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BRIEF REPORT

Less means more for pigeons but not always

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Abstract When humans are asked to judge the value of a set of objects of excellent quality, they often give this set higher value than those same objects with the addition of some of lesser quality. This is an example of the *affect heuristic*, often referred to as the *less-is-more effect*. Monkeys and dogs, too, have shown this suboptimal effect. But in the present experiments, normally hungry pigeons chose optimally: a preferred food plus a less–preferred food over a more-preferred food alone. In Experiment 2, however, pigeons on a less-restricted diet showed the suboptimal less-is-more effect. Choice on control trials indicated that the effect did not result from the novelty of two food items versus one. The effect in the less-food-restricted pigeons appears to result from the devaluation of the combination of the food items by the presence of the less-preferred food item. The reversal of the effect under greater food restriction may occur because, as motivation increases, the value of the less-preferred food increases faster than the value of the more-preferred food, thus decreasing the difference in value between the two foods.

Keywords Affective heuristic · Less-is-more effect · Suboptimal choice · Paradoxical choice · Level of motivation · Pigeons

Although we think of ourselves as rational beings, we do not always make optimal choices. For example, people will often give greater value to an overfilled 5-oz container with 7 oz of ice cream than to an underfilled 10-oz container with 8 oz of ice cream (Hsee, 1998). In such a case, one attribute, the amount of ice cream relative to the size of the container, is evaluated, while another, more important attribute—the actual amount of ice cream—is neglected. This phenomenon is known as the *less-is-more effect* (Slovic, Finucane, Peters, & MacGregor, 2002).

The less-is-more effect is well documented in humans. In one study, subjects were asked to rate a set of 24 pieces of dinnerware, as well as another set of the same 24 pieces plus 16 more pieces that included nine broken pieces (Hsee, 1998). Objectively, the 40-piece set was more valuable than the 24-piece set—since even if the nine broken pieces were discarded, 31 intact pieces of dinnerware would remain—but despite this, subjects still rated the 24-piece set more highly. Similarly, at a sports-card show, a set of ten baseball cards in mint condition was auctioned, as well as the same ten cards with an additional three cards that were judged to be in poorer condition (List, 2002). Although the three cards in poorer condition were not worth as much as the cards in mint condition, they were each worth something. Nevertheless, the highest bid was 59% higher on average for the 10-card set than for the 13-card set.

In another study (Chernev, 2011), subjects were asked to judge the number of calories in either a hamburger alone or a hamburger together with three celery sticks. On average, the hamburger alone was judged to have 734 calories, whereas the hamburger together with three celery sticks was judged to have only 619 calories. Thus, although the presence of the relatively healthy celery sticks actually added to the total calories, it was judged to reduce the calorie value of the hamburger.

The less-is-more effect is a specific case of the more general *affect heuristic*, in which qualitative aspects of a set are attended to more than the quantitative aspects. According to Hsee (1996), the affect heuristic will normally be applied to attributes that are readily *evaluable*, such as item quality, rather than by those that may be objectively more important, such as the total objective worth of a set of items of mixed

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quality. One can think of the lesser-valued items in the set as having a devaluing effect on the greater-valued items.

Interestingly, animals, too, appear to experience this kind of suboptimal judgment. For instance, monkeys that willingly ate a piece of sliced vegetable or a grape showed a preference for a grape over the vegetable slice when offered a choice between them. However, surprisingly, when they were offered a choice between a single grape and a grape plus a slice of vegetable, they reliably preferred the single grape (Kralik, Xu, Knight, Khan, & Levine, 2012).

In the present research, initially, we were interested in the generality of the effect in a species not as closely related to humans as monkeys. For this reason, we chose to test a well-studied avian species, (White Carneaux) pigeons, by offering them a choice between a preferred food (in some cases a pea, in other cases a kernel of corn) and a pea together with less-preferred food (a commercially available food pellet). As we found in Experiment 2, however, the less-is-more effect depended on the motivational level of the subjects.

Experiment 1

Method

Subjects Six adult White Carneaux pigeons (6–10 years old) were individually housed in wire cages, with free access to water and grit, in a colony room that was maintained on a 12:12-h light:dark cycle. The pigeons were maintained at 80% of their free-feeding weight, a level that is typical for pigeons used in experimental research. They were cared for in accordance with University of Kentucky animal care guidelines.

