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Report

Multinomial process tree models of control and automaticity in weapon misidentification

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ABSTRACT

When primed with a Black face, people are more likely to misidentify a non-weapon as a weapon. Weapon misidentification may hinge on the distinction between controlled and automatic processes. Various relationships between controlled and automatic processes are cast in the form of five multinomial process models, which are illustrated and compared. It is shown that variants of the traditional Process Dissociation model and the Stroop model are nested within the Quad-Model. Across four different studies, various complexity corrected model performance measures converged to support the Process Dissociation account. This account suggests that the automatic association between race and weapons is subordinate to controlled processing. More generally, these results suggest that the weapon-bias might be alleviated without interventions that directly target stereotypes.

Introduction

When determining if a weapon is present, people sometimes falsely claim to have seen a weapon when they have seen only a harmless object and a Black person (Payne, 2001; also see Correll, Park, Judd, & Wittenbrink, 2002; Greenwald, Oakes, & Hoffman, 2003; Lambert, Payne, Ramsey, & Shaffer, 2005). Such split-second errors could be terribly important if the error means pulling a trigger rather than pressing a computer key. The goal of the current research is to compare different process accounts of this error, and specifically, process accounts that can be cast in the form of multinomial process tree models. To this end, first, a set of multinomial models will be illustrated, including Process Dissociation models and the quadruple process model. It will be shown that the models are connected not only conceptually, but also via a specific mathematical relationship (i.e., they are nested). Second, these models will be empirically compared in terms of their ability to account for weapon misidentification data.

Weapon misidentification may hinge on the distinction between controlled processing and automatic accessibility of the stereotype (Payne, 2001). We define controlled processing broadly, as the use of information most applicable to one's current goals or task set. In the case of weapon identification, controlled processing can take the form of discriminating between the perceptual characteristics of gun and non-gun objects, and using this information to respond within a limited amount of time. In contrast, the activation of automatic processes may reflect primed associations that do not necessarily aid the accurate completion of one's goals. In the case of weapon identification, the automatic process of most interest is the stereotypical association between African Americans primes and weapons.

Two decades of research on dual-process theories have established the importance of distinguishing between automatic and controlled influences in social cognition (Chaiken & Trope, 1999). These theories describe distinct processes, but they rarely specify how the processes relate to each other. A "second generation" of research has recently begun doing so (Bargh, 2006). A complete dual-process theory must explain not only when distinct processes are likely to drive behavior, but also how those processes interact. For example, when automatic and controlled responses conflict, how is that conflict resolved?

Some dual-process theories ascribe a relatively dominant role to controlled processing, with automatic processes influencing behavior only to the extent that controlled processing fails (Jacoby, 1991; Payne, 2001). Other theories treat controlled processing as relatively subordinate, as a means to adjust an initial impression or decision that was based on automatic processes (Devine, 1989; Gilbert, Pelham, & Krull, 1988; Kahneman, 2003; for discussion, see Conrey, Sherman, Gawronski, Hugenberg, & Groom, 2005; Jacoby, Kelley, & McElree, 1999).

The relative dominance of controlled and automatic processes may depend on the task at hand. In the weapon identification task, consider three possible relationships between controlled and automatic processes:

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1. Control-Dominating relationship: A non-weapon is misidentified as a weapon only when both controlled processing fails and automatic racial bias occurs.
2. Automaticity-Dominating relationship: A non-weapon is misidentified as a weapon when an automatic racial bias occurs, regardless of controlled processing.
3. Probabilistic relationship: If both controlled processing succeeds and the automatic influence occurs on the same trial, the resulting conflict will be resolved probabilistically.

Note that these three possible relationships only refer to how conflict is resolved between control and automaticity. For example, even if the Control-Dominating relationship were true, it would still be possible for automaticity to play an important role in determining behavior. Automatic processes would still be relied upon to make decisions so long as controlled processes failed. Thus, the relationship between controlled and automatic processes may be very difficult to intuit a priori for any given task or situation. Whether the relationship takes one form or another is an empirical question that can be addressed via mathematical modeling.

Multinomial process tree models

The possible relationships between control and automaticity can be cast as multinomial process tree models. Multinomial models allow researchers to test theories of underlying processes in a way that traditional approaches like ANOVA cannot (Riefer & Batchelder, 1988). One reason for this is that multinomial models can have more than one process pathway or branch leading to the same response. To illustrate, consider a case where a person correctly identifies a gun after being primed with a Black face. According to the Process Dissociation model, there are two process pathways that can lead to this event. In the first pathway, control constrains processing to relevant perceptual characteristics of the gun, thereby leading to a correct gun response. In the second pathway controlled processing fails, but the gun response is still given because of the automatic influence of the prime. Multinomial models can help disentangle underlying processes in such situations (for a review, see Batchelder & Riefer, 1999).

