Running head: INACTION INERTIA AND HANDEDNESS

Inaction Inertia, the Sunk Cost Effect, and Handedness:

Avoiding the Losses of Past Decisions

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Abstract

Strength of handedness, or the degree to which an individual prefers to use a single hand to perform various tasks, is a neurological marker for brain organization and has been shown to be linked to episodic memory, attribute framing, and anchoring, as well as other cognitive domains and tasks. The present work explores the relationship between handedness and both inaction inertia and the sunk cost effect. In experiment 1, mixed-handers displayed a larger inaction inertia effect than strong-handers. In experiment 2, they displayed a larger sunk cost effect than strong-handers. Experiments 3 and 4 extended the sunk cost finding into a different domain and explored how mixed- and strong-handers react to additional information designed to increase the comparative advantage of terminating rather than continuing a failed project. Overall, we found that mixed-handers were more likely to show inertia effects because of an increased aversion to losses. The results of Experiment 4 suggest that, when provided with additional information that made it clear that continuing a project would be a greater loss than terminating it, mixed-handers no longer showed a larger sunk cost effect than strong-handers, highlighting the importance of carefully considering exactly how sunk cost scenarios are worded.

Inaction Inertia, the Sunk Cost Effect, and Handedness:

Avoiding the Losses of Past Decisions

Nobody likes to miss a great opportunity. Tickets at the 50-yard line for $10, clearance sales at a favorite store, alluring one-time offers at car dealerships, and even lucrative graduate school offers are all opportunities that one would feel unhappy about if missed. In fact, passing up an opportunity oftentimes has a psychological cost to the extent that individuals do not feel like buying discounted tickets (Perhaps grumbling to themselves "Even priced at $20, it isn't as good as that $10 deal last week.") or buying a desired object at their favorite store ("It was $40 cheaper last week… I cannot justify buying it now at full price!"). This phenomenon has been referred to as *inaction inertia* and is demonstrated when the act of bypassing an initial action (e.g., the $40 discount or the sale price) decreases the chances an individual will choose subsequent similar actions (e.g., pursuing a $20 discount, or buying the item later at full price).

Various examples of this can be seen in consumer purchasing behavior. For instance, it has been shown in research that individuals who miss a product on-sale will not pursue that product later when it returns to full price (Tykocinski & Pittman, 2001). Additionally, individuals who fail to take advantage of a great bargain will value modest bargains less than individuals who did not miss the first bargain (Arkes, Kung, & Hutzel, 2002). That is, even though a discount of 20% is objectively better than no discount at all, someone who passed on that 40% discount weeks earlier may subjectively value the 20% discount less than either an individual who took advantage of the 40% discount earlier or an individual who just happened to stumble upon the 20% discount with no prior knowledge of the 40% discount. In a sense, inaction inertia serves to irrationally paralyze a decision maker's objectivity when viewing future opportunities, by recalling implicitly previous missed opportunities.

The two-fold goal of the present paper is to extend this work by identifying an individual difference variable –strength of handedness – that helps to explain and predict how much inaction inertia one might experience and to use that explanation to generalize to another, related phenomenon referred to as the sunk cost effect. In Experiment 1, we conduct an initial exploration of the effects of strength of handedness on inaction inertia. We find differences and argue that our finding emanates from a differential focus on losses and show that mixed-handers experience inaction inertia more so than strong-handers. In Experiments 2 and 3, we extend this to the sunk cost effect – an example of something you might call *action inertia*. Finally, in Experiment 4, we use a methodology similar to that of Tykocinski, Pittman, and Tuttle (1995; Experiment 6) to change one's focus from past to future and demonstrate that the sunk cost effect, much like inaction inertia, can be reduced or removed.

Experiment 1

The term "inertia" has been used in the psychological literature for quite awhile, consistently referring to some sort of resistance to change (Pitz, 1969). Early work demonstrated ideas of inertia through constructs such as cognitive dissonance (Grabitz & Grabitz, 1972), childhood experiences of trauma (Levin, 1976), automatic processing (Dulaney, Ellis, & Woodley-Zanthos, 1989), and attention – specifically, that sustained attention produced better memory for an event (Anderson & Burns, 1993). While inertia is used loosely in the psychological area, the term "inaction inertia" has exclusively been tagged by decision-making researchers and consumer scientists to describe the behaviors outlined above – namely, that an action not taken reduces the likelihood that subsequent similar action opportunities will be taken.