Procedure The pigeons were tested individually in their home cage in the colony room. Each pigeon was tested to determine that it would eat the pea or the corn kernel, as well as the standard food pellet, when each was presented individually. Each pigeon was then tested for its consistent preference between the two. Each food item was presented on a white plastic container top (3.8 cm in diameter, with a 0.5-cm lip) on a black tray (12.8 cm wide × 11.0 cm deep). The two container tops that held the food items were placed 0.5 cm from the front edge of the tray and 5.0 cm apart (see Fig. 1). The experimenter sat directly in front of the cage so as not to bias the pigeon in either direction. The tray was baited by a second experimenter, and the experimenter who presented the choice to the pigeon maintained his gaze at the floor while the choice was presented. The tray was initially placed at a distance of 15 cm from the pigeon's cage for 5 s (to ensure that the pigeon had a chance to observe both alternatives) and then the tray was moved up to the front of the cage, with a smooth movement perpendicular to the front of the cage, where it remained until the pigeon chose one of the alternatives. The second

Fig. 1 A typical choice trial conducted in the pigeon's home cage

experimenter watched the pigeon make the choice and informed the first experimenter to quickly remove the apparatus once the pigeon consumed all of the food from the chosen alternative, so that the pigeon could not consume food from the alternative that was not chosen. A variable 15-s intertrial interval (ITI) separated trials.

All of the pigeons showed a consistent preference for either the pea (three pigeons) or the corn (three pigeons) over the food pellet. The pigeons were then tested with a choice between the preferred seed alone (pea or corn) and the preferred seed plus the less preferred pellet. To ensure that the preference for the optimal alternative did not result from some other variable, we included several kinds of control trial: (1) the preferred seed versus the less preferred pellet (to assess maintenance of the original preference), (2) the less preferred pellet alone versus the preferred seed plus the less preferred pellet (to determine whether there might be an aversion to the novel choice involving two food objects), and (3) two of the less preferred pellets versus the preferred seed plus the less preferred pellet (to control for the number of food items involved in each alternative). Each pigeon was tested for six blocks of eight trials, two of each trial type per block, on each of three days, for a total of 36 trials of each type. The positions of each two alternatives (left/right) were balanced over trials for each type of trial in each block of trials.

Results

Overall, the pigeons did not show the less-is-more effect (Fig. 2); that is, they preferred the optimal alternative—the more preferred seed together with the less preferred pellet over the more preferred seed alone (M=.75, SEM=.03), $t(5)$=8.43, p=.0004. Furthermore, choice on the control trials was consistent with the expected optimal choice. Specifically, the preferred seed continued to be preferred over the less preferred pellet (M=.84, SEM=.03), $t(5)$=10.05, p=.0002; the preferred seed plus the less preferred pellet was preferred over the less preferred pellet alone (M=.86, SEM=.03), $t(5)$=11.57, p=.0001; and the preferred seed plus the less preferred

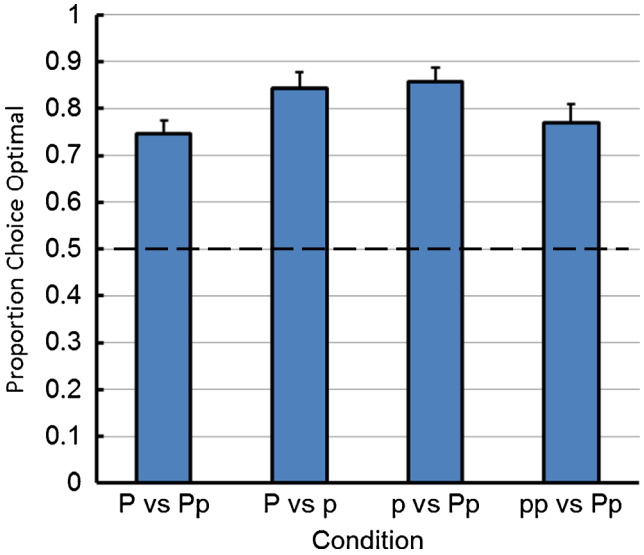

Fig. 2 Results of Experiment 1: Proportions of optimal choices, plotted for each of the choice conditions. P=pea (or corn), p=pellet, Pp=pea (or corn) and pellet, pp=two pellets

pellet was preferred over two of the less preferred pellets (M =.77, SEM=.04), $t(5)$=6.55, p=.002 (see Fig. 2).

