The Auditory And Visual Attentional Blink In Schizophrenia

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1. INTRODUCTION

Schizophrenia is a severe and persistent psychiatric illness, consisting of positive and/or negative symptoms resulting in marked social and occupational dysfunction. More importantly, schizophrenia is also associated with cognitive dysfunction. These cognitive impairments are present in childhood, are almost fully developed by the time of the first psychotic episode, and tend to remain relatively stable over time in the absence of intervention.[1] The range of cognitive impairments is extensive, and includes such domains as executive functioning, learning and memory, and attentional dysfunction.[1, 2] Understanding the nature and extent of cognitive deficits in schizophrenia is important because they have been shown to predict functional outcome for these individuals; that is, whether they are able to secure paid employment, maintain relationships, and live independently.[2]

Attentional dysfunction is considered a core cognitive deficit in schizophrenia,[3] and to date, numerous studies have examined attentional processes.[3-5] However, apart from studies utilizing sensory gating paradigms, the majority of these investigations have concentrated on visual-spatial types of attentional processes. Whether potential impairments exist in other types of attentional processes (e.g., temporal attention) and encompass other modalities (e.g., audition) is not fully known.

Experimentally, the temporal nature of attention can be studied with rapid serial visual or auditory presentation techniques (RSVP, RAP). In these procedures, a series of stimuli (letters, pictures, tones, etc) are presented in rapid succession at the same location, and participants must identify 1 or 2 prespecified targets. Studies using these procedures have consistently found that having to attend to the first target impairs the ability to identify a second target (probe) for ~ 500 ms - a phenomenon known as the *attentional blink* (AB).[6-8]

The AB has been shown to be influenced by extrinsic factors including stimulus complexity, task difficulty, and learning strategies.[7, 10] In addition, intrinsic factors such as aging, attention deficits, and focal brain lesions have been found to increase the magnitude of the AB.[11-13] Therefore, it was anticipated that brain disease, i.e., schizophrenia, would also affect the AB. Accordingly, the purpose of this study was to examine both auditory and visual temporal attention in individuals with schizophrenia, using attentional blink techniques.

2. METHOD

Participants: Participants were 31 DSM IV-diagnosed individuals (29 males; 2 females) with chronic schizophrenia recruited from an in-patient psychiatric hospital who were age- and gender-matched with 31 healthy control participants recruited from the University of Calgary and surrounding community. Participants ranged in age from 20 to 50 years.

Procedure and Stimuli: After training, participants were presented with 168 RAP streams (11 tones/sec) consisting of 25 equally loud tones ranging from 1000 to 2490 Hz. All tones were 85 ms in duration, separated by a silent 5 ms interstimulus interval. Targets to be named were 1500 (low) and 2500 (high) Hz tones increased in intensity by approximately 10 dB SPL above stream items. Both targets were present on half of trials, balanced across stimulus onset asynchronies (SOAs) of 90, 180, 270, 360, 450, 540, and 630 ms. In the visual task, participants were presented with 168 RSVP streams (11 lines/sec) consisting of 25 sequentially-presented lines at orientations ranging from 30° to 150°. Lines were 15 ms in duration, separated by a blank interval of 75 ms. Targets to be named were thicker lines of 45° (right), 90° (vertical), and 135° (left). Both targets were present on 1/2 of the trials, balanced across SOAs of 90, 180, 270, 360, 450, 540, and 630 ms.

3. RESULTS

Schizophrenia patients had a more pronounced AB for both visual and auditory stimuli compared to healthy controls and performance differed statistically across every SOA (p's < .01). In addition, a calculation of the overall magnitude of these ABs (difference in % *incorrect* between control condition and experimental conditions averaged across SOAs within tasks for each group) was significantly larger for this group (p's < .05). Specifically, AB magnitudes for schizophrenia versus non-schizophrenia are: Auditory: 38.5% vs. 22.3%; Visual: 36.8% vs. 27.4% (data not shown). Auditory and visual ABs are shown in Figures 1 and 2, respectively.

