Multi-d′ Model: New Signal-Detection-Theory-Based Framework for Eyewitness Performance in Lineups

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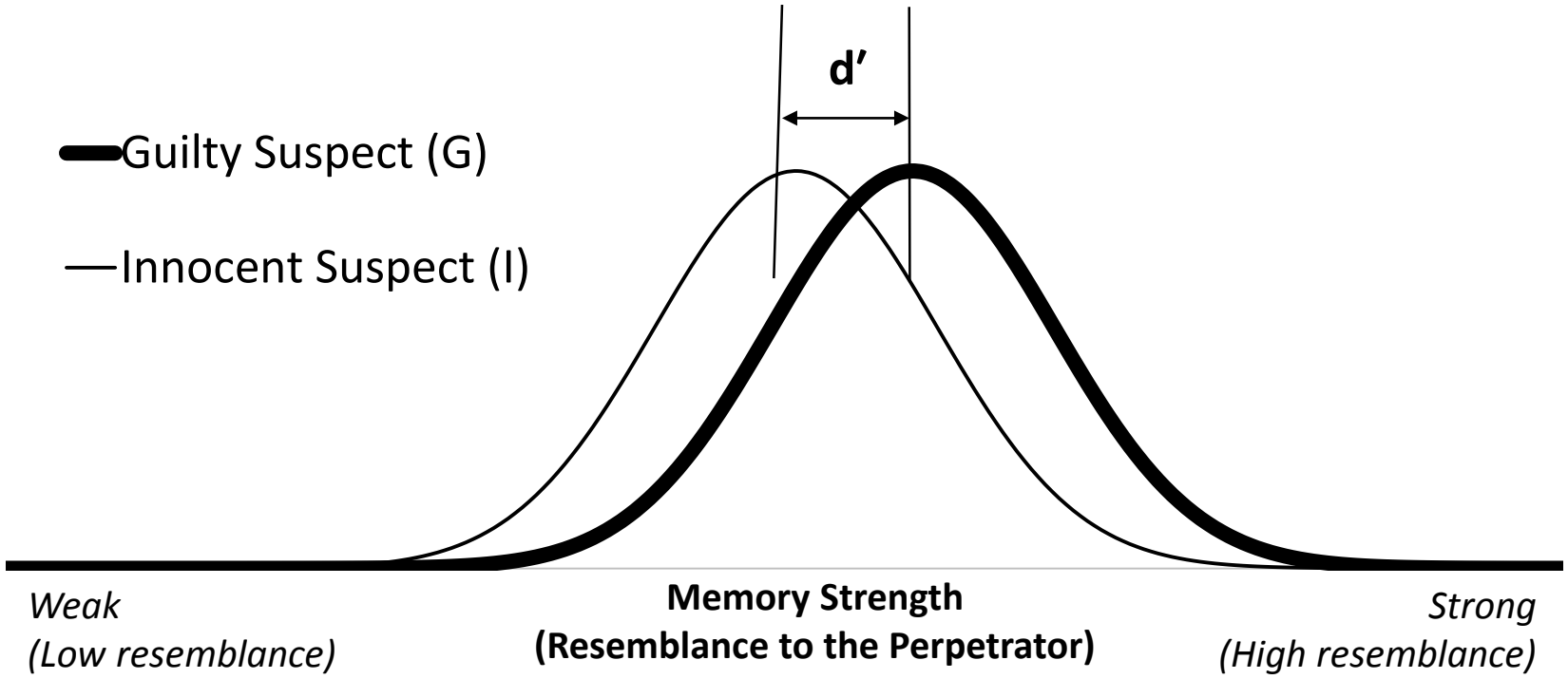
Signal Detection Theory (SDT) in Eyewitness Research

- SDT explains eyewitness performance in tasks which involve the discriminability of a guilty suspect from an innocent suspect
- d′ = z(guilty suspect ID rates) – z(innocent suspect ID rates)
- Empirical discriminability (Wixted & Mickes, 2015b; Wixted & Mickes, 2018)

