USE OF A PERSONAL DIGITAL ASSISTANT TO ADMINISTER AN AUTOMATED VISUAL SEARCH TASK

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INTRODUCTION

Visual search tasks are often used in psychopharmacology to assess changes (usually impairments) in cognitive function due to drugs and to CNS disorders. The commonest example is letter cancellation, where the task is to cross out all occurrences of one or more target letters in a page of random letters. Such tasks are sensitive to drugs affecting the CNS (see e.g. Parrott and Roberts, 1991; Fried et al., 1995; Millar et al., 1995), but like a number of such tasks are rather complex, and performance could be affected by influences on a range of abilities from aspects of feature extraction, through attention to the motor response.

A variety of visual search that involves a rather specific function is that characterised by "pop-out", where the target appears immediately without the necessity of the subject scanning the elements individually. Such visual search is considered to be carried out in parallel, that is all the elements of the display are processed at the same time. Typically the time taken to

detect a target in such a display is independent of the number of elements to be searched.

The interest in this task is strengthened by suggestions that dopamine may be involved in processes essential to the parallel search process. Thus Calvert and Troscianko (1992) showed that when patients with Parkinson's disease performed a task requiring the detection of a single vertical line in an array of horizontal lines, the time taken to detect the target increased with array size, in contrast to normal subjects where the time was independent of array size. Thus the patients used serial not parallel search.

More information can be obtained from the paradigm if the normal controls are given a serial search condition. The extent to which parallel search has been impaired can then be assessed. One way this can be done is by using a variety of letter shapes. Hess et al. (1992) showed that if the target is **L**, then search against a background of **X**s allows parallel search, but if the nontarget is **T** then search is serial. This test has been developed for a pen-

based electronic device, which allows a very natural user interface. This has been compared with several other forms of presentation of a similar test paradigm.

TEST DEVELOPMENT

The test was initially set up as part of a battery based on a computer using a push-button response box. In this version, some arrays have a target present, while others do not, and the subject presses a YES or NO button to indicate this. This works fine, but has the disadvantage that no information about "pop-out" can be obtained from the negative trials, so a substantial proportion of the trials do not contribute to the test result.

