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ABSTRACT

Eight autistic children and young adolescents (mean age 12.9 years) were compared to normal chronological age controls. Ss were required to discriminate briefly presented visual stimuli when they were preceded or followed by a visual noise mask and when they were not. The minimum stimulus exposure duration for criterion identification of unmasked letters, the critical stimulus duration, was determined first. Subsequently, Ss were required to identify the letters under conditions of forward and backward masking. Autistic Ss showed a slight deficiency in relation to equal chronological age normals in their ability to discriminate unmasked letters. When this deficiency was controlled for, however, they did not differ from the controls in the visual masking experiment. Results provided support for the notion of a discontinuity between the disorders of autism, mental retardation, and schizophrenia. (Author)

Visual Information Processing in Autistic Children and Adolescents

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Abstract

Autistic children and young adolescents (mean age = 12.9 years) were compared to normal chronological age controls. Subjects were required to discriminate briefly presented visual stimuli when they were preceded or followed by a visual noise mask and when they were not. The minimum stimulus exposure duration for criterion identification of unmasked letters, the critical stimulus duration (CSD), was determined first. Subsequently, subjects were required to identify the letters under conditions of forward and backward masking. Autistic individuals showed a slight deficiency in relation to equal chronological age normals in their ability to discriminate unmasked letters. When this deficiency was controlled for, however, they did not differ from the controls in the visual masking experiment. The results provided support for the notion of a discontinuity between the disorders of autism, mental retardation, and schizophrenia.

Visual Information Processing in Autistic Children and Adolescents

Researchers have disagreed about the distinctiveness (Lovaas & Newsom, 1976) and etiology (Bettleheim, 1967; Ferster, 1961) of early infantile autism (Kanner, 1943; Rimland, 1964; Rutter, 1968; Wing, 1972). Litrownik (in press; Litrownik & McInnis, 1981) suggested that research in autism might be facilitated by applying information processing theory, which views perception in terms of a sequence of stages ranging from input to response (e.g., Haber & Hershenson, 1973; Lindsay & Norman, 1977), to its study. Information processing studies of the visual system have relied heavily on the use of brief exposures of visual displays (Long, 1980).

Interpretations concerning group performance deficits for brief exposures of visual stimuli have been complicated by the uncertain nature of the initial representation of visual input, sometimes known as iconic memory or short term visual storage (see Coltheart, 1980; Long & Sakitt, 1980). A performance deficit following a detection, recognition, or discrimination procedure could result from a number of factors such as a deficiency in short term visual storage (e.g., built-up, decay rates, quality, strength) or speed of information processing throughout the visual system (Saccuzzo, Safran, Anderson, & McNeill, in press). Recently, Felsten and Wasserman (1980) supported the notion that when a noninformational backward masking stimulus follows a briefly presented informational visual stimulus in close temporal succession, the mask provides control of the duration of the informational pulse to the central nervous system and eliminates a number of what would otherwise be confounding variables in such tasks.

Research with the masking procedure has shown that adolescent schizophrenics (Saccuzzo & Schubert, 1981) and adolescent retarded individuals (Spitz & Thor, 1968) evidence a deficit in their ability to evade the effects of the masking stimulus. Despite some disagreements, this finding has generally been interpreted in terms of slow or inefficient processing and it has been replicated in schizophrenic (Braff & Saccuzzo, 1981; Saccuzzo, Hirt, & Spencer, 1974; Saccuzzo & Miller, 1977) and retarded (Galbraith & Gliddon, 1972; Saccuzzo, Braff, & Sprock, in press; Saccuzzo, Kerr, Marcus, & Brown, 1979; Thor, 1970; Welsandt & Meyer, 1974) individuals under a variety of conditions. Hornstein and Mosley (1979) were the first not to report a difference between retarded individuals and normals, but as Saccuzzo (1981) noted, their blank mask procedure was not as discriminating as the pattern mask used in most of the studies. Mosley (1980), furthermore, found a masking deficit in retarded individuals, although results were interpreted in terms of coding and selective attention. Nevertheless, the masking deficit in schizophrenics and retarded individuals is very well documented.

In the present study we applied a masking paradigm, which was similar to those that have led to identified deficits in schizophrenic and retarded individuals, to autistic individuals. Our goal was to determine if the autistic individuals would show a masking deficit.