Previous theorizing suggests that individuals might engage in inaction inertia for a variety of reasons including perceptual contrast, cognitive dissonance, self-perception, commitment,

counterfactual thinking, anticipated regret, and loss avoidance. Empirical data (Tykocinski, Pittman, & Tuttle, 1995) appear to rule out the first four explanations. Interestingly enough, the last three have gotten at least some support and may be mechanistically interconnected (Tykocinski & Pittman, 1998). Those arguing that counterfactualizing plays a role show that when individuals are not given the reason for why they missed the first opportunity, upward counterfactuals (e.g., "if only I hadn't been there a day late…") cannot be created, which appears to reduce the amount of inaction inertia displayed (Tykocinski & Pittman, 1995). Additional work adds support to this argument, finding that when information about the initial missed opportunity is ambiguous, hard to find, or just simply missing, inaction inertia seems to decrease (Van Dijk, Van Putten, & Zellenberg, 2007). Other researchers suggest that the simple act of considering regret (e.g., recalling how unfortunate it was that one passed on the initial opportunity) turns attention away from the financial advantage that taking the current bargain will provide (Harvey, Sevdalis, & Yip, 2006). Others argue that regret does not drive inaction inertia as much as inaction inertia creates regret as a byproduct (Van Putten, & Zellenberg, 2005). Debate as to direction of regret's role also leaves open a possibility that regret and inaction inertia may feed into each other, creating a vicious circle.

It is the third of these three reasons, however, upon which we would like to concentrate. Tykocinski, Pittman, and Tuttle (1995) convincingly make the case that individuals frame the initial inaction as a loss. That is, the attractive outcome (whether a huge savings of money, a lucrative graduate school offer, or something else) that could have been gained but was not is thought of as now lost. As Tykocinski, et al. put it: "Because the [second] opportunity in question is now associated with a negative psychological situation, individuals may be reluctant to process additional information that might reactivate this negative experience and provoke

processes such as counterfactual regret with its accompanying self-recriminations of the "I should have…" variety." In other words, the pain or loss of benefits associated with one's initial decision is not enough to overcome the gain of (albeit less or fewer) benefits associated with a subsequent opportunity. Thus, "by rejecting the subsequent opportunity promptly, individuals are spared from dwelling on an issue that for them is associated with a negative psychological outcome." Inaction inertia therefore is an attempt to distance oneself from (or avoid) a loss-induced, counterfactual-generating, regret-filled psychological experience. Indeed, this was confirmed in Tykocinski, et al's (1995) Experiment 6 (as well as a subsequent paper; see Tykocinski & Pittman, 1998) when participants, encouraged to focus on the possible future benefits of taking action now instead of trying to avoid the situation entirely, showed no inaction inertia.

So, what does this have to do with handedness? We begin by pointing out that while handedness has long been recognized as an important dimension of human individual difference, the majority of previous research has focused on left versus right handers. However, it is becoming increasingly apparent that degree of handedness (being strongly one-handed versus being mixed-handed, i.e., using the non-dominant hand for at least a few activities) may be more important than direction of handedness. In fact, studies that do not distinguish between degree versus direction of handedness may risk null results and lose statistical power by combining consistent and inconsistent handers (Schacter, 1994). Thus, the present paper, when referring to handedness, is referring to degree not direction.

Previous studies have linked degree or strength of handedness to a variety of individual differences, both inside and outside the area of decision-making. For example, research shows that mixed-handers exhibit better recall of episodic memories (Christman, Propper, & Brown,

2006; Christman, Propper & Dion, 2004; Propper, Christman, & Phaneuf, 2005). Handedness differences have also been found in the Stroop task (Christman, 2001) and perceptions of body image (Christman, Bentle, & Niebauer, 2007; Niebauer, Aselage, & Schutte, 2002). In decision-making, research has found that mixed-handers show larger attribute- and message-framing effects than strong-handers (Jasper, Woolf, Fournier, & Christman, 2009), and that mixed-handers show larger anchoring effects when the anchor is informative or relevant (Jasper & Christman, 2005). These results have been interpreted in terms of prior evidence that mixed-handers are also more prone to update beliefs (e.g., Christman, Henning, Geers, Propper, & Niebauer, 2008; Niebauer, Christman, Reid, & Garvey, 2004).