An alternative is to have targets present in all trials, and for the subject to point in some way to the target when it is detected. To compare different types of response, the test was set up on a computer with a mouse, with paper-and pencil, and on a pen-based electronic device (Apple MessagePad). These devices are referred to as "Personal Digital Assistants"
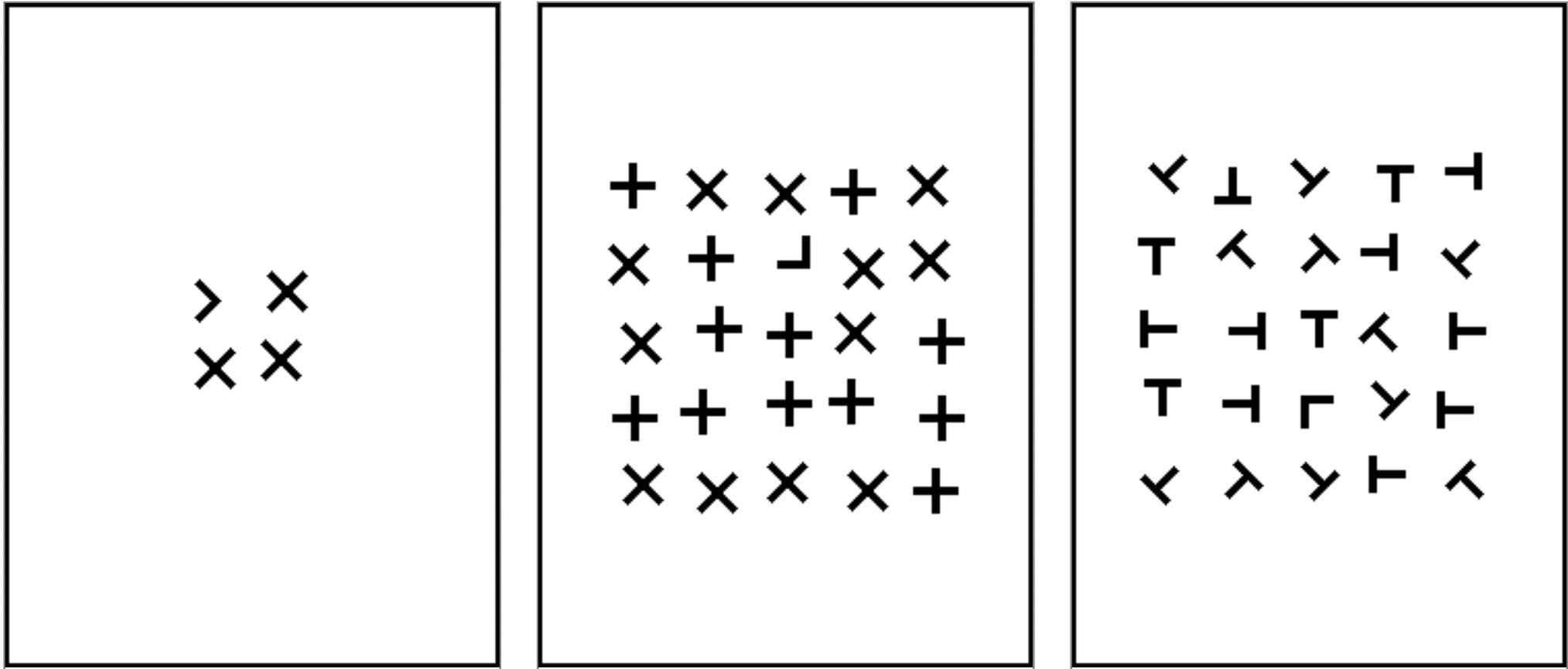
(PDA), and are of particular interest, as using a pen to
tap on the target provides a very natural form of response, especially for
subjects who are not familiar with computers. The test is illustrated in
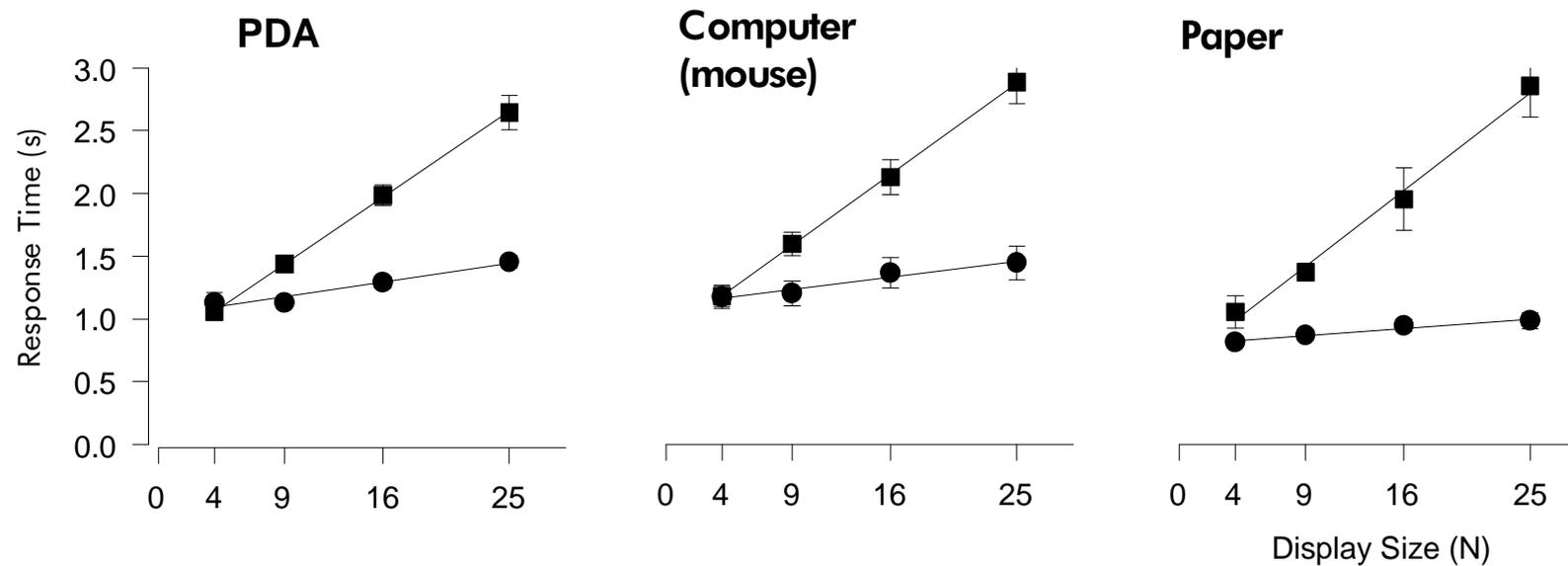Figure 1

