Attentional Cues in Chronic Schizophrenia: Abnormal Disengagement of Attention

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Posner's (1980) reaction time (RT) paradigm was used to examine the engagement and disengagement operations of visual selective attention in patients with schizophrenia. In the 1st experiment, 14 medicated, chronic schizophrenic subjects (diagnosed by criteria of the Diagnostic and Statistical Manual of Mental Disorders; American Psychiatric Association, 1987) and 15 age-matched normal control subjects made a speeded response to a target preceded by a valid, an invalid, or no cue. Control subjects showed the expected advantage and disadvantage in RT for valid and invalid cues, which suggests intact engagement and disengagement operations. For schizophrenic patients, valid cues also enhanced RT, but invalid cues did not slow RT. Similar results were found in the 2nd experiment. The failure of unpredictable, invalid cues to inhibit RT in chronic schizophrenia may be related to an abnormality in the disengagement operation of selective attention.

A disorder in attention has long been thought to underlie the information-processing disturbance of schizophrenia. Much of this research has often been hampered by both the absence of objective techniques to isolate attentional processes and the lack of specific biological models of attentional processes. Recently, however, the study of the various aspects of attention has become increasingly sophisticated at both the psychological and biological levels (Corbetta, Miezin, Dobmeyer, Shulman, & Petersen, 1990; Parasuraman & Davies, 1984; Posner & Peterson, 1990; H. Spitzer, Desimone, & Moran, 1988), the influence of which has spawned the burgeoning field of cognitive neuroscience (Churchland & Sejnowski, 1988). Central to this enterprise is the development of simple experimental paradigms that are capable of disentangling specific, elemental attentional processes and linking them to discrete neural systems.

Posner and his colleagues (Posner, 1980; Posner, Snyder, & Davidson, 1980) have developed a widely used experimental paradigm that has produced a fairly clear-cut set of data about the underlying neural structures of selective visual attention. In this paradigm, subjects look at a central fixation point for 1 second of which 33% is occupied by a visual cue that is either valid or invalid. This is followed by a 1-second target that appears in one of two small squares, or at central fixation, such as by displaying an arrow (Posner, 1980). The paradigm thus distinguishes two specific components of selective attention, namely engagement (benefit) and disengagement (cost). Studies have suggested that lesions of the posterior parietal lobe affect the disengagement operation, as demonstrated by increased cost for invalid cues (Posner, Walker, Fiedrich, & Rafal, 1984), and those of the thalamus are associated with a deficit in the engagement operation, as demonstrated by reduced benefit for valid cues (Rafal & Posner, 1987). A markedly different pattern of results, characterized by normal benefit for valid cues but no cost for invalid cues, has been obtained in idiopathic Parkinson's patients (Wright, Burns, Geffen, & Geffen, 1990) and in young normal subjects who were administered catecholamine (dopamine) antagonists (Clark, Geffen, & Geffen, 1989). In both studies the investigators interpreted the absence of cost for invalid cues in terms of an abnormality in the disengagement operation, but unlike parietal lesion patients, who showed excessively slow disengagement, the subjects in Wright et al.'s and Clark et al.'s studies showed excessively fast disengagement. That is, invalid cues did not slow RT.

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first to use this paradigm to investigate these component operations of selective attention in schizophrenia. They demonstrated that in relation to normal control subjects, patients with schizophrenia were especially slow in disengaging their attention from an invalid cue in the left visual field to a target in the right visual field. Posner et al. interpreted this finding as indicating a left hemisphere deficit in schizophrenia, similar to that demonstrated by patients with left parietal lesions, who have difficulty disengaging from an ipsilateral (left visual field) invalid cue and responding to a right visual field (left hemisphere) target. A similar pattern of results was obtained in chronic and never-medicated schizophrenics, which was also interpreted as a left hemisphere abnormality in schizophrenia (Potkin, Swanson, Urbanchek, Carreon, & Bravo, 1989).