Conceptually, these individual differences as a function of degree of handedness have been interpreted in terms of increased interaction between the left and right cerebral hemispheres in mixed-handers, as supported by findings that increasing strength of handedness is associated with decreasing size of the corpus callosum (e.g., Clarke & Zaidel, 1994; Cowell, Kertesz, & Denenberg, 1993; Witelson & Goldsmith, 1991). The mixed-handed advantage in episodic memory, for example, has been hypothesized to arise from the greater interaction between left hemisphere-based encoding and right hemisphere-based retrieval processes (e.g., Habib, Nyberg, & Tulving, 2003), while the mixed-handed advantage in belief updating has been hypothesized to reflect greater interaction between left hemisphere-based belief maintenance and right hemisphere-based belief updating mechanisms (e.g., Coltheart, 2005; Ramachandran, 1995). In sum, it appears that when a cognitive activity requires both hemispheres and/or greater access to the right hemisphere wherein a particular activity is localized, one finds handedness differences.

Interestingly enough, recent research suggests that mixed-handers' likelihood to engage in "risky" behaviors is best predicted by the perceived risks while for strong-handers it is best

predicted by the perceived benefits of the same situation (Christman, Jasper, Sontam, & Cooil, 2007). These findings were interpreted in terms of Davidson's (2000) theory of hemispheric differences in emotional processing, in which the left versus right hemispheres are specialized for positive, approach-related emotions versus negative, withdrawal-related emotions, respectively. Specifically, it was argued that the greater interhemispheric interaction associated with mixed-handedness results in greater functional access to right hemisphere processing, leading to a greater influence of loss/cost-related information. This is consistent with other research (Jasper & Christman, 2009) showing that mixed-handers are motivated to avoid the worst case scenario; specifically, they avoid the risky choice in the negative frame of a traditional "all-or-none" risky choice (or Asian Disease) scenario, since it involves the possibility of everyone dying. Strong-handers, on the other hand, are motivated to seek out the best-case scenario; thus, they prefer the risky choice in the negative frame of the same "all-or-none" scenario, since it involves the possibility of nobody dying.

Given that inaction inertia appears to be driven by avoiding thoughts of past losses, one would expect handedness differences in individuals placed in a situation wherein one has previously chosen inaction and now must make a choice between continued inaction (thereby ignoring a negative experience, but foregoing future benefits) or action (thereby overcoming that negative experience, and accepting those future benefits). Specifically, because mixed-handers appear to be more sensitive to losses, they should exhibit inaction inertia to a greater degree than strong-handers. Experiment 1 was designed to test this hypothesis.

Method

Participants

One hundred eighty nine undergraduate students enrolled in introductory psychology courses at The University of Toledo were selected to participate. Seventy one percent of participants were female, with an average age of 19.2 years (SD = 3.1). Participants received course credit for their time.

Materials

Participants were presented with two problems adapted from Zeelenberg, Nijstad, Van Putten, and Van Dijk (2006), in the context of a larger decision making study. One problem dealt with buying a couch for one's room (at a 50% discount initially, 20% later); the other described a weeklong trip to Daytona Beach (at $200 instead of $380 initially, $315 instead of $380 later). Both questions involved a missed opportunity (experimental condition) or an opportunity currently available (control condition). For example, in the couch problem, participants were told to imagine that they were interested in buying a couch, and that yesterday it was on sale at a 50% discount. They could not get to the furniture shop right away and when they returned a day later (today), the sale (in the experimental condition) was over, but the price was still reduced (albeit not as reduced as the day before, i.e., the discount was 20%). In the control condition, the sale price was still available. Two dependent variables were measured for each problem: the individual's likelihood to take the deal offered (1=very unlikely, 10=highly likely), and the individual's estimated regret rating given they had missed (or had they missed – in the control condition) the deal (1=low regret, 10=high regret).

