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Burdens of non-conformity: Motor execution reveals cognitive conflict during deliberate rule violations

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ABSTRACT

Rule compliance is pivotal for the regulation of social behavior. Still, humans deliberately violate rules at times – be it for personal reasons or for a higher good. Whereas previous research has studied the preconditions and consequences of rule violations, essentially nothing is known about the cognitive processes right at the moment a rule violation takes place. Here we show that merely labeling an action as rule violation induces substantial conflict between rule violation and compliance, as revealed by participants' bias towards rule-complying motor actions. Moreover, conflict that comes with violating a rule was much stronger than conflict that comes with following an alternative rule, even if both decisions result in the same observable behavior. These observations open a new theoretical perspective on rule violation behavior, shifting the focus toward the cognitive processes operating during the very act of rule violation.

1. Introduction

"I ain't gonna pay no attention to your rules" sings hard-rock legend AC/DC. Violation of social rules is not confined to hard rock musicians, however. It is a common human phenomenon with sometimes positive consequences, as with moral courage, and sometimes negative consequences as with scientific misconduct (Stroebe, Postmes, & Spears, 2012). Whereas behavioral research has delineated situational and organizational determinants of violation behavior (Phipps et al., 2008; Reason, 1990; Yap, Wazlawek, Lucas, Cuddy, & Carney, 2013), very little is known about the consequences of rule violation right at the moment it takes place. The present experiments are a first step in this direction by showing that even simple motor actions differ depending on whether they aim at following or breaking rules.

Because rules generally trigger compliance (Asch, 1956; Cialdini & Goldstein, 2004; Deutsch & Gerard, 1955; Ruff, Ugazio, & Fehr, 2013; van de Waal, Borgeaud, & Whiten, 2013; Whiten, Horner, & de Waal, 2005) and obedience to authority (Milgram, 1963, 1974), we hypothesized that rule violation inflicts conflict on the rule breaker who is torn between doing what is normally acknowledged and intentionally doing the opposite. Further support for this hypothesis comes from studies on how rules are represented in the human cognitive system and how their representation shapes an agent's behavior (for an overview, see Bunge & Wallis, 2007). Studies on rule representation often employed controlled stimulus–response (S–R) paradigms to assess how S–R mapping rules are learned and how they are implemented in task sets. A striking result of this line of research is that merely instructing an arbitrary S–R mapping rule will yield automatic response activation upon encountering the associated stimulus (Cohen-Kdoshay & Meiran, 2009; Hommel, 2000; Kunde, Kiesel, & Hoffmann, 2003, 2005; Reisenauer & Dreisbach, 2013; Wenke, Gaschler, & Nattkemper, 2007). Merely instructing a rule thus seems sufficient to automatically retrieve rule-based behavior whenever the agent is in a situation that is relevant to the rule at hand.

While automatic retrieval of rule-based behavior facilitates actions that aim at following the rule, such retrieval obviously hinders any actions that explicitly aim at violating the rule. In this latter case, the agent not only needs to deliberately access the intended action but might also be faced with cognitive conflict (Botvinick, Braver, Barch, Carter, & Cohen, 2001), resulting from the parallel activation of rule-based action plans alongside the intended action (Pfister, 2013).

To reveal such cognitive conflict, we designed a mouse-tracking paradigm in which participants moved a cursor toward a left or right target position according to an S–R mapping rule. Crucially,

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they obeyed the mapping rule in some trials but they violated it on occasion. To isolate the effects of labeling a certain behavior as rule violation from further processes that might accompany rule violation behavior, we ensured that the task did not involve any sanctions or otherwise negative consequences. We opted for analyzing movement trajectories of the mouse cursor to assess the impact of the task rule, because such trajectories offer a unique measure of bias towards specific response options (e.g., Freeman & Ambady, 2009, 2011; McKinstry, Dale, & Spivey, 2008; Pfister, Janczyk, Wirth, Dignath, & Kunde, 2014; Song & Nakayama, 2009). Among others, giving deceptive responses to simple yes/no questions was shown to yield a bias toward the honest response option (Duran, Dale, & McNamara, 2010), and, likewise, trajectories were biased toward tempting response alternatives when probing for self-control conflicts (Dignath, Pfister, Eder, Kiesel, & Kunde, 2014). Furthermore, mouse trajectories have been found to be sensitive to internal representations such as anticipated action consequences (Pfister et al., 2014; Wirth, Pfister, Janczyk, & Kunde, 2015). Spatial characteristics of the performed mouse movements thus appear as a prime measure to assess a possible impact of rule representations during the act of rule violation, and we hypothesized the corresponding trajectories to be attracted toward the rule-based response option. Two experiments provided compelling evidence for a profound impact, both, when participants were able to decide whether to violate or not (Experiment 1), and when violations were prompted externally (Experiment 2).

