Eye Left the Right Face: The Impact of Central Attentional Resource Modulation on Visual Strategies During Facial Expression Categorization

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INTRODUCTION

- The perception of facial expressions of emotions is impaired when central attentional resources are unavailable (ref. 1).
- We used the psychological refractory period dual-task paradigm (ref. 2) to verify if central resource depletion affects information processing strategies for the categorization of facial expressions.
- It is well known that attention modulates spatial resolution in the visual field (ref. 3). We were therefore particularly interested in the eye region, given its concentration in high spatial frequency content, relative to the rest of the face.

METHODS

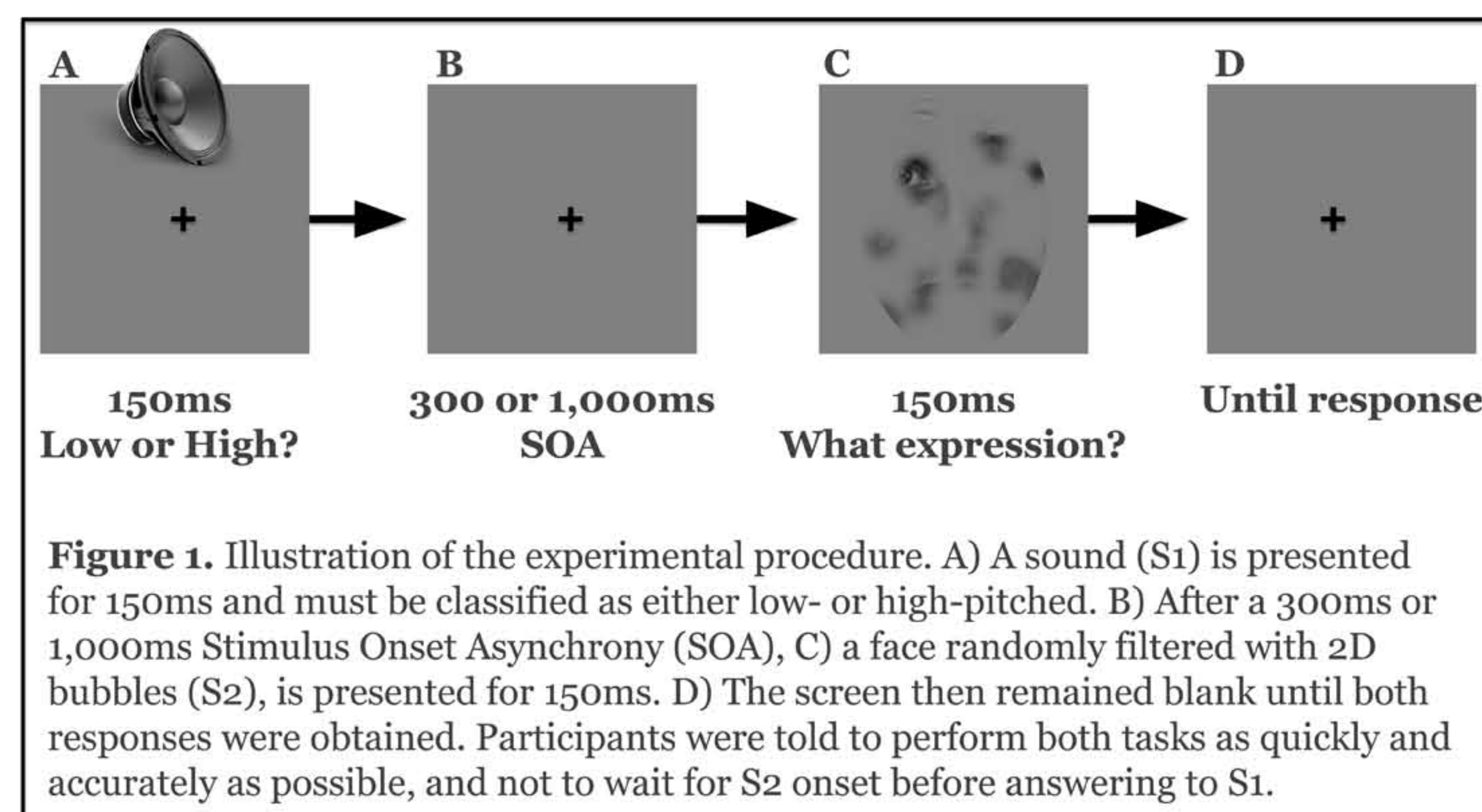**Participants:** 20, right-handed
Trials: 1920
Task 1 (T1): Sound categorization (Fig. 1A)
- Low-pitched (200Hz, 400Hz) or high-pitched (800, 1600Hz).