Posner's interpretation of a left hemisphere abnormality in schizophrenia is consistent with several lines of investigations, including neuropsychological (Gur, 1978), information processing (Posner et al., 1988, Experiment 3), neuroradiological (DeLisi et al., 1989) and neurophysiological (Faux, Torello, Mccarley, Shenton, & Duffy, 1988). Others, however, have suggested that the most salient aspect of the data from Posner's paradigm is that neither the valid nor invalid cues affected performance for targets in the left visual field (Coppola & Gold, 1990). That is, for left visual field targets, the patients showed neither benefit for valid cues nor cost for invalid cues. Coppola and Gold suggested that the lack of benefit for validly cued left visual field targets was consistent with early studies that indicated that schizophrenics do not benefit from a predictable, so-called "regular" temporal sequence but actually perform better with an unpredictable, irregular sequence (Shakow, 1962). Indeed, this failure to benefit from a regularly timed sequence of events, considered to be one of the most robust information-processing deficits of schizophrenia (Neale & Oltmanns, 1980), seems consistent with the schizophrenics' lack of benefit for highly probable, predictable, valid visual cues presented to the left visual field.

Posner and Early (1990) responded by acknowledging the merits of this alternative interpretation, but they noted that it did not take into account the different pattern of results for left and right invalid cues in schizophrenic patients. Posner and Early also noted the lack of benefit for validly cued left visual field targets. They suggested, however, that this was because the schizophrenics showed no cost for invalid cues presented in the right visual field followed by targets in the left visual field. As Posner and Early pointed out, cost will occur only if the right visual field cue effectively summons attention. They suggested that the patients who showed no cost may have had difficulties with engaging attention to the right visual field cue. According to Posner and Early, such an interpretation is consistent with a left hemisphere deficit. Invalid left visual field cues may thus also be slower than invalid right visual field cues because the former but not the latter is capable of summoning attention. Put simply, patients overrespond to left visual field cues and underrespond to right visual field cues.

Notwithstanding these ambiguities, the foregoing analyses offer two distinct sets of testable hypotheses. The first set, derived from Posner and Early (1990), predicts that schizophrenic patients will show (a) reduced benefit for valid right visual field cues, (b) reduced cost for invalid right visual field cues, and (c) increased cost for invalid left visual field cues. The performance asymmetry of schizophrenia is thus characterized by difficulties with both engaging attention to right visual field cues and disengaging attention from left visual field cues. To follow Coppola and Gold (1990), the second set of hypotheses is derived from Shakow's (1962) influential finding that a predictable temporal sequence does not facilitate RT in schizophrenia. The principal hypothesis here is that schizophrenics will show no cost for invalid cues, which are unpredictable and of low probability, irrespective of visual field—a pattern of performance that may also be consistent with that demonstrated by Parkinson's patients. These two sets of hypotheses were tested in our investigation.

**Method**

**Subjects** Fourteen right-handed male inpatient schizophrenics and 15 right-handed male normal control subjects participated in the study. The patients were between the ages of 26 and 55 years (M = 42.4 years), with 10–12 years of education (M = 11.8 years). All patients met the criteria for schizophrenia of three major diagnostic schemata: Washington University (WU; Feighner et al., 1972), Diagnostic and Statistical Manual of Mental Disorders (rev. 3rd ed.; American Psychiatric Association, 1987), and Research Diagnostic Criteria (RDC; R. L. Spitzer, Endicott, & Robins, 1977). Diagnoses were made on the basis of the Schedule For Affective Disorders and Schizophrenia, videotaped interviews, and reviews of the patients' charts. Scores on the Scale for the Assessment of Negative Symptoms (SANS; Andreasen, 1981) and the Scale for the Assessment of Positive Symptoms (SAPS; Andreasen, 1984) were available for 12 of the 14 patients. Mean ratings were 9.8 on the SANS and 11.8 on the SAPS. With respect to predominant schizophrenia subtypes, 8 patients met the criteria for positive schizophrenia, 4 patients met the criteria for mixed schizophrenia, and none of the patients met the criteria for negative schizophrenia (Andreasen & Olsen, 1982). Mean duration of illness was 20.5 years, with a mean age at onset of 23 years. At the time of testing, 9 of the patients had been hospitalized for at least 6 months, 2 for 2 months, and 2 were recently discharged and living in group homes after hospitalizations of 3 and 4 months; 1 patient had left the hospital against medical advice after 1 week of hospitalization. All patients were medicated with a mean neuroleptic dose equivalent of 869.8 mg chlorpromazine (Basuk, Schoonover, & Gelenberg, 1983). The control group, recruited from hospital staff, were between the ages of 34 and 57 years (M = 41 years), with 12–18 years of education (M = 14.3 years), and with no personal or family history of psychiatric illness. None of the subjects had a history of neurological illness, substance abuse, or head trauma. All subjects had normal or corrected-to-normal vision.