Following these decision problems, participants were given the Edinburgh Handedness Inventory (EHI; Oldfield, 1971) to determine their strength of handedness score. The EHI asks participants to rate the frequency with which they perform each of ten common tasks (e.g., writing, drawing, throwing) with their left or right hand. Participants are asked to indicate their

hand preference on the following scale: always left, sometimes left, no preference, sometimes right, or always right. Responses are summed across the ten tasks and can range from -100 (strongly left-handed) to +100 (strongly right-handed). A median split was performed on the scores such that those scoring 80 and above (absolute value) were categorized as "strong-handed" (n=91), while those scoring below 80 (absolute value) were categorized as "mixed-handed" (n=98). Factor-analysis work comparing the EHI with another handedness inventory (the Crovitz-Zener Questionnaire) and parental handedness scores indicates that it correlates highly with other measures of handedness and is valid (Bryden, 1977). The EHI has also been shown to be highly reliable when analyzed for direction of handedness (Bryden, 1977). Standard demographic information was also collected. Finally, the participants were granted credit, debriefed as to the aims of the research, thanked for their participation, and dismissed.

Results

Data were analyzed separately for each dependent measure. In each case, a 2 x 2 x 2 ANOVA was used with problem type (couch/trip) as a within-subjects variable and inaction inertia condition (got the deal/missed the deal) and handedness (mixed/strong) as between-subjects factors.

Likelihood Ratings. The results indicated that there was no effect of problem, F (1,185) = .409, p = .523. However, there was a main effect of condition, F (1,185)=24.56, $p < .001$, η^2 = .12. Individuals indicated they would be more likely (M = 7.4) to purchase the couch or trip when they had not missed the original deal (the control condition) than when they had missed the deal (M = 5.5). Handedness had no effect, F(1, 185)= .39, p = .531; however, an interaction was found between handedness and condition, F(1, 185)=4.25, p = .041, η^2 = .02. Follow up analyses were conducted and revealed that while strong-handers showed a significant difference

between received deal (M = 7.1) and missed deal conditions (M = 6.0), $t(89) = 2.06$, $p = .04$, $d = .43$, mixed-handers showed an even larger difference between the same conditions (M = 7.69 and M = 5.0, respectively), $t(96) = 4.96$, $p < .001$, $d = .60$. This indicates the inaction inertia effect is stronger for mixed-handers than for strong-handers.

Regret Ratings. There was no main effect of condition. Although in the predicted direction, individuals who missed the deal reported statistically similar regret scores (M = 7.6) as individuals who got the deal said they would feel had they missed it (M = 7.0), $F(1,185) = 2.45$, $p = .119$. There was also no main effect of handedness, $F(1,185) = .045$, $p = .832$**.** However, as predicted there was a marginally significant interaction between handedness and condition, $F(1,185) = 3.47$, $p = .064$, $\eta^2 = .02$, such that mixed-handers, when receiving the deal, gave descriptively lower mean regret ratings (M = 6.6) than strong-handers (M = 7.4). However, when the deal was missed, mixed-handers provided higher mean regret ratings (M=8.0) than strong-handers (7.3). Another way of putting it is that mixed-handers showed increased regret after having missed the deal, while strong-handers did not.

Discussion

The results of Experiment 1 provide evidence that mixed-handers show a larger inaction inertia effect relative to strong-handers. Specifically, they are less likely to take a second deal if they have missed a better, initial opportunity. Mixed-handers also display a marginally significant larger effect in terms of regret ratings. This is consistent with our hypothesis and is also consistent with the notion that inaction inertia is driven, at least in part, by the avoidance of a negative experience now associated with losses. Given that mixed-handers seem to be more sensitive to losses than strong-handers, it makes sense that they would exhibit larger effects.

Experiment 2 was designed to extend this to the sunk cost effect – another inertia phenomenon, this one centered on action rather than inaction.

Experiment 2

The sunk cost effect (SCE) is the tendency to continue to engage in a behavior after an initial investment of time or money has been made (Arkes & Blumer, 1985). For example, suppose an individual is engaged in a project and finds out that, although nearly complete, the project will not be profitable for his/her company. Normative decision theory argues that a prior investment should not influence one's consideration of current options; only the incremental costs and benefits of the current options should influence one's decision. Thus, the project should be terminated. However, many individuals continue to fund the project seemingly in vain, and thus demonstrate the sunk cost effect.

