## Supplemental Methods & Results

### Analysis S1. Experiment 1 population information and exclusion thresholds

In Experiment 1, we excluded a total of 473 out of 1443 participants [32.8%] for various issues related to data quality and eligibility criteria (leaving a total of N = 970 participants for analysis). Note, this exclusion rate is higher than a typical in-person experiment in our lab, but similarly high exclusion rates are often seen in online experiments (e.g., Logie & Maylor, 2009). This was our first time recruiting participants from the UCSD SONA pool to an online, remote experiment which may have contributed to the overall high exclusion rates. We did not have an explicit stopping rule; we collected as much data as we could based on the time constraints of the academic quarter (October through November 2019).

Note, some participants met multiple criteria for exclusion, so the following numbers do not add up to 473. N = 1 participant [<0.1%] was excluded for failing to meet the minimum age criterion of 18 years old, and N = 18 participants [1.25%] were excluded for failing to demonstrate normal color vision (did not correctly identify the embedded number in a digital rendering of an Ishihara plate). A total of N = 274 participants (18.99%) were excluded for failing to meet a minimum performance criterion of 75% correct responses. We excluded participants with overall average RT's greater than or less than 2.5 standard deviations beyond the population mean (mean RT < 274 ms or >1524 ms). This resulted in N = 8 [0.55%] excluded for excessively fast average RT's and N = 35 [2.43%] excluded for excessively slow RTs. Finally, when preprocessing the data, we automatically trimmed the RT data to exclude alltrials where participants responded extremely fast (<150 ms) or extremely slow (>2603 ms). We excluded participants who lost more than 15% of their data to this data-trimming procedure, N = 145 [10.1%]. The data trimming also resulted in the loss of our single 'critical' trial containing the distractor for N = 241 [16.7%] of subjects. Overall performance and response time are shown in Figures S1 and S2. Exclusion criteria cutoffs are shown with red dotted lines.

As noted in the main text, participants had an average age of 20.2 years (SD = 2.05, min = 18, max = 47). It is important to note that N = 14 [0.97%] chose not to respond or provided a nonsensical answer excluded from the average age value in the main text, e.g., 222 years old; one participant was excluded because they did not meet our age criterion [18+ years old]. Additional demographics information is shown in Figure S2.

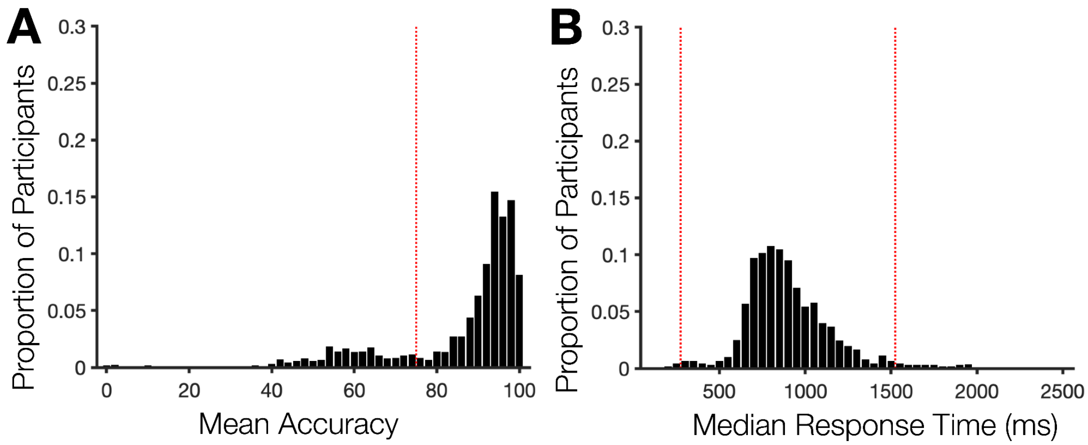


**Figure S1.** Performance histograms and cutoffs for Experiment 1. (A) Histogram of mean accuracy. The red dotted line denote the 75% cutoff used for performance exclusion. (B) Histogram of median response time. The red dotted lines denote the fast and slow cutoffs use for exclusion.

