Analysis of apparent demonstrations of responding in accordance with relational frames of sameness and opposition by Alonso-Alvarez and Perez-Gonzalez (2018): A rejoinder

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Alonso-Alvarez and Perez-Gonzalez (2018) describe two experiments on contextual control over derived relational responding (DRR), designed to investigate derived sameness and opposition relations as described within Relational Frame Theory (RFT; Dymond & Roche, 2013; Hayes, Barnes-Holmes & Roche, 2001). They argue that the outcomes of their experiments suggest that all previous empirical demonstrations of derived sameness and opposition might be explained more parsimoniously in terms of stimulus equivalence and exclusion. In what follows, we address limitations in the authors' analysis and offer a rejoinder to their thesis.

Their argument is first presented in a prior study by Alonso-Alvarez and Perez-Gonzalez (2017). In RFT-inspired studies into derived same and opposite relations, two arbitrary stimuli (hereafter denoted SAME and OPPOSITE, respectively) are first pretrained as cues for nonarbitrary same and opposite responding (e.g., Dymond, Roche, Forsyth, Whelan & Rhoden, 2007, 2008; Whelan & Barnes-Holmes, 2004). This procedure continues until participants select comparisons identical to the samples given SAME, and comparisons the most physically dissimilar from the samples given OPPOSITE, in unreinforced testing. Then, the participants are trained to form arbitrary stimulus relations in the presence of those cues (e.g., SAME-A1B1, SAME-A1C1, OPPOSITE-A1B2, OPPOSITE-A1C2) and tested for derived relations (e.g., SAME-B1C1, SAME-B2C2, OPPOSITE-B1C2, OPPOSITE-B2C1). In the case of the examples just given, correct responding would be taken as evidence for derivation of combinatorially entailed relations of same and

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opposite. B1 and C1 should be responded to as the same, as both are the same as A1. B2 and C2 should be derived as the same, as both are opposite to A1 (i.e., combining two opposite relations should yield a same relation). B1 and C2 should be derived as opposites, as should C1 and B2, because both cases involve combining a same and an opposite relation (i.e., which always yields an opposite relation).

Alonso-Alvarez and Perez-Gonzalez (2017) argued that a pattern of responding such as this might instead be explained in terms of equivalence, nonequivalence and exclusion responding. They suggest that "the cue for the selection of comparisons identical to the samples (SAME) could become a cue for selecting comparisons equivalent to the samples" while the "cue for the selection of comparisons the most dissimilar to the samples (OPPOSITE) could become a cue for the exclusion of comparisons equivalent to the samples (i.e., nonequivalent comparisons)" (p. 230). Following this, they argue that training Same-A1B1 and Same-A1C1 could produce the equivalence class A1B1C1, which would explain the choice of C1 given B1 and vice versa, with SAME as cue. In addition, training selection of "B2 and C2 [given] A1 and OPPOSITE would [make] B2 and C2 nonequivalent to A1". Further, because "B1 and C1 would be equivalent to A1, then B2 and C2 would also be nonequivalent to B1 and C1. Thus participants would [select] C1 [given] B2 and OPPOSITE because C1 and B2 [are] nonequivalent." Likewise, they would select C2 given B1 and OPPOSITE because C2 and B1 are equivalent. Finally, they would select "C2 given B2 and SAME by the exclusion of C1. If C1 and B2 [are] nonequivalent, then C1 could not [be] the correct choice [given] B2 and a cue for equivalence (SAME). Thus, participants [exclude] C1 and [select] C2" (p.231). They

argue that this latter explanation is not undermined by the presence of a third comparison in testing, because in the RFT procedure that they critique, this comparison also appears in training, and its selection is never reinforced during this stage. Hence, they argue, participants might automatically exclude it during testing.

To back up their thesis, Alonso-Alvarez and Perez-Gonzalez (2017) first trained college students to respond in accordance with conditional discriminations. Next, they trained them to maintain this pattern given arbitrary stimulus X1, and to reverse it given arbitrary stimulus X2. Subsequently, they showed that X1 and X2 appeared to control derived stimulus relations analogous to those controlled by Same and Opposite cues in RFT experiments, such as those cited above. They argued that this could be explained by at least two hypotheses: that X1 and X2 were cues for equivalence and nonequivalence and responding by exclusion, or that they functioned as cues for sameness and opposition.