Reasons for why individuals engage in the SCE have been varied and include a desire not to appear wasteful (Arkes & Blumer, 1985; Jang, Mattila, & Bai, 2007), a commitment and need to justify prior choices (Brockner, 1992; Staw 1991), and loss aversion (Garland & Newport, 1991; Schaubroeck & Davis, 1994; Whyte, 1986). Again, the third explanation – loss aversion – is the one on which we concentrate. Loss aversion (see Kahneman & Tversky, 1979) argues that individuals essentially work harder to avoid losses than they do to procure gains. It hurts greatly to lose anything of value. Thus, decision makers decide that the current project, however unfavorable the outcome may be, has been endowed with value and, if terminated, that value would be lost. Therefore, decision makers tend to move forward with the project, despite its potential failure.

In other words, like inaction inertia, in sunk cost one has already (this time implicitly) turned down an initial, better opportunity to minimize or "cut" one's losses, and the situation

may only get worse. Therefore, terminating the project would be a painful reminder of a negative experience (and nobody likes an unpleasant situation). Therefore, continuing the project is a quick and relatively painless way to avoid thinking about the current opportunity, which could rectify the situation, but also triggers the perception of loss. If this is indeed the case, we should also see handedness differences in the sunk cost effect. Specifically, mixed-handers should exhibit a greater sunk cost effect than strong-handers.

Method

Participants

103 undergraduate students enrolled in introductory psychology classes at the University of Toledo were recruited to participate to fulfill a course credit requirement. All participants were between the ages of 17 and 40 (M=19.3, SD=2.3). 65.6% of the participants were female.

Design & Procedure

Participants were recruited as part of a larger study in decision-making. As such, participants were given the radar-blank plane problem as one of a series of questions stapled in a seven-page packet. The radar-blank plane question was originally used by Arkes and Blumer (1985) and asks participants to decide whether or not to continue to build a plane that is undetectable by radar after having learned that a competitor has produced one that is better and after having made a substantial monetary investment (i.e., 90% of 10 million dollars). Arkes and Blumer (1985) found that most participants elected to continue the project and spend the remaining 10% of funds.

Packets were completed in groups of three to five participants in a lab room while an experimenter was present. The radar-blank plane problem appeared on page 4 of the packet.

Participants were required to check one of two options ("Yes, you should," or "No, you should not.") and were given as much time as they needed to complete the question.

Following the decision problems, subjects were given the EHI to determine their strength of handedness score. Using the same cutoffs as in Experiment 1, our sample consisted of 63 strong-handers and 40 mixed-handers. Standard demographic information was also collected. When all participants were finished with their questions, the packets were collected and the participants were debriefed.

Results

Table 1 shows the number and percentage of subjects who chose to terminate or continue the project. For comparison purposes, Arkes and Blumer's (1985) data is also presented. As you can see, our data replicated that of Arkes and Blumer's, with the majority (70.9%) of participants choosing to continue the project, significantly more than the 29.l% choosing to terminate the project, $\chi^2(1, N=103) = 17.95$, $p < 0.001$. When these data were separated by handedness, it was found that 82.5% of mixed-handers chose to continue the project, while only 63.5% of strong-handed participants elected to continue. A chi-square analysis confirmed that this difference was significant, $\chi^2(1, N=103) = 4.28$, $p < 0.05$.

Discussion

Experiment 2 was conducted to determine if strength of handedness was related to the sunk cost effect. Given that mixed-handers seem to be more averse to losses than strong-handers, we predicted that mixed-handers would show a larger sunk cost effect: a prediction borne out by the data. An interesting follow-up question is whether or not these findings generalize to another domain. Experiment 3 was designed to address this

question. Specifically, the scenario was changed to a medical context and designed to assess the effects of manipulating the amount of money invested in a project. Previous research has shown that individuals show a larger sunk cost effect when the proportion of money invested is high than when the proportion of money invested is low (Garland, 1990; Garland & Newport, 1991). This is comparable to Tykocinski, et al.'s (1995) relative attractiveness manipulation for inaction inertia. They found that participants were less likely to take the second action (i.e., demonstrated more inaction inertia) when the discrepancy in attractiveness between the initial and final action opportunities was large rather than small.

