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Effects of orientation and differential reinforcement on transitive stimulus control

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ABSTRACT

The emergence of transitive relations between stimuli that had never appeared together is a key process underlying concept formation. An unresolved theoretical issue with respect to transitive relations has been to determine whether differential reinforcement of stimulus-stimulus (S-S) relations though matching-to-sample, or contiguous S-S correlations/pairings, is more critical for producing transitivity. The current study inquired whether simple environmental S-S pairings, versus differential reinforcement of S-S relations, versus environmental S-S pairings with an orientation requirement, produced the greatest instances of transitivity. 12 groups of participants were parsed into one of four procedures (matching-to-sample, stimulus-paring, stimulus-pairing-w/response, stimulus-pairing-w/orientation) along one of three training structures (linear, many-to-one, one-to-many). All participants underwent a fixed number of training trials for establishing three, three-member stimulus sets (A1B1C1, A2B2C2, A3B3C3), followed by a single sorting test for AC transitivity. Our results demonstrate orienting towards environmental S-S pairings yield the greatest degree of transitivity. The effectivity of pairing procedures for establishing transitive relations, particularly when compared to matching-to-sample, can inform the development of educational interventions for individuals for whom the latter procedure (involving differential reinforcement) is ineffective.

1. Effects of orientation and differential reinforcement on transitive stimulus control

A long-standing goal for behavioral scientists has been the development of a satisfactory account of concept formation without recourse to mentalistic determinants (e.g., Hayes et al., 2001; Hull, 1920; Skinner, 1957; Smoke, 1932; Staats, 1961; Tonneau, 2001; Zentall et al., 2002). The formation of concepts, according to Kendler (1961), involves the "acquisition (and) utilization of a common response to dissimilar stimuli" (p. 447), where 'stimuli' are thought to constitute of physically grounded representations of ideas (Fields et al., 1984). Through the investigation of various stimulus-stimulus (S-S) relationships, such as a transitive S-S relation, the goal has been to understand how "ideas" (Fields et al., 1984, p. 143) relate to one another. Briefly, a transitive S-S relation describes the emergent relation between two stimuli based on their mutual associations with (at least) a third, mediating stimulus (Hayes et al., 2001; Hull, 1920; Mowrer, 1960; Sidman, 1994).

To illustrate what a transitive S-S relation may look like, imagine that a human participant is trained along the relation 'A goes with B' (A → B), whether through differential reinforcement (e.g., Amd et al., 2013) and or environmental S → S pairings (e.g., Pimenta and Tonneau, 2016). Next, imagine s/he is trained that 'B goes with C' (B → C). It follows that after learning A → B and B → C, our hypothetical participant may derive that A → C and C → A without further instruction – these constitute instances of transitive S-S relations. In the terminology of Fields et al. (1984), our hypothetical participant would have demonstrated "transitive stimulus control". Given their functional equivalence (Fields et al., 1984), the labels "transitivity" and "transitive stimulus control" will be used inter-changeably throughout the present manuscript. The current study explores yields of transitive stimulus control following exposure to one of four procedures (matching-to-sample vs. stimulus-pairing vs. stimulus-pairing-response vs. stimulus-pairing-orientation-response) parsed along three training structures (linear vs. one-to-many vs. many-to-one). We investigate whether differentially reinforcing S-S relations (Arntzen, 2012; Arntzen et al.,