Alonso-Alvarez and Perez-Gonzalez (2018) extend Alonso-Alvarez and Perez-Gonzalez (2017) in two respects. In Experiment 1, they provide evidence showing that X1 and X2 were functionally similar to Same and Opposite cues in a wider array of tests of same and opposite than used in Alonso-Alvarez and Perez-Gonzalez (2017). In Experiment 2, they aimed to further support the hypothesis that X1 and X2 functioned as cues for equivalence and nonequivalence and responding by exclusion and not as Same and Opposite cues. They used novel participants and established X1 and X2 as per Experiment 1. They then showed that X1 and X2 could control responding explicable in terms of equivalence, nonequivalence and exclusion, but not in terms of Same and Opposite control. Based on their results, they argued that *all* previous data reported as evidence of control by same and opposite cues, can be now interpreted as control by equivalence, nonequivalence and exclusion.

In response, first, we would argue that the Alonso-Alvarez and Perez-Gonzalez (2017, 2018) thesis is incompatible with data generated with research protocols that have not employed their particular methodology. For example, in Steele and Hayes (1991; Experiment 2) participants were given training to

establish Same, Opposite and Different cues, and were subsequently given test probes for all three patterns of DRR. These included three probes in which the sample (C1) and comparison stimuli (B1, B2 and N3) were the same but in which only the contextual cue differed and in which, given SAME, participants chose B1, given DIFFERENT, they chose B2 and given OPPOSITE, they chose N3. This outcome thus exemplified three different patterns of DRR and showed Different and Opposite as two different patterns. Steele and Hayes (1991, p.552) directly addressed the use of the terms 'equivalence and exclusion' as a potential explanation for their data as follows:

> Many of the probe performances can be explained on the basis of equivalence and exclusion. Explaining Experiment 2 strictly in these terms is difficult because three distinct patterns of performance were shown. This seems at least to require an appeal to higher order forms of exclusion, in which stimuli selected by virtue of exclusion in the presence of DIFFERENT were themselves excluded in the presence of OPPOSITE. Such an analysis would be complicated but is surely not impossible. Despite the fact that Alonso-Alvarez and Perez-Gonzalez reference the Steele and Hayes (1991) paper, they make no mention of this important aspect of Experiment 2.

Other more recent studies focusing on transformation of functions through same and opposite relations have also produced data that cannot be explained in terms of equivalence, nonequivalence and exclusion. Stewart et al. (2015) first trained and tested participants such that discriminative functions of selecting along an auditory nonarbitrary dimension (i.e., selecting a button producing one, two, or three electronic 'peals') were established in a small number of textual stimuli B2, X1 and X2. Participants were then trained and tested for derived relations in accordance with same and opposite between B2, X1 and X2 and several novel stimuli. Findings showed that stimuli derived as the same as B2 (conditioned with one peal) always acquired the nonarbitrary property of one peal (i.e., the same property) while stimuli derived as being opposite to B2 always acquired the property of three peals

(i.e., as different as possible in this context from one peal) rather than randomly acquiring properties of either two or three peals (either of which is different from one peal). This outcome can only be explained in terms of participants responding in accordance with opposition rather than distinction. As another example, Perez, de Almeida and de Rose (2015) established a relational network in which stimuli C1 and C2 were, respectively, similar and opposite to the facial expression of happiness (A1). Using the Implicit Relational Assessment Procedure (IRAP), they showed that C2, opposite to happiness, was similar/equivalent to a sad expression (confirmed using an explicit "happy-sad" scale). This transformation of function, in which the opposite of a happy expression became similar to a sad expression, could not be explained by contextual control over equivalence and exclusion but suggests that C2 and A1 were related by opposition.

Apart from this, several previous studies have either established or strengthened opposition relational responding as an operant response in young children (e.g., Barnes-Holmes, Barnes-Holmes & Smeets, 2004; Cassidy, Roche & Hayes, 2011; Hayes & Stewart, 2016). These trained performances are always characterized by a pattern in which the combination of an even number of opposition relations results in a derived sameness relation while the combination of an odd number of opposition relations results in a derived opposition relation. This is a pattern that differs from both sameness and difference and that can be established without any reference to exclusion relations. The fact that such a pattern can be established under contextual control of a cue such as the word 'opposite' is evidence of the RFT argument that opposition relations are an operant repertoire. Furthermore, the idea that this and other relational repertoires are important parts of the human verbal repertoire is further bolstered by a more recent series of studies which have shown the potential intellectual benefit in children of establishing and strengthening such relations. Cassidy, et al. (2011) were the first to show that training multiple stimulus relations including same, opposite, more and less could significantly boost intellectual skills in children and substantially beyond the level facilitated by training equivalence relations alone. A more recent study (Colbert, Tyndall, Roche & Cassidy, 2018) has provided evidence of the efficacy of training same and opposite relations in particular by showing that completion of the same and

opposite portion of the training protocol conferred almost as much intellectual benefit as completion of the protocol as a whole.