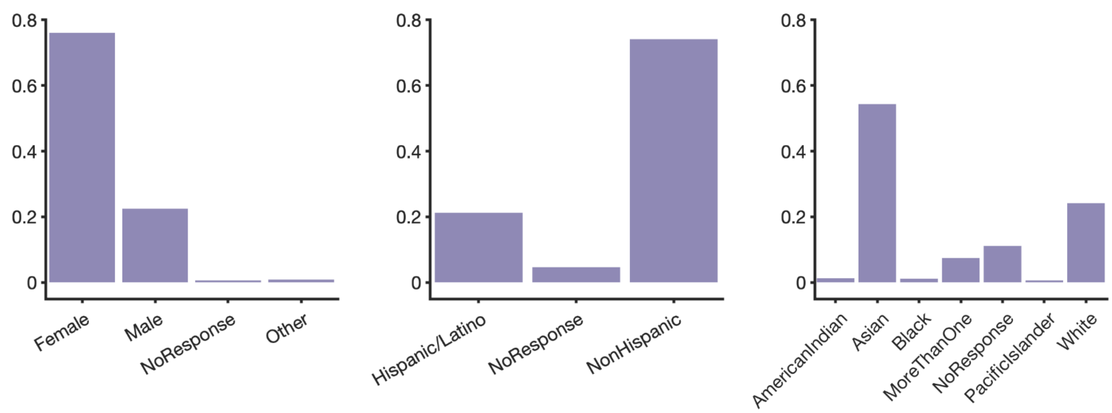


**Figure S2.** Gender, ethnicity, and race information for Experiment 1. We receive funding from the National Institutes of Health, so the ethnicity and race items were collected using categories aligned with the NIH reporting criteria.

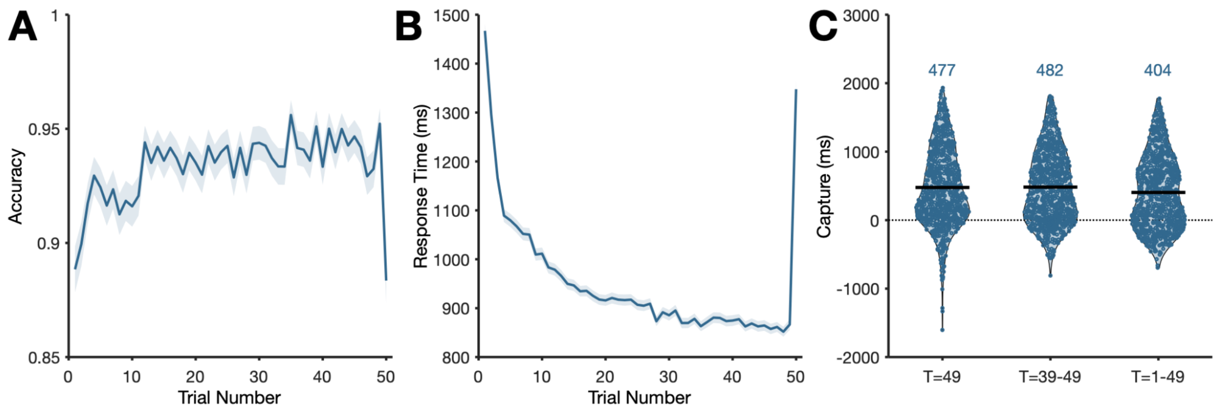


**Figure S3.** Experiment 1 accuracy, and key effects using accurate trials only. (A) Accuracy as a function of trial number in Experiment 1. (B) Response time as a function of trial number in Experiment 1 calculated using accurate trials only. (C) Capture in Experiment 1 calculated using accurate trials only. The x-axis indicates the method used to calculate the distractor absent response time (1 prior trial [T=49], 10 prior trials [T=39-49], all prior trials [T=1-49]).