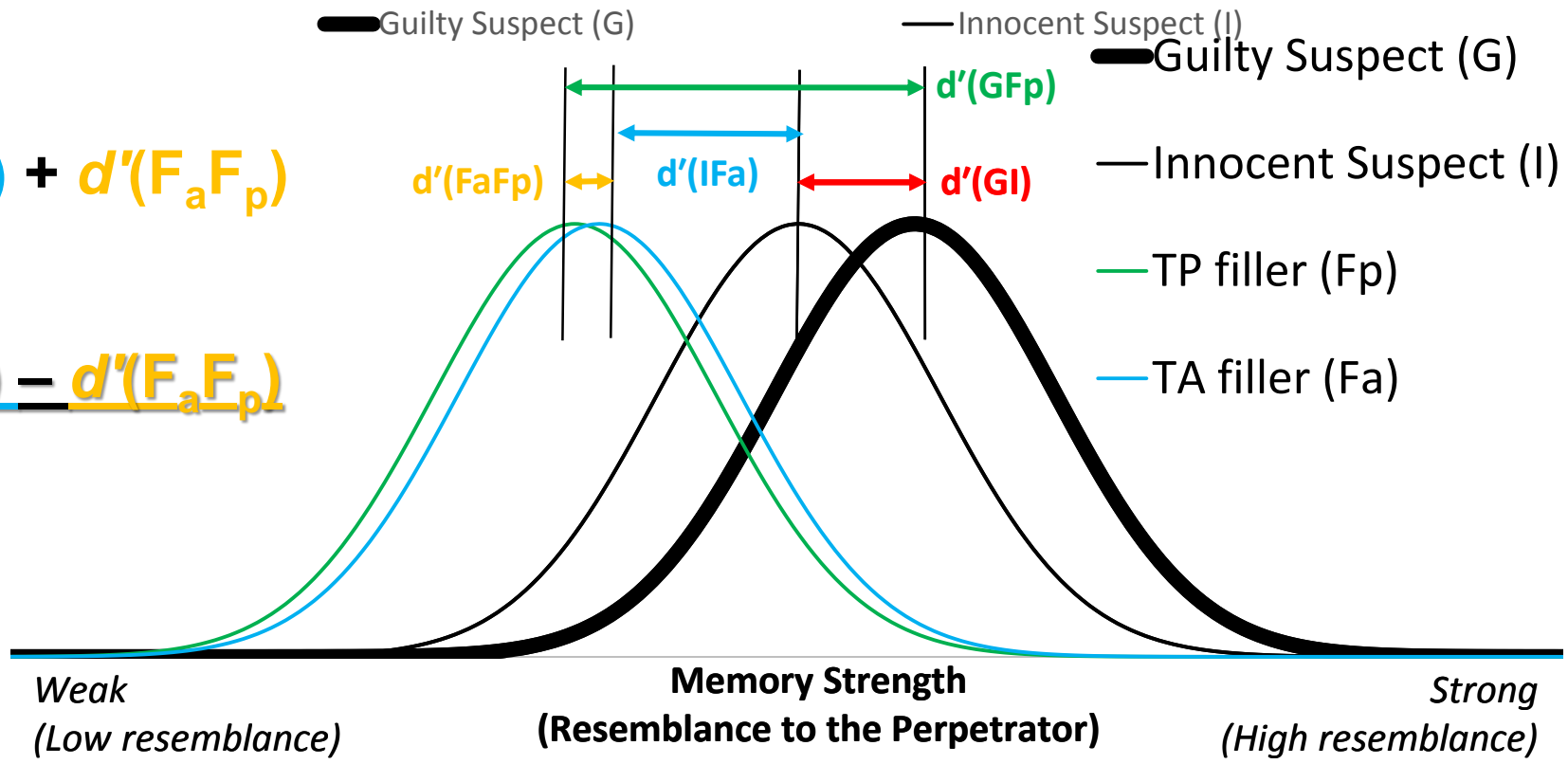


Multiple d′ in Lineups

- **Four different d′ measures emerge by considering the memory-strength distribution of fillers**

$$d'(GF_p) = d'(GI) + d'(IF_a) + d'(F_aF_p)$$

$$d'(GI) = d'(GF_p) - d'(IF_a) - d'(F_aF_p)$$



Theoretical Validation of Multi-d′ Model

- Additivity of d′ (Macmillan & Creelman, 2005)

