

Higher-Order Awareness without First-Order Accuracy: Implications for Models of Metacognition

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Typically operationalised using confidence

- Objective decision accuracy – demonstrates knowing
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Signal detection has been applied to metacognition

- Lau (2008) proposed a SDT based framework for metacognition
- SDT measures (type I and II d-prime) widely used (Galvin, 2003)
- Meta d-prime improvement (Rounis et al. 2010, Maniscalco & Lau, 2011)

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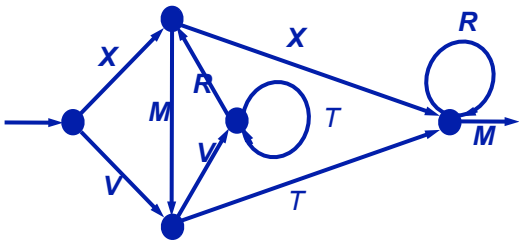
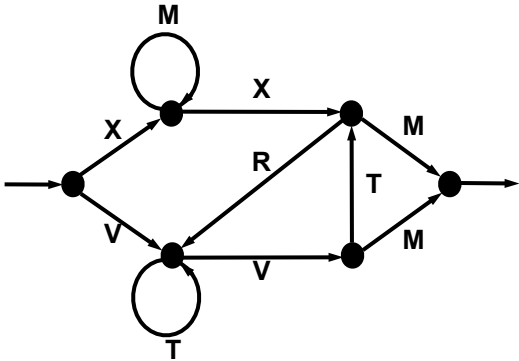
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We sought an empirical test of the SDT based framework

- We employ data from the artificial grammar learning (AGL) paradigm
- Examine constraints inherent in the SDT framework
- Evaluate predictions relating to both Type II and Meta d-prime

Knowing and Metacognition in AGL



Training for Group A

XMMXM
 VTTVTM
 VVTRTVM

...

Training for Group B

XMTRM
VVRMTM
VTRRRRM

...

Testing for Group A and B

VTVTM

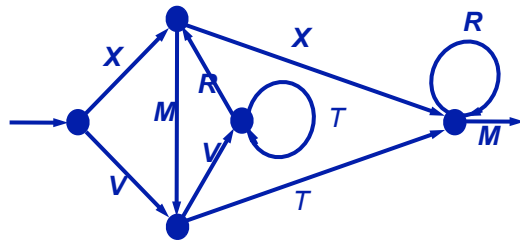
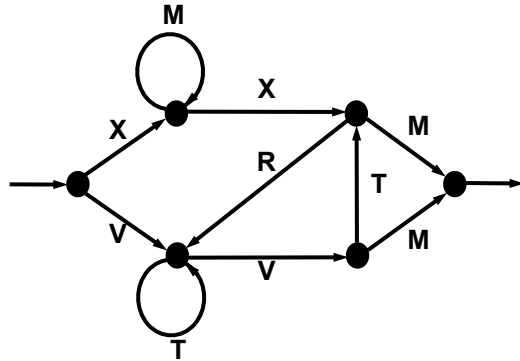
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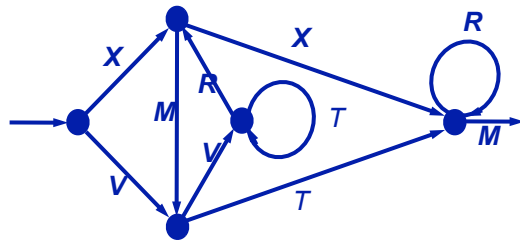
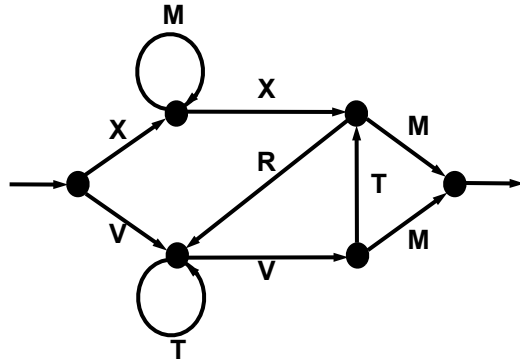
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Judgements required

1. String grammaticality
 (Decision accuracy)
2. Their confidence
 (Metacognitive accuracy)

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Typical results

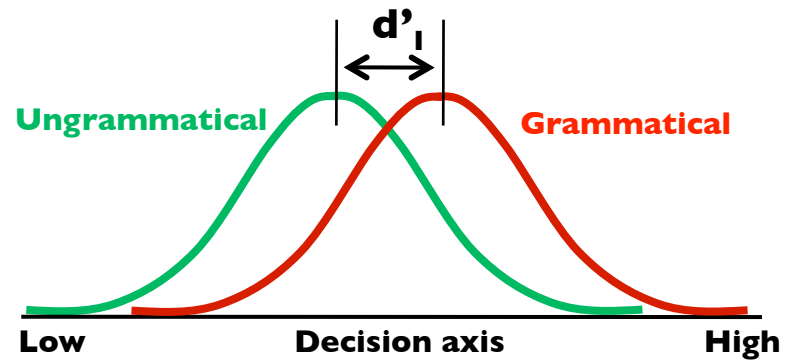
1. Decision Accuracy variable
(65% - 70% is normal)
2. Metacognitive accuracy partial
(55% right without confidence)

SDT applied to AGL

Type I d-prime (d'_1)

Hit – Respond Grammatical when string IS Grammatical

FA - Respond Grammatical when string IS NOT grammatical

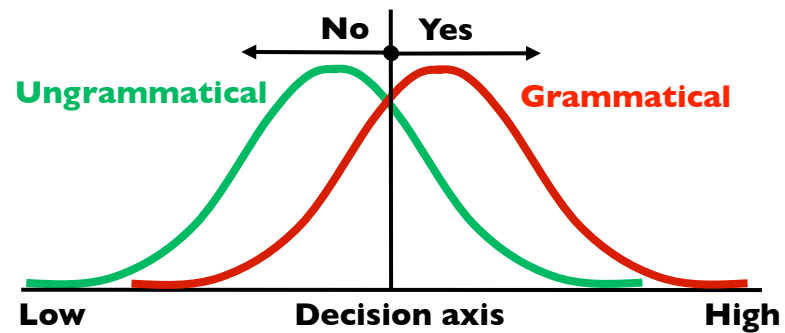


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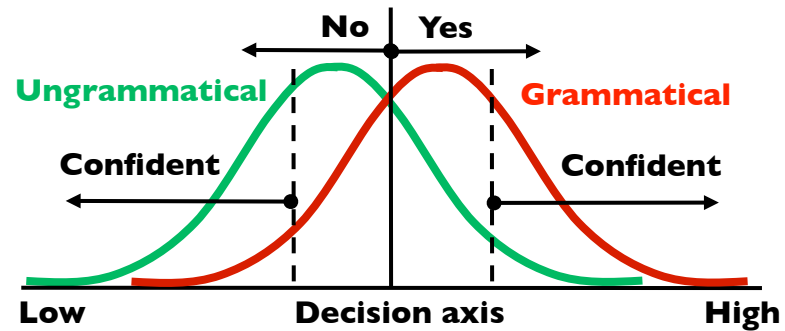