**Stimuli and task.** An IBM (Armonk, NY) microcomputer controlled the stimulus displays and recorded the responses. Stimuli were presented on an Amdex (Elk Grove Village, IL) Model 710 color monitor. Subjects made responses by pressing one of two buttons of a Microsoft (Seattle, WA) mouse placed on the table near the subject's dominant hand. The stimuli, timing, and sequence of stimulus events were identical to those used by Posner et al. (1988). The stimuli were presented against a black background. Each trial always had a central fixation point (cross) with two white 8° squares, each presented 8° to the left and right of the central fixation cross. After an interstimulus interval (ISI) of either 100 or 800 ms, a target stimulus (star) was presented in either the left or right square. On most trials the target was preceded by a visual cue in which one of the two squares turned a bright red and remained on throughout the ISI. The cue was either correct, validly
indicating the location of the target (i.e., target appears in the bright-
ened red square), or incorrect, invalidly indicating the location of the
target (i.e., target appears in the square opposite the brightened red
square). On some trials a target was preceded by no advanced cue. The
targets occurred with equal probability in either the right or left
square. The intertrial interval was 1,000 ms, and the response-time
interval was 3 s. Within a block of 240 trials, there were three types of
trials, valid, invalid, and no cue. Sixty-four percent were valid, 16%
were invalid, and 20% were no cue (see Figure 1).

**Results and Discussion**

The principal results of Experiment 1 indicate that both control
subjects and patients demonstrated enhanced RTs for validly
cued targets, regardless of visual field. By contrast, unlike

Figure 1. Schematic of experimental task. (The cue involves bright-
eining one of the peripheral boxes. For valid trials the target [a star]
appears in the cued box, and for invalid trials the star appears in the
box opposite the cued box.)
normal control subjects, schizophrenic patients did not show the expected disadvantage in RTs for invalidly cued targets, regardless of visual field. These results indicate intact engagement but abnormal disengagement of attention in medicated patients with chronic schizophrenia. The data indicate, however, no statistically significant performance asymmetry in the distribution of attention in the patients. Thus in terms of the two hypotheses presented earlier, these findings are consistent with the notion, as suggested by Coppola and Gold (1990), that unpredictable, invalid cues are not associated with the expected disadvantage in RT in patients with chronic schizophrenia. On the other hand, though, the absence of a statistically significant performance asymmetry is not consistent with Posner and Early's (1990) hypothesis.

Experiment 2

The purpose of Experiment 2 was twofold. First, Experiment 2 was conducted to determine the reliability of the results of Experiment 1. Replications, even within the same groups of patients with schizophrenia, are seldom reported, even though they are critical for the development of empirically based models. Second, Experiment 2 uses central cues (arrows) instead of peripheral cues. Whereas the latter is thought to activate an automatically driven, exogenous, involuntary attention system, central cues initiate an endogenous conscious system (Jonides, 1981; Posner, 1980). Thus, the extent to which the patients' difficulties are related to either involuntary or voluntary properties of attention (or both) may be addressed.

Method

Subjects. Subjects were 9 of the 14 patients with schizophrenia who participated in Experiment 1. They were between the ages of 26 to 48 years (M = 40.2 years), with 10–12 years of education (M = 11.7 years). Mean ratings were 9.6 for negative symptoms and 11.3 for positive symptoms, as assessed by SANS and SAPS, respectively. Six of the patients fulfilled the criteria for positive schizophrenia, and 3 patients met the criteria for mixed schizophrenia (Andreasen & Olsen, 1982). All subjects had normal or corrected-to-normal vision.

Task and stimuli. The experimental paradigm was the same as that used in Experiment 1, except that central cues were used in place of peripheral ones. The central cue was an arrow, centered at fixation. The cue arrow indicated whether the target (a star) would appear in the left or the right square. As in Experiment 1, within a block of 240 trials, 64% of the cue arrows were valid, correctly indicating the subsequent location of the target; 16% of the cue arrows were invalid, and the target appeared in the location opposite of the direction of the arrow; and in 20% of the trials, no arrow cues were presented.

Design and procedure. The experiment consisted of three blocks of 240 trials. Subjects were again instructed to maintain fixation on a central cross and to respond as quickly as possible to a target star. Data were analyzed in a within-subjects, repeated measures ANOVA.

