Supplementary Materials

Visual Verbal N-Back Working Memory Task

The Visual Verbal N-Back Working Memory Task was designed to include a parametric increase in working memory load demand within one task run. During scanning, the participant sees a string of consonant letters (except L, W, and Y) presented every three seconds. Letters are presented in black type on a white background. Four conditions are presented: 0-back, 1-back, 2-back, and 3-back, in a blocked task design. The 0-back control condition has a minimal working memory load; the task is to decide whether the current letter matches a single target letter specified before the block began. During the 1-back condition the task is to decide whether the current letter matches the previous one. During the 2-back condition the task is to decide whether the letter currently presented matches the letter presented two back in the sequence. During the 3-back condition the task is to decide whether the letter currently presented matches the letter presented three back in the sequence. For each letter seen the participant is asked to respond by button press to indicate if the letter is a match (i.e., was the same as the designated target or the letter presented one, two, or three back in the sequence) or a nonmatch. Therefore, a button press response is expected for every stimulus.

Stimuli may be presented in upper or lower case, and the participant is instructed that case does not matter in determining whether a stimulus is a match or not. Response accuracy and reaction time are recorded by Presentation software (Neurobehavioral Systems, Berkeley, CA). Each condition is presented in 27-second blocks (nine stimuli per block) preceded by three seconds of instruction (e.g., “the match is one back”). The four experimental conditions are each presented three times in pseudorandom order for a total of 12 task blocks (total task length

~seven minutes). The order of presentation is summarized as follows: 1, 3, 2, 0, 3, 0, 2, 1, 2, 0, 3, 1. During each block there is a possibility of two or three matches (for a total of seven total correct matches per condition), and the number of matches is equivalent across conditions. Within each task block there are also embedded "foils" matching other task conditions (e.g., a potential 2-back match within a block where the correct match is 3-back). An example of each task condition is presented in **Supplementary Figure 1**.

Scoring considers percent correct adjusted for guessing for each condition, using the formula: Total Correct = ((True Positive Responses – (0.35 * False Positive Responses))/7) * 100

Participants rehearse the task outside the scanner to ensure understanding of task demands. Both the visual verbal and a similar auditory verbal paradigm have been successfully implemented in a variety of clinical populations by our lab and others, and have been shown to produce robust activation in bilateral frontal, parietal, subcortical, and cerebellar circuitry consistent with expected networks of brain activation for working memory processing, as well as to differentiate between clinical and control populations [1-15]. In some populations (e.g., older participants or young children, patients with psychosis), a version containing only 0-back, 1-back, and 2-back conditions may be preferred. Task files (i.e., visual stimuli and Presentation software paradigm) are available from the corresponding author on request.

References

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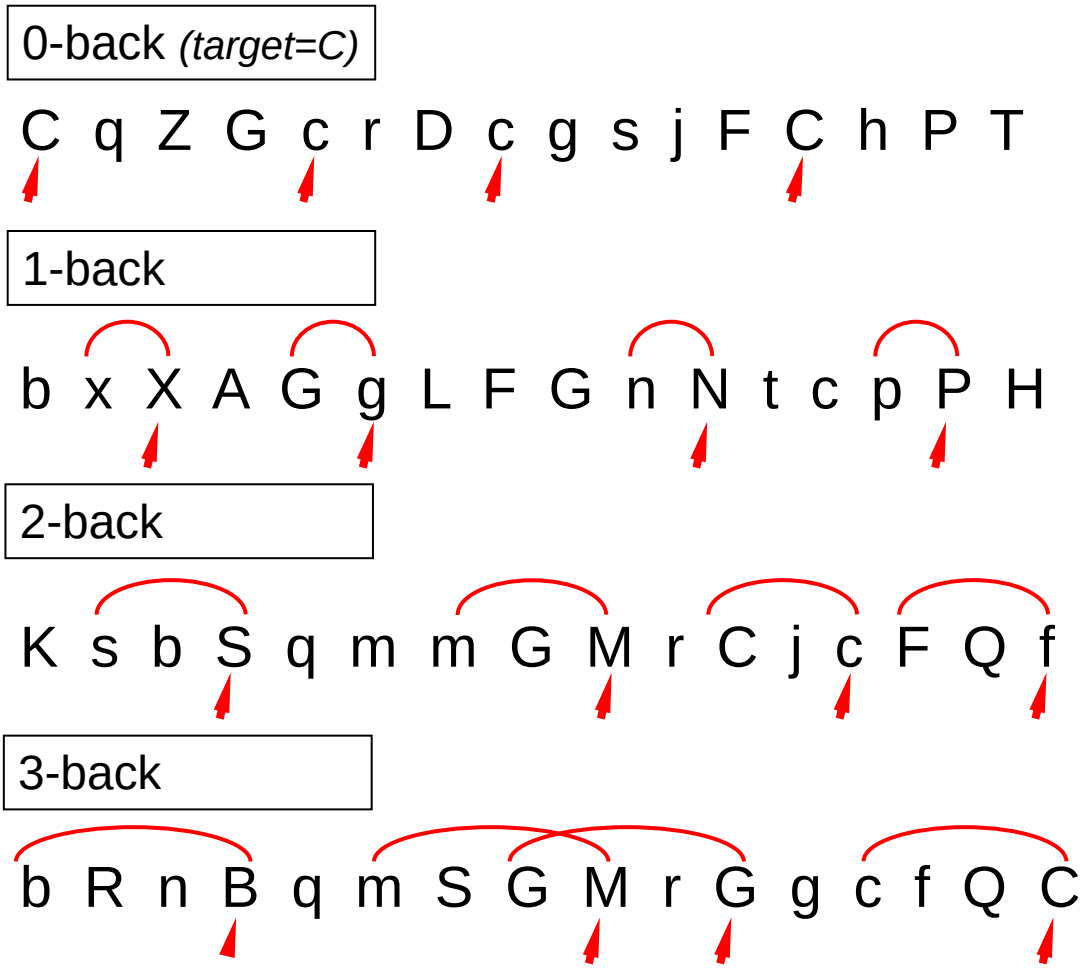
Supplementary Figure 1.



Supplementary Figure 1. Example of Visual Verbal N-Back Working Memory Task.