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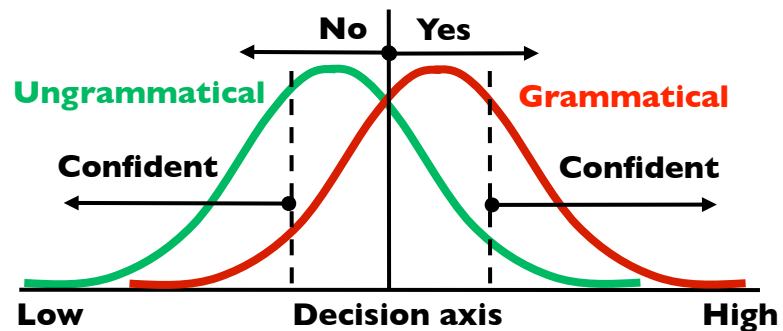


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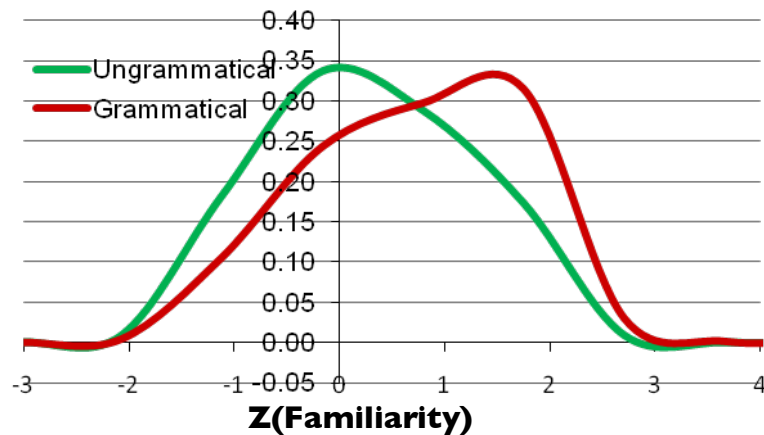
Type I d' -prime (d'_I)

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Equivalent distributions assuming responses based on subjective familiarity ratings (N = 384)

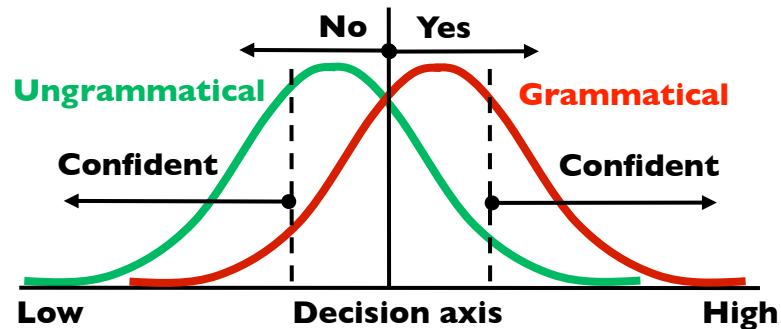


Scott & Dienes (2008) *JEP:LMC*

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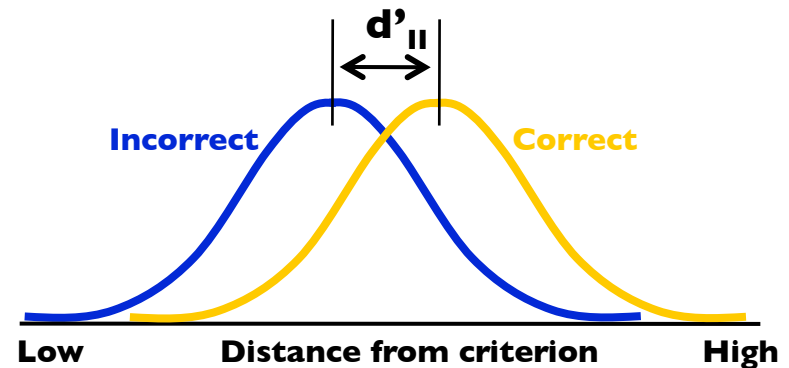
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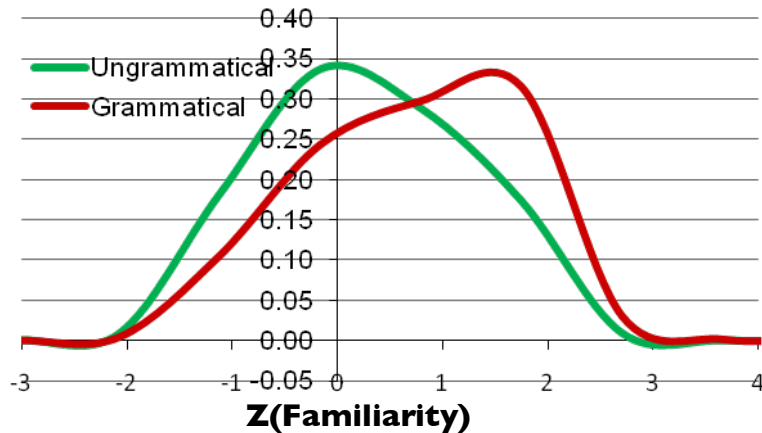


Type II d-prime (d'_{II})

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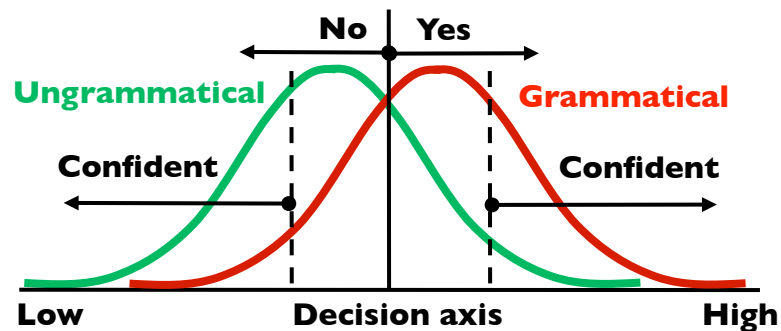


