

Response Strategy Reverses Serial Dependence: From Attraction to Repulsion

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Abstract

Perceptual decisions are substantially biased by recent stimuli—a phenomenon termed serial dependence. Yet, what determines whether this bias is attractive (toward the previous stimulus) or repulsive (away from it) remains unclear. Previous studies focused on task structure and did not consider how individuals' response strategies might influence bias. Here, we show that response speed—whether natural or instructed—critically shapes the direction of serial dependence. In a two-face discrimination task using a uniform morph continuum between two female identities, slower responders showed attraction, while faster responders showed repulsion. To test causality, we repeated the experiment and manipulated strategy within subjects by instructing participants to prioritize either speed or accuracy. The more participants sped up, the more repulsive their bias became. Repulsion in fast responses appeared consistent with a shift toward long-term representations—specifically, stronger attraction toward the nearest face prototype and reduced influence of the previous stimulus. These findings demonstrate that response strategy modulates serial dependence, likely by altering the balance between short- and long-term history.

Keywords: Serial dependence; attraction; repulsion; response strategy; response time; prototype; faces

Introduction

Serial dependence—the influence of recent experience on perception—has been extensively studied over the last decade. Yet, the mechanisms underlying this phenomenon remain debated (Cicchini, Mikellidou, & Burr, 2024). In particular, both attractive and repulsive effects have been systematically reported, but no simple rule has been formalized to explain what determines their direction (Pascucci et al., 2023). A recent theoretical framework suggests that repulsion is driven by bottom-up sensory encoding, while attraction reflects the top-down integration of task-relevant predictions (Hahn & Wei, 2024). Here, we explore a phenomenon not accounted for by current models: implicit shifts in response strategy consistently reverse the direction of serial dependence—from attraction to repulsion—despite identical stimuli and task structure.

Methods

Stimuli

Twenty-one face images were generated by morphing between two female identities (*Dafna* and *Liat*) in 5% increments, ranging from 0% Liat (100% *Dafna*) to 100% Liat (Figure 1 A). These morphs served as the stimulus pool.

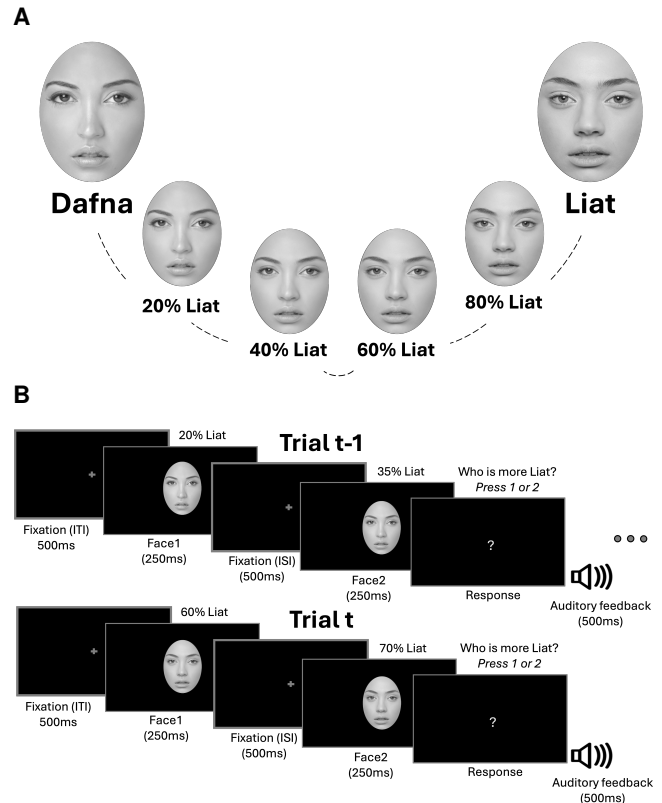


Figure 1: Stimuli and task structure. **A.** Example face stimuli: *Dafna* (0%), *Liat* (100%), and a subset of intermediate morphs. **B.** Trial sequence of the two-face serial discrimination task.

Two-face serial discrimination task

Experiment 1: No specific strategy prescribed Participants performed a two-face serial discrimination task. On each trial, two faces (250 ms each), randomly sampled from the uniform morph distribution, were presented sequentially with a 500 ms inter-stimulus interval (ISI) (Figure 1 B). Inter-trial intervals (ITIs) of 500, 1500, or 3500 ms were administered in separate blocks of 50 trials (200 trials per ITI). The distance between the two face stimuli was uniformly sampled between 0% and 30%. Participants were asked to indicate which face was more similar to *Liat*. Response time was unconstrained. Auditory feedback was provided at the end of each trial, and summary feedback was given after every block.

Experiment 2: Strategy manipulation In a follow-up experiment, the same task was used with a counterbalanced within-subject design. In one half of the session, participants were instructed to prioritize accuracy; in the other half, to prioritize speed. Both the inter-stimulus interval (ISI) and inter-trial in-

terval (ITI) were fixed at 500 ms. Each participant completed 400 trials, and feedback was provided as in Experiment 1.

