Multinomial Processing Trees

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One-High-Threshold Model

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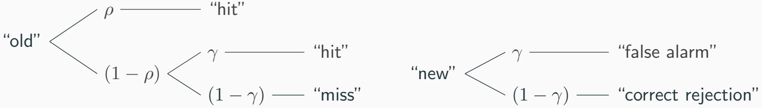
The tree representation shows the "flow" of the process



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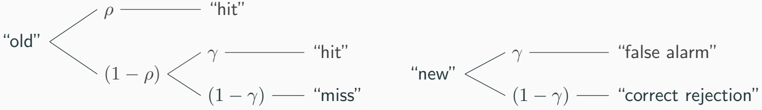

The parameters ρ and γ together determine the hit rate θ^{h} and false alarm rate θ^{f}

$$\begin{aligned} \theta^{\mathrm{h}} &= \rho + (1-\rho)\,\gamma \\ \theta^{\mathrm{f}} &= \gamma \end{aligned}$$

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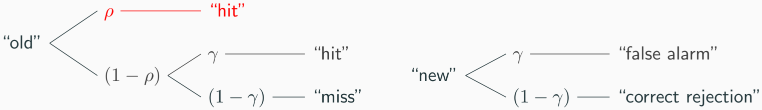

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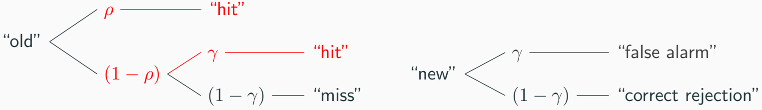

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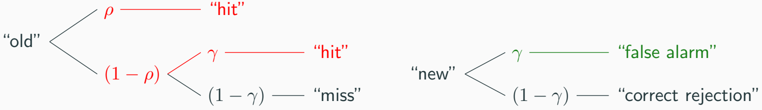

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We consider only the white and black face primes, and how people make decisons about the tool and gun targets in relation to the stereotype congruency and incongruency

Rivers et al. (2017) Data

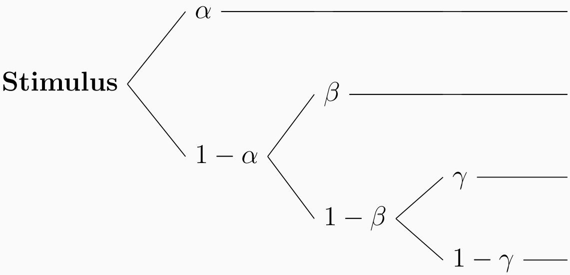
There were 1440 trials for each of the possibilities: white tool, white weapon, black tool, black weapon conditions $\times$ two timing conditions

500ms	White	Black
Tool	885 (61%)	766 (53%)
Weapon	967 (67%)	1074 (75%)

1000ms	White	Black
Tool	1280 (89%)	1229 (85%)
Weapon	1281 (89%)	1288 (89%)

Weapon Priming MPT Model

The “Stroop” model has sequential automatic, control, and guessing processes, controlled by three parameters

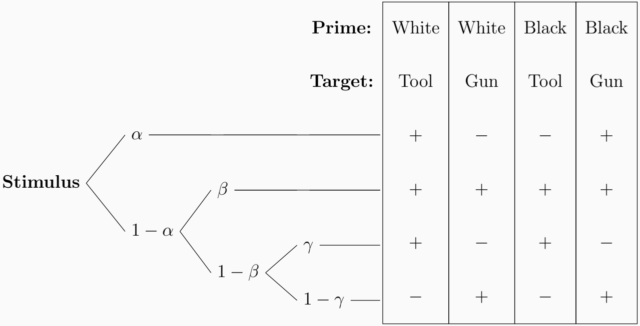


Prime:	White	White	Black	Black
Target:	Tool	Gun	Tool	Gun
α	$+$	$-$	$-$	$+$
β	$+$	$+$	$+$	$+$
γ	$+$	$-$	$+$	$-$
$1-\gamma$	$-$	$+$	$-$	$+$

Weapon Priming MPT Model

The model involves three parameters, one for each process:

- a probability α of an automatic process that answers "tool" for a white face prime and "gun" for a black face prime
- a probability β of a control process that generates the correct answer
- a probability γ of guessing "tool"



Weapon Priming MPT Model

$$
\begin{aligned}
\theta^{wt} &= \alpha + (1-\alpha)\,\beta + (1-\alpha)\,(1-\beta)\,\gamma \\
\theta^{bt} &= (1-\alpha)\,\beta + (1-\alpha)\,(1-\beta)\,\gamma \\
\theta^{wg} &= (1-\alpha)\,\beta + (1-\alpha)\,(1-\beta)\,(1-\gamma) \\
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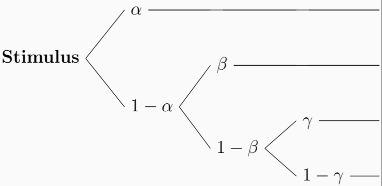

Prime:	White	White	Black	Black
Target:	Tool	Gun	Tool	Gun
α	+	−	−	+
β	+	+	+	+
γ	+	−	+	−
$1-\gamma$	−	+	−	+

Weapon Priming MPT Model

For data that have k^{wt}, k^{bt}, k^{wg} and k^{wg} correct responses out of n total trials, the model assumes that

$$\begin{aligned}
k^{\mathrm{wt}} &\sim \mathrm{binomial}\big(\theta^{\mathrm{wt}}, n\big)\\
k^{\mathrm{bt}} &\sim \mathrm{binomial}\big(\theta^{\mathrm{bt}}, n\big)\\
k^{\mathrm{wg}} &\sim \mathrm{binomial}\big(\theta^{\mathrm{wg}}, n\big)\\
k^{\mathrm{bg}} &\sim \mathrm{binomial}\big(\theta^{\mathrm{bg}}, n\big)
\end{aligned}$$

The model also assumes all automatic and control rates are equally likely, and that guessing "tool" will happen around half the time:

$$\begin{aligned}
\alpha &\sim \mathrm{uniform}\big(0, 1\big)\\
\beta &\sim \mathrm{uniform}\big(0, 1\big)\\
\gamma &\sim \mathrm{beta}\big(3, 3\big)
\end{aligned}$$

Key Points

The weapon-priming model is an example of an MPT model for addressing a social psychology phenomenon

Makes inferences about underlying executive control processes

The analysis of different deadline conditions in the experiment showed different use of automatic versus control processes