$d'(GI) = d'(GF_p) - d'(IF_a) - d'(F_aF_p)$

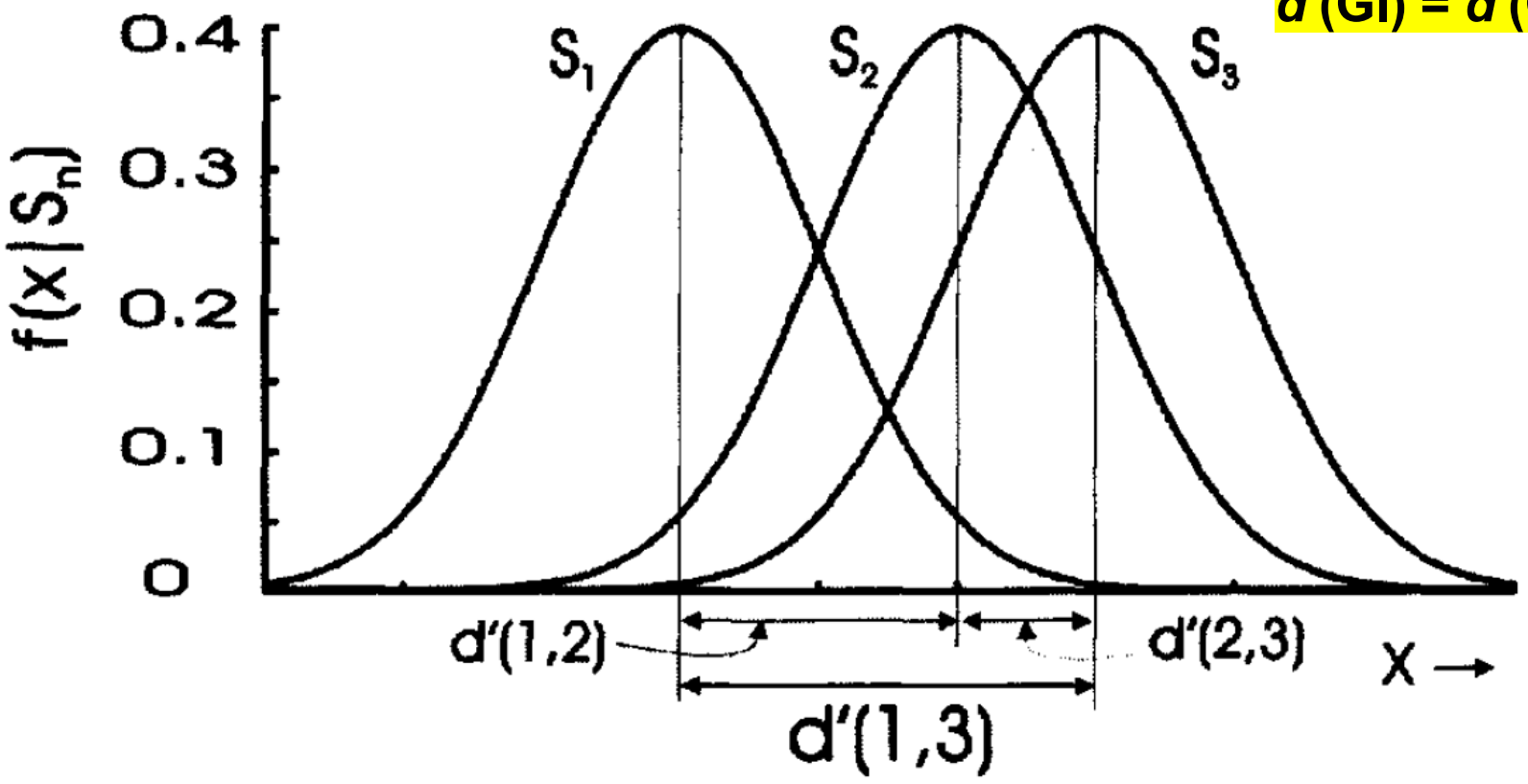


FIG. 5.1. An additivity condition (Eq. 5.1) for perceptual one-dimensionality:
$d'(1,3) = d'(1,2) + d'(2,3)$.

Empirical Validation of Multi-d′ Model

$$d'(GI) = d'(GF_p) - d'(IF_a) - d'(F_aF_p)$$

Study	Lineup Type	G	F_p	R_p	I	F_a	R_a	$d'(GF_p)$	$d'(IF_a)$	$d'(F_aF_p)$	d′(GI)	$d'(GF_p) - d'(IF_a) - d'(F_aF_p)$
Carlson & Carlson (2014)	Simul.	.32	.44	.24	.06	.64	.30	-0.30	-1.87	0.50	1.07	1.07
	Seq.	.25	.55	.20	.07	.69	.24	-0.80	-1.98	0.37	0.81	0.81
Steblay, Dysart & Wells (2011)	Simul.	.52	.25	.24	.28	.26	.46	.73	.06	.03	.64	.64
	Seq.	.44	.19	.39	.15	.17	.68	.73	-.08	-.08	.89	.89

Application of Multi-d′ model to Show-ups vs. Lineups

- Duncan's signal detection model of compound decision tasks (SDT-CD, 2005)
  - ✓eyewitnesses viewing lineups discriminate a perpetrator from fillers (**identification decision**) in the context of uncertainty regarding the presence of the perpetrator (**detection decision**)

- **Identification-discriminability** comprises $d'(GF_p)$, $d'(IF_a)$, & $d'(F_aF_p)$

- **Detection-discriminability** is quantified by the imbalance of rejection rates between TP and TA lineups.
