Individual Criterion Shifting is Associated with Measures of Metacognition

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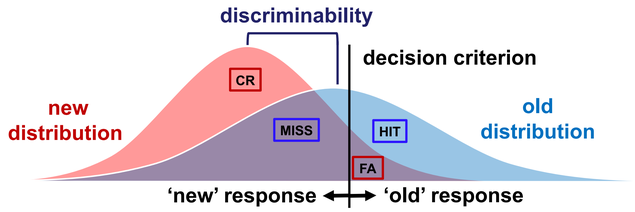
Introduction

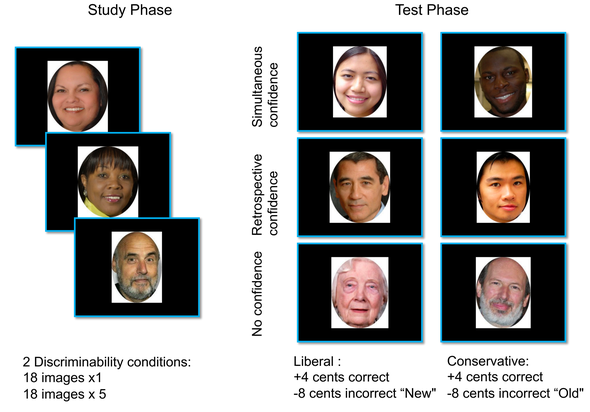
Signal Detection Theory



- High inter-individual variability and high intra-individual stability have been observed in the extent to which people shift their decision criterion during recognition memory experiments.[1]
- Recognition memory tasks often utilize response scales comprised of both choice and confidence judgments.
- Does an individual's ability or tendency to shift their criterion relate to their use of confidence scales? Is criterion shifting associated with an individual's ability to discriminate correctness with confidence?
- Confidence thresholds can also be characterized as decision criteria. Do individuals who place their manipulated decision criteria nearer to their high confidence criteria also shift their criteria more?
- Do individuals discriminate accuracy with confidence equally well when they rate confidence during a decision as opposed to after a decision? Do decision strategies differ when confidence judgments are simultaneous versus retrospective?

Methods

- 126 participants (42 M, 84 F; M_{age} = 19.53, SD = 2.01) were paid based on performance.
- Correct responses were awarded with a 4-cent gain. Criterion placement was manipulated using payoffs:
  - Conservative condition: incorrect "old" responses (false alarms) resulted in money loss (-8 cents).
  - Liberal condition: incorrect "new" responses (misses) resulted in money loss (-8 cents).
- Participants decided whether faces shown during each test phase had been previously seen ("old") or not seen ("new") in the study phase. On "no confidence" trials, participants only made a recognition decision and not a confidence judgment. When trials included a confidence judgment, confidence was either rated at the same time as the recognition judgment or immediately afterwards.



Methods

Classic Simultaneous Scale

High Old	Med Old	Low Old	Low New	Med New	High New

Retrospective Confidence Scale

Old	New

➡

Low	Med	High

Decision Criterion: the threshold between old and new responses. $c = -½(z[H] + Z[FA])$

Criterion Shift: the extent to which people change their decision threshold when circumstances elicit a change, such as when a certain type of error is more desirable to avoid.
$C =$ *c [conservative] – c [liberal]*

Discriminability: a measure of how well old can be distinguished from new. $d' = z(FA) – z(H)$

Metacognitive Efficiency: a measure of how well confidence discriminates between correct and incorrect decisions, taking task performance (type 1 d') into account. Estimated using a type-2 SDT framework and maximum likelihood estimation.[2,3]

Metacognitive Bias: a general tendency to give high confidence responses. Here, measured as the % of responses rated with high confidence.

Results

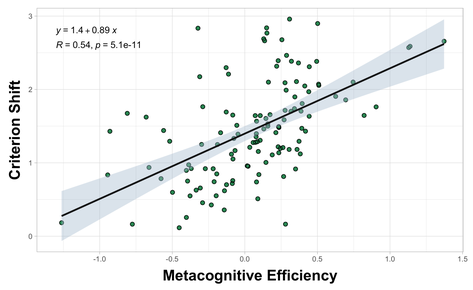


Figure 1. Metacognitive efficiency correlated with criterion shifting. This was true whether the criterion shifting values were calculated from trials with confidence ratings or trials without confidence ratings.

