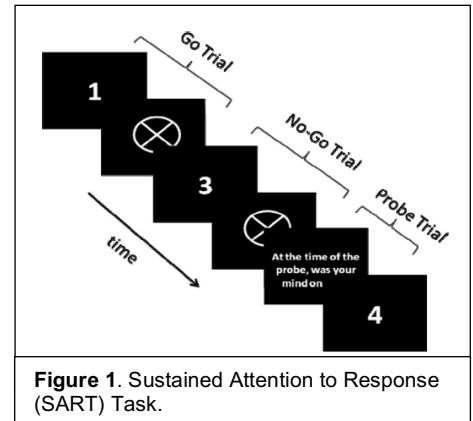


PARAMETERS

General Description:

The **SART** is a computer-based go/no-go task that requires participants to withhold behavioral response to a single infrequent target presented (often the digit 3) amongst a background of frequent non-targets (0 -9). The participant is asked to respond to the non-target and to inhibit their response to the target. To perform well, individuals must remain “sufficiently attentive to their responses, such that, at the appearance of a target, they can substitute the directly antagonistic response”. Usually around 225 single digits are displayed within a 4-5 minute period. The SART is a good measure of working memory, sustained attention, and impulse control.



In classic vigilance paradigms where responses are required for rare target presentations the automation of the simple target/response relationship may rapidly reduce the need for active attention to task.

Final parameters implemented:**SART TASK**

See: <https://www.youtube.com/watch?v=OjvW4q0v5AI&t=113s> for example

Task instructions are given to subjects at the beginning of the experiment and again prior to the start of each 4x5 min block of trials.

Instructions: Please seat comfortably approximately 57 cm from your computer display and turn off all software programs that may be running in the background.

Slide 1

In this task, you will see a series of numbers appear on the screen, separated by the

"⊗" sign. Your job is to push <SPACE> when you see any number EXCEPT for the number 3. When you see the number 3, do nothing. We want you to give equal emphasis to accuracy and speed during this task.

Press <SPACE> to continue.

Slide 2

The numbers will appear VERY QUICKLY. Do not get overwhelmed. The "⊗" sign will come up quickly after each number. You may still press <SPACE> during this time.

Press <SPACE> for every number EXCEPT 3. Do not press anything for the number 3.

Press <SPACE> to start the practice trials.

Methods for Design:

The SART consists of a continuous array of single digits (0 through 9).

- A practice block (160-trial with 8 probes; 3 minutes) is followed by four blocks (~5 min ea) of the task (1040 trials total not including the practice block).
- Seventy-two target probes (number 3) will be randomly dispersed throughout the 1040 trials.
- Each block will consist of 260 single digits (0 through 9) presented pseudo-randomly to establish pre-potent motor response, such that targets (3, no-go trial) are separated by at least 5 non-target digits (0-2; 4-9, go trial) with 18 trials or ~7% of trials for each block being no-go trials. This also allows us to use each digit 10 times and reduces the time for each block to 4 minutes and 59 sec.
- In order to accommodate the change in timing, please make sure that the number 3 is randomly dispersed throughout the 260 trials with the stipulation that at least 5 non-target numbers (0-2, 4-9) separate each instance of a target “3”.

A self-timed rest period follows each block to minimize task demand carryover among blocks.

The digits should be displayed centrally on a computer screen in one of five randomly assigned fonts (48, 72, 94, 100, and 120 point) representing digit heights between 12 and 29 mm. Each digit should be displayed for 250 ms and then replaced by a 900 ms duration mask composed of an X presented within a 29 mm ring with a diagonal cross in the middle.



Presentation is regularly paced at an onset-to-onset interval of 1150 ms. Both digits and mask should be white against a black background. Participants are required to respond to the digits with a key press with the exception of the number 3 which requires no response (Four blocks at .05 target probability).

After each block (including the practice block), two probe questions should be presented in succession. The first asks, “Where was your attention focused during this block of trials?” Participants should respond on a 6-point Likert scale, where 1 represents “on task” and 6 “off task.” A second question asks, “How aware were you of where your attention was during this block of trials?” Participants respond on a similar scale, where 1 represents “aware” and 6 “unaware.” The probe questions should be displayed until a response is made.

Reaction times of all key presses relative to digit onset should be collected.

Analyses

Inhibitory performance is quantified through failures of omission to targets (SART errors) generally indicating a more pronounced distraction than a large response time coefficient of variability (reaction time [RT] CV). Sustained attention is assessed through stability of performance over blocks of trials.

