Active and passive tactile braille recognition

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Subjects made visual matches to individual braille characters or named two-letter braille words. Tactile examination of braille was either active or passive. Active touch yielded superior performance to all passive conditions, with static presentations producing the poorest performance. Naive subjects were very poor at reading simple braille words with passive touch, but active exploration aided word identification.

The purpose of the present study was to compare active and passive touch in braille recognition. Considerable controversy has surrounded Gibson's (1962) formulation of the active versus passive issue in tactile perception (Loomis & Lederman, 1984). Gibson argued that passive touch, in which stimulation is imposed on a stationary perceiver, is inadequate for the detection of form. Moreover, Gibson asserted that passive perception is not "natural." According to this view, experiments directed toward the study of passive touch could be considered ecologically invalid. Gibson thought that passive perception was likely to promote attention to subjective sensory experiences, whereas active exploration of the tangible environment prompts amodal perceptual events.

Unfortunately, the experimental evidence is inconclusive on the relative accuracy of active and passive tactile pattern perception. Some studies support the distinction and report an advantage for active exploration of form (e.g., Gibson, 1962; Heller, 1980, 1984); another study has yielded no difference between the modes in textural judgments (Lederman, 1981); and others have even reported better performance when subjects were passive (Heller & Boyd, 1984; Magee & Kennedy, 1980; Richardson, Wuillemin, & MacKintosh, 1981). To cloud the issue even further, comparisons of active and passive braille reading have been inconclusive. Day and Dickinson (1979) reported the only direct comparison of active and passive touch in braille reading and failed to find a significant effect of perceptual mode. However, their active condition had higher performance levels, and the effect of mode approached significance ($p = .10$). Furthermore, Day and Dickinson used a very unnatural procedure for active touch: The subjects' fingers were clamped in a device that only allowed horizontal scanning without retracing. New braille readers normally engage in a variety of exploratory scanning movements when first learn-

ing to read braille (Heller & Mitchell, 1985). Experienced readers of braille may even engage in vertical or horizontal scanning (Foulke, 1982).

The present experiment compared active scanning of braille with passive-static presentations and several passive scanning methods. It was expected that active touch would aid character recognition. Moreover, static presentation was expected to impair perception if stimulus change were important for braille reading.

METHOD

Subjects

The subjects were 60 adults recruited on an undergraduate campus. Half of the subjects were male, and half were female.

Stimuli

Standard braille characters representing all letters of the alphabet were embossed on braille paper with a Perkins Brailier. Two random arrangements of braille were presented to each subject. Rows of five or six characters were fastened to strips of clear acrylic, and a Masonite baffle was used to block vision of the tangible code. A drawing of the braille and letter equivalents was available to observers throughout the experiment.

Procedure

Subjects made visual matches to the tangible code by naming the letter corresponding to the braille character that they touched. All observers were allowed 15 sec per braille character and were required to use the index finger of the preferred (writing) hand. Active touch subjects were simply told to feel the braille with light pressure and were prevented from using fingernails. For passive-static touch, each braille symbol was pressed upward against the stationary fingertip of each subject. Individuals were instructed to hold their index fingers still against the edge of a foam-covered shelf, with the final digit extending over the edge. In the passive-horizontal procedure, the fingertip was held still while each braille character was pressed against it, with lateral back-and-forth movement. Passive-vertical presentations were used for a fourth group of subjects. One last condition involved passive touch, but permitted subjects some degree of control over stimulus presentations. On the assumption that one important component of the advantage of active touch entails control over stimulation (Loomis & Lederman, 1984), it was thought that recognition would be helped by allowing persons the option of either vertical or horizontal scanning, or both. Thus, individuals in the passive subject-control group could demand horizontal or vertical scanning, and the experimenter moved the stimuli to comply with these requests. The stimuli were moved at a rate of about 1 cm per second, and light force was applied.

Each subject was exposed to the 26 braille characters twice, in random sequences. Feedback was not given and patterns were upright.

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RESULTS AND DISCUSSION

Subjects more accurately named braille characters when touch was active (see Table 1). The experiment took the form of a mixed-factor analysis of variance, with the factors being perceptual mode (active/passive) and blocks of trials, with repeated measures on trials. Data analysis showed significant effects of perceptual mode [$F(4,55) = 11.31, p < .001$] and trials [$F(1,55) = 16.38, p < .001$], but a nonsignificant interaction [$F(4,55) = 1.67, p > .05$]. A Newman-Keuls test on the means, with the data collapsed over trials, indicated that the active touch group was superior to all other groups ($p < .01$), that the passive-static group was significantly worse than all the others ($p < .01$), and that the passive-horizontal, passive-vertical, and passive subject-control groups were not significantly different from one another ($p > .05$ for all comparisons). Recognition was especially poor in the static condition.

The advantage of active touch was apparently consistent with Gibson's (1962) account of the nature of tactile perception. The results were inconsistent, however, with the report that experienced braille readers can decode braille by passive touch (Grunwald, 1965). Consequently, an additional experiment was performed that compared active and passive braille reading of two-letter words. Active touch was contrasted with a passive-horizontal procedure in which reading was always from left to right. Subjects attempted to read 20 words without feedback or time limits. Individuals in both conditions were restricted to using the fingerpad (see Heller & Mitchell, 1985). A 1 cm per second rate was used, and words were always repeated until each subject attempted identification. A drawing of the braille code and letter equivalents was available to observers. The mean number of words correct for the active and passive conditions were 11.25 and 2.25, respectively. Active braille reading was significantly better than passive [$t(14) = 5.9, p < .01$]. It appears that although

practiced braille readers can make use of passive touch to identify braille, the novice has much more difficulty.

Active touch is probably important for veridical perception when naive observers are confronted with novel and difficult tasks that place a burden on memory (Heller, 1980). Moreover, it is suggested that active movement may be especially helpful during early phases of learning braille. Not only does movement aid in pattern detection, it may also allow the coding of patterns in terms of kinetic configurations. Heller (in press) reported evidence that naive observers engage in tracing behaviors when first attempting to examine braille. Such tracing would not be needed by skilled braille readers who can simply employ horizontal scanning. The naive braille reader, however, is likely to try to trace out patterns such as the character representing a C (**). Thus, the advantage of active touch may lie in the possibility of constructing movement patterns as a form of representation.

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Table 1

Mean Number Correct and Percent Correct (PC) for Active and Passive Touch and First and Second Blocks of Trials

Perceptual Mode	Block 1	Block 2	Total	
	Mean	Mean	Mean	PC
Active	11.08	13.42	24.50	47.1
Passive-Horizontal	6.75	8.00	14.75	28.4
Passive-Vertical	7.50	8.83	16.63	32.0
Passive Subject-Control	7.00	8.67	15.67	30.1
Passive-Static	2.50	2.33	4.88	9.4