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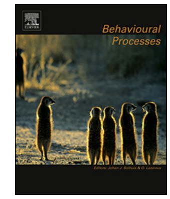

The impact of high versus low levels of derivation for mutually and combinatorially entailed relations on persistent rule-following

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A B S T R A C T

The effects of rules on human behaviour have long been identified as important in the psychological literature. The increasing importance of the dynamics of arbitrarily applicable relational responding (AARR), with regards to rules, has come to be of particular interest within Relational Frame Theory (RFT). One feature of AARR that previous research has suggested may differentially impact persistent rule-following is level of derivation. However, no published research to date has systematically explored this suggestion. Across two experiments, the impact of levels of derivation was examined on persistent rule-following at two stages of relational development: mutual entailment (Exp. 1) and combinatorial entailment (Exp. 2). A Training IRAP was used to establish a mutually entailed relational network in Experiment 1 and a combinatorially entailed network in Experiment 2, and to train these networks to different levels of derivation. This was followed by a contingency switching Match-to-Sample (MTS) task to assess rule persistence. Results from both experiments were generally consistent with the suggestion that lower levels of derivation produce more persistent rule-following. Unexpectedly, however, the findings from Experiment 1 also indicated that persistence was moderated by the type of novel word employed. Variations in results across both experiments and their implications for future research are discussed.

1. Introduction

Within the behaviour-analytic literature, human behaviour has often been distinguished from that of non-humans with respect to two key features – instructional control and derived relational responding. However, recent research has highlighted that studies integrating both of these features (i.e. instructional control and derived relations) has been extremely limited (see Harte et al., 2017; Monestes et al., 2017). Instructional control, also known as rule governed behaviour (RGB), was first suggested by B.F. Skinner (1966) in the context of problem solving. Rules were then defined as stimuli that specified reinforcement contingencies which allowed a listener to solve problems without needing to contact contingencies directly. For example, the simple rule "If the juices don't run clear, put the chicken back in the oven" ensures that the listener can learn to properly roast a chicken without directly experiencing sickness by eating undercooked poultry. The concept of derived stimulus relations was formalised in the behaviour-analytic literature in the early 1970s by Sidman (1971) in the context of developing procedures for teaching basic reading skills to individuals with learning disabilities. The basic finding was that having been taught a limited number of word-referent relations a number of novel untaught relations emerged (see Sidman, 1994, for a book-length treatment).

One of the key findings in the literature on instructional control or RGB is that such behaviour is often associated with lack of sensitivity to scheduled reinforcement contingencies (e.g. Catania et al., 1989). Research on this rule-based insensitivity has examined a wide range of variables that appear to moderate the insensitivity effect, including: the presence or absence of a rule-giver (e.g. Kroger-Costa and Abreu-Rodrigues, 2012); prior experience with following rules (e.g. Martinez-Sanchez and Ribes-Inesta, 1996); instruction accuracy (e.g. Hojo, 2002); and the presence of human psychological suffering (e.g. Baruch et al., 2007; Hayes, 1993; Rosenfarb et al., 1992).

As noted above, the study of RGB, and the associated insensitivity effect, have made little or no connection with the empirical literature on derived stimulus relations. *Conceptually*, however, the link between the two areas has been strong for some decades, particularly within the literature on Relational Frame Theory (RFT, Hayes et al., 2001), which has emerged as one of the main behaviour-analytic treatments of derived stimulus relations. The basic argument is that the pattern of derived relational responding identified by Sidman, and known as stimulus equivalence, constitutes only one class of generalised operant behaviour. According to RFT, there are many such classes, including

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arbitrarily applicable relations of similarity, difference, opposition, comparison and hierarchy (see Hughes and Barnes-Holmes, 2016, for a recent extensive review). The important point here is that both Sidman (1994) and Hayes et al. (see also Hayes, 1989) argued that the human capacity for learning to respond in accordance with derived relations may be critical in understanding how rules or instructions come to specify contingencies of reinforcement. Indeed, Hayes at al. drew heavily on RGB, the insensitivity effect and derived relations in developing behaviour-analytic explanations for human psychological suffering and the treatment of that suffering, largely in the form of Acceptance and Commitment Therapy (ACT, see Hayes et al., 1999, for a book-length treatment).

Some RFT research has suggested that derived relational responding could provide the basis for a technical analysis of instructional control and, indeed, laboratory models of instructional control as derived relational responding have been successfully developed (O'Hora et al., 2004, 2014), thus, bringing together the research in both areas. For example, O'Hora et al. (2014) trained participants to respond through derived instructions by teaching them to respond in accordance with novel networks of derived relations. Specifically, novel images were trained to be functionally equivalent to the words "same", "opposite", "before" and "after", and these stimuli were then used to establish relational networks that controlled sequences of responses using nonsense stimuli that functioned in a broadly similar way to the use of rules in natural language.