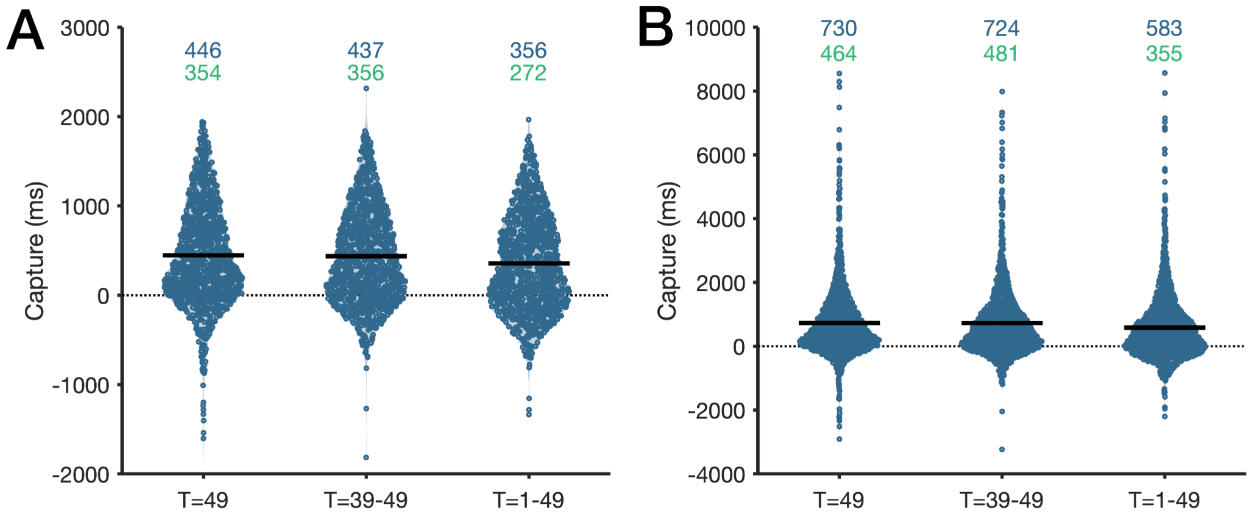


**Figure S4.** Main Experiment 1 results with more liberal data trimming and subject exclusion criteria. (A) The results from Figure 2B with more liberal exclusion criteria. We raised the exclusion criteria to exclude as few people as possible (exclusion criteria: failed color blindness test [1.25%] or below-chance performance of less than 50% correct [4%]). Note, however, since we did still trim the RT values, 16.7% were lost from this figure panel due to having a trimmed RT value on the single distractor present trial. Using a less stringent exclusion criterion had minimal effect on the magnitude of response time costs. Violins show the full distribution of values, and thick black lines show the mean value. Mean values are written in blue text and median values are written in green text. (B) The results from Figure 2B with fewer exclusion criteria (same as Figure S4A) and extremely minimal trimming of response times (excluding only N = 3 out of 1443 participants had a response time greater than 10 seconds on the critical distractor present trial). Excluding no trials did result in longer average estimates of capture (583-730 ms), though the median did not move as much as this increase was driven primarily by the long tail (355-464 ms). We note that the majority of additional singleton experiments in the literature have an enforced maximum response deadline (e.g., of 2 seconds). As such, we felt that the figures with trimmed responses times provided a more fair comparison point with the broader literature, since our experiment did not have an enforced response deadline. Violins show the full distribution of values, and thick black lines show the mean value. Mean values are written in blue text and median values are written in green text.