2. Experiment 1: Choosing to violate

We compared two groups of participants: a violation group and a reversed rule group. Participants of the *violation group* were instructed with one specific S–R mapping rule but were asked to indicate whether or not they wanted to follow the rule before each trial. Participants in the *reversed rule group*, by contrast, received slightly changed instructions: They were presented with two tasks with oppositional mapping rules and they indicated whether they would perform the original task or the task with opposite mapping. Thus, one and the same motor action was labeled as rule violation for the participants of the violation group whereas it was labeled as an equally acceptable behavioral option for the participants of the reversed rule group (see Fig. 1 for a schematic of the experimental design).

To evaluate cognitive conflict during rule violation as compared to using the reversed mapping rule, we analyzed the trajectory of the participants' mouse movements. For these movements, we computed the maximum absolute distance (MAD) between the actual trajectory and a straight line from start- to endpoint of the movement, and the corresponding area under the curve (AUC). Positive values of both, MAD and AUC, indicate that a movement is torn to the competing response alternative, indicating a persisting influence of the original mapping rule during violations (violation group) or the opposite mapping rule for reversed rule responses (reversed rule group).

2.1. Methods

2.1.1. Participants, apparatus, and stimuli

We recruited 20 participants for the violation group (mean age = 20.5 years, 14 female, 2 left-handed) and another 20 participants for the reversed rule group (mean age = 21.4 years, 17 female, 2 left-handed). Handedness was determined by self-report and participants operated a standard computer mouse with their right hand and placed their left hand on the arrow keys of the keyboard.

Stimuli appeared on a 17″ computer monitor at a viewing distance of about 60 cm. Target stimuli were two astrological symbols (Aries vs. Gemini, displayed in 60 pt. MS Gothic font), mapped to a left and a right response, respectively. The S-R mapping was counterbalanced across participants. That is: For one half of the participants, the Aries symbol prompted a movement to the left target area whereas the Gemini symbol prompted a movement to right target area; for the other half of the participants, the Gemini symbol prompted a movement to the left target area whereas the Aries symbol prompted a movement to right target area.

2.1.2. Framing and instructions

At the beginning of the session, participants were introduced to the concept of home and target areas and were given time to acquaint themselves with the setup by moving the cursor between the home area and the target areas. When they felt confident to continue, the experimenter pressed the space bar, which made the two possible target stimuli appear simultaneously on the screen. The experimenter then told the participant that the following task would revolve around a rule that mapped the two target stimuli to a left or right response. Participants could terminate this display by moving their cursor to one of the target areas which cleared the screen, followed by the task rule which was displayed in large (40 pt.) font.

During this initial framing, participants in the violation group were informed that the study investigated the impact of rules on behavior and that they were to work according to a single task rule. The experimenter took care to stress the word "rule" and to avoid alternative terms to describe the task such as "stimulus classification" or "categorization". After memorizing the mapping rule, participants were informed that they could choose before every trial whether they wanted to follow the rule or whether they wanted to violate the rule and intentionally commit an error. The experimenter also asked the participants to decide spontaneously between rule following and rule violation without using any specific strategy. To conclude the instructions, a summary screen showed four bullet points that described the experimental procedure, again emphasizing that participants would indicate to either follow the rule or violate it and commit an error by intention.

The instructions of the reversed rule group differed from those of the violation group by framing the study as investigating task performance when working on two different tasks. The instruction screen therefore presented both mappings simultaneously with the labels "Task 1" and "Task 2". Also in contrast to the violation group, participants of the reversed rule group were asked to choose whether to perform Task 1 or Task 2 at the beginning of each trial and to choose spontaneously between these two options. All other aspects of the task were as described for the violation group.

2.1.3. Procedure

Participants completed a training block and 8 experimental blocks of 50 trials each, 25 trials with Aries and 25 trials with Gemini as target stimulus (see Fig. 1 for a schematic of the trial procedure). At the beginning of each trial, participants indicated their current intention ("compliance response"). For the violation group, the corresponding display featured the correct task mapping in the upper half of the screen. The lower half of the screen showed two boxes containing the German words "Korrekt" (*Eng.* correct) and "Fehler" (*Eng.* error), to indicate both options that were available to the participant to choose from. We chose the label "error" instead of "violation" to further stress that this behavior was not in accordance with the still active rule and to avoid misunderstandings in terms of applying the reversed rule. The locations of the correct option and the error option were counterbalanced across participants but constant across trials for each individual. Participants responded whether they would comply to the mapping rule by pressing either the up-key or the down-key on the computer keyboard with their left hand.