Stimulus onset asynchrony (SOA): 300ms or 1,000ms (Fig. 1B)
Task 2 (T2): Facial expression categorization (Fig. 1C)
- Faces depicting one of the six basic facial expressions (ref. 4, 5): anger, sadness, disgust, fear, joy, and surprise.
- Faces were filtered with randomly located Gaussian windows ($\sigma= 12$; ref. 6).
- The number of bubbles was modulated with QUEST (ref. 7) to maintain 58.33% correct responses.

Figure 1. Illustration of the experimental procedure. A) A sound (S1) is presented for 150ms and must be classified as either low- or high-pitched. B) After a 300ms or 1,000ms Stimulus Onset Asynchrony (SOA), C) a face randomly filtered with 2D bubbles (S2), is presented for 150ms. D) The screen then remained blank until both responses were obtained. Participants were told to perform both tasks as quickly and accurately as possible, and not to wait for S2 onset before answering to S1.

ANALYSES & RESULTS

- Performance was identical at short (64.55% correct) and long (64.52%) SOA, $t(19)= .51$, $p> .05$, but categorization was 252ms slower at short SOA, $t(19)= 9.344$, $p< .001$.
- A classification image (CI) was produced by performing a multiple linear regression of bubble coordinates on performance scores. The null hypothesis (NH) mean and standard deviation were estimated from random permutations of accuracy scores and used to z-score the CI.
- A pixel test ($\sigma= 16.97$, Zcrit= 3.327) and cluster test (Zcrit= 2, k= 2,148 pixels) determined the statistical threshold (ref. 8), $p= .05$.
- The same facial regions were used at long (Fig. 2, left) and short (Fig. 2, middle) SOA, but the left eye was more heavily processed at long SOA (Fig 2., right), $p< .05$.