Discussion

Surprisingly, the results of the experiment with pigeons were not consistent with the results with monkeys (and humans): Although the monkeys and humans chose suboptimally, the pigeons did not. Species differences are typically difficult to interpret, because species such as monkeys and pigeons differ in many ways; however, we hypothesized that our pigeons might have been more food motivated than were the monkeys. The pigeons in our study were on a diet typically used in learning studies (see Poling, Nickel, & Alling, 1990), one that was more restricted than the monkeys' diet. It may be that high levels of motivation elicit a tendency to forage optimally (MacArthur & Pianka, 1966). In recent research (Pattison & Zentall, in press), we have also found that dogs show the less-is-more effect, and they too were well fed and were working for treats (i.e., they were only modestly food motivated). To test the hypothesis that the difference in the results of the experiments with humans, monkeys, and dogs and the results of Experiment 1 with pigeons was due to differences in motivational level rather than to a species difference, in Experiment 2 we manipulated the level of food motivation for the pigeons.

Experiment 2

Method

Subjects Ten adult White Carneaux pigeons that were experimentally naïve to the less-is-more procedure, yet were similar in other respects to those of Experiment 1, were used in Experiment 2. They were kept and cared for similarly to the pigeons in Experiment 1. One pigeon was dropped from the study for a failure to show a consistent food preference.

Procedure One group of five pigeons were presumed to be strongly motivated for food by testing them at 80% of their free-feeding weight at the time of testing, and they had been 22 h without food, a level of food restriction used in most behavioral research involving food reinforcement with pigeons. For the second group of four pigeons, the level of motivation was reduced by feeding them up to their free-feeding weight and testing them after 4 h without food.

In the second experiment, we also tested the pigeons in their home cage, but we moved their home cage to a separate room so that they could be tested with less distraction from the other pigeons in the colony room. After trying out a variety of grains, we found that all of the pigeons would eat both peas and milo seed, but they all showed a consistent preference for a pea over a milo seed. On test trials, we offered the pigeons in both groups a choice between the more preferred pea (alone) and the pea together with a milo seed. Again we included several control trials, including (1) the preferred pea versus the less preferred milo seed (to assess maintenance of the original preference), (2) the less preferred milo seed alone versus the preferred pea plus the less preferred milo seed, (3) two of the less preferred milo seeds versus the preferred pea plus the less preferred milo seed, and (4) a control trial that had not been present in Experiment 1, the preferred pea versus two preferred peas. For each pigeon, each type of trial was tested 12 times each in six blocks of ten trials apiece on three separate days, for a total of 36 trials of each type. Again, the position of the two alternatives was balanced over trials for each type of trial in each block.

Results and discussion

Once again, we found that the pigeons in the normal (high) food motivation group showed the optimal choice for the pea plus the milo seed over the pea alone (M=.71, SEM=.02), $t(4)$ =9.63, p=.0006; however, the pigeons in the less motivated group preferred the pea alone to the pea plus the milo seed (M =.37, SEM=.03), $t(3)$=4.49, p=.02; that is, the pigeons in the less motivated group showed the less-is-more effect.

A two-way mixed effect analysis of variance that compared the two groups (high vs. low motivation) on the three critical conditions (pea vs. pea and milo; pea vs. milo; one pea vs. two peas) indicated significant effects of group, $F(1, 7)$=5.71, p =.048, and condition, $F(1, 14)$=27.72, p<.0001, which were qualified by a significant Group×Condition interaction, $F(1, 14)$=5.04, p=.022. As can be seen in Fig. 3, only the low-

motivation group in the pea versus pea-plus-milo choice showed a preference for the suboptimal alternative.

With regard to the control trials, as expected, the pigeons in both groups preferred the optimal alternative. Specifically, they preferred the pea over the milo seed, the pea plus the milo seed over the milo seed, the pea plus the milo seed over two milo seeds, and two peas over one pea, all $ps<.02$ (see Fig. 3). The results of the control trials indicate that the suboptimal choice by the low-motivation group resulted from the devaluation of the pea by the milo presented with it, rather than an effect of general lack of motivation, which would have been reflected in indifference between the two alternatives. Finally, we observed no systematic trends between sessions (which might suggest learning effects) or within sessions (which might suggest satiation effects).