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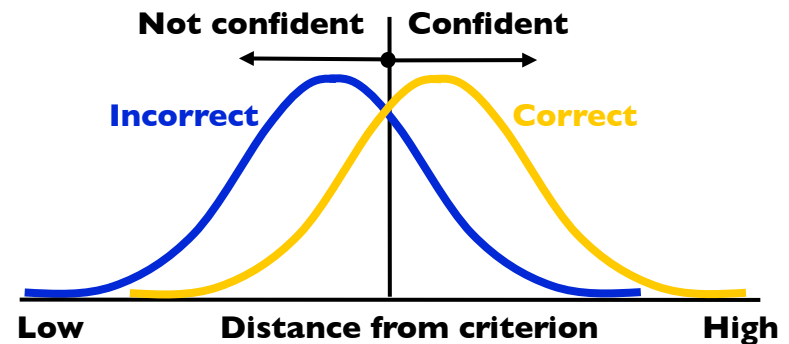
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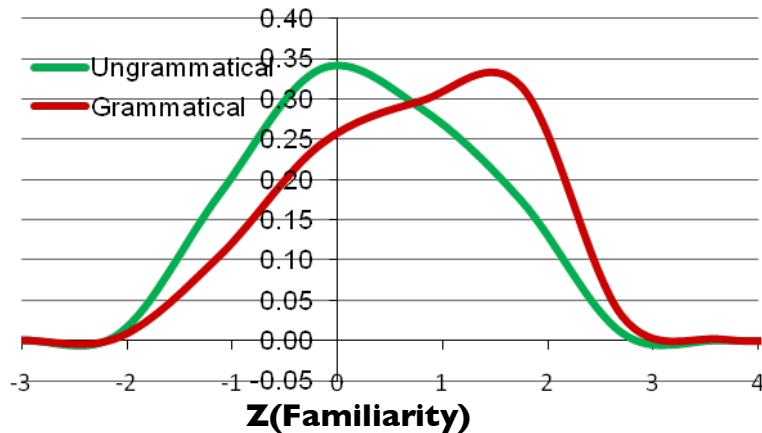


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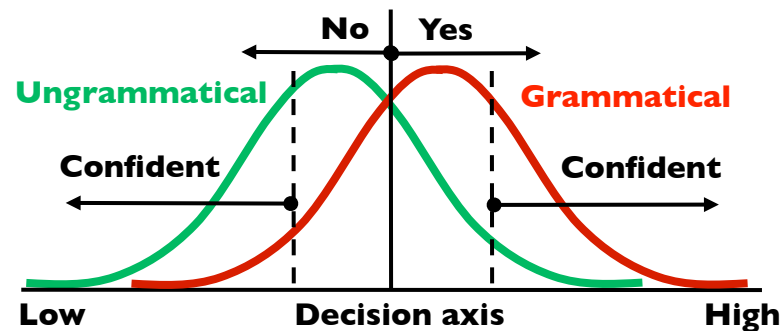


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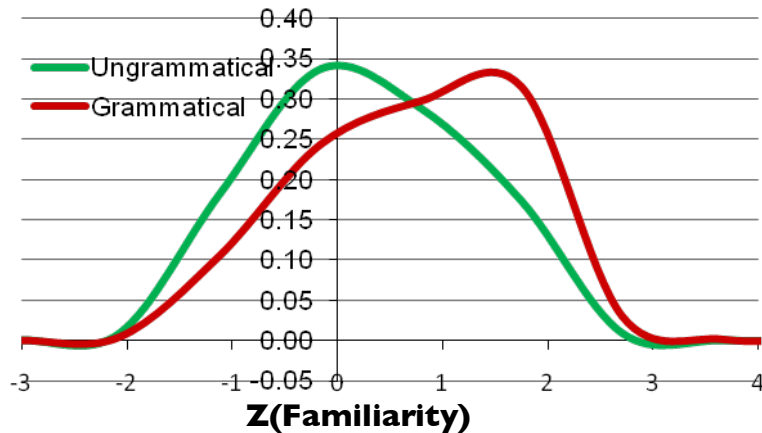
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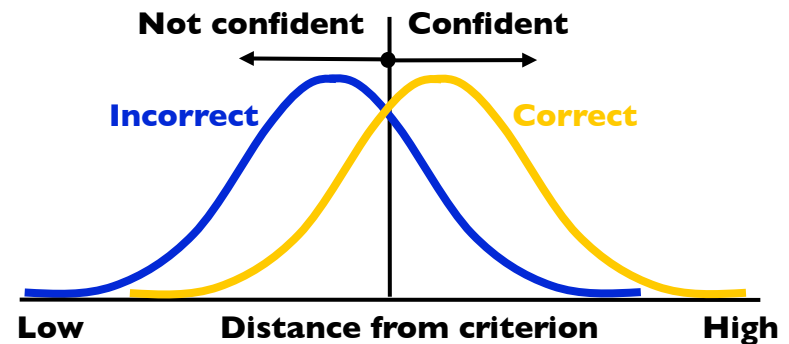
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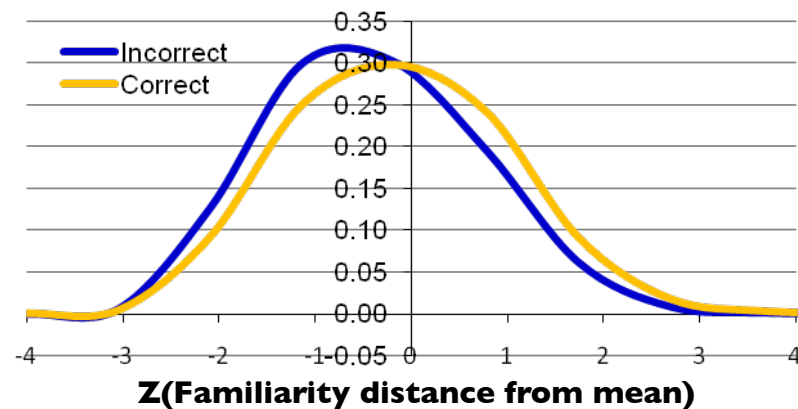
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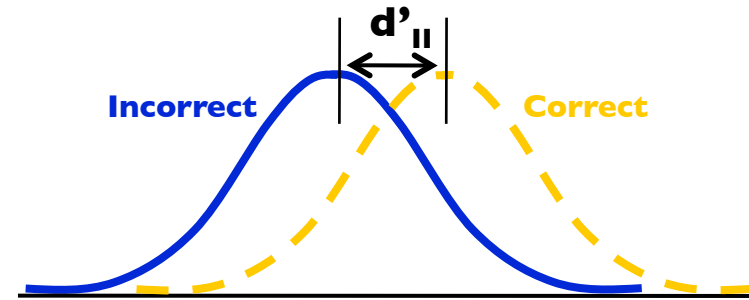
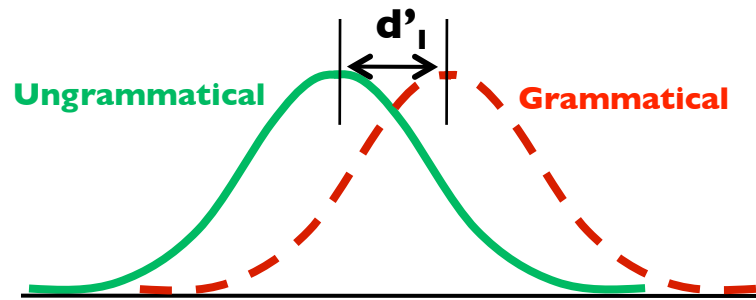