- We looked at the distribution of significant pixels along the image x- (left-right) axis. This vector was smoothed with a Gaussian kernel ($\sigma= 8.49$) and z-scored with the NH mean and standard deviation, estimated from random permutations of SOA (pixel test: Zcrit = ±2.64, $p= .05$).
- SOA condition mediated a shift in visual strategy (Fig. 3), such that the left side of the face was processed more heavily at long SOA (blue line), whereas the right side of the face was processed more heavily at short SOA (red line), $p< .05$.
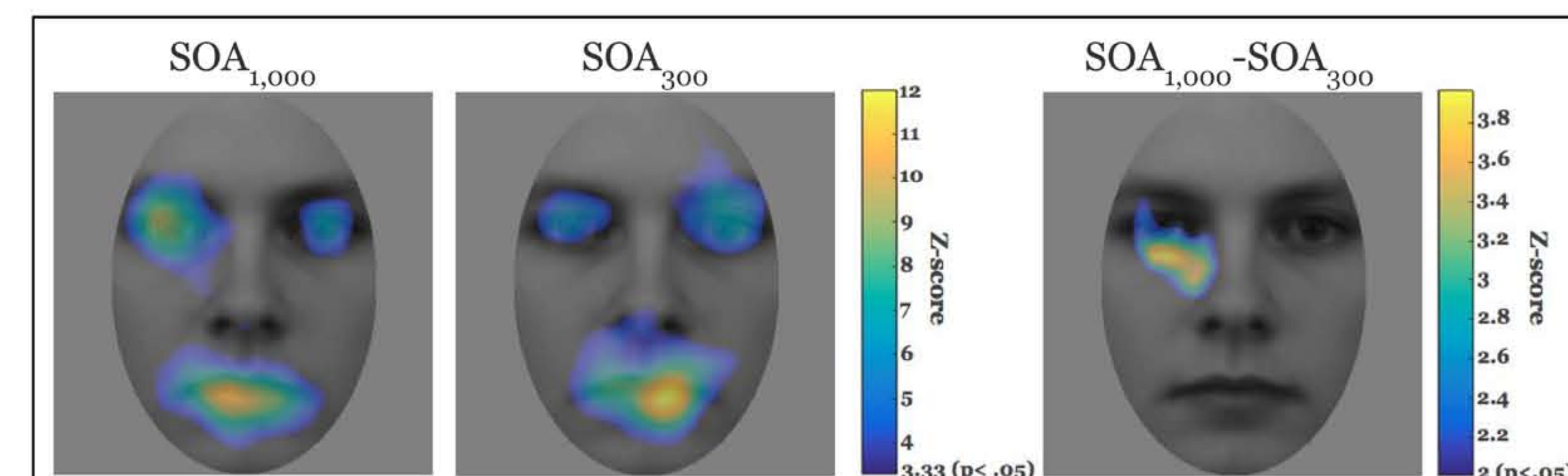
Figure 2. The effect of SOA condition on visual information extraction strategies. Left and middle: Classification images (CIs) for $SOA_{1,000}$ and SOA_{300}, respectively. Right: Difference CI, $SOA_{1,000}$-SOA_{300}. Coloured pixels are significant, $p< .05$.
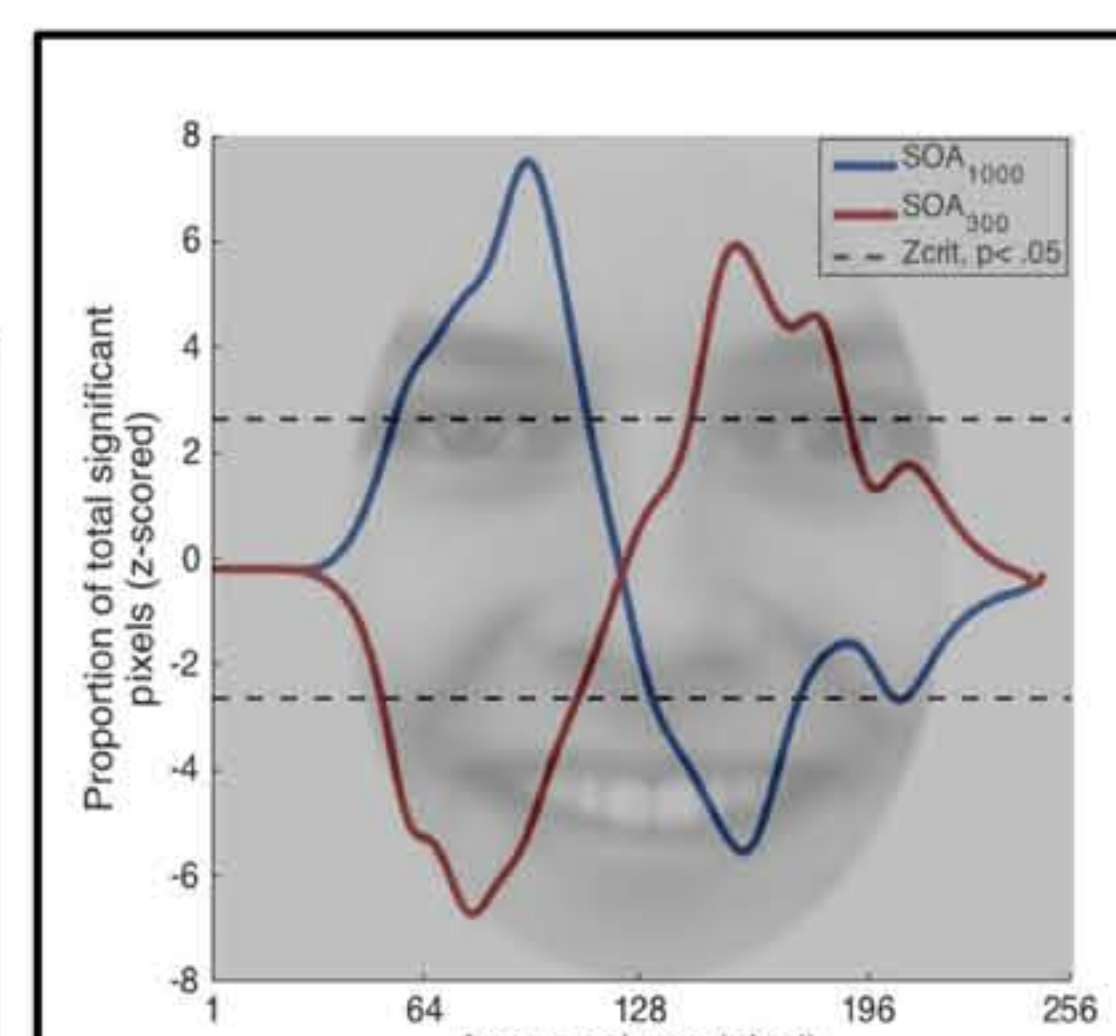
Figure 3. Z-scored distribution of significant pixels along the image x-axis at long (blue) and short (red) SOA. Dotted line: statistical threshold, Zcrit= ±2.64., $p< .05$.

DISCUSSION

- Central attentional resource availability modulated information processing strategies: Specifically, the left eye was more heavily processed when central resources were fully available.
- Face utilization was asymmetric: When central resources were available, participants relied more heavily on the left side of the face, consistent with the left-visual field/right hemisphere superiority (ref. 9).
- Strikingly, a right side bias emerged when central resources were not fully available. Future work should aim to verify if this reflects greater implication from the left hemisphere.

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