The studies described all employ methodologies that go beyond the approach discussed by Alonso-Alvarez and Perez-Gonzalez (2018) and demonstrate that a wider survey of the literature undermines their general thesis. Even without going beyond the research protocol on which they focus, however, substantial arguments can still be made that tend to undermine their claim. Alonso-Alvarez and Perez-Gonzalez argue (based on Experiment 1) that their conditional discriminative training can establish stimuli with identical functions to those seen following nonarbitrary relational training as used in RFT studies. Furthermore, they argue (based on Experiment 2) that the function of these stimuli is equivalence and nonequivalence (distinction) rather than same and opposite. Several counterarguments may be made here. First, as mentioned, one of the key arguments underpinning the Alonso-Alvarez and Perez-Gonzalez thesis is that some comparison stimuli that appear in tests of same and opposite would be automatically excluded by the participant because they had previously appeared in training and choosing these stimuli had never been reinforced. For example, they argue that "the selection of C2 in the presence of B2, with Same as contextual cue, could be explained by the exclusion of C1, a comparison nonequivalent to B2" (2018, p.214). This argument rests on the untested assumption that participants will automatically reject a third stimulus that also appears in this trial type if it had previously appeared in training and choosing it had never been reinforced. By extension, the same argument could potentially apply to cases involving additional comparisons also. However, the suggestion is not based on empirical evidence.

Another counterargument begins by observing that both conditional discrimination training and RFT-style nonarbitrary relational training are potentially capable of producing derived same and opposite relations. Perhaps the RFT protocol is more likely to do so than the alternative protocol, but this is an empirical matter. In addition, it is also possible that stimuli established using either method could potentially control both same and opposite as well as a pattern more similar to that suggested by Alonso-Alvarez and Perez-Gonzalez (2018) within the same experiment, depending on the training and testing contexts. For example, as discussed, the Alonso-

Alvarez and Perez-Gonzalez training phase may have cued same and opposite responding for at least some participants. However, the researchers deliberately designed particular test trials to rule out the possibility of continuing to respond based on same and opposite. From an RFT point of view, humans have a prolonged history of DRR in which relational coherence is reinforced and incoherence punished (e.g., Wray, Dougher, Hamilton & Guinther, 2012). Thus, people try to respond as coherently as possible within and across contexts. Hence, a participant who had previously responded solely based on same and opposite might now, in the context of these trial-types, attempt to exclude one or more alternatives based on some additional rule (e.g., exclude stimuli the choice of which has never previously been reinforced). This outcome could certainly have happened in the Alonso-Alvarez and Perez-Gonzalez study. However, to more properly test such hypotheses within their methodological approach, further experimentation would be helpful.

In addition to challenging the concept of same and opposite contextual control, Alonso-Alvarez and Perez-Gonzalez (2018) claim that their data might also undermine the RFT argument in favor of multiple stimulus relations more broadly. They argue that if, as they claim, relational responding is never truly under the control of same and opposite cues, perhaps the same might be the case for other forms of nonequivalent relations, such as more/less relations. Notwithstanding the considerable weaknesses in the first claim regarding same and opposite, such arguments should not be applied to other forms of relational responding in the absence of a full unpacking of the argument and ideally empirical evidence of the ability to generate complex "apparent" DRR in accordance with multiple relations and attendant forms of stimulus function transformation (e.g., Dougher, Hamilton, Fink, & Harrington, 2007; Dymond & Barnes, 1995, 1996; Hoon, Bickford, Samuels, & Dymond, 2019; Hughes et al., 2018; May, Stewart, Baez, Freegard & Dymond, 2017; McLoughlin & Stewart, 2017; Munnelly, Stewart, & Dymond, 2019; O'Hora, Barnes-Holmes, Roche, & Smeets, 2004; O'Hora, Barnes-Holmes & Stewart, 2014; Slattery & Stewart, 2014; Stewart, Slattery, Chambers & Dymond, 2018; Whelan, Barnes-Holmes, & Dymond, 2006).

In conclusion, Alonso-Alvarez and Perez-Gonzalez's (2018) claim that all previous empirical demonstrations of derived same and opposite might be explained more parsimoniously in terms of stimulus equivalence and exclusion has several technical and conceptual weaknesses. We have suggested several projects that might help test their thesis more rigorously as well as pushing forward research on DRR and stimulus control. These include examining transformation of function of stimuli using a protocol such as the IRAP to test whether the stimuli do indeed participate in derived relations of same and opposite (Perez et al., 2015); investigating the extent to which participants will automatically reject a stimulus in testing if it has previously appeared in training, but choosing it has never been reinforced; and investigating whether participants induced to respond in accordance with both same and opposite might also subsequently respond in accordance with exclusion if the context appeared to require it. Despite the fact that we disagree with their conclusions, we welcome Alonso-Alvarez and Perez-Gonzalez's emphasis on studying derived relations other than stimulus equivalence, which we hope will stimulate further basic and applied research.

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