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Contrast and value: Beyond the work ethic effect. A reply to Zentall (2008)

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Zentall (2008) challenges Arantes and Grace's (2008) failure to replicate Clement, Feltus, Kaiser, and Zentall (2000) by suggesting that our results may have been due to insufficient training or to subjects' experimental histories, and that our results are actually consistent with those of Clement et al. when examined closely. On the contrary, our pigeons received more training than Clement et al.'s did, and when an overall measure of preference on test trials was calculated, independent of the effect of initiating event that we reported, there was no evidence of preference for the stimulus preceded by the greater response requirement in our data. Although there have now been two unsuccessful attempts to replicate Clement et al.'s work ethic effect, there is evidence that in some situations, the value of a stimulus, as assessed by transfer tests, varies inversely with the context of reinforcement. It is important to look for convergent results using other procedures and transfer tests, such as resistance to change, to identify the principles that determine when contrast manipulations affect value and when they do not.

Arantes and Grace (2008) report two experiments that attempted to (1) replicate the work ethic effect reported by Clement, Feltus, Kaiser, and Zentall (2000); (2) determine whether the results were similar for simultaneous and successive discrimination training; and (3) analyze the effects of amount of training on the preference for the high-effort stimulus. However, both experiments failed to replicate Clement et al.'s results. Instead of a consistent preference for the high-effort stimuli, we found that for both S^+ and S^- test trials, preference for the FR20 stimulus depended on the initiating event that preceded the choice stimuli. Specifically, pigeons preferred the FR20 stimulus on trials preceded by FR1 or by no response requirement and preferred the FR1 stimulus on trials preceded by FR20. We also found that preferences on test trials became more extreme as amount of training increased and were generally stronger on S^- than on S^+ trials.

In his commentary, Zentall (2008) argues that our failures to replicate Clement et al. (2000) should not be taken as evidence that the work ethic effect is unreliable. He suggests that our results may be due to methodological shortcomings such as insufficient training or subjects' experimental histories, and that they are actually consistent with those of Clement et al. when examined closely. However, we do not find these arguments convincing.

We are puzzled by Zentall's comment that we trained the pigeons to criterion and then tested them in Experiment 1, and consequently failed to replicate the work ethic effect because of the "minimal amount of training provided" (p. 20). This is incorrect; our pigeons received more training than did those of Clement et al. (2000). In Experiment 1, our pigeons completed an average of 37.2 baseline sessions prior to test. Given that the average number of sessions to reach criterion in the simultaneous condition was 2.1, our pigeons had an average of 35.1 sessions of overtraining prior to test, as compared with Clement et al.'s, which had a total of 23.0 sessions (3.0 sessions to reach criterion plus 20.0 sessions of overtraining). Overall, the training our pigeons received was comparable to the amount that Singer, Berry, and Zentall (2007) found was necessary for a reliable within-contrast effect to emerge. Thus, it is unlikely that our failure to replicate Clement et al. in Experiment 1 was due to insufficient training.

Regarding our Experiment 2, Zentall claims that the preference for the stimuli that followed the greater response requirement in baseline trials increased as more training was provided. He calculates the overall average preferences in the S^+ and S^- trials for the subgroup of 4 pigeons that received extended training as 56% and 65%, respectively, concluding that "although the magnitude of both effects was smaller than that reported by Clement et al. [2000], the effects were in the same direction and were proportionally similar" (p. 20).

However, this interpretation is erroneous. Later in his commentary, Zentall acknowledges the effect of the event initiating the test trial that we obtained in both experiments, noting that it "can be considered orthogonal to the within-trial contrast effect" (p. 21). Although it is possible that both effects could be present in the data, by averaging across all three trial types Zentall has confounded them in his analysis of our data. Given the effect of the initiating event, because two thirds of the test trials were preceded by FR1 or by no response (i.e., conditions identical or similar to FR1) and one third were preceded by FR20, the preferences that Zentall calculated are biased in favor of the stimulus preceded by the FR20 in baseline. An estimate of the within-trial contrast effect that is not confounded with initiating event can be obtained by calculating an average in which the FR20 trials are equally weighted with the FR1 and no-response trials. This yields preferences of 49% and 57% for the S^+ and S^- preceded by the FR20 for the extended-training subgroup in Experiment 2. When similar averages are calculated for the simultaneous condition in Experiment 1 and for the last

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three test sessions in Experiment 2 (see Figures 3 and 6 in Arantes & Grace, 2008), the values are 45% and 57% for the stimuli in Experiment 1 and 43% and 50% in Experiment 2. Averaging across the three independent determinations, the overall preference for the stimulus preceded by the high-effort response requirement is 46% and 55% for S^+ and S^- test trials, respectively. Thus, when the effect of initiating event is taken into account, there is no evidence of within-trial contrast in our data.