Equivalent distributions assuming symmetrical confidence bounds and mean criterion



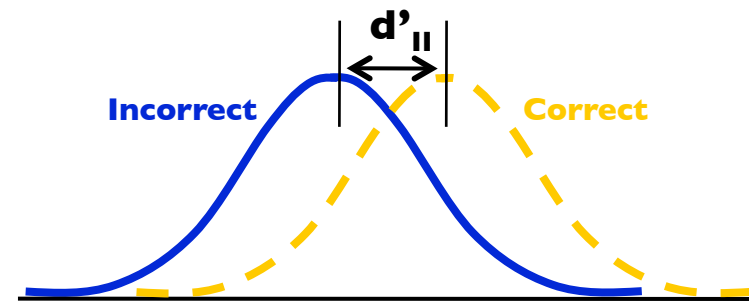
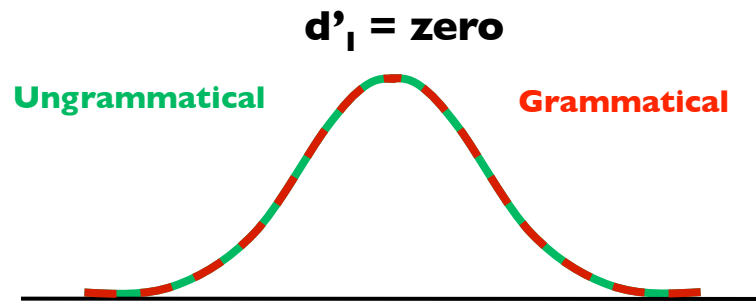
Constraints inherent in the SDT model

I. When type I d-prime is zero type II d-prime must also be zero



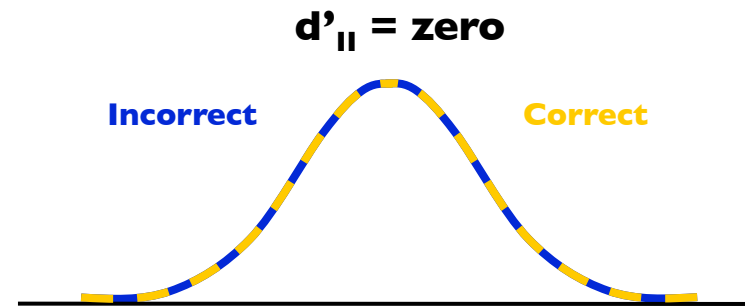
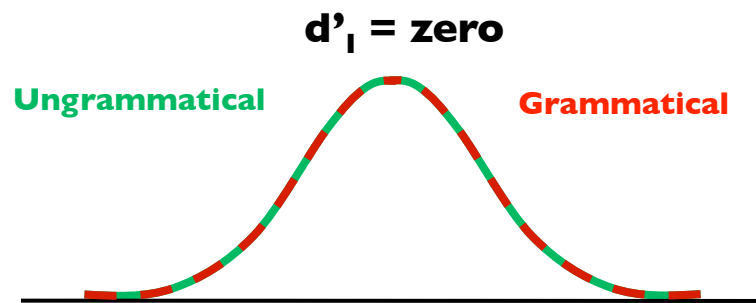
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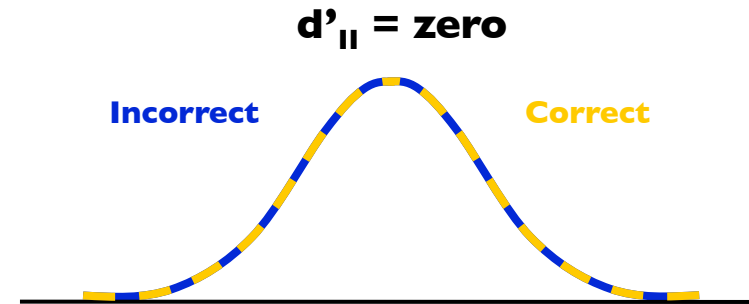
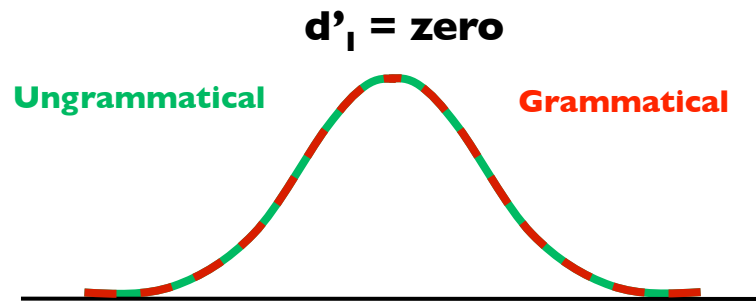
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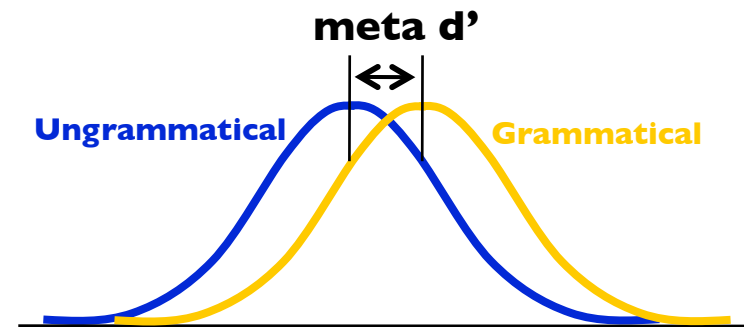
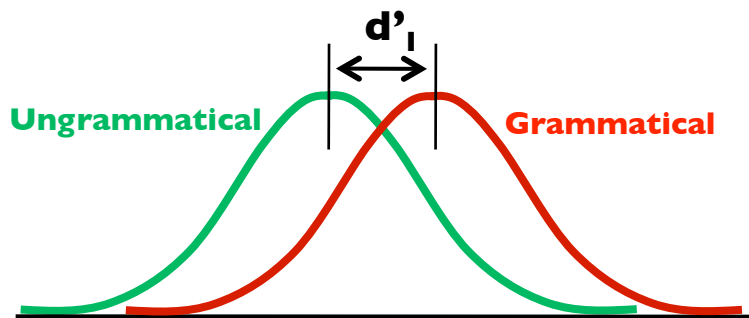


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2. Meta d-prime must always be less than type I d-prime



Evaluating metacognitive accuracy in the absence of decision accuracy

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Data compiled from 8 standard AGL studies (N = 450)