*Remove trials with less than 150 ms response time, more than 3 SD above group mean RT but include 0

*Eliminate anyone who missed more than 15% of trials

Objective Task Performance1. **Speed/Efficiency of Processing (Reaction Time)**

1. Overall **Mean RT** for a correct response was the time from presentation of the target stimulus to the reaction (button press).
2. Pre-error speeding (Mean RT for 4 trials preceding incorrect NoGo response)
3. Post-error slowing (Mean RT for 4 trials following incorrect NoGo response)

response latencies preceding No-Go errors are generally faster than those preceding correctly withheld No-Go or standard Go responses (McVay & Kane, 2009; Robertson et al., 1997; Smallwood, et al., 2004

2. Variability (usually the **coefficient of variation (CV)** is calculated by dividing the SD of an individual's RT by the mean RT for correct non-target trials. – *Greater CV reflects greater RT variability - a lesser degree of disengagement or less consistent speed of responding and is correlated with greater self-reported mind-wandering* (Cheyne et al., 2009; Mrazek, Smallwood & Schooler, 2012; Smallwood et al., 2004; Jha et al., 2015).

1. CV also reflects relation between Performance and Mind-wandering
2. Correlations of self-reported mind-wandering (probe 1 and probe 2) with a. errors of commission; b. CV; c. RT

3. **Accuracy:**

1. **Total Errors of commission (or percent correct)** (*response inhibition errors/failures to withhold a response to the target “3”*) -reflect a pronounced state of task disengagement
 1. Over entire task
 2. Across time/blocks (sustained attention)
2. **Total errors of omission (or percent correct)** (failures to respond to a nontarget “1-2,4-9”), -attention processing
3. **d'** – perceptual sensitivity index; reflects a subject's perceptual sensitivity to a target; it is the distance between signal and noise distributions in standard score units, calculated as $z(h) - z(f)$ with z, h, and f equal to normal deviance, hit rate, and false alarm rate, respectively. High d' indicate high levels of signal detection relative to noise and suggest better discrimination between target and non-target stimuli.
4. An estimate of d' can be also found from measurements of the hit rate and **false-alarm** rate. It is calculated as:

$z\text{-score} = \text{NORMSINV}(\text{probability})$

$d' = Z(\text{hit rate}) - Z(\text{false alarm rate})$

Excel command = DPRIME NORMSINV(H) - NORMSINV(F)

3. A' (non-parametric) = A' typically ranges from .5, which indicates that signals cannot be distinguished from noise, to 1, which corresponds to perfect performance. Values less than .5 may arise from sampling error or response confusion; the minimum possible value is 0.

Sustained Attention to Response Task (SART) (20 min)

VAGO

See Stanislov & Todorov, 1999; Pollack and Norman (1964); a complete history is provided by Macmillan and Creelman (1996) and W Smith. A' typically ranges from .5, which indicates that signals cannot be distinguished from noise, to 1, which corresponds to perfect performance. Values less than .5 may arise from sampling error or response confusion; the minimum possible value is 0. In Figure 1, A' has a value of .89. A' also estimates the Receiver operating characteristic (ROC) curve area, and does so without assuming that the decision variable has a particular (e.g., normal) distribution.

$$\text{APRIME} = 0.5 \left(\frac{\text{ABS}(H - F) + 1(H - F)}{(H - F)^2 + \text{ABS}(H - F)} \right)$$

$$* (H - F)^2 + \text{ABS}(H - F)$$

$$/(4 * \text{MAX}(H, F) - 4 * H * F)$$

H=the variable containing the hit rate

F=false-alarm rate.

SPSS lacks the sign function, so the statement $\text{ABS}(H - F)/(H - F)$ is used instead.

Hit Rate - (the probability of responding yes on signal trials); ratio of accurate responses to the total number of times a target stimulus was presented, and is calculated as (total trials – number of correct rejections – omission errors)/total target (“3”) stimuli.

false-alarm rate - (the probability of responding yes on noise trials) fully describe performance on a yes/no task.

The **false alarm rate (False)** was the ratio of mis-responses to the total number of non-target stimuli, and is calculated as (number of cancelled non-target stimuli + commission errors)/total non-target (1,2,4,5-9) stimuli.

How to deal with hit rate of 1 and false alarm rate of 0:

If you have any hit rates of 1.0 or false alarm rates of 0, you need to do a standard correction on those first. There is some controversy about the best way to correct hit and false alarm rates, but the "standard" method is the one described below:

Let's say that N is the maximum number of false alarms (i.e., it's the number of lures). Not counting zero, the smallest false alarm rate you have is 1/N. If you have a measured false alarm rate of 0, you know that the true false alarm rate falls somewhere between 0 and 1/N, so the usual strategy is to just use 1/(2N) instead of zero (which is the same as saying that you observed half a false alarm). So, if N = 40 and you have a false alarm rate of 0, use 1/80 (.0125) instead). The same reasoning applies to a hit rate of 1.0. Instead of using 1.0, use $1 - 1/(2N)$, where N is now the number of targets.