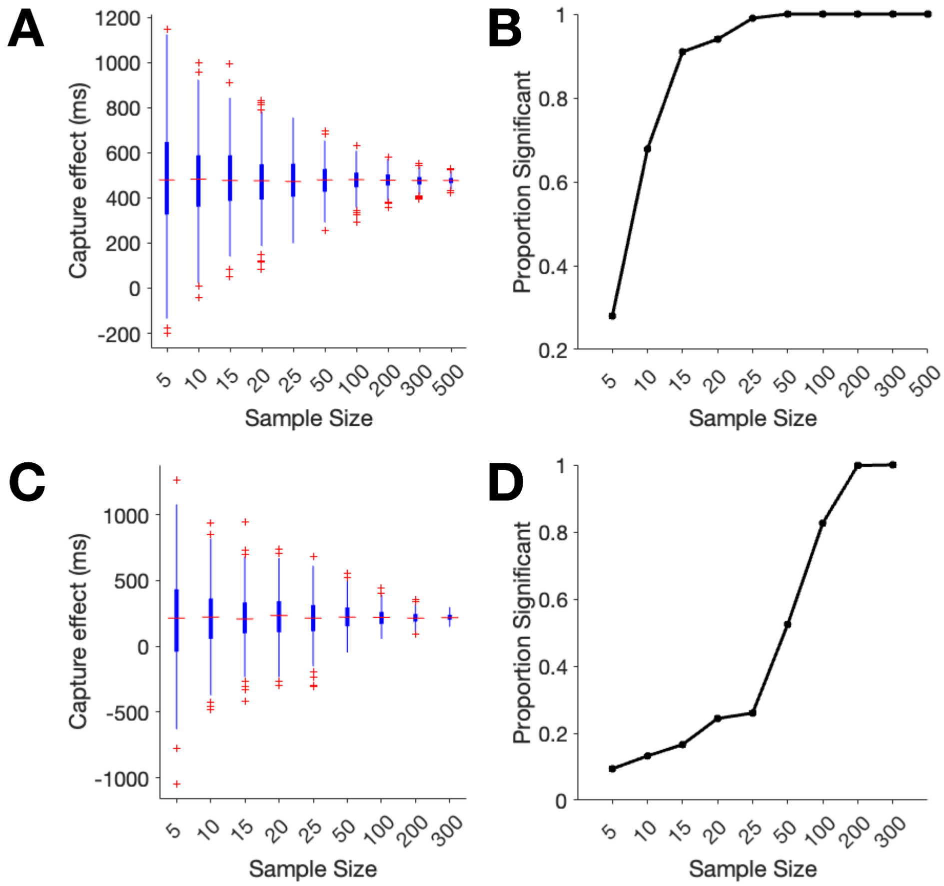


**Figure S5.** Down-sampling analysis to illustrate the effect of sample size on experimental effects (see: Xu et al., 2017). From our full experimental sample, we randomly down-sampled smaller groups of subjects (Sample Size) and measured the capture effect (500 random iterations). (A) Down-sampling results to detect the overall initial capture effect in Experiment 1. The x-axis shows the sample size of the sub-samples and the y-axis shows the. Standard box-and-whisker plots are shown for each sample size. As expected, the stability of estimates improves with larger sample sizes. (B) Proportion of sub-samples showing a significant capture effect. (C) Down-sampling results to detect a difference in capture as a function of long-term feature history ("Color Constant" condition vs. "Color Variable" condition). The x-axis shows the sample size per condition, and the y-axis shows the difference between the Color Constant and Color Variable conditions. Standard box- and whisker- plots are shown for each sample size. (D) Proportion of sub-samples showing a significant difference between the two conditions of interest. At least N = 100 participants per condition are required to reliably detect even a large condition difference (~200 ms).

**Table S1.** Capture effects from the literature review

| Authors | Year | Exp | Capture (ms) | Set Size |
|---|---|---|---|---|
| Theeuwes | 1991 | Exp 2 (Form) | 123.1 | 5 |
| Theeuwes | 1991 | Exp 2 (Form) | 114.7 | 7 |
| Theeuwes | 1991 | Exp 2 (Form) | 141.3 | 9 |
| Theeuwes | 1992 | Exp 1A (Form) | 18.1 | 5 |
| Theeuwes | 1992 | Exp 1A (Form) | 21.4 | 7 |
| Theeuwes | 1992 | Exp 1A (Form) | 34.0 | 9 |
| Theeuwes | 1992 | Exp 1B (Section 1) | 13.2 | 5 |
| Theeuwes | 1992 | Exp 1B (Section 1) | 15.8 | 7 |
| Theeuwes | 1992 | Exp 1B (Section 1) | 23.2 | 9 |
| Theeuwes | 1992 | Exp 1B (Section 2) | 4.2 | 5 |
| Theeuwes | 1992 | Exp 1B (Section 2) | 6.9 | 7 |
| Theeuwes | 1992 | Exp 1B (Section 2) | 6.9 | 9 |
| Theeuwes | 1992 | Exp 1B (Section 3) | 10.5 | 5 |
| Theeuwes | 1992 | Exp 1B (Section 3) | 10.6 | 7 |
| Theeuwes | 1992 | Exp 1B (Section 3) | 14.2 | 9 |
| Theeuwes | 1992 | Exp 2 (Color) | 6.2 | 5 |
| Theeuwes | 1992 | Exp 2 (Color) | 16.3 | 7 |
| Theeuwes | 1992 | Exp 2 (Color) | 24.0 | 9 |
| Theeuwes | 1994 | Exp 1 (Color) | 30.0 | 4 |
| Theeuwes | 1994 | Exp 1 (Color) | 48.6 | 7 |
| Theeuwes | 1994 | Exp 2 (Color) | 15.4 | 4 |
| Theeuwes | 1994 | Exp 2 (Color) | 8.1 | 7 |
| Bacon & Egeth | 1994 | Exp 1 | 21.0 | 5 |
| Bacon & Egeth | 1994 | Exp 1 | 32.6 | 7 |
| Bacon & Egeth | 1994 | Exp 1 | 34.0 | 9 |
| Theeuwes et al. | 2003 | Exp 1 (Shape) | 208 | 8 |
| Hickey et al. | 2006 | Exp 1 | 103.0 | 10 |
| Hickey et al. | 2006 | Exp 2 | 321.0 | 10 |
| Leber & Egeth | 2006 | Exp 1 (Singleton Group) | 93.0 | 5 |
| Leber & Egeth | 2006 | Exp 1 (Singleton Group) | 112.0 | 9 |
| Chisholm et al. | 2010 | Exp 1 (AVGP | 93.0 | 10 |