Zentall speculates that a possible source of the difference between our results and those of Clement et al. (2000) is our pigeons' prior experimental histories—specifically, their exposure to free-operant procedures such as concurrent chains, concurrent schedules, and multiple schedules. However, we think this is unlikely. Zentall describes these procedures as "relatively lean" reinforcement schedules, and noted that for pigeons with such experience, the FR20 response requirement may not have been sufficiently extreme as to generate within-trial contrast. Despite this history, we found that about one third to one half of our pigeons needed special training before they would complete the FR20 response requirement, suggesting that it was indeed aversive for them. Moore and Fantino (1975) showed that required responding during discriminable periods of nonreinforcement is aversive, rather than high response rates per se, consistent with the view that keypecking is a biologically prepared behavior for pigeons (Hearst & Jenkins, 1974). Thus, it is not surprising that an FR20 requirement might be aversive even for pigeons with extensive experimental histories. Finally, it is important to note that, although pigeons may make thousands of responses per hour in free-operant procedures such as concurrent chains, concurrent schedules, and multiple schedules, the overall rate of reinforcement under such procedures is often similar to those associated with the discrete-trial conditional discrimination tasks that Clement et al.'s pigeons had been exposed to.

Although our results and those of Vasconcelos, Urcuioli, and Lionello-DeNolf (2007) show that Clement et al.'s (2000) work ethic effect is not reliable, there is clear evidence that in some situations the relative value of a stimulus, as assessed by transfer tests, varies inversely with the context of reinforcement in a manner consistent with behavioral contrast. Zentall and colleagues have reported a number of studies in which pigeons showed a preference during probe trials for stimuli that were associated with relatively more aversive prior events (e.g., DiGian, Friedrich, & Zentall, 2004; Friedrich & Zentall, 2004), and similar results have been found by Kacelnik and colleagues with other species, including insects (Kacelnik & Marsh, 2002; Pompilio, Kacelnik, & Behmer, 2006). However, all of these studies have used simple choice probes as transfer tests. In our view, it is important to look for convergent results using other procedures, in order to identify those conditions in which contrast manipulations affect value and those in which they do not, if we are to arrive at a deeper understanding of how learning depends on the context of reinforcement.

One area of research that may be relevant is resistance to change. Since Nevin's (1974) pioneering study, researchers have found in a large number of experiments that responding in the presence of a stimulus associated with a relatively rich reinforcement schedule decreases less, relative to baseline, than does responding in the presence of a stimulus associated with a lean schedule, when a disruptor such as prefeeding or response-independent food is applied. On the basis of these results, Nevin has proposed behavioral momentum theory, which assumes that resistance to change provides a measure of "behavioral mass," or response strength that is independent of response rate (see Nevin & Grace, 2000, for a review). Grace and Nevin (1997) showed that resistance to change and preference in concurrent chains are correlated, leading Nevin and Grace (2000) to propose that "behavioral mass" and "value" are different labels for the same construct that represents what is learned about the conditions of reinforcement associated with a particular stimulus.

As Vasconcelos and Urcuioli (2008) have noted, the pattern of results in their experiments—that is, finding an effect of deprivation level when pigeons were exposed to one stimulus at a time but not when two stimuli were presented concurrently—is similar to that in studies of resistance to change, raising the possibility of a common explanation. There is also evidence that contrast effects on resistance to change are obtained in some situations but not others (Grace, McLean, & Nevin, 2003; Nevin, 1992; Nevin & Grace, 1999). We believe that future research should explore systematically the convergences between value as assessed by choice probes after training in discrete-trial discrimination tasks and value as measured by resistance to change after training on free-operant procedures. Such research has the potential to extend the generality of our understanding of contrast and value, beyond the question of whether a specific result, such as the work ethic effect, is reliable.

AUTHOR NOTE

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