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- Classified each string as grammatical or ungrammatical
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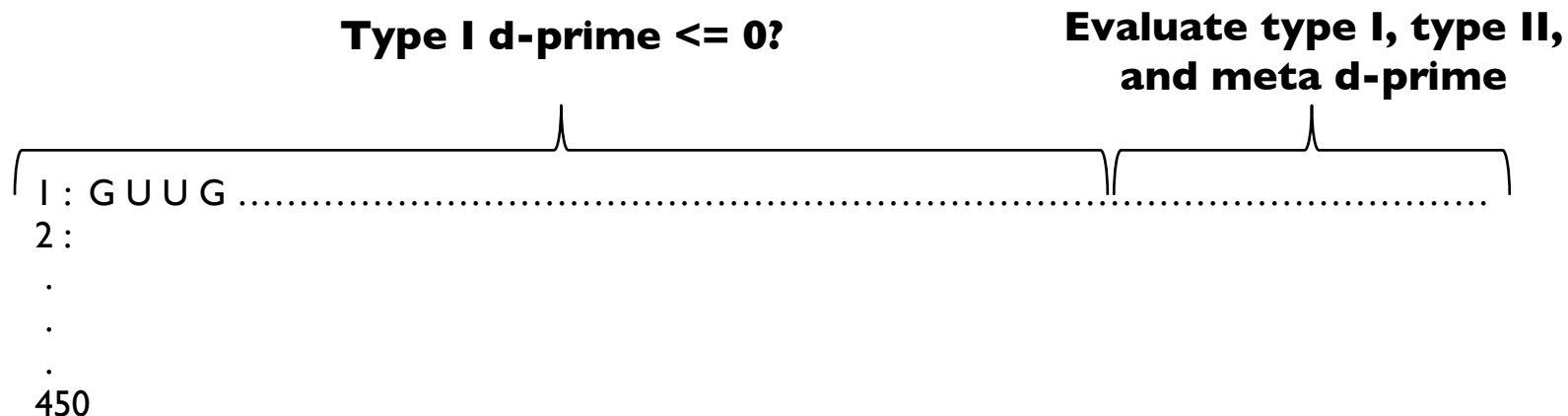
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Selected according to decision accuracy while avoiding bias:

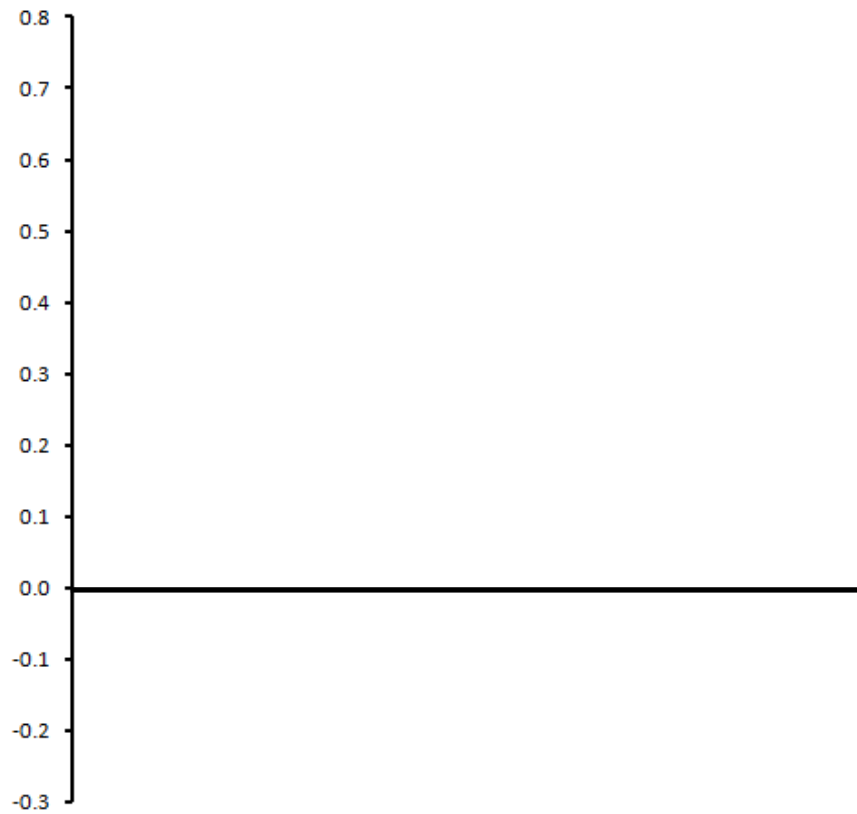
- Categorised based on type I $d' \leq 0$ for the first $\frac{3}{4}$ of responses.
- Conducted analysis on the final $\frac{1}{4}$ of their responses.



