# A GLIMPSE CAN SLOW YOU DOWN: DUAL-TASK INTERFERENCE BETWEEN VISUAL PROCESSING AND A SIMPLE IMPERATIVE RESPONSE

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## Introduction

The present study assessed the interference that occurs when a simple well-practiced action is timed to coincide with an important perceptual task, encoding a visual stimulus for later recognition. We combined a simple visual processing task, encoding briefly presented pictures of faces and geometric shapes for a memory test, with a simple overt motor response, clicking a computer mouse, the two tasks entwined in a dual-task paradigm resembling that employed in studies of the psychological refractory period (Pashler, 1994).

Our experiment avoided direct response interference by employing a memory-encoding task that required subjects to delay their recognition response well beyond the customary range of stimulus onset asynchronies used in psychological refractory period paradigms. In addition to the relatively long interval between required responses, our experiment differs from typical dual-task studies in the novelty and uncertainty inherent in recognition-memory tasks. Task uncertainty about visual processing in dual-task paradigms typically involves choices among a known set of known alternatives, whereas in the present study new memory targets continued to appear until near the end of the session.

The present study was designed to assess bidirectional interference between the two tasks. In all conditions, on most trials a face or a simple geometric shape appeared briefly (50 ms) in the center of a computer screen (see Figure 1). Images were small in order to concentrate attention on the central locus and to minimize eye movements. In four of the conditions, a recognition-memory test for the target followed 2900 ms later.

Two main experimental conditions, along with four control conditions, were designed to allow us to assess possible dual-task interference between commanded clicks and memory encoding. Dual-task interference only occurs when the two tasks are in close temporal proximity. We expected that bidirectional interference would occur when overt click responses overlapped with presentation of face and shape memory targets. This overlap was incorporated into one dual-task condition but not the other. For subjects in the *after* condition, a click command appeared 150 ms after the presentation of a target stimulus. For subjects in the *before* condition, a click command appeared 150 ms before presentation of a target stimulus. The 150-ms interstimulus interval (ISI) between click commands and targets falls within the range of ISIs that yields interference effects in typical PRP experiments. In short, the dual-task paradigm enabled us to assess the influence of target encoding on click response times and the reciprocating influences of click responses on memory performance.

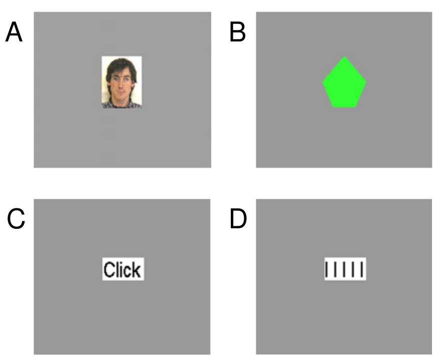



Figure 1 shows examples of the computer screen in the experiment, showing a sample face (A), a sample shape (B), the click command (C), and the striped warning signal (D).

## Method

Undergraduate students ($N$=180) were divided equally into six between-subjects conditions (Figure 2). The six conditions formed two clusters of three conditions, with two of the three conditions in each cluster being control conditions. Experimental subjects in the *after* condition received a 250-ms click command that appeared 150 ms after a 50-ms presentation of a target stimulus; then, after an ISI of 2500 ms, they received the memory test. Control subjects in the *after-no-MT* condition received the *after* protocol, but no memory test. Control subjects in the *after-no-R* condition received the *after* protocol, but no click command.

Experimental subjects in the *before* condition received a 250-ms click command at an ISI of 150 ms before a 50-ms presentation of a face or shape memory target. Then, after an ISI of 2500 ms, they received the memory test. Control subjects in the *before-no-MT* condition received the *before* protocol, but no memory test. Control subjects in the *before-no-R* condition received the *before* protocol, except that there was a 250-ms warning signal (which did not require a response) instead of a click command.

Each condition consisted of 141 trials, with the type of presented stimulus randomly varied within subjects: On 47 trials, the presented stimulus was a face, and on another 47, it was a shape. On an additional 47 trials, which occurred randomly among the *face* and *shape* trials, only the word *click* was presented (for 250 ms). The *click* command appeared at the same central location as the target. Subjects were instructed to click the computer mouse when this prompt appeared on the screen. A total of 23 faces and 23 shapes were used as stimuli.

Dependent variables were: (a) click response times on both face and shape stimuli, (b) memory performance and memory response times to both face and shape stimuli; (c) click RT on click-alone trials; and (d) percentage of response compliance for all trial types.

All click response times were measured between the onset of the 250-ms click command and the termination of an additional 6500-ms compliance window (i.e., within a 6750-ms window). Non-compliances were failures to respond to click commands within the 6750-ms window. In the two conditions without click commands in close proximity to targets non-compliances were click responses during the 6750-ms window.

