Backward figural masking as a function of chronological age and intelligence¹

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Abstract

Interstimulus intervals permitting backward masking of a disk by a ring were studied as a function of chronological and mental age. A significant decrease in interstimulus masking intervals as age (7-10 years) increased was found, supporting the conclusion that figural masking is a Type I perceptual phenomenon.

Introduction

The work of the Geneva group over the past twenty years as summarized by Piaget (1958) has indicated that most perceptual phenomena dealing with distortions and displacements fit into a dichotomy. Type I phenomena, in general, decline in magnitude with increasing chronological age through childhood and seem to be unrelated to intellectual ability (Pollack, 1963, 1964b). These phenomena, which include simultaneous geometric illusions and fixation effects, appear to be determined largely by psychophysical variables such as figure-ground contrast (Oyama, 1961), intercontour distances (Piaget, Lambercier, Boesch & von Albertini, 1942) and intercontour orientation (Pollack, 1964a). Type II phenomena, by contrast, increase in magnitude with increasing chronological age and do appear to be related to intellectual ability (Pollack, 1964b; Prysiaziuk & Kelm, 1963). These phenomena, which include successive and intermodal illusions and aftereffects, appear to be determined by a combination of the effects of the above variables with the integration of stimulus effects across time or sense modalities (Ikeda & Obonai, 1955; Pollack, 1964b).

A previous experiment (Pollack, 1965) on backward figural masking demonstrated that the length of the interstimulus interval permitting masking, as well as its very occurrence, depended upon the relative figure-ground contrast of the masking and masked figures, the presence or absence of angles in the masked figure, and the intercontour orientation of the figures. Such findings tend to indicate that masking might be a Type I phenomenon.

The method of presentation in masking situations is successive rather than simultaneous; however, the subjective experience is one of simultaneity (Werner, 1935). Ikeda & Obonai (1955) found that physical succession in itself is not sufficient to transform phenomena from Type I to Type II, since with the concentric circles illusion, an interval of at least 200 msec. between onset of inducing and test circles was necessary for the transformation. The succession of stimuli, therefore, must be marked and definite.

If backward figural masking is indeed a Type I phenomenon, then interstimulus intervals permitting

masking should become shorter as a function of chronological age. Further, although a substantial negative correlation between mean masking interval length and chronological age could be expected, the negative correlation with mental age should be somewhat lower.

Subjects

All 48 Ss were pupils in a suburban elementary school.² There were 12 Ss at each of the ages 7, 8, 9, and 10. In each group there were 6 boys and 6 girls, all with uncorrected 20/30 vision or better.

Apparatus

Stimuli were presented binocularly using a three-channel tachistoscope (Scientific Prototype Corporation, Model GA). Intensities of all three channels were kept at a constant 4.7 ft-c as measured at the eyepiece by a Macbeth Illuminometer.

The stimulus figure to be masked was a mid-gray disk, 21.6 mm in diameter. The masking figure was a white ring with an inner diameter of 25 mm and a thickness of 10 mm. Both figures were centered and pasted on 5 x 7 in black cards. A blank black card was presented during the interstimulus interval. The maximum visual angular extent of any figure was 2 deg 20 min. at a viewing distance of 1100 mm.

Procedure

The sequence of stimulus presentation was: (1) figure to be masked, 12 msec.; (2) interstimulus interval, variable; (3) masking figure, 12 msec. The method of limits was used to determine the intervals which would produce masking. The interstimulus interval was varied in 10 msec. steps ranging from 0 to 250 msec. There were 16 counterbalanced trials given in a single session. Frequent rest periods were given. Ss were shown instances in which the inner figure could be seen clearly and instances in which it did not appear. They were instructed to say "yes" when they saw the inner figure and "no" when they did not. IQ test scores (Finch, 1957) for most Ss were secured from school records.

Results and Discussion

The means of the 16 midpoints between interstimulus intervals eliciting reports of detection or non-detection were computed, resulting in a mean masking interval (MMI) for each S. Data for ascending and descending trials were combined, since preliminary analysis showed no consistent starting position effect. Using these MMI's, an analysis of variance was performed comparing age groups. This yielded an F of 14.64 ($df = 3/44$, $p < .001$). Bartlett's test showed no significant heterogeneity of variance. All t 's between pairs of age groups

Fig. 1. Mean interstimulus interval for backward figural masking as a function of chronological age.

were significant beyond the .05 level of confidence except for that between the two oldest groups.

A trend test showed no significant deviation from linearity. The resulting equation was $y = 170.935 - 17.57x$. Since, by inspection, the differences between the means of the age groups became smaller as the children grew older (see Fig. 1) and the t between the 9- and 10-year-olds was not significant, and also since the two adult Ss of an earlier study (Pollack, 1965) showed MMI's of 77.75 msec. and 79.06 msec. under the same experimental conditions, it might be expected that the addition of intermediate age groups would have produced a negatively accelerated negative growth function.

Correlation between mental age (MA) and chronological age (CA) was .79 ($N=42$, $p < .001$); r between CA and MMI was $-.66$ ($N=48$, $p < .001$), and r between MA and MMI was $-.53$ ($N=42$, $p < .001$). Although the correlation of MMI with MA was lower than that with CA, the difference was not significant, probably because of the high correlation between MA and CA. Rank-difference correlations between IQ and MMI within each age group were $-.21$ at age 7 ($N=12$), $-.45$ at age 8 ($N=10$), $.14$ at age 9 ($N=10$), and $.15$ at age 10 ($N=10$). None approached statistical significance.

The conclusion that backward figural masking is a Type I phenomenon was supported in two ways. First, the MMI declined steadily as chronological age increased, which was shown both in the group compari-

sons and in the correlation between MMI and CA. Second, although the correlation between MMI and MA was not significantly lower than that with CA, there were no significant correlations with IQ within age groups. Neither was there any consistency in the signs of the correlations; two were positive and two were negative. It appears, therefore, that the physical succession of stimuli present in the figural masking situation is not sufficient to produce the effects observed with Type II phenomena. Succession, apparently, must be perceived or detected as such before Type II effects can become evident.

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Notes

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