual stimuli were presented.

Dependent variables and stimulus events were recorded on a Beckman RS Dynagraph. Stimulus onset and offset, stimulus duration, and intertrial intervals were automatically programmed (Porges & Fitzgerald, in press).

Experimental Design

As indicated in Table 1, the research design consisted of three independent groups: (a) visual-haptic (VH); (b) visual-visual (VV); (c) haptic-haptic (HH). During Habituation Period One, Ss in Group VH and Group VV received repeated presentations of visual stimulus 1 (14-inch perimeter form) until habituation occurred. Similarly, Ss in Group HH received repeated presentations of haptic stimulus 1 (14-inch perimeter form) until habituation occurred. Following Habituation Period One, Ss in each of the three groups were randomly assigned to one of two subgroups. The habituation criterion was three consecutive trials during which no GSR occurred.

Intersensory condition. For Habituation Period Two, Ss in Group VH were subdivided into Haptic group A and Haptic group B. Subjects in Haptic group A received repeated presentations of haptic stimulus 1. Subjects in Haptic group B received repeated presentations of haptic stimulus 2.

Intrasensory condition. For Habituation Period Two, Ss in Group VV were subdivided into Visual group A and Visual group B. Subjects in Visual group A received repeated presentations of visual stimulus 1,

TABLE 1

Design for investigating intersensory transfer of form is represented. Stimulus 1 was a 14-inch perimeter form, while stimulus 2 was a 16-inch perimeter form.

	Habituation Period One	Stimulus Presented	Habituation Period Two	Stimulus Presented
Intersensory	Group VH	Visual 1	Haptic group A (VHA)	Haptic 1
			Haptic group B (VHB)	Haptic 2
Intrasensory	Group VV	Visual 1	Visual group A (VVA)	Visual 1
			Visual group B (VVB)	Visual 2
	Group HH	Haptic 1	Haptic group C (HHC)	Haptic 1
			Haptic group D (HHD)	Haptic 2

while Ss in Visual group B received repeated presentations of visual stimulus 2.

Subjects in Group HH were subdivided into Haptic group C and Haptic group D. Subjects in Haptic group C received repeated presentations of haptic stimulus 1, while Ss in Haptic group D received repeated presentations of haptic stimulus 2.

Procedure

Each child was brought to the experimental room and seated in front of the stimulus presentation apparatus. Electrode sites were cleaned with 70% ethanol. GSR was recorded with Grass Instruments silver cup electrodes attached to the palmar region of the hand, dorsal portion of the hand, and to the forearm of the non-preferred hand three inches below the elbow. Grass electrode-paste served as the electrolytic medium. A five minute adaptation period, during which S was given instructions, preceded onset of Habituation Period One.

For Habituation Period One, Ss in Groups VH and VV were instructed to watch the screen for pictures that would appear. Visual stimulus duration was 20 seconds. Random intertrial intervals (ITI) ranged from 10-25 seconds, with a mean of 15 seconds. Subjects in Group HH received the following instructions: "Here is a form for you to feel. You may explore the form for as long as you like." While administering the instructions, E removed S's hand from the table and assisted S in locating the stimulus by placing S's hand on the stimulus. After giving the instructions, E removed S's hand and the experiment began. Subject began exploring the form when E told him to start and removed his hand when E told him to stop. Haptic stimuli were presented for

20 seconds. The ITI ranged from 10-25 seconds, with a mean of 15 seconds.

A two minute rest period followed Habituation Period One. In Habituation Period Two, Ss in Groups VH and HH were administered the instructions regarding haptic exploration of the stimulus form. Subjects in Group VV received the same instructions as they received prior to Habituation Period One. Stimulus durations and ITIs were identical to those employed in Habituation Period One. After Habituation Period Two ended, S was asked whether the form he just explored (either visually or haptically) was the same as or different than the form he received during Habituation Period One.

The following dependent variables were recorded and analyzed: (a) first fixation time, (b) total fixation time, (c) average fixation time, (d) first touching time, (e) total touching time, (f) average touching time, (g) GSR frequency, and (h) GSR amplitude.