Experiment 3

Experiment 3 was adapted from the work of Van Dijk and Zeelenberg (2003). They used a simple medical scenario in which participants own a small pharmaceutical manufacturing company and are developing and marketing a new migraine headache medication. Van Dijk and Zeelenberg provided both a high sunk cost condition (where a large sum of money had been invested) and a low sunk cost condition (where a smaller amount had been invested), as well as a no sunk cost (control) condition and what they termed an "ambiguous" sunk cost condition (where the amount was unknown). Their results showed no significant difference between the high and low sunk cost conditions, presumably due to the fact that in both cases the sunk costs were relatively large. However, they did find that participants were more willing to continue the project after having incurred any sunk costs (high or low). Their data also suggested that when the amount of money invested was unknown, a smaller sunk cost effect was displayed. Van

Dijk and Zeelenberg theorized that this was because the unknown information is discounted.

Method

Participants

One-hundred eighty-five individuals – some from an undergraduate psychology course and some from an online survey source – were recruited to participate in Experiment 3; we dropped four because of missing data. Participants ranged in age from 18 to 66 (M=29.1, SD=11.3); 59.2% were female.

Design & Procedure

Participants were given one of four sunk cost conditions within a packet of "decision-making" questions. The four conditions were high sunk cost (HSC), in which a proportionally large amount of money ($800,000) had been invested in the project, low sunk cost (LSC), in which a proportionally small amount of money ($200,000) had been invested, ambiguous sunk cost (ASC), in which the amount of money invested (somewhere between $200,000 and $800,000) was uncertain, and no sunk cost (NSC), in which no money had been invested. The wording for the question was adapted from Van Dijk and Zeelenberg, (2003). Dollars were substituted for Dutch guilders (fl) in the original paragraph[1]. The question read as follows:

> "As a president of a relatively small factory in the health sector you are developing several new health products. As part of this endeavor, you are preparing to market a new medicine against migraine. You are considering whether or not to go ahead with introduction of the medicine. The costs of such a course of action would be $1 million.[…] At this moment you learn that one of

the world's largest suppliers of health products is also planning to introduce a medicine against migraine. There is an apt possibility that their medicine will outperform yours. Now, what would you decide? Would you continue the development and introduction of the medicine against migraine? Or would you stop the migraine project, and use your funds for development of an alternative product?"

All 4 conditions were identical except for what appeared within the brackets above (Note: Brackets did not appear in the paragraph given to participants). Those statements varied by condition and read as follows:

HSC: "Your factory has already made an investment of $800,000"

LSC: "Your factory has already made an investment of $200,000"

ASC: "Your factory has already made an investment of between $200,000 and $800,000 in the product; however the exact amount of money invested is currently not known…."

NSC: nothing appeared in the bracketed area

After filling out the packet of questions, participants were asked to complete the EHI. The median absolute value on the EHI was again 80. Based on the same cutoffs as Experiments 1 and 2, there were 87 mixed-handers and 94 strong-handers.

Results

Table 2 shows the number and percentage of participants choosing to continue the migraine medicine project in the present work and as reported by Van Dijk and Zeelenberg (2003). Participants responded differently across conditions and descriptively replicated those of Van Dijk and Zeelenberg (2003). Specifically, participants were less

likely to demonstrate the SCE as the amount of money invested decreased (or was uncertain). A chi-square analysis was performed and verified that the differences across the four conditions were significant, $\chi^2(3) = 8.72$, $p = .03$. A second chi-square analysis was performed that compared willingness to continue the project under some versus no or ambiguous sunk cost (i.e. the LSC and HSC versus the ASC and NSC conditions). This analysis also produced significant results, $\chi^2(1) = 5.40$, $p = .02$. Specifically, individuals were more likely to exhibit the SCE in conditions where the amount of money invested was known (76.6%) rather than unknown (60.7%), which replicates Van Dijk and Zeelenberg.

For the purposes of our paper, though, the handedness differences were most important. As Figure 1 shows, mixed-handers continued to invest in the failed medicine project at a higher rate in three out of the four conditions, notably the three that involved at least some investment or sunk cost. While strong-handers showed a marginally significant difference between the three conditions, $\chi^2(2) = 5.66$, $p = .059$, mixed-handers did not, $\chi^2(2) = 4.35$, $p = .113$. That is, amount of money invested did not seem to matter. Interestingly enough, when the data were collapsed across these three conditions, a significant handedness difference was found, $\chi^2(1) = 3.73$, $p = .05$, replicating the results of Experiment 2.

Discussion

In Experiment 2, we established that mixed-handers show larger sunk cost effects than strong-handers under the context of investing in a radar-blank plane. The goal of Experiment 3 was to replicate and extend these findings to a medical setting involving the research and development of a new migraine medication. Experiment 3 also manipulated the size of the initial investment.