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|---|---|---|---|---|
| Chisholm et al. | 2010 | Exp 1 (NVGP) | 162.0 | 10 |
| Hickey & Theeuwes | 2011 | Exp 1 | 83.0 | 10 |
| Hickey et al. | 2011 | Exp 1 | 82.0 | 6 |
| Kiss et al. | 2012 | Exp 1 | 81.0 | 6 |
| Burra & Kerzel | 2013 | Exp 1 (Unpredictable Target) | 67.0 | 10 |
| Burra & Kerzel | 2013 | Exp 1 (Predictable Target) | 19.0 | 10 |
| McDonald et al. | 2013 | Exp 1 | 124.0 | 10 |
| Graves & Egeth | 2015 | Exp 1 (Colors Swapping) | 45.0 | 5 |
| Barras & Kerzel | 2016 | Exp 1 (Singleton\ Mode) | 30.0 | 8 |
| Barras & Kerzel | 2016 | Exp 2 (Singleton Mode) | 37.0 | 8 |
| Kerzel & Barras | 2016 | Exp 1 (Fixed, Singleton) | 57.8 | 5 |
| Kerzel & Barras | 2016 | Exp 1 (Fixed, Singleton) | 76.6 | 9 |
| Kerzel & Barras | 2016 | Exp 1 (Random, Singleton) | 121.2 | 5 |
| Kerzel & Barras | 2016 | Exp 1 (Random, Singleton) | 127.5 | 9 |
| Barras & Kerzel | 2017 | Exp 1 (Singleton Color, High) | 50.1 | 8 |
| Barras & Kerzel | 2017 | Exp 1 (Singleton Color, Low) | 25.9 | 8 |
| Gaspelin et al. | 2017 | Exp 1 | 51 | 6 |
| Gaspelin & Luck | 2018 | Exp 1 (2 colors swapping) | 15.0 | 4 |
| Gaspelin & Luck | 2018 | Exp 2 (4 colors swapping) | 7.0 | 4 |
| Gaspelin & Luck | 2018 | Exp 3 (2 colors swapping) | 13.0 | 6 |
| Adams & Gaspelin | 2020 | Exp 1 | 53.0 | 6 |
| Adams & Gaspelin | 2020 | Exp 2 | 36.0 | 6 |
| Adams & Gaspelin | 2020 | Exp 3 | 59.0 | 6 |
| Adam et al. | 2021 | Exp 1C | 31.7 | 3 |
| Adam et al. | 2021 | Exp 1C | 32.0 | 4 |
| Adam et al. | 2021 | Exp 1C | 42.8 | 5 |
| Adam et al. | 2021 | Exp 1C | 51.2 | 6 |
| Adam et al. | 2021 | Exp 2A | 21.1 | 4 |
| Adam et al. | 2021 | Exp 3A | 47.5 | 4 |
| Adam et al. | 2021 | Exp 3B | 38.8 | 4 |
| Adam & Serences | 2021 | Exp 1A | 32.5 | 4 |
| Kerzel & Huynh Cong | 2022 | Exp 1 (Random, Low) | 24.0 | 5 |
| Kerzel & Huynh Cong | 2022 | Exp 1 (Random, Low) | 29.0 | 9 |
| Kerzel & Huynh Cong | 2022 | Exp 1 (Random, High) | 27.0 | 5 |
| Kerzel & Huynh Cong | 2022 | Exp 1 (Random, High) | 63.0 | 9 |

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|---|---|---|---|---|
| Kerzel & Huynh Cong | 2022 | Exp 1 (Blocked, Low) | 21.0 | 5 |
| Kerzel & Huynh Cong | 2022 | Exp 1 (Blocked, Low) | 37.0 | 9 |
| Kerzel & Huynh Cong | 2022 | Exp 1 (Blocked, High) | 43.0 | 5 |
| Kerzel & Huynh Cong | 2022 | Exp 1 (Blocked, High) | 46.0 | 9 |
| Kerzel & Huynh Cong | 2022 | Exp 2 (Random, Low) | 27.0 | 5 |
| Kerzel & Huynh Cong | 2022 | Exp 2 (Random, Low) | 40.0 | 9 |
| Kerzel & Huynh Cong | 2022 | Exp 2 (Random, High) | 28.0 | 5 |
| Kerzel & Huynh Cong | 2022 | Exp 2 (Random, High) | 74.0 | 9 |
| Hauck & Lien | 2022 | Exp 1 (Table 1) | 72.5 | 10 |