Visual fixation. First and total fixation time were recorded for each visual presentation trial. First fixation time was defined as the amount of time S spent looking at the stimulus during his first gaze. Average fixation time for each trial was computed by dividing total fixation time by number of fixations (Cohen, 1969). A second E who had earlier given the instructions recorded S's fixation responses through one of the observation windows located on each side of the screen. Inter-observer reliabilities were determined earlier resulting in 100% agreement among observers.

Touching time. Since there has been no previously reported attempt to study habituation to haptically presented stimuli, there have been no scoring procedures developed. Response measures analogous to those used in visual fixation studies were developed. First and total touching time were recorded during each haptic presentation trial. Average touching time was computed in the same way as average fixation time. The second E also recorded each S's touching time.

GSR. For visually presented stimuli, only responses of 1000 ohms or more occurring three seconds after stimulus onset were scored. Frequency of responses meeting this criterion was also recorded. The purpose of eliminating those responses occurring before three seconds from the analysis was to avoid the inclusion of responses merely to the onset of a stimulus from those occurring to stimulus characteristics. GSR amplitude was computed for each response and transformed into a conductance score.

For haptic presentations, a GSR was said to occur if it was of a magnitude of 1000 ohms or more (Corah & Stern, 1963) and occurred one to three seconds after S had traced the complete outline of the form. If S failed to trace the complete outline, then the last four seconds of a trial was examined for a response. Nonspecific (NS) GSRs were also scored if they occurred during a haptic presentation trial. Nonspecific GSRs were defined as those GSRs which occurred during a haptic presentation trial, but not to the habituation criteria events. The GSR frequency and amplitude were recorded. Amplitude was transformed into conductance scores. GSRs occurring to stimulus onset and offset were not included in the analysis.

All Ss included in the data analysis were able to correctly discriminate verbally between stimuli presented in Habituation Period One and Habituation Period Two.

Results

Main Effects

A three-way analysis of variance (Winer, 1962) was performed to assess the effects on habituation rate of presenting the same stimulus in Habituation Period Two that S received in Habituation Period One. The analysis of variance was computed on the proportion-of-trials-to-habituation-score with sex (2), sensory group (3), and stimulus (2) as the factors. In order to control for individual differences in habituation rate, a proportion score was computed by placing the number of trials to habituation in the second period over the number of trials to habituation in the first period[1]. The results of the analysis of variance revealed no significant main or interaction effects due to sex.

There was a significant main effect for sensory group ($F = 10.27$, $df = 2/48$, $p < .005$). This effect may be attributed to the significant difference in the proportion of trials score between Group VH and Group VV ($t = 2.56$, $df = 38$, $p < .02$). In addition, there was a significant difference in the proportion of trials score for Group VH and Group HH ($t = 2.53$, $df = 38$, $p < .02$). There was no significant difference between Group VV and Group HH. Group VH had a higher proportion of trials score due to the more rapid habituation rate to the visual stimulus presented in Habituation Period One than to the haptic stimulus presented in Habituation Period Two (independent of whether the stimulus was the same as or different from the stimulus in Habituation Period One). This finding is specific to Group VH and relates to the observation that, in general, Ss required more trials to habituate to a haptic stimulus than to a visual stimulus.

There was a significant main effect due to type of stimulus presented in Habituation Period Two ($F = 37.18$, $df = 1/48$, $p < .001$). Non-directional t tests (Winer, 1962) were performed on the proportion of trials score to stimuli 1 (same) and stimuli 2 (different) for each sensory group. These planned comparisons indicated highly significant differences between Group VHA-Group VHB proportion scores ($t = 3.85$, $df = 18$, $p < .01$); Group VVA-Group VVB proportion scores ($t = 3.46$, $df = 18$, $p < .01$); and Group HHC-Group HHD proportion scores ($t = 2.86$, $df = 18$, $p < .02$). These significant differences support the hypothesis that Ss who were presented a different stimulus in Habituation Period Two required more trials to habituate than those Ss presented the same stimulus.

Within Period Effects

A second analysis was performed to examine the relationship between intersensory and intrasensory transfer of form and habituation of the dependent measures. Since the criterion for habituation did not involve a fixed number of trials, a mean for each response measure was computed from the first half of the habituation trials and the second half of the habituation trials. This computation was done for the first and second habituation periods. A non-directional t test for correlated means (Winer, 1962) was used to test for significance[2].