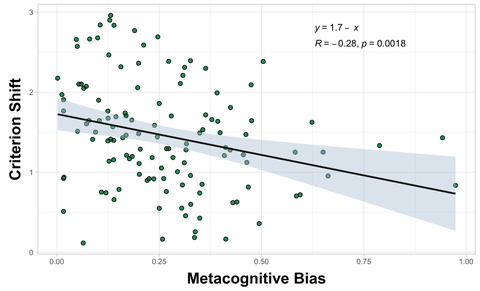


Figure 2. Metacognitive bias correlated negatively with criterion shifting.

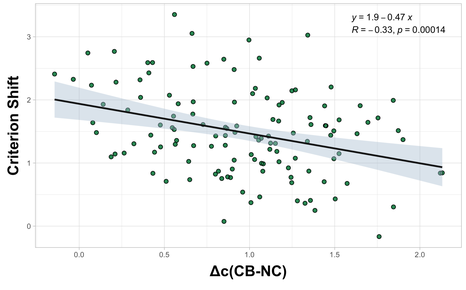


Figure 3. The difference between metacognitively available decision behavior and actual behavior can be examined as the difference between the criterion people set for high confidence responding (cCB) in confidence-rating trials and the criterion for choice responding (cNC) during corresponding conservative and liberal no-confidence trials. Individuals who placed their decision criterion nearer to their high confidence criteria did shift their criterion to a greater extent, but high variability was observed (**Figure 4**).

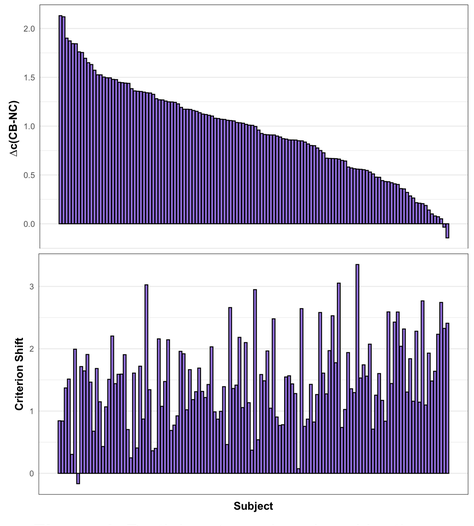


Figure 4. Participants rank-ordered by the difference between their high-confidence criterion and manipulated decision criterion, compared to their overall criterion shifting.

Results

Simultaneous versus Retrospective Confidence Ratings

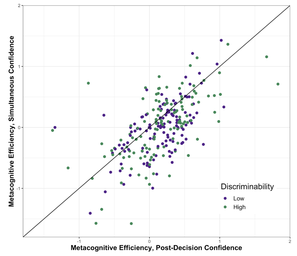


Figure 5. The straight line represents a theoretical 1:1 ratio. For most participants, metacognitive efficiency was higher when they rated the confidence of their recognition decision retrospectively rather than simultaneously.

- Metacognitive efficiency was higher for individuals when they used the retrospective scale as opposed to the simultaneous scale (Figure 5).
- Individuals responded with high confidence more frequently when rating their confidence after the decision, even when discriminability did not differ.
- Individual criterion shifting does not change when confidence is rated after a decision as opposed to simultaneously.

Discussion

- Higher metacognitive efficiency was associated with greater criterion shifting. Individuals who were better at discriminating the accuracy of their decisions, given their level of performance, were also more inclined to strategically change their decision criterion.
- Individual tendencies in reporting confidence relate to criterion shifting. Those who report high confidence more frequently may be less inclined to utilize strategic criterion shifting.
- Individuals who set their decision criterion on conservative and liberal trials closer to the corresponding high-confidence criterion did shift their criterion to a greater extent, but variability was high.
- Judgments of confidence made after the decision were better able to discriminate accuracy than judgments made at the same time of the decision. Confidence rated after the decision may emerge from a different process or evidence base than confidence rated simultaneously with the decision. Despite the differences observed in confidence reporting and metacognition, the extent of individual criterion shifting was the same whether confidence was rated retrospectively or simultaneously.

References

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2. Maniscalco, B., & Lau, H. (2012). A signal detection theoretic approach for estimating metacognitive sensitivity from confidence ratings. *Consciousness and Cognition*, *21*(1), 422–430.
3. Maniscalco, B., & Lau, H. C. (2014). *Signal Detection Theory Analysis of Type 1 and Type 2 Data: Meta- d′ , Response-Specific Meta- d′ , and the Unequal Variance SDT Model. In S. M. Fleming & C. D. Frith (Eds.), The Cognitive Neuroscience of Metacognition (pp.25-66). Springer.*
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