This table shows the values plotted in the literature review figure. We have included a total of 75 unique capture values from 24 unique papers (Adam et al., 2021; Adam & Serences, 2021; Adams & Gaspelin, 2021; Bacon & Egeth, 1994; Barras & Kerzel, 2016, 2017; Burra & Kerzel, 2013; Chisholm et al., 2010; Gaspelin et al., 1/2017; Gaspelin & Luck, 2018; Graves & Egeth, 2015; Hauck & Lien, 2022; Hickey et al., 2006, 2011; Hickey & Theeuwes, 2011; Kerzel & Barras, 2016; Kerzel & Huynh Cong, 2022; Kiss et al., 2012; Leber & Egeth, 2006; McDonald et al., 2013; Theeuwes, 1991, 1992, 1994; Theeuwes et al., 2003).

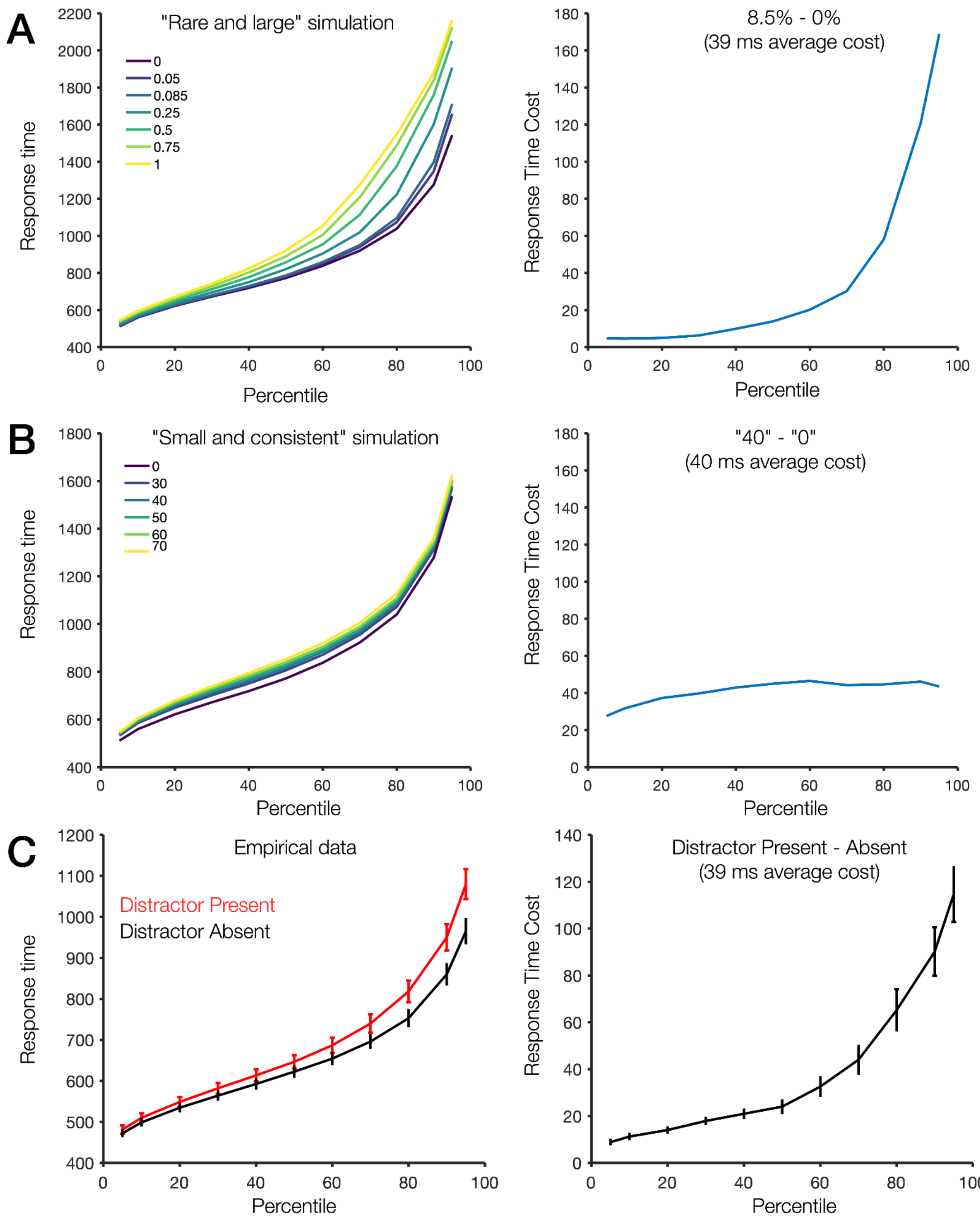


**Figure S6. Response time as a function of percentile bin for the "rare and large" versus "small and consistent" simulations and empirical data.** (A) Left: Response times as a function of the percentage of "surprise capture" trials mixed into the "distractor absent" distribution. A response time cost of 39 ms was best approximated by sampling 8.5% of trials from the "surprise capture" distribution. Right: The difference between the "8.5% capture" line and the "0% capture" line. The cost is non-zero for all percentile bins, but increases in an exponential fashion for higher percentiles. (B) Left: Response times as a function of the average magnitude of the noisy delay (e.g., small but consistent 40 ms difference). Right: The difference between the “40 ms cost” line and the “0 ms cost” line. The cost is non-zero for all percentile bins, but does not greatly change as a function of percentile bin. (C) Left: Response times for the distractor absent and present conditions in Adam et al. (2021) Experiment 1C, plotted as a function of percentile bin. Right: The difference between the distractor absent and present lines. The cost is non-zero for all percentile bins ($p < .001$), but markedly increases as a function of percentile bin, similar to the “rare and large” simulation.

**Analysis S2. Experiment 2 population information and exclusion thresholds.