General discussion

The results of the present experiments confirm that the less-is-more effect can be found in pigeons, but it is found only when there is a modest level of motivation. When motivation is high, other mechanisms come into play. That the less-is-more effect can be found in a nonprimate species such as the pigeon suggests that it reflects basic behavioral principles that have evolved in many species. The present experiments may also identify important conditions under which the less-is-more effect will occur. Although one might think that more-motivated animals would choose more impulsively—and thus, suboptimally (see, e.g., Laude, Pattison, & Zentall, 2012)—the results indicate that highly motivated animals may be less susceptible to this effect. The difference may be that in the present case, the pigeons can see the two food alternatives, whereas in the case of Laude et al.'s study, in which suboptimal choice was found for the more-motivated but not for the less-motivated pigeons, the choice was between two stimuli: the suboptimal alternative, which occasionally (20% of the time) led to a conditioned reinforcer associated with a high probability of reinforcement (100%), and the optimal alternative, which more often (100% of the time) led to a conditioned reinforcer, but one that was associated with a lower probability of reinforcement (50%), giving this option 2.5 times greater probability of reinforcement. We accounted for the suboptimal choice in the Laude et al. experiment in terms of the large positive contrast between the initial choice and the high-valued conditioned reinforcer that sometimes followed. It was assumed that for low-motivation pigeons the contrast was not as great, and they could better assess the overall rate of reinforcement.

Although the difference between the present results and those of Laude et al. may appear paradoxical, they are also in keeping with findings by Yerkes and Dodson (1908), who proposed that an increase in motivation may facilitate the performance of relatively easy tasks (the present choice task), but is likely to interfere with the performance of more difficult tasks (see also Pelham & Neter, 1995).

Evidence from the human literature also indicates that when outcomes are probabilistic, it is more likely that increasing the emotional content of a choice will result in greater use of the affect heuristic, leading to greater suboptimal choice (Finucane, Alhakami, Slovic, & Johnson, 2000; Rottenstreich & Hsee, 2001). However, this may be true only when the outcomes are probabilistic, as they were in the pigeon experiment by Laude et al. (2012).

One might argue that under low levels of motivation, pigeons merely chose the more-preferred pea over the other alternative containing the milo—perhaps they were not hungry enough to consume both the pea and the milo. However, if that were true, it would suggest indifference between the two alternatives, because each contained a pea, which was not the

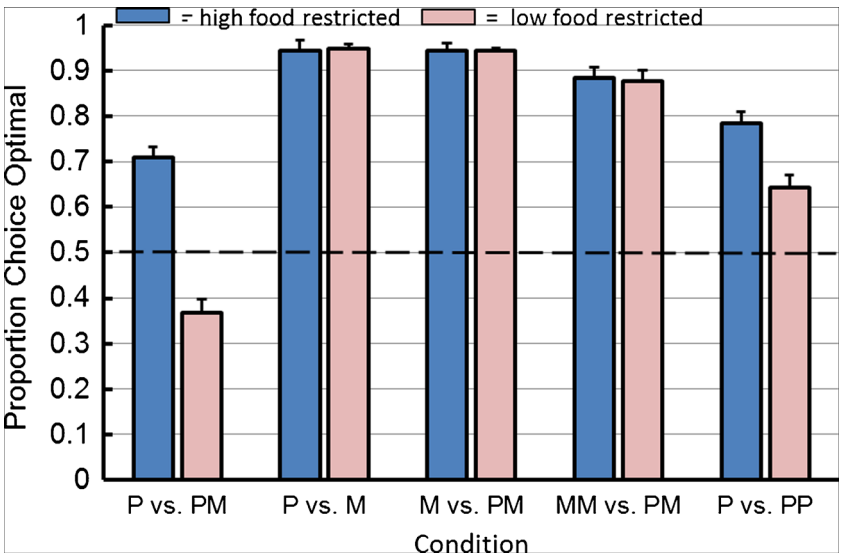

Fig. 3 Results of Experiment 2: Proportions of optimal choices, plotted for each of the choice conditions for the high-food-restricted and low-food-restricted groups. P=pea, M=milo seed, PM=pea and milo seed, MM=two milo seeds, PP=two peas

result that we obtained. Additionally, the fact that the pigeons also preferred the two-pea over the one-pea alternative indicates that avoidance of the novel two-item alternative was not responsible for the preference. Furthermore, the preference for two peas demonstrates that the cause was also not that grasping two items with the beak was more difficult for the pigeons than grasping one. Finally, the absence of systematic within-session and between-session changes in preferences suggests that within-experiment learning and satiation effects did not have an important effect on the results.