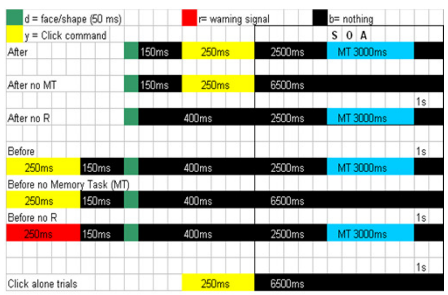



Figure 2 shows a summary of the six conditions used in the study.

## Results

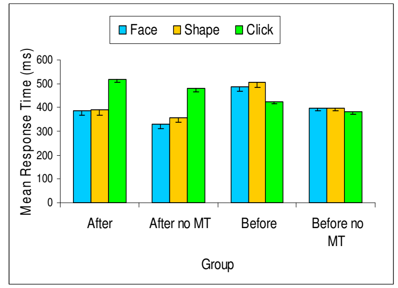



Figure 3 (above) shows mean click response times (with –*SE*) for face, shape, and click-alone trials for *after* and *before* subjects and their respective controls. Indicative of interference, response latency of the imperative stimulus, a command to click a computer mouse, increased by about 100 ms if it *preceded* a the brief (50 ms) presentation of a face or shape stimulus that was a target for the recognition-memory test. The latency of the click response also increased if it *followed* the presentation of a memory target to be encoded for the recognition-memory test.

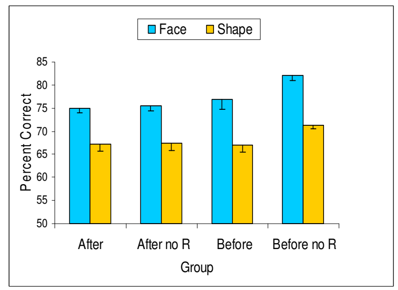
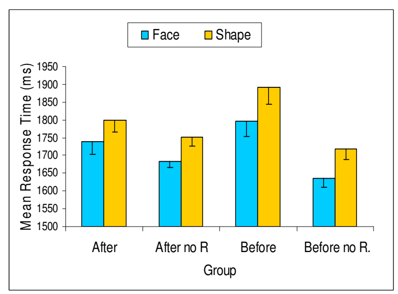



Figure 4 (above) shows the mean percent correct (with –*SE*) on the memory task for *after* subjects and corresponding *after-no-R* controls, as well as for *before* subjects and *before-no-R* controls. Note that making the click response after presentation of memory targets did not impair performance. By contrast, making the click before targets *did* impair memory performance. This same pattern is also evident in the memory response times shown in Figure 5 (below).




Note that Figures 4 and 5 both show significantly better memory performance for faces than shapes for both *before* and *after* conditions. Better performance to face is probably due to faces having more distinguishable features than shapes.

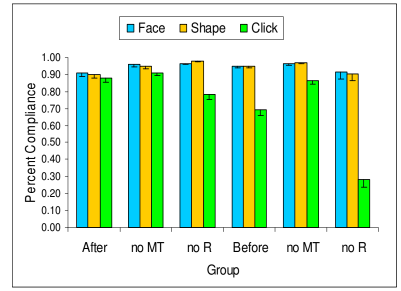



Figure 6 (above) shows the mean percent compliance (with –*SE*) on the click command for all six groups. Click command compliance was greater when click commands preceded memory targets than when they followed memory targets. Evidently subjects were less attentive to click commands that followed memory targets than when the click command served as warning signals for the presentation of targets. In addition, non-compliance was greatest for the *no-R* control conditions, possibly because click commands were less frequent in these conditions.

## Discussion

The present study showed bidirectional interference when a command to click a computer mouse preceded face and shape memory targets in close temporal proximity. When the command to click followed a memory target, however, response latency increased, but memory performance was unimpaired. The observation of longer click response latencies accords with Meyer & Kieras (1997) strategic response deferral account of dual-task interference. That is, actions that potentially interfere with an important perceptual task are delayed.

The dual-task protocols described in Figure 2 might be useful in identifying individuals proficient at both response compliance and recognition memory—that is, individuals with high compliance, fast click response times, high percentages correct for faces and shapes, and short memory response times. The present dual-task paradigm offers a quick and efficient tool for screening applicants for jobs requiring dual-task skills, such as target recognition and reaction in combat and police operations, flight control, and rapid computer interactions (Meyer & Kieras, 1997). In addition, such protocols may have diagnostic potential in medical applications.

## References

Meyer, D.E., & Kieras, D.E. (1997). A computational theory of executive cognitive processes and multi-task performance: II. Accounts of psychological refractory-period phenomena. *Psychological Review*, *104*, 749–791.

Pashler, H. (1994). Dual-task interference in simple tasks: Data and theory. *Psychological Bulletin*, *116*, 230–244.

## Website

http://www-unix.oit.umass.edu/jwmoore/crp/