**

In Experiment 2, we excluded a total of 182 out of 1443 participants [15.1%], leaving a total of N = 1025 participants for analysis. We did not have an explicit stopping rule; we collected as much data as we could based on the time constraints of the academic quarter (March through April 2020). Note, some participants met multiple criteria for exclusion, so the following numbers do not add up to 182. N = 1 participant [<0.1%] was excluded for failing to meet the minimum age criterion of 18 years old, and N = 14 participants [1.2%] were excluded for failing to demonstrate normal color vision (did not correctly identify the embedded number in a digital Ishihara plate). A total of N = 110 participants (9.1%) were excluded for failing to meet a minimum performance criterion of 75% correct responses. We excluded participants with overall average RT’s greater than or less than 2.5 standard deviations beyond the population mean (mean RT < 331 ms or >1473 ms). This resulted in N = 9 [0.75%] excluded for excessively fast average RT’s and N = 25 [2.1%] excluded for excessively slow RTs. Finally, when preprocessing the data, we automatically trimmed the RT data to exclude all trials where participants responded extremely fast (<150 ms) or extremely slow (>2603 ms). We excluded participants who lost more than 15% of their data to this data-trimming procedure, N = 103 [8.5%].

As noted in the main text, participants had an average age of 20.3 years (SD = 1.9, min = 18, max = 38). Note, one participant was excluded from this average age because they did not meet our age criterion [18+ years old]. We also collected demographics information based on NIH reporting criteria. When asked about which ethnicity best described them, 284 reported Hispanic or Latino, 883 reported not Hispanic or Latino, and 40 indicated No Response. When asked which race best describes them, 8 reported American Indian or Alaska Native, 633 reported Asian, 22 reported Black or African American, 89 reported more than one race, 6 reported Native Hawaiin or Pacific Islander, 310 reported White, and 139 indicated No Response.