Visual fixation time[3]. Although the difference between the means for first fixation time within periods one and two are in the predicted direction, first fixation time showed no significant response decrement within Habituation Periods.

There was a significant decrease in total fixation time during

Habituation Period One ($t = 5.28$, $df = 39$, $p < .001$). During Habituation Period Two, total fixation time showed a significant response decrement for both Group VVA ($t = 2.87$, $df = 9$, $p < .02$) and Group VVB ($t = 3.00$, $df = 9$, $p < .02$).

Average fixation time, like first fixation time failed to show a significant response decrement during Habituation Periods One and Two, although the difference between the means was in the predicted direction.

Touching time[4]. First touching time evidenced no significant response decrement during the Habituation Periods. As was the case with average fixation time and first fixation time, the difference between means was in the predicted direction within each Habituation Period with the exception of Group VHA during Habituation Period Two.

Total touching time decreased significantly ($t = 3.94$, $df = 19$, $p < .001$) during Habituation Period One for all groups. It did decrease during Habituation Period Two for each sensory group except for Group VHA, but not significantly.

With the exception of Group VHB ($t = 2.32$, $df = 9$, $p < .05$), average touching time failed to show a significant response decrement during each Habituation Period.

GSR frequency and amplitude. During Habituation Period One, GSR frequency showed a significant decrease for the visual sensory condition ($t = 4.22$, $df = 9$, $p < .01$). In the haptic sensory condition, both GSR frequency ($t = 6.21$, $df = 9$, $p < .001$) and NS GSR frequency ($t = 3.99$, $df = 9$, $p < .01$) decreased significantly.

During Habituation Period Two, Group VHA showed a significant decrease in GSR frequency ($t = 3.20$, $df = 9$, $p < .02$). Group VHB showed a significant response decrement for both GSR frequency ($t = 3.45$, $df = 9$, p .01) and NS GSR frequency ($t = 3.84$, $df = 9$, $p < .01$). Group VVA ($t = 4.22$, $df = 9$, $p < .01$) and Group VVB ($t = 6.95$, $df = 9$, $p < .001$) showed a significant decrease in GSR frequency. Likewise, Groups HHC [GSR frequency ($t = 4.36$, $df = 9$, $p < .01$)] and HHD [GSR frequency ($t = 3.61$, $df = 9$, $p < .01$) and NS GSR frequency ($t = 5.49$, $df = 9$, $p < .001$)] showed a significant response decrement. Group VHA and Group HHC failed to indicate a significant decrease in NS GSR frequency.

GSR amplitude decreased significantly for the visual sensory condition during Habituation Period One ($t = 6.77$, $df = 39$, $p < .001$). GSR amplitude ($t = 4.64$, $df = 19$, $p < .001$) and NS GSR amplitude ($t = 3.82$, $df = 19$, $p < .01$) also decreased significantly for the haptic sensory condition.

During Habituation Period Two, GSR amplitude decreased significantly for the following sensory groups: Group VHA ($t = 2.44$, $df = 9$, $p < .05$), Group VHB ($t = 3.06$, $df = 9$, $p < .02$), Group VVB ($t = 4.84$, $df = 9$, $p < .001$), Group HHC ($t = 3.83$, $df = 9$, $p < .01$), and Group HHD ($t = 2.77$, $df = 9$, $p < .05$). GSR amplitude failed to decrease significantly for Group VVA. In addition, NS GSR amplitude decreased significantly for the following sensory groups: Group HHD ($t = 3.04$, $df = 9$, $p < .02$), Group VHA ($t = 2.76$, $df = 9$, $p < .05$), and Group VHB ($t = 2.33$, $df = 9$, $p < .05$). NS GSR amplitude did not decrease significantly for Group HHC.

In summary, the results of the above analysis indicate the consistent habituation of GSR frequency and amplitude for most all of the sensory groups during Habituation Periods One and Two.

Between Period Effects

A third analysis compared the mean difference scores obtained from the first and second habituation periods. A mean difference score was computed by obtaining the difference between the mean response magnitude of the first half of trials from the mean response magnitude of the second half of trials for each period for each response. Although the mean difference score showed a decrease from Habituation Period One to Habituation Period Two, this difference was not statistically significant.