Method

Subjects

Eight autistic individuals and eight normal controls were tested. Autistic individuals had been diagnosed in accordance with criteria established by the National Society for Autistic Children (Ritvo & Freeman, 1978). All showed signs of impaired developmental rate and/or sequence, responsiveness to sensory stimuli, language, and social responsiveness prior to 30 months of age. In addition, they showed evidence of intellectual retardation based on verbal IQ scales, however, performance IQ measures (e.g., Leiter International Performance Scale) indicated mildly retarded to normal intellectual levels of functioning. All autistic individuals possessed some expressive language and were able to understand and complete the required task with a minimum of prompting. Mean age for the autistic group was 12 years, 11 months (range = 8-11 to 15-11, S.D. = 3.20). Chronological age matched normal control individuals had a mean age of 13-0 (range = 9-4 to 16-0, S.D. = 2.99). The groups did not differ significantly in age ($p > .25$). In addition, chronological age controls were administered the Wechsler Intelligence Scale for Children (WISC-R) or the Wechsler Adult Intelligence Scale Vocabulary subscales as an estimate of their current intellectual functioning. Vocabulary scaled scores for these subjects ranged from 9 to 13, indicating a level of intelligence within average limits.

Apparatus and Stimuli

Stimuli were presented in a Gerbrands (model 5195) three-field tachistoscope. Black paratype (Helvetica Medium 24 pt. H18-24) Ts and As were presented as target stimuli. The masking stimulus consisted of paratype Xs side-by-side and above-and-below each other ($\overset{X}{\underset{X}{XX}}$) such that it completely superimposed itself on the target stimuli when both target and mask were simultaneously presented. The target stimulus subtended a visual angle of 0.4° at a viewing distance of 84 centimeters. Field 1 of the tachistoscope contained a fixation dot, Field 2, the letters T or A, and Field 3, the masking stimulus. Luminance of the fixation field was set at 1 footlambert, while stimulus and masking fields had a luminance of 15 footlamberts. A 2,000 millisecond pre-exposure interval (i.e., the interval between offset of the masking stimulus and illumination of the fixation field) was employed, as suggested by Langford and Saccuzzo (Note 1).

Procedure

Subjects were first taken to an experimental room and tested with the American Optical Eye Chart (No. 1930) to insure that they met the criterion for vision correctable to at least 20/30. Control group subjects were also given the WISC-R or WAIS Vocabulary subtest at this time.

Lighting was dimmed and subjects were allowed approximately 8 minutes to adapt to the low levels of illumination in the room. The experimenter then instructed the subjects that a T or A would be presented on each trial, and that their task would be to identify which had been presented. Subjects were encouraged to guess. Prior to testing each subject was given practice with the task until it was clear that he or she understood the task and could identify the letters. Stimuli were viewed binocularly.

The general procedures used by Saccuzzo et al. (1974, 1979) were used. In the first part of the session the minimum stimulus exposure duration for seven consecutive identifications of an unmasked target, a measure Saccuzzo et al. (1979) called the critical stimulus duration (CSD), was determined. As in Saccuzzo et al. (1979), the stimulus duration was first set at 1 millisecond and then increased in steps of 1 millisecond until the subject reached the criterion. If a subject was correct on any given trial, the stimulus duration was left unchanged. If, however, a subject was incorrect, the stimulus duration was increased by 1 millisecond for the subsequent target presentation. A new stimulus was provided for each trial in a predetermined random order.

In the second portion of the session subjects were tested under conditions of visual masking. The backward masking condition was presented under five levels: a no mask control and 25-, 75-, 150-, and 300-millisecond delays between onset of the target stimulus and onset of the mask. Under forward masking conditions, in which the mask preceded rather than followed the target stimulus, subjects were tested under conditions of 75- and 150-millisecond delays of the target stimuli from the onset of the masking stimulus presentation. A simultaneous presentation of the stimulus and mask was also used. During these procedures the duration of the target stimuli was always the individual's previously-determined CSD plus a 2-millisecond constant. This procedure precluded the possibility that any obtained masking deficit could be attributed to a differential ability to discriminate the stimuli when no mask was presented. Duration of the mask was 30 milliseconds. Eight consecutive trials were administered at each mask/stimulus delay level for a total of 64 trials per subject. Order of masking condition was counterbalanced such that half of the subjects in each group were administered the forward masking condition first, and half received the backward masking condition first. The order of the stimulus onset asynchrony (SOA) levels (i.e., intervals between onset of the first stimulus, target or mask, and onset of the second) was randomized identically for the two groups.

Results

A *t*-test analysis of the minimum critical exposure duration for criterion identification of unmasked stimuli (i.e., CSD) indicated that autistic individuals had significantly ($t = 2.30$, $p < .05$) longer CSDs ($M = 4.1$, S.D. $= 2.2$) than chronological age matched normals ($M = 2.1$, S.D. $= 0.4$). Thus, they required longer than the controls to discriminate the letters at criterion levels.