Figure 1. sample displays from the visual search task. Array size varied from 4 to 25. The target was always **L**, in any orientation, and the non-targets were either **T**s or **X**s. The subject was instructed to respond to the target as quickly and as accurately as possible.
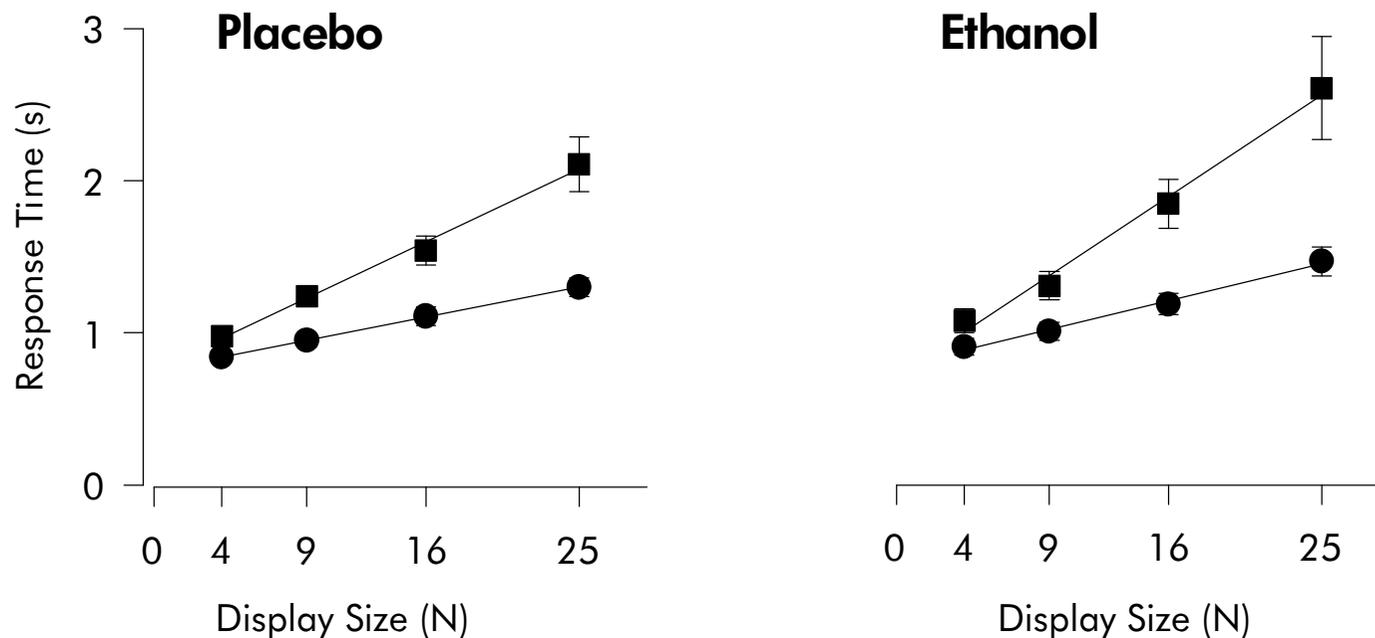
Figure 3. Effects of ethanol (0.88 g/kg) in 18 healthy volunteers (Newman et al., in preparation) assessed using the PDA version of the task. Ethanol led to an overall slowing of responses of about 8%. The slowing was similar for all types of response, indicating that parallel search was not disrupted by CNS depression of this degree.
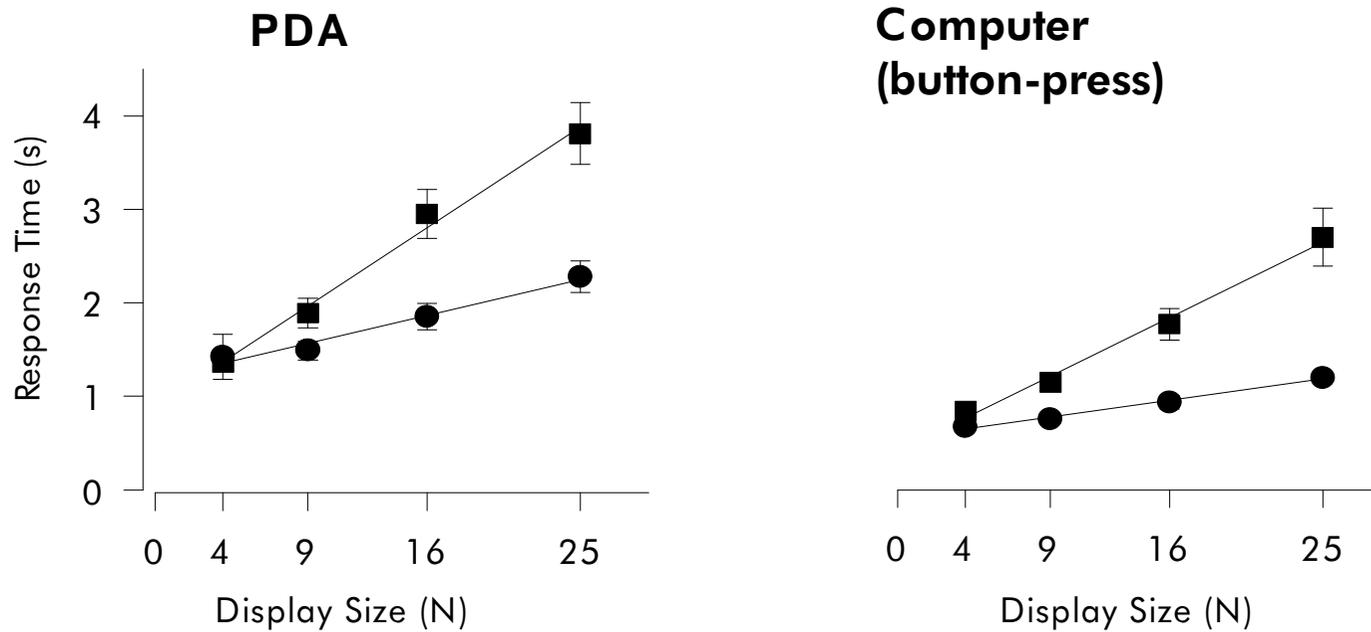
Figure 4 A comparison of the PDA version of the test and the original computer version of the test (button press) in 9 neurologically normal older subjects aged 62-83 years (mean 70) Data from Bland et al. (unpublished). Again, a clear difference between the two modes of search is seen

DISCUSSION

These data indicate that the detection of **L** against the two non-targets **X** and **T** forms a robust method of comparing parallel and serial search modes. Parallel search is indicated by an increase of response time with increasing array size, the magnitude of the slope being typically 0.06 s/element.

The three test methods involving pointing show very similar results. The only significant difference found was that the overall response times were faster for paper. This probably relates to the fact that in the paper condition it was possible for the subject to look ahead at the upcoming arrays while marking the current one. With the automated forms of presentation, this was not possible, as a new display only appeared after the completion of the response.

Ethanol at a dose of 0.88 g/kg slowed all reactions, but did not have any particular effect on parallel search - the pattern of responses is very similar for the two conditions. This is an important baseline finding, since in

general agents with specific affects on receptors such as dopamine are sedative. If CNS-depression is not associated with an effect on parallel search this will make it much more straightforward to investigate the effects of such selective agents.

Older subjects again showed a similar pattern of serial and parallel search. This is of importance for similar reasons in relation to possible work in parkinsonism, where control subjects will of necessity be elderly

Taken together with results from a study investigating computer anxiety (Tseng et al., this meeting) these results show that pen-based assessment of visual search offers a convenient and easy to use method of administration that may have advantages over conventional computer-based assessment.

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