Overall, the results of Experiment 3 were consistent with that of Van Dijk and Zeelenberg (2003). As predicted, decision makers were more likely to terminate the project as the amount of money initially invested decreased. They were also more likely to terminate the project when the amount of money was unknown (no and uncertain investment) rather than known (small and large investment). The results were also consistent with those of Experiment 2. Specifically, our findings showed that mixed-handers were more likely than strong-handers to continue investing across the three investment conditions. In sum, it appears that mixed-handers engage in sunk cost more so than strong-handers, and their decision to continue or terminate does not seem to be predicated on the domain or the amount initially invested.

Given that mixed-handers' desire to choose the sunk cost option does not appear to be swayed by amount invested, one might ask what would it take for them to break away? Interestingly, previous research shows that mixed-handers are more likely to update their beliefs than strong-handers (e.g., Christman, Henning, Geers, Propper, & Niebauer, 2008; Niebauer, Christman, Reid, & Garvey, 2004). Perhaps if one included more detailed information emphasizing the relative attractiveness of terminating rather than continuing, mixed-handers would have a change of heart. Experiment 4 was designed to explore this possibility.

Experiment 4

A typical sunk cost problem does not describe the alternative option (terminating the current project and investing in another) in great detail. Nor does it typically spend a lot of time contrasting the competitor's product with one's own, i.e., other than generally indicating that "things don't look good for the success of your product." Because of this lack of information, mixed-handers, more so than strong-handers, may opt to stay put and continue their investment. To these subjects, sticking with what they know may be more comfortable (and perhaps less

risky) than what they don't know. As we argued earlier, it appears to be a way of avoiding the negative thoughts associated with losses. Indeed, if one thinks there is a possibility of some success, the relative losses of termination may be greater than those of continuation. Giving participants greater detail with which to compare and contrast the options may be one way to mentally segregate the past from the future (Thaler, 1999) and shift the balance of power from continuation to termination, which should reduce the SCE, particularly in mixed-handers.

One way to accomplish this would be to emphasize the benefits rather than losses of termination. For example, one might add a few lines focusing participants on how much less one would lose (a savings) by terminating now rather than later. Or one could give specifics about a promising new project in which one might invest the remaining funds after termination. This is similar to something Tycocinski, Pittman, and Tuttle (1995) did with the inaction inertia phenomenon. Specifically, participants read a scenario about a frequent flyer program that they had failed to sign up for. Half the participants were told that "…by not signing up [previously] then, you lost 10,000 free miles"; the other half read that "…by signing up now, you can still gain 5,500 free miles [from the current trip]." Results showed that participants given an explicit "loss" focus showed an inaction inertia effect much like control subjects not given additional information. However, participants given a future "gain" focus did not show the inaction inertia effect.

Another way of contrasting continuation and termination options would be to emphasize the certainty or finality of the outcome. Again, sunk cost problems typically have some ambiguity regarding the success of one's current project. In Experiment 3, for example, the medication scenario indicated that there was "an *apt* possibility that their medicine will outperform yours." If what we argued is true, providing additional, more certain information

about the competitor's project and its greater relative chances of success should decrease one's insistence on investing in the current project. Given their greater sensitivity to new, relevant information and their greater focus on losses, this change should affect mixed-handers more so than strong-handers. We therefore predict that by providing more salient information within the problem regarding the outcome of continuing the project, mixed-handers will begin to update their beliefs and change preference accordingly.

Method

Participants

One-hundred twenty-six participants from the same pool as Experiments 1 and 2 were recruited to participate in Experiment 4. 83.3% were female.

Design & Procedure

The participants were recruited as part of a larger study and received one of four sunk cost problems, as well as several other decision-making questions. Two independent variables, each with two levels, were manipulated within the problem to create the four different conditions. The first variable assessed the affects of additional information about the alternative by including or excluding an additional sentence toward the end of the problem emphasizing the attractiveness of the competitor's project in comparison to the current project. The second factor varied the total amount of money required for the project; this manipulation was adapted from Garland and Newport (1991). Specifically, in Experiment 3, the amount ($1 million) was relatively low, and we changed the proportion invested ($200,000, i.e., 20% versus $800,000, i.e., 80%). In Experiment 4, the proportion (80%) remains constant while we vary the absolute magnitude of the money involved (1 million versus 10 million dollars).