The differential effect of high versus low motivation found in the present study suggests that less-motivated animals may choose suboptimally because they attend to the *quality* of the outcomes associated with the alternatives, whereas more-motivated animals choose optimally because, in addition to the quality, they also evaluate the *quantity* of the outcomes. The focus on quantity rather than quality by pigeons under high motivation is in keeping with the *numerosity heuristic*. For example, Pelham, Sumarta, and Myaskovsky (1994) found that choice by children tends to be made on the basis of the number of food units rather than total reinforcement, especially under conditions in which they tend to make rapid judgments. Although in the present experiments we did not take latency measures, it is reasonable to suggest that the pigeons in the high-motivation condition made their choices faster than those in the low-motivation condition.

A more likely account of the failure to observe a less-is-more effect in the high-motivation conditions is that greater motivation increased the value of the less-preferred milo more than it increased the value of the more-preferred pea, because the value of the pea was already closer to its ceiling level (see the hypothetical functions presented in Fig. 4). That is, it may be that the increase in motivation resulted in a decrease in the *difference* in value between the pea and the milo sufficient to overcome the devaluation that resulted from combining the two grains at lower levels of motivation.

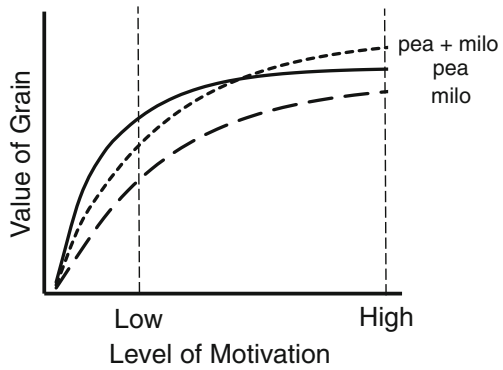

Fig. 4 Hypothesized functions relating the level of motivation to the values of the pea, the milo, and the combination of the pea and the milo. At low levels of motivation, when the milo is presented with the pea, it devalues the pea, but at higher levels of motivation, the value of the milo increases faster than the value of the pea (which is close to asymptote), with the effect of overcoming the negative effect of combining the pea and the milo

These results raise interesting questions about previous findings regarding the less-is-more effect in humans, as well as monkeys. The humans were tested under conditions that would be considered low motivation (they were merely asked to estimate the value of an option: ice cream, dishes, or baseball cards) and the monkeys were tested under what can be assumed to be relatively modest levels of motivation (with fruit and vegetable rewards). Furthermore, we have recently completed a study in which pet dogs (that were not placed on a restricted diet) also showed the less-is-more effect when offered a choice between a piece of cheese plus a piece of carrot versus a piece of cheese alone (Pattison & Zentall, in press). These results make for interesting speculation. For example, if humans of low socioeconomic status were tested, would they assign value more optimally than those of high or medium socioeconomic status?

Interestingly, although research with humans has shown that the less-is-more effect has been found quite reliably when people rate the outcomes individually, the effect can be reversed by giving humans a choice between the two alternatives. That is, for humans, the less-is-more effect can be overridden when the optimal choice can be seen clearly by allowing for a direct comparison between the two alternatives. When given a choice, humans can see that the preferred items are contained within the alternative with the larger number of items, and they tend not to choose suboptimally (Hsee, Loewenstein, Blount, & Bazerman, 1999; Hsee & Zhang, 2004, 2010). It is likely, however, that humans have had a lot of experience making comparisons when they are given choices. That is, humans have learned that when they are given a choice, it is important to look for differences between the alternatives in order to help them make optimal decisions. Animals, on the other hand, are likely to have had considerably less experience making two-alternative choices and looking for differences between alternatives presented to them (Shapiro, Siller, & Kacelnik, 2008).

Although the present research identifies conditions under which pigeons show the less-is-more effect (low rather than high motivation), a more definitive account of the conditions under which this effect occurs in humans and other animals will have to await further study.

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