Discussion

The present study was designed to study the intrasensory and intersensory discrimination of form. The overall pattern of results for each of the sensory groups confirms the hypothesis that habituation is more rapid when Ss are presented the same stimulus than when they are presented a different stimulus in Habituation Period Two.

The results for the visual-visual groups are consistent with those of previous research with children and adults which have shown decreases in total fixation time with repeated presentations of the same stimulus (Cantor & Cantor, 1964a, 1964b; Berlyne, 1958). In addition, results of the present study confirm Berlyne et al's (1963) findings with adults which indicate habituation of GSR frequency. On the other hand, first fixation time and average fixation time did not yield evidence of habituation. This finding is in contrast to those found by studies with infant Ss that have demonstrated habituation of first fixation time (McCall & Kagan, 1967) and average fixation time (Cohen, 1969). In this regard, the habituation results of Group HH followed a similar pattern to those for Group VV. Among the various measures of touching time, total touching time was the only one to evidence habituation. GSR frequency and amplitude habituated during both Habituation Periods.

A question of special interest concerns intersensory integration of form; i.e., that condition during which Ss were presented a visual stimulus in Habituation Period One and a haptic stimulus during Habituation Period Two. As indicated by habituation of GSR frequency and amplitude, intersensory integration of form was demonstrated.

Moreover, during Habituation Period One there was significant decrement in total fixation time with repeated stimulus presentation. Group VHB had a similar decrement in mean touching time during Habituation Period Two. These results are in line with Sokolov's theory of habituation, which suggests that a "neural model" of a stimulus event is constructed with repeated presentations of that stimulus event. Sokolov's theory was primarily proposed to account for the response consequences of the intrasensory presentation of stimuli, where the second stimulus remains in the same sensory modality as the first stimulus. On the other hand, the results of the present study suggest the application of Sokolov's theory to the intersensory condition as well. Note, however, in the present study, Ss in the intersensory conditions all experienced a change in sensory modality during Habituation Period Two, but for one half of these Ss (Group VHA) the perimeter of the stimulus was the same while for the other half (Group VHB) it was different. Thus, Ss in Group VHB received both a change in sensory modality giving rise to the stimulus and a change in a physical characteristic of the stimulus. Since habituation was slower for Ss in Group VHB, it appears likely that at least two processes may be involved in the intersensory integration of form: (1) the formation of the form model from one sensory modality through exploration of the form; and (2) transfer of the form model from one sensory modality by integrating stimulus information from the two sensory inputs.

Two alternative hypotheses concerning the nature of sensory integration have been advanced. Piaget and Inhelder (1956), in the first of these, proposed that cognitive factors function not only to construct the form percept, but also function to convert a haptic percept to a visual percept. Their model suggests that information is integrated before before it is stored. Nevertheless, this hypothesis remains to be empirically verified. Connolly and Jones (1970) propose an information systems hypothesis to account for developmental changes in intersensory perception as well as the assymetrical differences in performance on intersensory tasks. This model suggests that information obtained from the various sensory modalities is held in short-term storage systems of which the visual storage system is the most efficient. On the other hand, transfer of information between modalities is dependent upon information held in an integrated long-term storage center. Further, they postulate that information is recoded between modalities before committing it to a short-term memory store. For example, in their studies of visual and kinesthetic matching (Connolly & Jones, 1970; Jones & Connolly, 1970), they presume that visual sensory input is recoded into a kinesthetic code (visual-kinesthetic matching) and held in a kinesthetic memory store before being reproduced kinesthetically. The reverse process occurs in a kinesthetic-visual matching task. Thus, the worse performance observed for the visual-kinesthetic task over the kinesthetic-visual task may be attributed to the increased efficiency of the visual system (due to 'rehersal') while the kinesthetic memory system suffers temporal decay. Although their hypothesis adequately accounts for the visual-kinesthetic integration, it fails to account for results reported by others for visual-haptic integration. Several investigators (Blank, Altman, & Bridger, 1968; Lobb, 1965; Eastman, 1967) obtained better performance on visual-haptic tasks in children and adults than on haptic-visual tasks [Although Cashdan (1968) and Gaydos (1956) found the opposite to be true with adults.]. Extending the Connolly and Jones model to account for the results for the visual-haptic tasks, leads to the conclusion that the haptic storage system is more efficient than the visual storage system. Such a conclusion contradicts Connolly and Jones' assumptions concerning the functioning of the visual storage system; thus, their explanation of intersensory integration seems questionable, or at best of limited application.