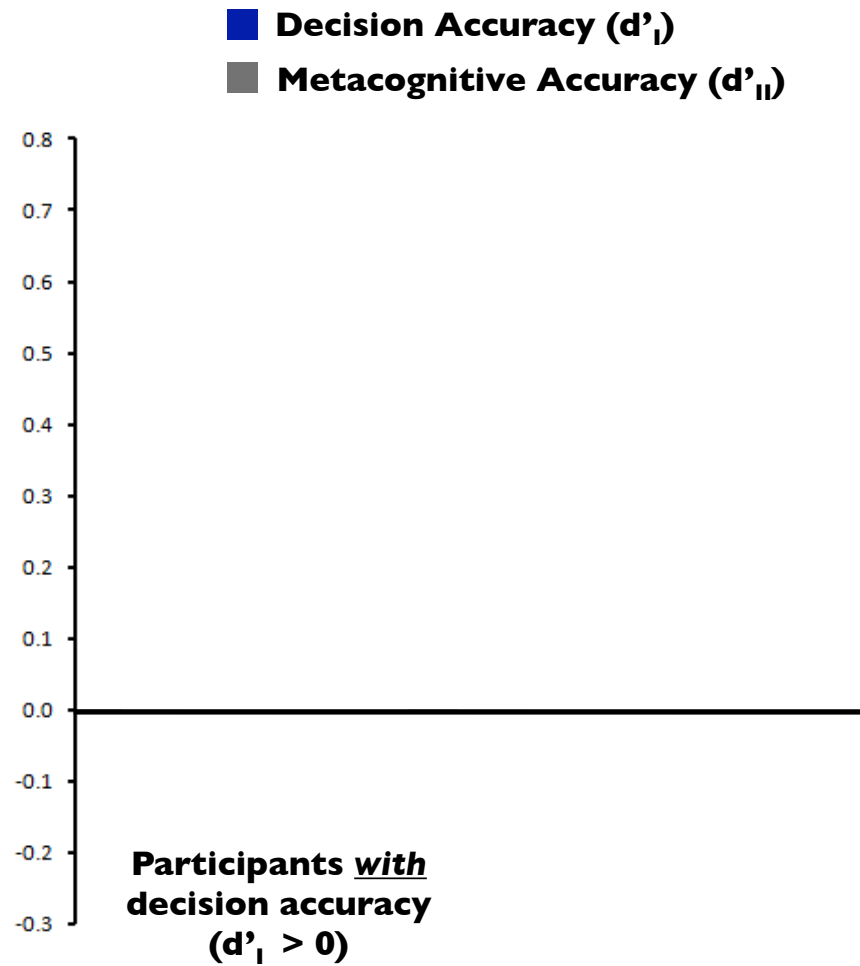
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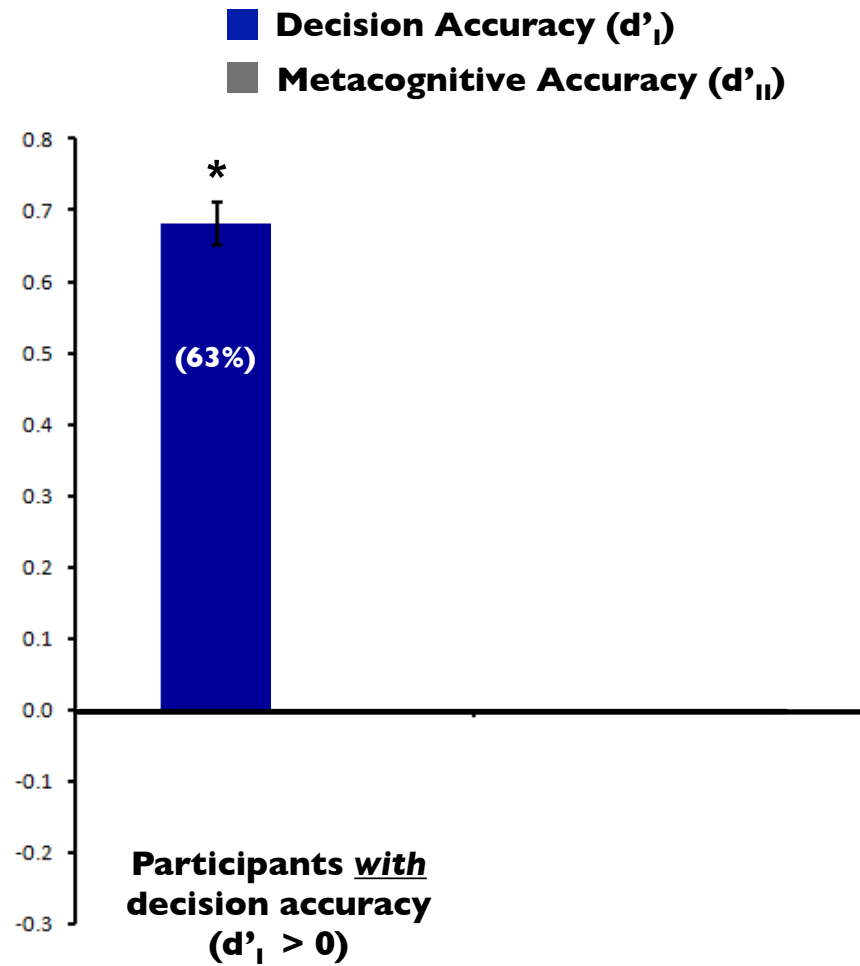
■ **Decision Accuracy (d'_I)**
■ **Metacognitive Accuracy (d'_{II})**