The number of correct responses for each SOA level and for the simultaneous and no mask control conditions were subjected to a 2 (group) X 8 (masking interval) analysis of variance with repeated measures on the last factor. The only significant finding was the main effect for masking interval, $F(7,198) = 5.65$, $p < .01$. A Newman-Keuls multiple comparison test revealed that the subjects had significantly fewer correct responses at the simultaneous and 25-millisecond backward masking SOA levels, when they were responding at about chance, in comparison to all other masking intervals ($p < .01$). No other significant effects were found. Table 1 provides the mean number of correct responses at each SOA level under conditions of forward and backward masking for autistic individuals and chronological age controls.

Insert Table 1 about here

Discussion

Results indicated that autistic individuals required a longer exposure duration (CSD) for criterion accuracy than equal chronological age normals. These same subjects, however, showed no relative deficit in evading the effects of the mask. Thus, the autistic individuals in the present study failed to show the same processing deficits that retarded and schizophrenic individuals evidenced when assessed in a similar condition with comparable controls. That is, retarded and schizophrenic subjects show not only longer stimulus durations, but are also impaired by the mask. Autistic individuals in the present study required a slightly longer stimulus exposure duration than chronological age matched normals, but unlike retarded and schizophrenic individuals they were unaffected by the masking stimulus (i.e., their performance was equivalent to the comparison group).

The finding of no masking deficit in the present study supports the view that autism is a disorder that can be distinguished from both mental retardation and schizophrenia because the latter two groups have a well documented and substantial masking deficit. The autistic individuals in this study were actually superior to their chronological age counterparts in evading the effects of the mask, though nonsignificantly so. Although the mean ages of the retarded and schizophrenic subjects of previous masking studies was higher than the autistic individuals of the present study, Saccuzzo and Schubert (1981) have demonstrated that adolescent schizophrenics (ages 13-18) as well as adolescent schizotypal personalities showed a masking deficit when compared to matched controls. Thus, it is unlikely that differences in the results of the present study and those found with schizophrenic and retarded individuals can be attributed to age. Documentation of a masking deficit in child schizophrenics, however, would provide even further support for the hypothesis that childhood schizophrenia and autism are distinct disorders.

The longer CSDs demonstrated by the autistic group could be interpreted in terms of a variety of factors such as input capability or generalized deficits. However, the differences between the groups were much smaller than those found in the Saccuzzo et al. studies. Furthermore, alternative explanations unrelated to input, such as strategies of processing and retrieval, are just as tenable. In addition, the absence of a significant Group X Masking interaction for forward versus backward masking contradicts an input disorder in autism, suggesting that the CSD deficit was due to more central processes (see Liss & Haith, 1970).

The failure to find a masking deficit in the higher functioning (i.e., verbal) autistic individuals suggests that unlike schizophrenic and retarded persons, autistic individuals do not evidence a deficit in speed of processing. An input deficiency is possible but unlikely. Compared to other groups such a deficiency in autism would be extremely minor. Thus, our findings did not support either a peripheral (i.e., sensory) or a speed of processing deficiency in autism. The problem in autism may thus be at higher cortical levels, or in response variables (Litrownik, in press; Litrownik & McInnis, 1981; Litrownik, McInnis, Wetzel-Pritchard, & Filipelli, 1978).

Future research might attempt to replicate the present findings using a fixed stimulus duration as in Saccuzzo and Schubert (1981), critical interstimulus intervals as in Saccuzzo et al. (1979), or CSDs without a constant as in Saccuzzo et al. (in press). Further studies are also needed for nonverbal and lower functioning autistic individuals.

Reference Note

1. Langford, R. A., & Saccuzzo, D. P. Visual information processing as a function of the preexposure field and onset sequence. Paper presented at the meeting of the American Psychological Association, Montreal, Canada, 1980.

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TABLE 1

Mean Number of Correct Responses for Autistic and Normal Subjects

Group	Forward Masking						Backward Masking									
	Sim.[a]		75		150		25		75		150		300		NM[b]	
	M	S.D.	M	S.D.	M	S.D.	M	S.D.	M	S.D.	M	S.D.	M	S.D.	M	S.D.
Autistics	3.87	.927	7.87	.330	7.62	.484	4.87	1.89	7.0	1.22	7.62	.992	7.62	.992	7.62	.992
Normals	3.5	1.41	8.00	0	8.00	0	3.50	1.22	6.37	1.72	7.8	.330	7.8	.330	8.0	0

[a]Sim. = Simultaneous control condition.
[b]NM = No mask control condition.