Behavioural Processes 112 (2015) 22–28

Contents lists available at ScienceDirect

Behavioural Processes

journal homepage: www.elsevier.com/locate/behavproc

The sunk cost effect in pigeons and people: A case of within-trials contrast?

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ARTICLE INFO

Article history:
Available online 7 October 2014

Keywords:
Sunk cost effect
Within-trials contrast
Concurrent choice
Investment size
Delay to choice

ABSTRACT

Pigeons show the sunk cost effect in procedures in which their choice between two outcomes is biased by a prior investment. We review recent studies of the sunk cost effect in pigeons, in which choice procedures are analogous to studies with humans using hypothetical scenarios to make explicit a prior investment and the later choice. Zentall's (2010) theory of within-trial contrast can account for the sunk cost effect – an effortful prior investment contrasts with choice outcomes to increase the value of the outcome in which the prior investment was made. The account correctly predicts that in both pigeons and humans, increased prior investment increases the sunk cost effect. We present data from a study with humans using hypothetical scenarios in which delay was varied between the time of the prior investment and later choice. Extending the delay reduced the sunk cost effect, suggesting the need for a second process by which value is depreciated, in addition to the value-enhancing effect of contrast.

This article is part of a Special Issue entitled: Tribute to Tom Zentall.

Contents

1. Introduction: the sunk cost effect

The sunk cost effect is of interest because theories of rational decision making attribute choice to the effects of future outcomes or prospects and not to the effect of prior investments (Tversky and Kahneman, 1981). When a prior investment has been made, expenditure of effort, time, or money has already occurred ('sunk'), and choice should be determined by the relative merits of future outcomes of the choice. In the sunk cost effect, however, choice is biased by the prior investment and is therefore seen to be suboptimal.

In scenario-based studies of the effect with humans, participants preferred the option in which they had made a prior investment (Arkes and Blumer, 1985). To give an example, in an unpublished study, we devised a set of scenarios like those used by Arkes and Blumer, in which 57 student participants were told that earlier they had purchased a ticket for a ski trip to Queenstown for $300, and more recently purchased a ticket for a trip to Wanaka for $100 which they were told they preferred (both are major New Zealand ski fields), only to discover later that the tickets were for the same weekend and not refundable. Which did they choose, using a 1–6 preference rating scale (with endpoints labeled as 'strongly prefer'

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http://dx.doi.org/10.1016/j.beproc.2014.09.035
0376-6357/

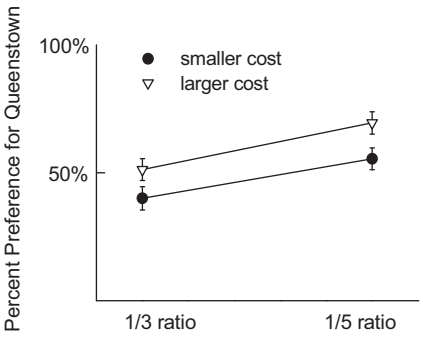

Fig. 1. Preference of human participants ($N = 57$) for the sunk cost option (the initial investment in a Queenstown ticket) as a function of the ratio of costs of the tickets (Queenstown versus Wanaka) and their overall cost, in a hypothetical scenario. Error bars are standard errors of the mean.

each alternative)? Because the Wanaka trip was stated as being preferred, it was the rational choice and the Queenstown trip (the sunk cost) should not be chosen. Fig. 1 shows, however, that about 50% of the time they chose to retain the original investment, as in the seminal Arkes and Blumer study. In a repeated-measures design, we varied the overall size of the investment and the ratio of early to later costs ($450/$90 and $900/$180 – both 5:1; or $150/$50 and $300/$100 – both 3:1). Preference was independently influenced by both overall cost, $F(1, 56) = 29.43$, $p < .001$, $MSE = 1.21$, $\eta_p^2 = .37$, and ratio of costs, $F(1, 56) = 33.5$, $p < .001$, $MSE = 0.77$, $\eta_p^2 = .34$ (Fig. 1). Numerous scenario-based studies have demonstrated the sunk cost effect with human participants, and some have shown that the effect is more probable when the cost of the initial investment is greater (Bornstein and Chapman, 1995; Garland, 1990; Garland and Newport, 1991).