Results and Discussion

The median RTs to the targets were computed for each cue condition, as in Experiment 1. An ANOVA with the three within-subject variables of ISI (100 or 800 ms), visual field of target (left or right), and cue condition (no cue, valid, or invalid), gave significant effects for ISI, F(1, 8) = 20.38, p < .01, for cue, F(2, 16) = 7.99, p < .01, and a nearly significant effect for visual field of target, F(1, 8) = 3.71, p = .09. In addition, there was a significant Target × Cue interaction, F(2, 16) = 5.78, p < .01. Figure 4 presents the mean RTs as a function of visual field of target and cue condition. As Figure 4 shows, fastest RTs occurred for valid cues, irrespective of visual field. However, in relation to their RT performance in the baseline, no-cue condition, the schizophrenic patients again did not show the ex-
Figure 4. Mean of median reaction time in milliseconds to targets as functions of cue condition (no cue, valid, or invalid) and visual field of target (left or right) for schizophrenic subjects.

expected disadvantage for invalid cues, particularly for right invalid cues before left visual field targets.

To examine whether the reduction in cost for invalid cues is similar for both peripheral and central cues, data were submitted to an ANOVA with four within-subject variables of experimental condition (peripheral or central), ISI (100 or 800 ms), visual field of target (left or right), and cue condition (no cue, valid, or invalid). Significant effects were again obtained for ISI, \( F(1, 8) = 29.1, p = .001 \), which reflected the fastest RT for 800-ms ISI, for visual field of target, \( F(1, 8) = 5.35, p < .01 \), which reflected the fastest RT for right visual field targets, and for cue, \( F(2, 16) = 23.98, p < .001 \), which reflected the fastest RT for validly cued targets. In addition, the Target \( \times \) Cue interaction remained significant across experimental condition, \( F(2, 16) = 7.65, p < .01 \), although there was a nearly significant three-way interaction of Experimental Condition \( \times \) Target \( \times \) Cue, \( F(2, 16) = 3.09, p = .07 \). The latter reflects a trend for reduced cost of right invalid central cues.

As in Experiment 1, the specific benefits and costs of valid and invalid cues were computed and submitted to ANOVA with three within-subject variables of experimental condition (peripheral or central), ISI (100 or 800 ms), and visual field of target (left or right). Significant effects were obtained only for ISI, \( F(2, 7) = 15.68, p < .01 \), and the ISI \( \times \) Target interaction, \( F(2, 7) = 6.16, p < .05 \). For the 100-ms ISI condition, schizophrenic subjects had benefits of 104 ms and 43 ms for validly cued targets presented to the left and right visual fields, respectively. Corresponding values for the 800-ms ISI condition were benefits of 74 ms and 22 ms for validly cued targets presented to the left and right visual fields, respectively. By contrast, the patients showed no cost for invalid cues, particularly for right invalid cues in the 100-ms ISI condition.

Because these visual field differences in benefit and cost may be confounded by baseline differences in RTs for left and right visual field targets in the no-cue condition, relative measures of benefit and costs were computed, as in Experiment 1. An ANOVA again showed significant effects only for ISI, \( F(2, 7) = 7.91, p < .05 \), and the ISI \( \times \) Target interaction, \( F(2, 7) = 5.51, p < .05 \). Across ISI conditions, patients showed identical benefit of 12% and 5% for valid cues of the left and right visual fields, respectively. By contrast, for the relative cost measures, patients showed cost, albeit minimal (1%), only for invalid left visual field cues in the 800-ms ISI condition. The patients showed no relative cost for invalid cues in any of the other conditions. There were no significant visual field differences in these benefit and cost measures. Finally, the error rate was 2.9% for the patients.

In summary, similar to the results of Experiment 1, schizophrenic patients again showed reduced cost for invalid cues. The pattern of results was therefore similar for both peripheral and central cues. In addition, the data also indicated a significant Target \( \times \) Cue interaction for schizophrenic patients, which suggests that right invalid cues were particularly ineffective in slowing RT.

General Discussion

The results of both of these experiments indicate that patients’ RTs were less affected or slowed by invalid cues. Unlike normal control subjects, schizophrenic patients were able to rapidly disengage attention from an invalid cue to a target in the opposite visual field. This was not simply because they ignored the cues, given that valid cues facilitated performance for both patients and control subjects. The invalid cues, which were of relatively low probability, were less disruptive of performance in schizophrenic patients than in normal subjects. This
is consistent with Shakow's (1962) notion, as outlined by Coppola and Gold (1990), that RT performance of schizophrenics is less disrupted by unpredictable sequences of stimulus events. This is presumably because patients have difficulties with maintaining a mental set, which would allow them to benefit from regular, predictable sequences.