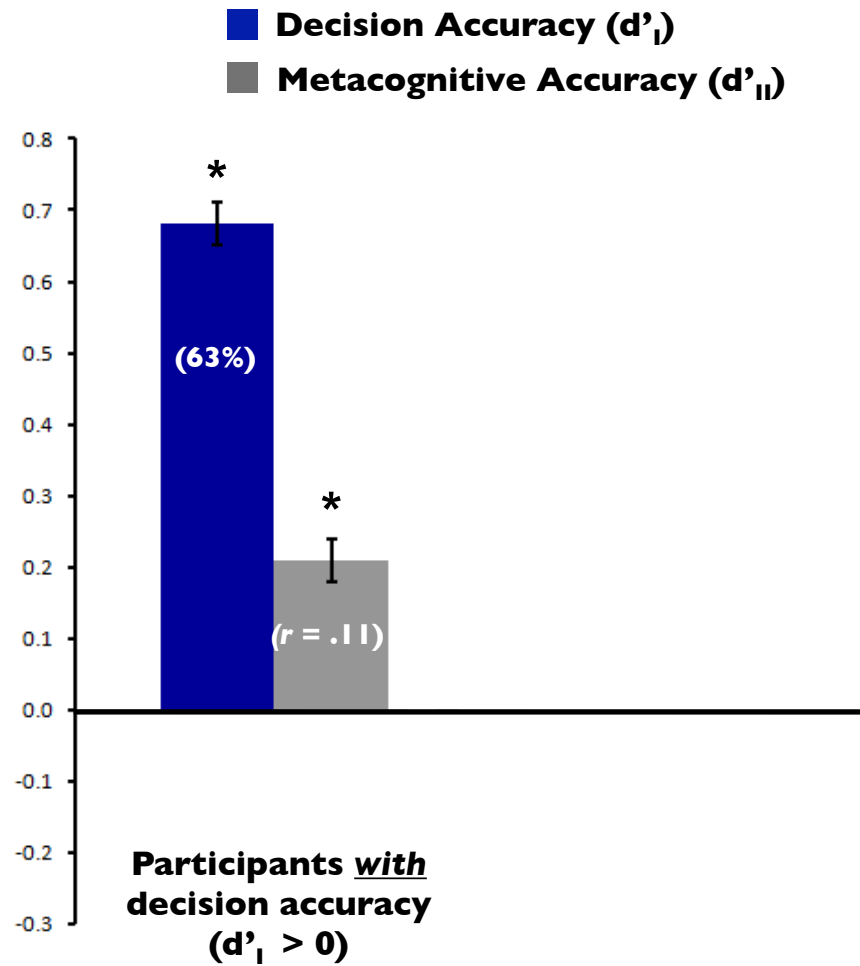
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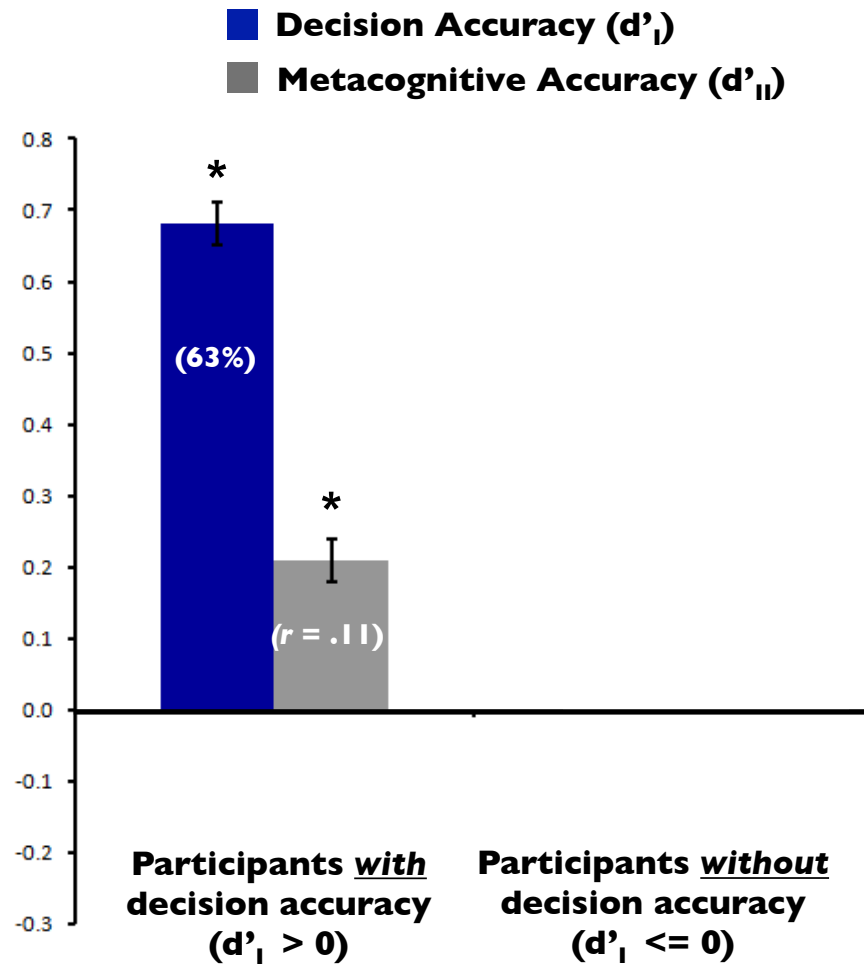
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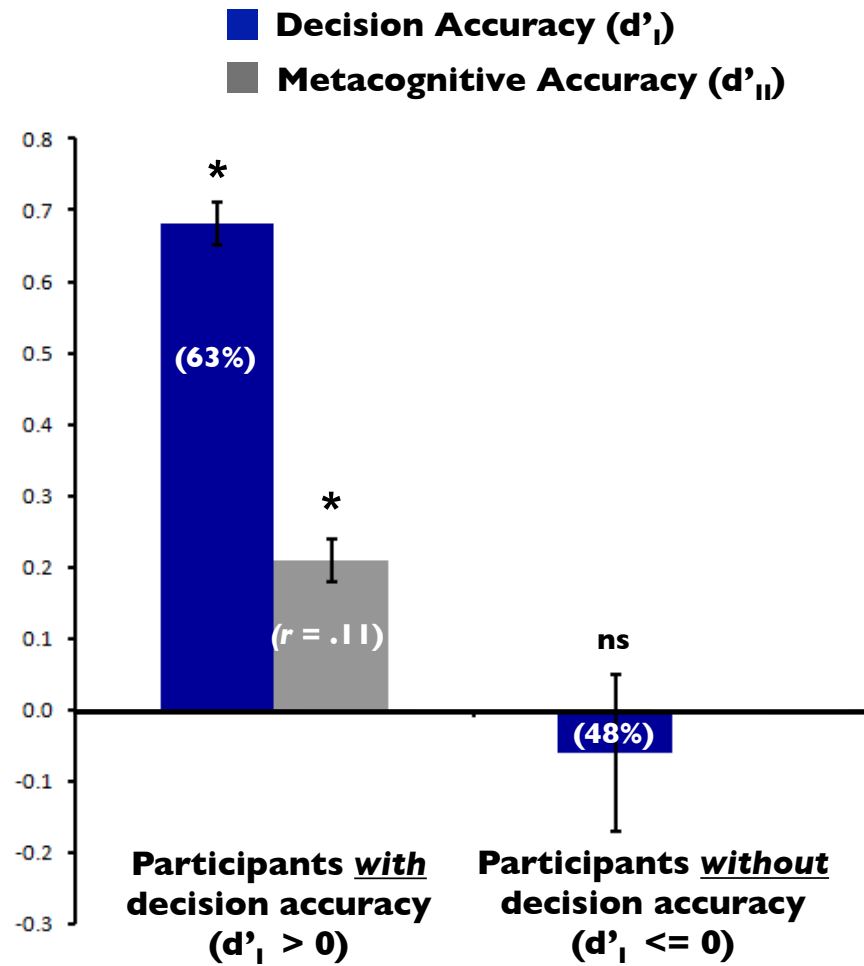
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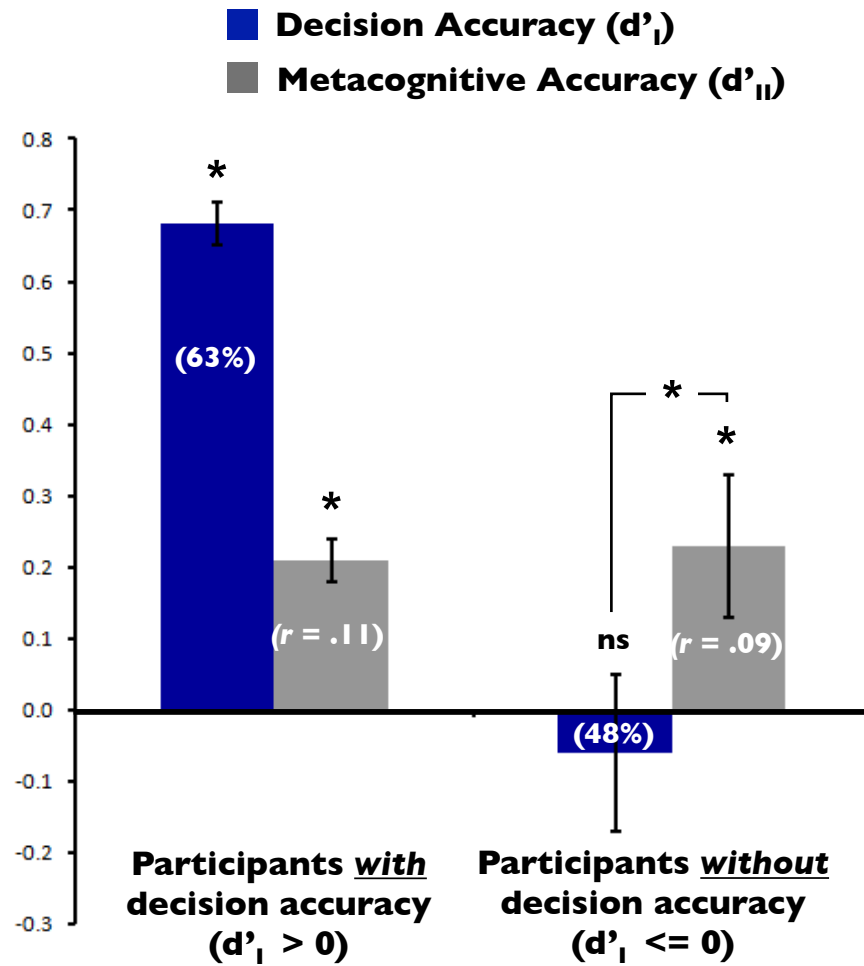
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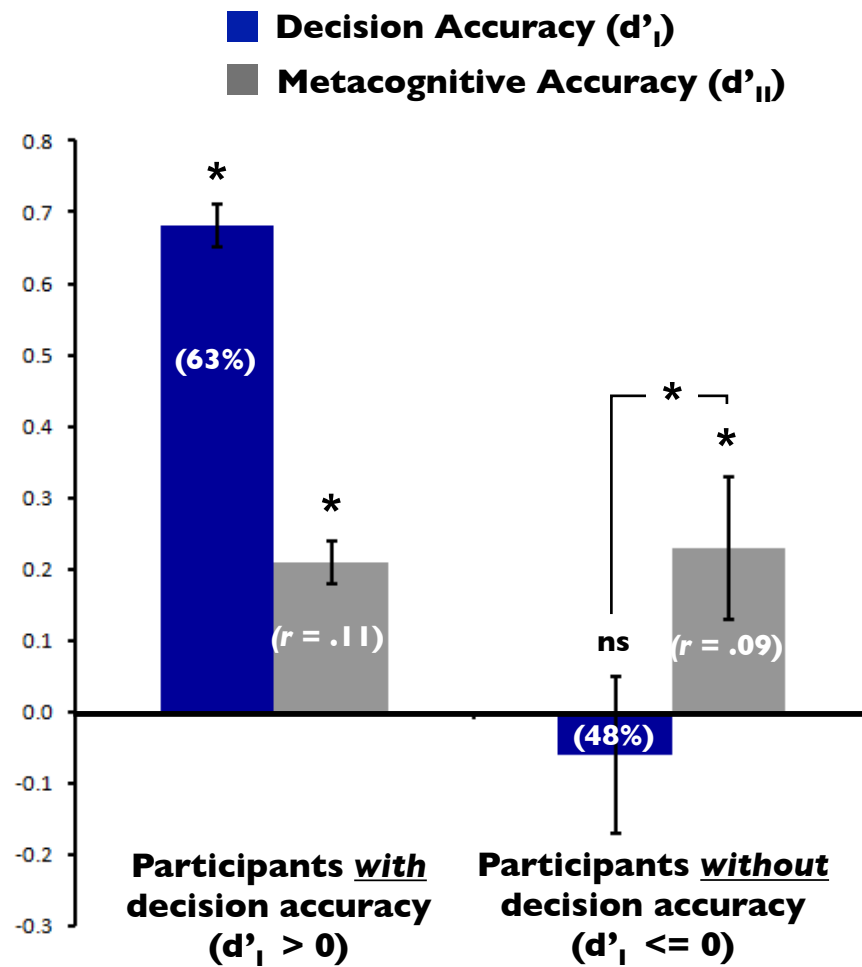
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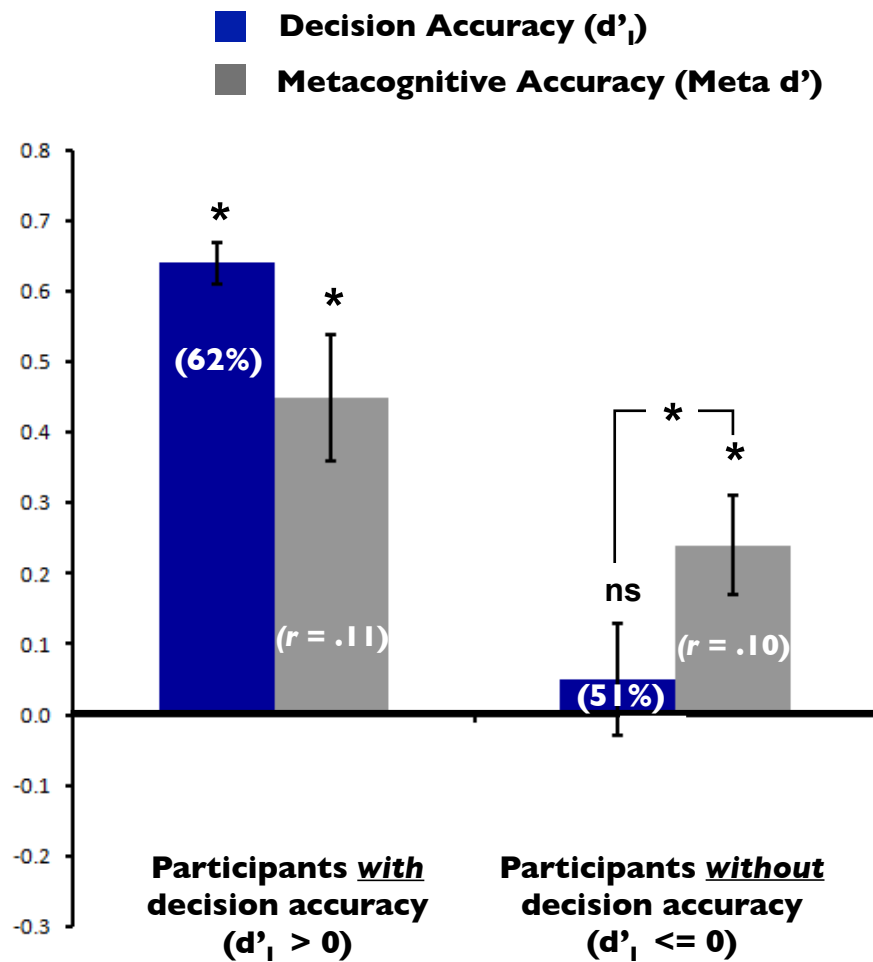
Results: Type II d-prime



Significant metacognitive accuracy in the absence of decision accuracy.

When type I d-prime is not significantly different from zero type II d-prime is significantly greater than zero.

Results: Meta d-prime



In the absence of significant decision accuracy, meta d' is significantly greater than type I d' -prime.

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A purely hierarchical model of metacognition (such as SDT) is inconsistent with this finding.

We must look to models of metacognition that permit the double dissociation between decision accuracy and metacognitive accuracy e.g. Pasquali, Timmermans, and Cleeremans (2010).

Thank you

Collaborators



Zoltan Dienes



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University of Sussex

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