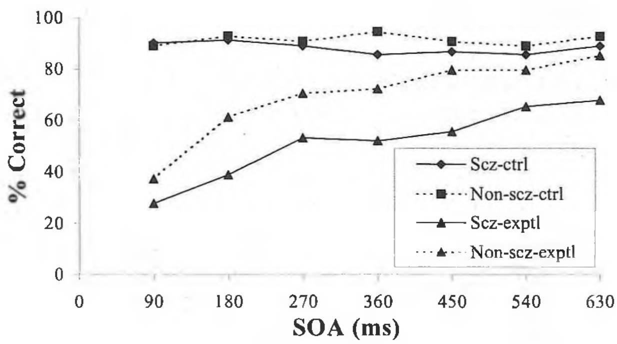

Figure 1. Auditory AB in schizophrenia and non-schizophrenia

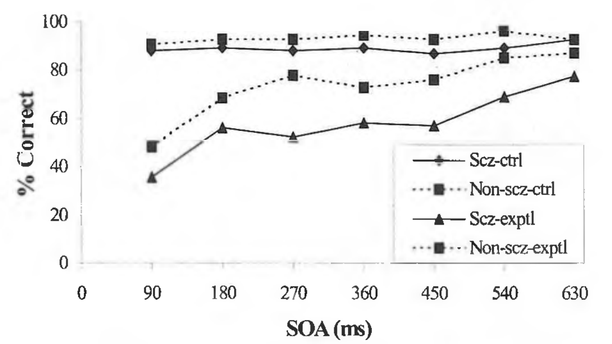

Figure 2. Visual AB in schizophrenia and non-schizophrenia

DISCUSSION

As anticipated, the presence of schizophrenia affected the AB; schizophrenia patients produced larger (deeper) and more protracted (longer) ABs when compared to those of healthy controls. These results suggest that schizophrenia patients are impaired on measures of temporal attention. Furthermore, because AB differences were found for both auditory and visual stimuli, the temporal attention impairment in schizophrenia appears to be modality independent; that is, it extends across modalities.

Group differences across cognitive tasks are common in studies of schizophrenia and it has been proposed that this is indicative of a generalized cognitive deficit in this population. However, differential impairments in some tasks (e.g., learning and memory, attention) are also quite robust.[1, 2] It may be that schizophrenia reflects specific cognitive deficits superimposed upon a generalized cognitive deficit. In support of this latter claim, post-mortem studies have revealed cytoarchitectural abnormalities in the schizophrenia brain, where there are too many neurons present in deeper cortical layers (1 to 3), and too few in more superficial layers (4 to 6). The consequences of such abnormalities is noisy and inefficient communication between and among cortical areas, which at the most basic level, manifests itself as a reduced ability to discriminate signal from noise. By extension, it seems probable that complex tasks, which would rely on more extensive communication between cortical sites would be most prone to impairments, while simple tasks might escape performance deficits.

Although our investigation was not specifically directed at the question of differential versus generalized deficits, our findings are nevertheless broadly consistent with the above interpretation of schizophrenia. For example, while there appears to be a trend for the schizophrenia patients' performance to be slightly poorer in both control conditions – a relatively simple task – their performance is statistically equivalent to that of the control group. Conversely, in the much more difficult dual-task (experimental) conditions, performance was substantially poorer. Thus, temporal attention is *generally* impaired when considering that dual-task deficits extend across modalities, but is *differentially* impaired when dual-task performance is compared to single-task performance.

In conclusion, individuals with schizophrenia demonstrated a reduced ability to discriminate two – but not one – target(s) in a stream of distractors, independent of modality. These findings extend the previous research of visual-spatial attention deficits by demonstrating similar impairments in the temporal domain, providing the task at hand is cognitively demanding. To the extent that functional consequences can be extrapolated from experimental studies, then the finding of deficits in the temporal allocation of attention likely has implications for those everyday activities requiring the processing of multiple, nearly-simultaneous stimuli under distracting conditions, such as driving.

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