Results also demonstrated that responding in accordance with these derived rules was sensitive to differential consequences and direct contingency control. The authors concluded that derived rule-following is a possible source of behaviour control that must be considered in the context of RGB.

More recently, research has begun to extend this line of work and to examine the impact of derived relations on persistent rule-following or contingency-based insensitivity (Harte et al., 2017). Across two experiments, Harte et al. sought to determine the extent to which participants would persist in rule-following when the reinforcement contingencies were reversed, and thus following the rule was no longer rewarded. The main objective in the study was to determine if persistence in rule-following would differ between rules that did or did not require derived relational responding. Specifically, across both experiments participants received either a direct rule or a rule that involved a novel derived relational response, followed by a matching-to-sample (MTS) task. The MTS task initially reinforced behaviour that was consistent with the direct or derived rule, before an un-cued contingency switch in the latter part of the task.

In Experiment 1, all participants received 10 trials in which the direct or derived rules were consistent with the MTS task contingencies before the contingency reversal, followed by 50 trials in which the direct or derived rule no longer matched the contingencies. Experiment 2 partially replicated Experiment 1, but participants were provided with 100 trials (rather than only 10) before the contingency reversal. While there were no significant differences in rule persistence between conditions in Experiment 1, the provision of a direct (rather than derived) rule in Experiment 2 resulted in significantly more persistent rule-following (i.e. only when the opportunity to follow the reinforced rule was relatively protracted). In addition, it was only in the Direct Rule Condition in Experiment 2 that significant correlations were observed between rule compliance and self-reported stress.

One limitation of the Harte et al. (2017) study, which was acknowledged by the authors, was the dichotomy made between direct and derived rule-following. Strictly speaking, for RFT even the direct rule condition involved a certain (low) level of derivation. That is, according to the theory, virtually all behaviours that involve human language and cognition, by definition, comprise some level of derivation in the sense that they are *derived* from a history of arbitrarily applicable relational responding (see Barnes-Holmes et al., 2017, for a detailed discussion). From this perspective, the direct rule did not require a novel derivation within the experiment, but the ability to follow the rule was based on a (distant) history of deriving. In contrast, the derived rule condition involved that distant history, but also required a novel derivation.

The primary purpose of the current study was to determine if levels of derivation (high versus low) within the experiment, rather than relying upon the dichotomy between direct and derived rules employed by Harte et al., would produce differences in persistent rule-following, as observed in the original study. That is, would a condition that involved low levels of derivation produce more persistent rule-following than a condition that involved high levels of derivation? The study also sought to examine the impact of high versus low levels of derivation in terms of mutually versus combinatorially entailed relations. Specifically, Experiment 1 involved deriving a relation between two directly related stimuli (mutual entailment), whereas Experiment 2 involved deriving a relation between two indirectly related stimuli (combinatorial entailment). A range of self-report measures of psychological suffering were used to explore the extent to which derived rule-following may correlate with self-reported levels of distress in the general population. Finally, the current research differed from that of Harte et al. (2017) in that a Training version of the Implicit Relational Assessment Procedure (IRAP) was employed here to establish the mutually and combinatorially entailed relations. The primary reason for using the Training IRAP was based on pilot research, which indicated procedural problems in using the original software to manipulate levels of derivation within the experiment. Given the exploratory and relatively inductive nature of the current research, we refrained from making formal predictions.

2. Experiment 1

2.1. Method

2.1.1. Participants

A total of 88 individuals participated in Experiment 1, 62 females and 26 males. They ranged in age from 18 to 38 years old ($M = 22.36$, $SD = 4.12$) and were recruited through random convenience sampling from the online participant system at Ghent University. All participants were Caucasian with Dutch as their first language and were paid 10 euros for participation. All were randomly assigned to one of two conditions, referred to as Low versus High Derivation. The data from 28 participants (17 from the Low Derivation Condition and 11 from the High Derivation Condition) were excluded because they failed to meet specific criteria on either the Training IRAP or the MTS task (see below), leaving $N = 60$ for analysis, 30 in the Low Derivation Condition and 30 in the High Derivation Condition. Initially, we planned to collect data from just 30 participants in each condition, but an unexpected trend towards a significant interaction effect with a procedural variable emerged with this number of participants (details provided below). At this point, it was decided to run a set number of additional participants to determine if the trend continued to significance.

2.1.2. Setting

The experiment was conducted in an experimental cubicle at Ghent University in which participants were seated in front of a standard Dell laptop. The experimenter was present at the beginning of each task to instruct participants, and also while participants completed the Familiarisation Blocks of the Training IRAP (see Section 2.1.4.2.1 below). Participants were alone while completing all other tasks in the experiment.

2.1.3. Materials and apparatus

Experiment 1 involved two computer-based tasks (a Training IRAP and an MTS task) and four self-report measures. All participants completed all aspects of the experiment on a standard Dell personal