In multinomial models, each parameter ranges from 0 to 1 and represents the probability with which a process occurs. The top panel of Fig. 1 shows the processes in the traditional Process Dissociation Model (Jacoby, 1991; Payne, 2001). In that model, when controlled processing succeeds with probability C, a correct response (+) is given in all conditions. When controlled processing fails with probability $(1 - C)$, the automatic influence of the prime determines the response. When the automatic influence is stereotype-consistent with probability A, the response is correct for the White-tool and Black-gun conditions, but incorrect (−) for the other conditions. With probability $(1 - A)$, the response is counter-stereotypical, with a tool response following Black primes and a gun response following White primes. Note that the A parameter is irrelevant whenever controlled processing succeeds. Thus, even though the automatic process operates faster, controlled processing dominates automaticity in the Process Dissociation model (see Payne, 2001, 2005; Payne, Lambert, & Jacoby, 2002, for evidence that C and A parameters represent controlled and automatic processes, respectively; for related evidence, see Klauer & Voss, 2008).

By contrast, in the bottom panel of Fig. 1, automaticity dominates controlled processing. We refer to this as the "Stroop model" because it is based on a model developed for the Stroop task (Lindsay & Jacoby, 1994), a task where the relatively automatic, unintended process of word-reading can dominate the intended process of color-naming. In the Stroop model, if the prime has an automatic influence, a stereotypic response is given, and this occurs regardless of the status of controlled processing. Only when an automatic influence does not occur (with probability $1 - A$) does controlled processing matter. Thus, Process Dissociation and Stroop models represent the Control-Dominating and Automaticity-Dominating relationships, respectively.

The third possible relationship can be represented by the Quad-Model (Conrey et al., 2005). The original depiction of the Quad-Model is shown in Fig. 2. Parameter AC is analogous to parameter

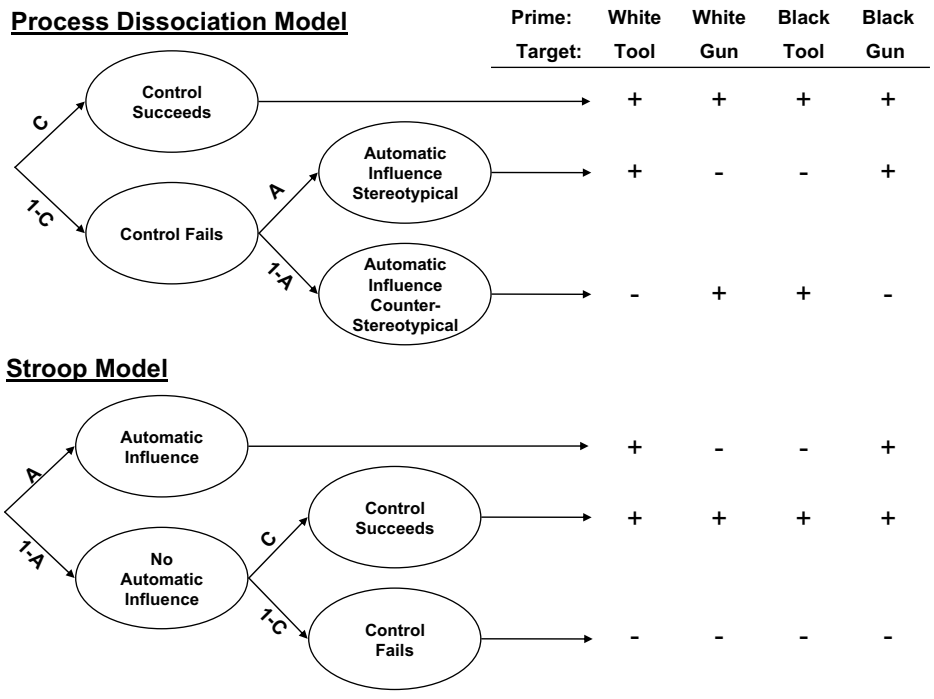

Fig. 1. The Process Dissociation (top) and Stroop (bottom) multinomial models. Branches lead to correct (+) and incorrect (−) responses.