2. The sunk cost effect in pigeons

In terms of the distinction suggested by Fantino (2004), the above scenario with humans involves "resource allocation", as opposed to "continuing-to-invest" in which participants are asked whether they wish to invest further money or time in a losing venture. The first study to demonstrate the sunk cost effect in nonhuman animals, was reported by Navarro and Fantino (2005) and was analogous to a continuing-to-invest problem. Their procedure offered pigeons a choice between persisting in a fixed-ratio schedule from the beginning of the trial, versus escaping from the fixed-ratio schedule with the possibility of encountering a more favorable fixed ratio on the next trial. Unlike a resource-allocation procedure, the choice between two rewarding outcomes in the continuing-to-invest procedure is not explicit.

The first study using a procedure analogous to the resource-allocation scenario-based studies with humans, was reported by Pattison et al. (2012). It was analogous to the human procedures because the pigeon had an explicit choice between continuing to respond on the option where an initial investment of pecks had been made, versus switching to a new option, which was equal or less demanding in its work requirement to obtain the reward. Pattison et al. trained pigeons to choose between red and green keys, one associated with a work requirement of 15 pecks, and the other with 30 pecks. On choice trials, each trial started with the center key lit with the color (red or green) associated with the 30-peck option. At this point 5, 10, 15, 20, or 25 pecks had to be made, after which the center key turned off and the two side keys were lit with the corresponding colors of the 15-peck and 30-peck options. If the animal chose the 15-peck option, the other key would turn off and completion of the peck requirement ended in reward. The same was true for choices of the 30-peck option. The important aspect of the procedure was that if pigeons chose the 30-peck option, the number of pecks needed to complete the schedule was not 30, but the difference between 30 and the number of pecks on the center key prior to the choice (the investment).

For instance, if on a particular trial the prior investment was 10 pecks on the center key, choice of the 30-peck option would require 20 pecks to produce food. But if the prior investment had been 25 pecks, only 5 additional pecks would be required to produce food. The prior investment did not commit the animal to stay with that color, pigeons were free to choose either option, and both ended in reward. Overall, the results showed that pigeons tended to choose the 30-peck option even when it required more pecks to complete the schedule compared to the 15-peck option, a result consistent with the sunk cost effect. Additionally, across trials, the higher the prior investment, the greater was the preference for the 30-peck option. This last result is consistent with our result reported above, in which preference for the sunk cost option was more likely when investment amounts were greater, and were a larger ratio of the cost of the alternative (also see Garland, 1990; Garland and Newport, 1991).

3. The sunk cost effect is not influenced by future prospects

In Pattison et al.'s (2012) procedure, the number of pecks required for the investment was the complement of the number of pecks required to produce the post-choice reward, and so either the investment or the future effort could influence choice. That is, the sunk cost effect could have resulted from many pecks for the investment, or from fewer pecks (compared to the 15-peck alternative) remaining to produce reward. Pattison et al.'s result has been confirmed, however, in a recent study reported by Magalhães and White (2014a) using the concurrent-chains procedure.

The concurrent-chains procedure is illustrated in Fig. 2. Each trial has two steps: a choice phase and an outcome phase. In the choice phase, pigeons choose between left and right keys, each running a variable interval schedule. Responses in the choice phase lead to one of two outcomes with different work requirements in the outcome phase. Reward follows completion of the work requirement associated with the outcome phase. The main advantage of the concurrent-chains procedure is that choice is assessed in the choice phase in which work requirements are otherwise equal, independently of the work requirements or rewards in the outcome phase which might differ between the two alternatives. By varying the relative work requirements in the outcome phase, Magalhães and White (2014a) were able to assess the contribution of future prospects to preference, separately from the effects of an investment prior to the choice phase. In the choice phase, two components signaled by green and red cues were in effect, in order to control for left and right side bias (Fig. 2). Both red and green components were identical in every respect except that in the red components, choice was preceded by a prior investment of 20 pecks on the left key, whereas in green components the investment of 20 pecks was on the right key. The important variable in this procedure was preference for left or right key in red and green components, measured by the ratio of responses on each key during the choice phase.

An effect of the prior investment, the sunk cost effect, was shown by a bias toward the left in red components and a bias toward the right in green components. This differential bias is reflected in the separation or intercept difference between the parallel lines in Fig. 3 (Experiment 1b). Magalhães and White (2014a) showed that this differential bias provided a measure of the sunk cost effect, and was independent of the effect of variation in the ratio of outcome-phase work requirements – the slope of the lines in Fig. 3. In other words,