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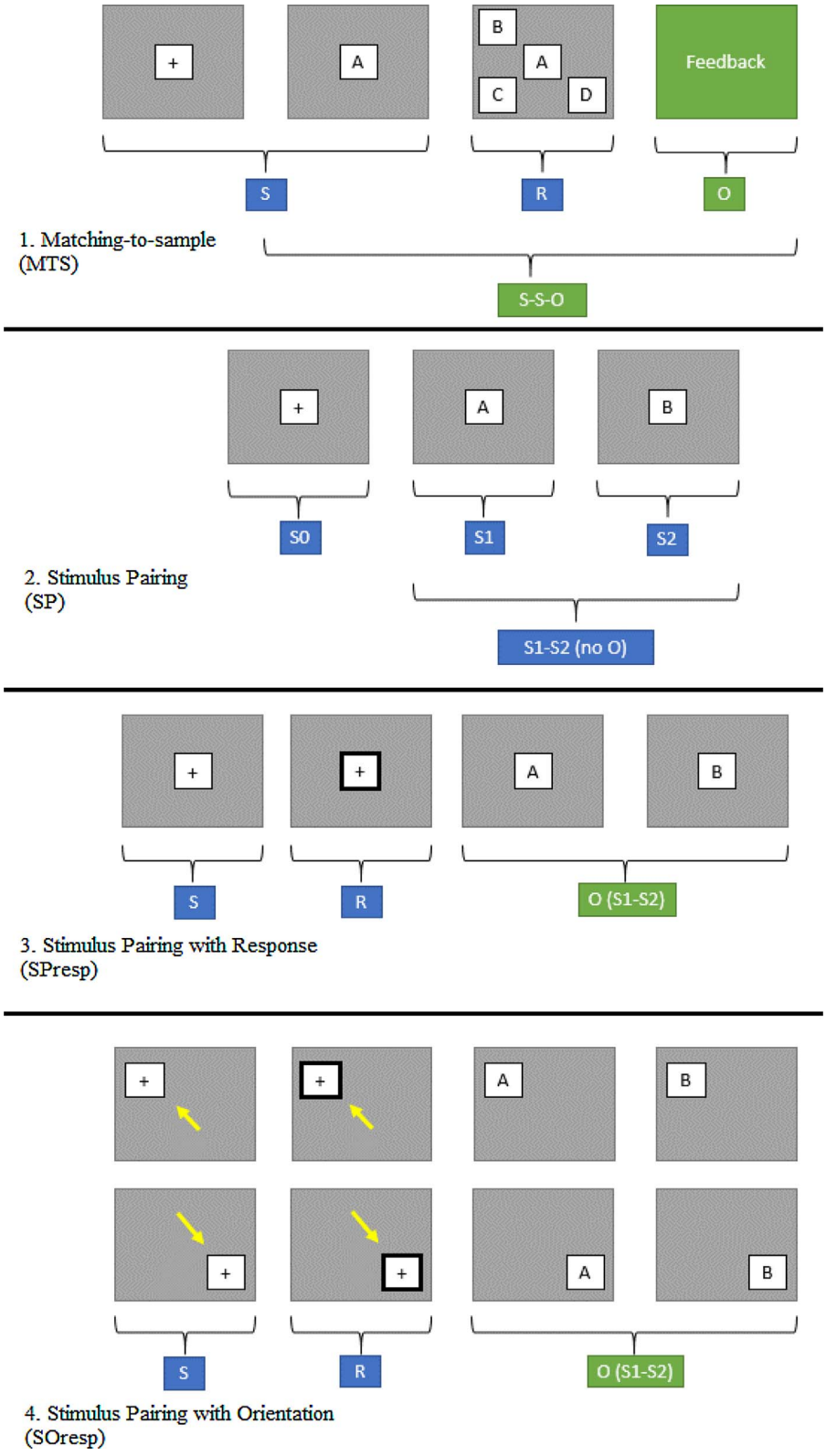

Fig. 1. Procedures compared in the current study. 'S', 'R' and 'O' refer to Stimulus, Response and Outcome, respectively. Only the MTS (Panel 1) differentially reinforced S-S relations. The SOresp (Panel 4) required an orienting response before stimulus pairs were presented. Both the SPresp (Panel 3) and SOresp procedures reinforced trial progression and the successive presentation of different S-S pairs. Only the SP (Panel 2) required no active responses from the participant in order to progress through trials.

2011; Nartey et al., 2015; Saunders and Green, 1999), or presenting stimulus pairs successively (Leader et al., 1996; Pimenta and Tonneau, 2016; Tonneau and González, 2004), or presenting stimulus pairs successively with a pre-programmed orientation requirement (cf., Sokolov, 1963), mitigates the emergence of transitivity (more on orientation responses later).

This line of questioning gained traction following a series of studies conducted by Leader and colleagues (Leader et al., 1996, 2000; Leader and Barnes-Holmes, 2001), where participants who had passively viewed S-S pairings yielded greater instances of transitive stimulus control when compared to participants exposed to a conventional matching-to-sample task, which employed differential reinforcement, although this finding has been disputed (Clayton and Hayes, 2004; Kinloch et al., 2013). Despite a considerable literature on the role of