The strongest finding across both experiments thus indicated an abnormally rapid disengagement of attention from invalid cues in patients with schizophrenia. Although such rapid disengagement of attention may be construed as one instance in which the schizophrenic disorder confers an advantage, this seems unlikely for the following reasons. First, as Wright et al. (1990) pointed out, abnormally rapid disengagement of attention may also disrupt the ability to sustain attention for any extended period, which has long been thought to be a cardinal cognitive symptom of schizophrenia (Nestor, Faux, McCarley, Shenton, & Sands, 1990; Nuechterlein & Dawson, 1984), and which is also affected by neuroleptic treatment (Nestor et al., 1991). Second, selective attention is generally thought to involve both facilitatory and inhibitory functions. Laberge and Brown (1989) suggested that inhibitory operations act after facilitation to maintain a steep gradient of response to a target location. In schizophrenic patients, these data suggest that the so-called attentional gradient is considerably flatter than in normal persons, perhaps in large part because of defective inhibitory operations in maintaining a selected or engaged area of focus. Another RT study has also suggested that an inhibitory deficit underlies the failure of schizophrenics to benefit from regular, predictable stimulus events (Steffy & Galbraith, 1974).

That patients may be able to engage their attention, albeit not as effectively as healthy control subjects, but have particular difficulties with the later inhibitory operations is also consistent with several different lines of investigation. For example, Bleuler (1911/1950) was the first to note that schizophrenic discourse is often contaminated by associative intrusions, as evidenced by the famous example of his patient's identifying the members of her family as "father, son... and the Holy Ghost" (p. 26). Strong experimental evidence for this clinical phenomenon was recently provided by Kwapis, Hegley, Chapman, and Chapman (1990) who demonstrated that patients with schizophrenia showed a heightened semantic priming effect, which distinguished them from both bipolar patients and normal control subjects. Maher (1983) suggested that the information processing mechanisms that underlie this heightened semantic priming may reflect either faulty decay or faulty inhibition of activated but not relevant associations. The results of our study suggest that faulty inhibitory processes may underlie the associative disturbance of schizophrenia.

The underlying neurobiology of the inhibitory network has yet to be elucidated, although such difficulties appear to be particularly prominent for semantic processing, which would be consistent with left hemisphere dysfunction. Also relevant to understanding the neurobiology of attention in schizophrenia are findings of recent studies (Clark et al., 1989; Wright et al., 1990) that have examined engagement and disengagement operations of selective attention in Parkinson's patients and healthy control subjects administered dopamine or noradrenergic antagonists. The striking finding of these studies is that both patients and medicated normal control subjects performed in a manner similar to that demonstrated by schizophrenics in the present experiments in that invalid cues did not result in the expected disadvantage in RT. These findings were also interpreted as indicating an abnormality in the disengagement of attention. The extent to which abnormally rapid disengagement of attention can be attributed to a specific abnormality in dopamine is unclear, however. Indeed, schizophrenia is now longer thought to be associated with global hyperdopaminergic activity but, rather, is viewed in terms of dopamine dysregulation so that both hyper- and hypodopaminergic activity in different brain regions is possible (Davis et al., 1986). Similarly, Parkinson's disease affects other neurotransmitters in addition to dopamine, including norepinephrine and serotonin (Weiner & Lang, 1989). Finally, systemic administration of pharmacological agents, such as dopamine antagonists, affects multiple sets of receptors in distinct and sometimes opposite ways so that only tentative inferences about location and the mode of action can be made (see Steriade & McCarley, 1990).

Our findings do not consistently demonstrate a performance asymmetry in attention in patients with schizophrenia. The results, for example, do not indicate that the patients were particularly slow in disengaging their attention from invalid left visual field cues. In both experiments, though, patients did show abnormally rapid disengagement of attention or reduced attentional cost for invalid cues, particularly for those presented to the right visual field. In Experiment 2, this was demonstrated by the significant interaction between cue and visual field of target. Similarly in Experiment 1, schizophrenic patients showed a cost of −17 ms for invalid left visual cues and no cost for invalid right visual field cues, whereas normal control subjects showed costs of −29 ms and −27 ms for invalid left and right visual field cues, respectively. These differences were statistically significant (p < .001). Yet in the absence of a significant three-way interaction of Group × Cue × Visual Field of Target, these differences can only be considered as post hoc in nature. These findings do, however, suggest a statistical trend in partial support of Posner and Early's (1990) formulation that right visual field cues less effectively summon attention than left visual field cues in patients with chronic schizophrenia. This is also consistent with a left hemisphere dysfunction.

