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Control of attention in schizophrenia

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Abstract

The deficits of attention contribute significantly to the clinical picture of functional disability seen in schizophrenia, but there is no consensus as to whether this cognitive function can be fractionated to allow further characterisation of the impairment. We examined fifteen patients with chronic schizophrenia and fifteen controls using paired tasks designed to measure four hypothetical aspects of attentional control: the ability to focus attention, to resist distraction, to shift attention, and to divide attention. The group with schizophrenia showed a significant improvement in accuracy on a digit span repetition task when a simultaneous box-crossing task was added (divided attention condition). Although the patient group showed impaired performance across nearly all of the tasks, they were not disproportionately impaired during the task conditions assumed to demand greater attention. These results suggest that the aspects of attention and executive function under study are not significantly affected by schizophrenia and indicate the need for further characterisation of the impairment usually reported using conventional tests of attention on those with schizophrenia.

Keywords: Attention; Schizophrenia; Cognition; Psychosis; Central executive; Cognitive models

1. Introduction

The deficits of attention found in schizophrenia are powerful determinants of functional impairment (Ikebuchi et al., 1999; Penn et al., 1995), and have become the target of therapeutic intervention (Suslow et al., 2001). They are seen in nonschizophrenic relatives of those with schizophrenia (Nuechterlein et al., 1994), and in those with schizotypal personality disorder (Siever et al., 2002), suggesting that they are a manifestation of the primary neuropathology of schizophrenia rather than epiphenomenal. Accordingly, scientific study of these attentional deficits ought to shed light on the neurocognitive (and ultimately neuronal) underpinnings of the disorder (Braff, 1993), but efforts to characterise them are limited by our understanding of the nature of attention itself.

Attention is probably not a unitary process (Pashler and Johnston, 1998), and one approach to the exploration of attention is to determine whether logically distinct components can be shown to suffer differential impairment (or dissociation) in different neurological or psychiatric diseases. For example, one candidate subcomponent of attention is the capacity to divide attention between two tasks. It has been shown that it is possible to choose two tasks such that both young and elderly normal study participants can perform them concurrently with little impairment of performance on either task, but this capacity is markedly impaired in Alzheimer's disease (Baddeley et al., 1986, 2001) and shows more marked decline with progression of the disease than would be expected on the basis of the performance decline on each of its component parts (Baddeley et al., 1991). More recently, it has been shown to be

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unaffected by normal aging in contrast to indices of other hypothetical components of attention (Baddeley et al., 2001).

These findings challenge the model of a single pool of attentional resource, and support the view that attentional control may depend on a range of executive processes. They are consistent with the working memory model proposed by Baddeley and his co-workers (Baddeley and Hitch, 1974; Baddeley, 1986) in which two modality-specific modules, named the phonological loop and the visuospatial sketchpad, operate under the control of a third component, the central executive. In this model, it is the central executive that is responsible both for coordinating simultaneous activity involving the other two systems, and also for control of attention generally. Schizophrenia and Alzheimer's disease share several neurocognitive features; patients with Alzheimer's disease also show striking deficits of attention and performance on other tasks usually taken as a measure of central executive function (Perry and Hodges, 1999); and the memory impairment seen in schizophrenia overlaps in severity with that seen in populations with Alzheimer's disease (McKay et al., 1996). However, there have been some reports that schizophrenia does not impair the ability to divide attention (Salame et al., 1998; McKenna et al., unpublished data).

Another candidate subprocess is the capacity to switch attention. Generation of a random sequence of keypresses, words or numbers behaves like a central executive task in its capacity to disrupt the concurrent performance of other tasks assumed to rely on the central executive for instance verbal fluency tasks (Baddeley et al., 1998). Norman and Shallice's (1986) model can explain this observation, because it suggests that a random generation task would require the repeated intervention of the Supervisory Attention System to disrupt the retrieval of stereotyped sequences and switch between strategies. In a further experiment, Baddeley et al. (1998) showed that a task requiring the subject to switch retrieval strategies by alternately reciting letters of the alphabet and integers (A-1-B-2-C-3, etc.) had a similar capacity to disrupt the randomness of a concurrent random keypressing task. There is, therefore, reasonable evidence to consider switching an important aspect of attention, and as such, it is worthwhile to explore the extent to which it might be distinct from other aspects.

A third aspect of attention is resistance to distraction as exemplified by the capacity to attend to a target stimulus in the presence of non-target stimuli. Friedman and Miyake (2004) have presented evidence that this task typifies an important inhibitory component of executive control. The ability to process target letters among similar non-targets has been found to be affected by Alzheimer's disease as well as age (Baddeley et al., 2001).

Finally, the capacity to focus attention as measured by the extra time needed to complete a choice reaction task vs. a simple reaction task is a further candidate for a potentially separable process. In a previous study (Baddeley et al., 2001), it was found to be affected by age but not by Alzheimer's disease per se.

A methodological problem in attempting to measure specific cognitive processes stems from the fact that such measurement is inevitably based on tasks that are not process-pure, but tend also to require a range of other cognitive capacities. We attempt to minimise this problem by adopting sub tasks that reflect two levels of difficulty within the same broad task framework. For example, we study visual search for letters against a similar and dissimilar array of background letters, where we expect the similar background to be harder than the dissimilar. We test this prediction, examine the overall effect of schizophrenia on performance, and crucially look for an interaction between level of difficulty and subject group. If for example, patients have particular difficulty in coping with visual distraction, then we would expect an interaction such that they were more slowed down by similarity then controls. Several paired tests of this kind had already been devised and used with a group of patients with Alzheimer's disease (Baddeley et al., 2001) and we wished to use these plus a further test designed to measure the cost of switching retrieval strategies, in order to explore the deficit of attention seen in schizophrenia, and in doing so, to explore the extent to which control of attention might be fractionated on the basis of differential impairment in schizophrenia.

2. Method

The investigation was carried out in accordance with the Declaration of Helsinki 2004 and was approved by the appropriate ethical committee. The entire case register (127 patients) for the South Bristol Rehabilitation service was put into random order using a pseudo-random number generator. Patients were considered for recruitment into the study according to this ordering; however screening of the entire series yielded only 15 subjects who met our criteria and gave informed consent. Patients were eligible for inclusion if they were aged between 18 and 65 and satisfied DSM-IV criteria for schizophrenia. All had been under the care of specialist Mental Health services for at least one year, but further information on the duration of illness is not available. They were not included if they met DSM-IV criteria for substance dependence, or if they had an identified organic brain syndrome. They were also excluded if they had a severe physical illness because this might impair test performance mentally or physically. Fifteen controls were recruited, matched for age, gender and educational