Serial dependence measure (assuming attraction)

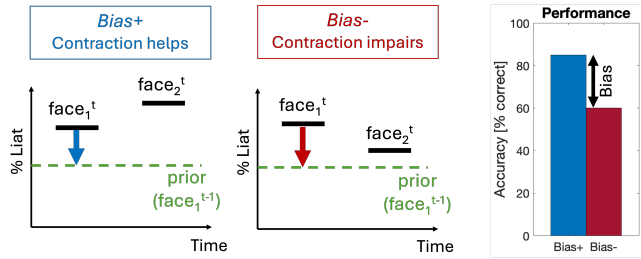


Figure 2: Schematic illustration of the bias calculation: difference in accuracy between *Bias+* and *Bias-* trials.

Serial dependence in the face discrimination task was quantified by comparing performance between two trial types, as illustrated in Figure 2. A *Bias+* trial is defined as one in which $\text{sign}(\text{face}_2^t - \text{face}_1^t) = \text{sign}(\text{face}_1^t - \text{prior})$, and a *Bias-* trial is defined as one in which $\text{sign}(\text{face}_1^t - \text{face}_2^t) = \text{sign}(\text{face}_2^t - \text{prior})$, where face_1^t and face_2^t are the two faces presented on trial t , and the prior refers to the first face of the preceding trial (dashed line). The arrows in Figure 2 illustrate attraction toward the prior, which increases perceived differences on *Bias+* trials and decreases them on *Bias-* trials. Serial dependence was computed as the difference in accuracy between *Bias+* and *Bias-* trials.

Results

Experiment 1: No prescribed strategy — most participants show attraction; faster responders show repulsion

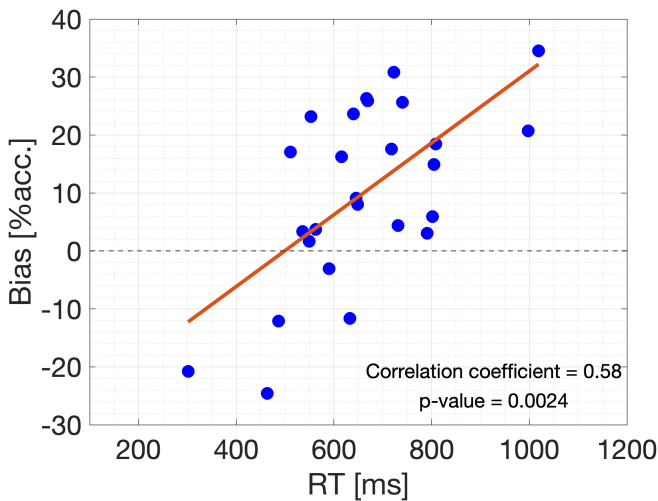


Figure 3: Serial dependence vs. response time (Spearman's $\rho = 0.58$, $p = .0024$, $n = 27$).

Figure 3 shows a significant Spearman correlation between participants' mean serial dependence (averaged across ITIs)

and their mean response time. Participants with shorter response times ($RT < 500$ ms) exhibited repulsive serial dependence, while those with longer response times showed attractive serial dependence. Participants performed the task with a mean accuracy of 71%.

Experiment 2: Strategy manipulation — the more participants sped up, the more repulsive the bias became

Figure 4 shows a significant negative Spearman correlation between participants' serial dependence in speed-priority blocks and their reduction in response time relative to accuracy-priority blocks. Participants who sped up the most under speed instructions exhibited the strongest repulsive bias. In contrast, those who responded more slowly tended to show a more attractive bias. Participants performed the task with a mean accuracy of 68% in accuracy-priority blocks and 66% in speed-priority blocks.

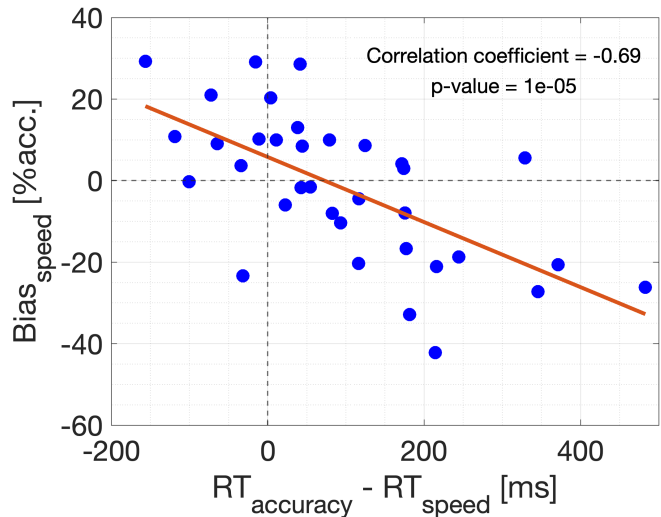


Figure 4: Serial dependence in the speed-priority blocks vs. response time difference between accuracy- and speed-priority blocks (Spearman's $\rho = -0.69$, $p < .00001$, $n = 35$).

Discussion

Serial dependence in face perception is flexibly modulated by response strategy. In Experiment 1, faster responses were associated with stronger repulsion from the previous stimulus, while slower responders showed attraction—revealing a correlation across participants. Experiment 2 extended this finding by manipulating strategy within participants: instructing them to prioritize speed led to faster responses and greater repulsion, with a strong negative correlation between serial dependence and the magnitude of speed-up. This provides causal evidence that strategic shifts in behavior can modulate the direction of serial dependence. Repulsion may reflect attraction to the nearest face-prototype (*Liat* or *Dafna*) and reduced influence of the prior stimulus. These findings suggest that response strategy plays a critical role in shaping how perceptual history is integrated into current decisions.

References

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