Thus, the performance asymmetry in this study was accompanied only by a reduced cost for invalid right visual field cues but not by increased cost for invalid left visual field cues or by reduced benefit for valid right visual field cues, as suggested by Posner and his colleagues. However, the absence of a performance asymmetry, similar to that demonstrated by Posner et al. (1988), may be related to differences in experimental paradigms and in the clinical status of the patients. With regard to the former, the paradigm used here required a choice RT decision, whereas the one used by Posner et al. (1988) required only a simple RT decision. In our experiments, the RT decision involved both detection and location of the target, whereas in Posner et al. (1988) study, only detection of the target stimulus was required. These differences must not be overlooked as they may have resulted in significant processing changes.

With regard to the subject differences, all patients in this study were medicated at the time of testing and for several years before the testing, as they were chronically ill. With respect to predominant schizophrenic subtypes, the patients had either a
positive schizophrenia, characterized primarily by positive symptoms of delusions, or a mixed schizophrenia, defined by both positive and negative symptoms, such as affective blunting, emotional withdrawal, and avolition; none of the patients exhibited a primarily negative-symptom schizophrenia. Such a chronic and generally unremitting clinical profile suggests that many of the patients in this study may have been considered resistant to treatment. By contrast, the patients in Posner et al.'s (1988) study were acutely ill, without long histories of neuroleptic treatment. Thus, in relation to the patients in this study, the patients in Posner et al.'s (1988) study were clearly at different stages in their illnesses. Recently, Strauss, Novakovic, Tien, Bylsma, and Pearson (1991) argued that the attentional asymmetry in schizophrenia may vary with the stage of the illness. Those investigators were unable to demonstrate an attentional asymmetry in remitted schizophrenic patients. They suggested that the attentional asymmetry in schizophrenia may be present in the acute but not remitted stages of the illness. Our findings further suggest that reduced cost of invalid cues, irrespective of visual field of target, characterizes the attentional abnormality of chronic, unremitting schizophrenic patients with long histories of neuroleptic treatment. The extent to which these findings are specific to schizophrenia or to psychosis in general remains unclear. Similarly, the extent to which they may be related to neuroleptic treatment is also unclear. The potential role of eye movements in the observed attentional abnormalities of the schizophrenic patients also needs to be evaluated in future studies.

We used a cost–benefit analysis to demonstrate reduced attentional cost for invalid cues, particularly those presented to right visual field, in patients with schizophrenia. Both cost and benefit were measured in relation to a baseline no-cue condition. Yet, as Jonides and Mack (1984) noted, cost–benefit analyses are often confounded by the fact that baseline and cue conditions may differ on a variety of dimensions, apart from that which is specifically related to the informative cue. However, in both experiments of our study, the no-cue and cue conditions differed only with respect to the presence of the informative cue. That is, each trial began with a fixation point that served as a warning stimulus, presumably to control for differences in general alertness, and that was followed by the critical experimental manipulation (cue or no cue) designed to alter allocation of attention.

In summary, the advantage of this paradigm is that it provides a simple objective means to test specific hypotheses about attentional operations in schizophrenia. With this paradigm, component operations can be isolated. Moreover, the general properties of the attentional system can be examined; for example, the endogenous and exogenous properties of visual attention can be investigated by simple cue manipulations, such as comparing the effects of symbolic and peripheral cues. As such, the paradigm holds great promise for understanding attentional functions in schizophrenia.

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**Carr Appointed Editor of the Journal of Experimental Psychology: Human Perception and Performance, 1994–1999**

The Publications and Communications Board of the American Psychological Association announces the appointment of Thomas H. Carr, PhD, Michigan State University, as editor of the *Journal of Experimental Psychology: Human Perception and Performance* for a 6-year term beginning in 1994. As of December 15, 1992, manuscripts should be directed to

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Manuscript submission patterns for *JEP: Human Perception and Performance* make the precise date of completion of the 1993 volume uncertain. The current editor, James E. Cutting, PhD, will receive and consider manuscripts until December 14, 1992. Should the 1993 volume be completed before that date, manuscripts will be redirected to Dr. Carr for consideration in the 1994 volume.