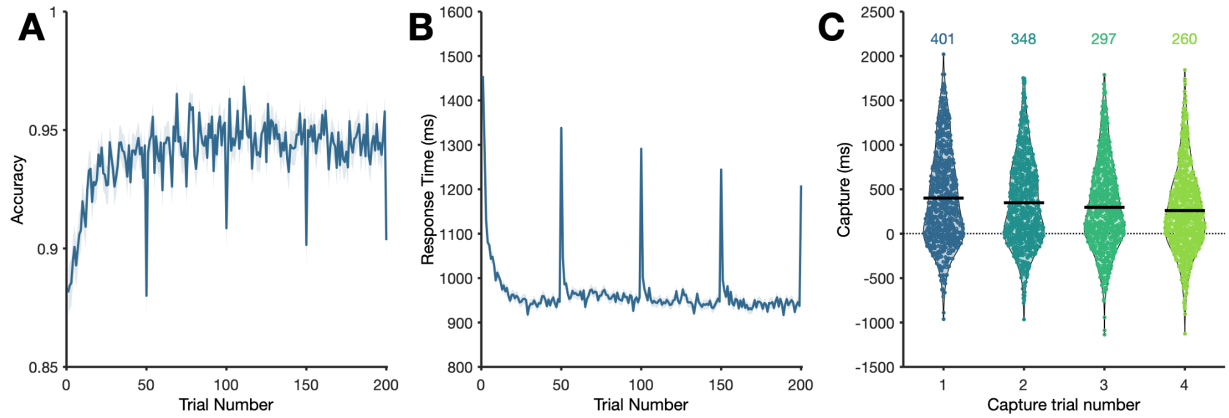


**Figure S7.** Experiment 2 accuracy, and key effects using accurate trials only. (A) Accuracy as a function of trial number in Experiment 2. (B) Response time as a function of trial number in Experiment 2 calculated using accurate trials only. (C) Capture in Experiment 2 calculated using accurate trials only.

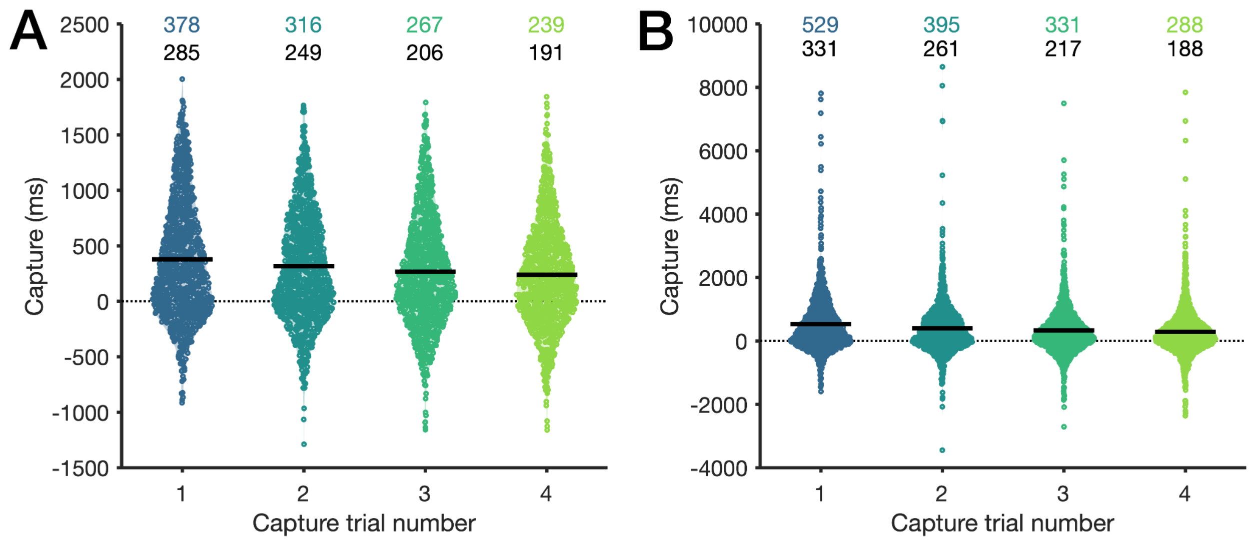


**Figure S8.** Main Experiment 2 results with more liberal data trimming and subject exclusion criteria. (A) The results from Figure 2B with more liberal exclusion criteria. We raised the exclusion criteria to exclude as few people as possible (exclusion criteria: failed color blindness test [1.2%] or below-chance performance of less than 50% correct [1.9%]). Note, however, since we did still trim the RT values, on average N=105.5 [8.7%] were lost from each capture trial due to having a trimmed RT value on that particular trial. Using a less stringent exclusion criterion had minimal effect on the magnitude of response time costs. Violins show the full distribution of values, and thick black lines show the mean value. Mean values are written in colored text and median values are written in black text. (B) The results from Figure 2B with fewer exclusion criteria (same as Figure S7A) and extremely minimal trimming of response times (N = 3 to 6 out of 1207 participants had a response time greater than 10 seconds for each of the 4 critical distractor present trials). Excluding fewer trials again resulted in somewhat longer average estimates of capture (288-529 ms), though the median did not move as much as this increase was driven primarily by the long tail (188-331 ms). We note that the majority of additional singleton experiments in the literature have an enforced maximum response deadline (e.g., of 2 seconds). As such, we felt that the figures with trimmed responses times provided a more fair comparison point with the broader literature, since our experiment did not have an enforced response deadline. Violins show the full distribution of values, and thick black lines show the mean value. Mean values are written in colored text and median values are written in black text.

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