  - ✓z(Rejection rates in TA lineups) – z(Rejection rates in TP lineups) = $d'(R_aR_p)$

Application of Multi-d′ model to Show-ups vs. Lineups

	Show-up		lineups	
	TP	TA	TP	TA
Suspect ID	.47	.23	.45	.17
Filler ID	NA	NA	.24	.26
Rejection	.53	.77	.31	.57
d′(GI)	0.66		0.83	
d′(GF_p)	NA		0.58	
d′(IF_a)	NA		-0.31	
d′(F_aF_p)	NA		0.06	
d′(R_aR_p)	0.66		0.67	

Identification

Detection

Differential Filler Siphoning Effect

(Smith et al., 2017; Wells, Smalarz, & Smith, 2015; Wells, Smith, & Smalarz, 2015)

$$d'(GI) = d'(GF_p) - d'(IF_a) - d'(F_aF_p)$$

Note. The data of Table 1 in Steblay, Dysart, Fulero, & Lindsay's meta-analysis (2003) was used.

For more details…

- Lee, J., & Penrod, S. D. (in press). New Signal-Detection-Theory-Based Framework for Eyewitness Performance in Lineups. *Law and Human Behavior*. doi: http://dx.doi.org/10.1037/lhb0000343

- Contents
  - Multiple d′ Measures in prior eyewitness studies
  - Relationships among Multiple d′ Measures
  - Application of the Multi-d′ Model to Eyewitness Research
    - Lineup Bias
    - Filler Selection Methods (match-to-suspect vs. match-to-description)
    - Eyewitness Confidence
    - Lineup Presentation Mode (simultaneous vs. sequential)

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