There are additional problems with previous studies of intersensory integration; specifically, gathering information within one modality about the shape of the object, stimulus complexity, and the cognitive function of integrating this information. Piaget and Inhelder (1956) found evidence of intersensory integration (visual-haptic) in three-year-old children using very simple kinds of non-euclidean forms. Their results raise the possibility that previous studies have confounded stimulus information gathering ability with the ability to integrate stimulus information. Abravanel (1968) and Ruzskaya and Zinchenko (Zaporozhets, 1965) have reported that the exploratory responses to euclidean forms presented haptically and visually in three-and-four-year-old children were crude and precluded the knowledge of the complete shape of the form. Therefore, intersensory integration may be present at a younger age, but may be limited by the inefficient nature of the exploratory responses.

Another factor affecting intersensory integration is memory and its related effect on the rate at which a 'model' of the stimulus is formed. It may take longer for younger Ss to form a model of the stimulus than older Ss. One finding relating to this question is that the use of a simultaneous matching procedure results in fewer errors than a successive matching procedure (Blank & Bridger, 1964; Birch & Lefford, 1963). This difference is probably due to the requirements of the successive matching task that S remember the standard stimulus through many comparisons of test stimuli. Secondly, the previous methods used may not have allowed S sufficient time to form a complete 'model' of the form, therefore resulting in errors in identification due to the method employed. Partial support of this hypothesis is derived from studies using a simultaneous matching procedure (Blank & Bridger, 1964) or a discrimination learning task (Blank et al, 1968) in comparison with studies using a successive matching procedure (Birch & Lefford, 1963). This difference could be due to an increased exposure to the relevant stimulus by the simultaneous matching and discrimination learning methods employed. Nevertheless, the comparison is inconclusive due to the nonequivalence of stimulus complexity employed in these studies.

In the present study, analysis of the effects of the task on the dependent response measures indicated consistent habituation of GSR frequency and amplitude while total fixation and touching times habituated inconsistently. Thus, the present results support a multiple response recording strategy (Fitzgerald & McKinney, 1970).

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Footnotes

[1]The proportion-of-trials-to-habituation-score was used in order that the differential rates of habituation would not be confounded by individual differences in the number of trials to habituation. Individual differences in habituation rates were controlled by using each S's rate of habituation in Habituation Period One.

[2]A two-way analysis of variance (Winer, 1962) was performed to assess the effects of sex of S on performance over trials given in Habituation Period One and Habituation Period Two. The analysis of variance was computed on the mean response magnitude for each dependent measure during Habituation Periods One and Two. In the analysis of variance, sex (2) was one factor with repeated measures on a second factor, trials (2). The results of the analysis of variance for Habituation Period One indicated a significant sex main effect for first touching time ($F = 9.43$, $df = 1/18$, $p < .01$) and average touching time ($F = 7.91$, $df = 1/18$, $p < .025$) for Group HH. Females explored the stimulus longer on their first touch ($t = 3.42$, $df = 38$, $p < .01$) and explored the stimulus longer on each touch ($t = 3.34$, $df = 38$, $p < .01$). The results of the analysis for Habituation Period Two showed a significant sex x trials interaction effect for first fixation time ($F = 7.81$, $df = 1/8$, $p < .025$) for Group VVB. First fixation time showed a significant response decrement ($t = 3.42$, $df = 4$, $p < .05$) for females in Group VVB, but not for males in the same group.

[3]The number of fixations was recorded and analyzed. The results of the analysis of variance and non-directional t tests failed to reveal any significant differences. This finding confirms the results of Lewis, Kagan, and Kalafat (1966) with infants indicating no differences in

number of fixations.

[4]All Ss in the haptic sensory conditions during Habituation Periods One and Two traced the complete perimeter of the stimulus presented. It was noted through informal observation that Ss gave GSRs when contact was made with the acute angles of each stimulus during a haptic trial. These GSRs did decrease in magnitude, but did not completely disappear. These observations imply that S was using the acute angles and their location as cues to aid them in discovering the shape of the stimulus and in discriminating between stimuli. These observations and the proposed hypothesis suggest future areas to be investigated.