

Methods

Participants. 8 University of Rochester students (2 male; all right handed (Edinburgh handedness questionnaire, average handedness coefficient = 0.95) ranging from 20 to 29 years ($M = 22.1$ years, $SD = 2.9$ years) participated in the study in exchange for payment. They all had normal or corrected-to-normal vision, and gave written informed consent in accordance with University of Rochester participant review boards.

Materials. The stimuli were words denoting colors (e.g., “RED”), objects (e.g., “FIRE”), or strings of X’s that corresponded to the number of characters in the word distractor conditions (e.g., “XXX” for “RED”). The words or characters were capitalized, presented in a white Arial font, and bathed in one of six colors (red, blue, green, purple, pink, yellow). The distractors were red, blue, green, purple, pink, and yellow for the color word distractor condition, and fire, ocean, dollar, eggplant, ham, and corn for the non-color word distractor condition. The stimuli were 150x80 pixels so as to require that participants viewed the target color within a region also occupied by the distractor word (see Supplemental Figure 1 for schematic). For example, if a color word, object word, or string of X’s had 7 characters, that stimulus would be smaller than a stimulus that had 4 characters.

Testing Apparatus. The experiment was run on a desktop computer with a monitor resolution of 1920x1080 pixels. Stimulus presentation and response latencies were controlled and measured with DMDX (Forster and Forster, 2003). Participants sat approximately 60 centimeters away from the computer screen. They named the color of the image presented to them into a microphone. Stimuli subtended $\sim 3^\circ$ of visual angle.

Design. The design of the experiment was a 3 (distractor type: color, object, or XXX) by 2 (congruency: congruent, incongruent) within-subjects design.* Each participant took part in 5 blocks of 180 trials (~10 minutes per block). Of the 180 trials, 90 were congruent trials and 90 were incongruent. Of the 90 congruent trials, 30 were color-congruent trials, 30 were object-congruent trials, and 30 were XXXX trials (same distribution for the incongruent trials). Seven of the eight participant completed the design five times (900 trials per participant) and one subject completed the design three times (540 trials) for a total of 6,840 trial across all participants.

Procedure. The experiment began with the experimenter explaining to the participant that on each trial they must name the color of the stimulus presented to them (ignoring the colors black and white). They were told that the only allowable responses were red, blue, green, purple, pink, and yellow; it was made explicitly clear that a word or a string of X's was to be presented within the stimulus, but to only identify the background color. The experiment then began. On each trial, a fixation cross appeared on the screen for a jittered amount of time (450, 550, 650, 750 ms). Next, the stimulus was presented centrally and stayed on the screen until a response was recorded or two seconds had passed.

Results

Only latencies from correct trials were analyzed (~2% of all trials were errors). Latencies from correct trials were cleaned by excluding RTs faster than 200 ms, and greater than or less than two standard deviations above and below the mean for each

* The XXX condition was arbitrarily divided into 'congruent XXX' and 'incongruent XXX' following the same design and distribution as for the color word and non-color word distractor conditions. This factor was collapsed to form a single XXX condition against which to measure distractor effects.

participant, calculated across conditions (of the remaining correct responses, ~5% of trials were removed). Mean latencies, standard deviations, and error rates for all trials are displayed in Table 1.

A 3X2 ANOVA was performed with the factors Condition (three levels: color, object, X-type) and Congruency (two levels: congruent, incongruent). There were main effects of condition ($F(2, 14) = 18.51$, $MSE = 650.84$, $p < .001$, $\eta^2 = .73$) and congruency ($F(1, 7) = 51.99$, $MSE = 441.41$, $p < .001$, $\eta^2 = .88$); furthermore, the interaction of the two factors was significant ($F(2, 14) = 49.27$, $MSE = 275.04$, $p < .001$, $\eta^2 = .88$).

Planned comparisons (t-tests, two-tailed) tested for effects of congruency, separately for color word and non-color word distractor conditions. For color word distractors, color incongruent stimuli were named slower than color congruent stimuli ($t(7) = 7.78$, $p < .001$; interference effects ranged from 36 to 158 ms, mean, 110 ms; SEM, 14 ms). For non-color word distractors, incongruent non-color word distractors slowed naming latencies compared to congruent trials ($t(7) = 3.03$, $p < .05$; interference effects ranged from -7 ms to 45 ms; mean, 19 ms; SEM, 6 ms). In addition, compared to the baseline of a string of X's, while there were no differences for the congruent color word condition ($t < 1$), there were interference effects for the congruent non-color word distractor condition ($t(7) = 4.15$, $p < .01$; interference effects ranged from 3 to 63 ms, mean, 27 ms; SEM, 6 ms), the incongruent color word distractor condition ($t(7) = 6.90$, $p < .001$; interference effects ranged from 35 to 163 ms, mean, 109 ms; SEM, 16 ms), and the incongruent non-color word distractor condition ($t(7) = 6.92$, $p < .001$; interference effects ranged from 10 to 68 ms, mean, 46 ms, SEM, 7 ms).

Supplemental Figure 1