The sunk cost problem that we utilized was the same one used in Experiment 3. The only difference was the text surrounding the manipulated variables. It read as follows (manipulations in brackets):

> As a president of a relatively small factory in the health sector you are developing several new health products. As part of this endeavor, you are preparing to market a new medicine against migraine. You are considering whether or not to go ahead with introduction of the medicine. The total costs of such a course of action would be **[$1/$10] million**. Your factory has already made an investment of **[$800,000/$8 million]**. At this moment you learn that one of the world's largest suppliers of health products is also planning to introduce a medicine against migraine. Your marketing people tell you that there is an apt possibility that their medicine will outperform yours. **[It is clear that their medicine works faster, is more effective, and is far more economical than the medicine your company is developing.]** Now, what would you decide? Would you continue the development and introduction of the medicine against migraine? Or would you stop the migraine project, and use your remaining funds for development of an alternative product?

Handedness was assessed in a similar fashion as the previous experiments, with a median absolute value of 90. Using this value to classify participants into the two handedness groups, there were 65 strong-handers and 61 mixed-handers.

Results

Table 3 reveals the percentage of participants choosing to continue the migraine medicine project as a function of both the magnitude of the current investment and the

amount of additional information provided about the competitor's project. Descriptively, slightly more individuals overall chose to continue in the $10 million than in the $1 million condition (48.5% vs. 43.3%); however, this difference was not significant, $\chi^2(1, N=126) = 0.34$, $p > 0.05$. When separated by handedness, slight descriptive differences were again found, consistent with the overall findings, but there was no difference between the low and high investment amounts within strong-handers (51.5% versus 40.6%), $\chi^2(1, N=65) = 0.78$, $p > 0.05$, or mixed-handers (45.5% versus 46.4%), $\chi^2(1, N=61) = 0.01$, $p >0$ .05. Thus it can be concluded that the absolute magnitude of the money involved did not have an effect on the decision to continue or terminate, which replicates the work of Garland and Newport (1991).

The second variable manipulated was the inclusion or exclusion of an additional sentence that provided further information, emphasizing the comparative losses of continuing the current project versus terminating and reinvesting the money saved. Overall, this additional information had a pronounced effect. When given additional information, only 31.7% of participants chose to continue the current project, while 59.1% chose to continue when the additional information was absent. This difference was statistically significant, $\chi^2(1, N=126) = 9.52$, $p < 0.05$. When separated by handedness, both mixed- and strong-handers were descriptively less likely to continue the project when given more information. For mixed-handers, the difference (27.6% versus 62.5%, respectively, for the experimental and control conditions) was significant, $\chi^2(1,N=61) = 7.47$, $p < 0.01$. For strong-handers, the difference (35.5% versus 55.9%, respectively) was marginally significant, $\chi^2(1, N=65) = 2.72$, $p < 0.10$. This suggests that the information had a bigger impact on mixed- than strong-handers. However, when

mixed- and strong-handers were compared directly at each level of information, we found no difference for either the control condition ($\chi^2(1, N=66) = 0.30, p > 0.05$) or the experimental condition ($\chi^2(1, N=60) = 0.43, p >0 .05$).

Discussion

The goal of Experiment 4 was to determine if providing additional information about the certainty or finality of the outcome of a competitor's project moderated one's willingness to continue investing in one's own failed project. Our thinking was that the additional information would shift the comparative loss from favoring continuation to favoring termination. That is, by reducing the uncertainty surrounding the failure of one's own project, termination is now seen as a relative gain compared to continuation, which serves only to lose more money. Previous research has shown that mixed-handers are more sensitive to information and update their beliefs more readily than strong-handers. Research also shows that mixed-handers are more sensitive to losses. Thus, our prediction was that, although mixed-handers seem to be more prone to sunk cost, they would also be influenced more by informationally relevant changes to the situational context. Indeed, this is what we found. Although not significant, mixed-handers appear to show a larger change in their behavior between the control (no additional information) and experimental (additional information) conditions. Perhaps even more important is the fact that after adding information, mixed-handers and strong-handers now show no difference in the sunk cost effect.

A secondary goal was to assess the affect of varying the magnitude of investment in the current project. Consistent with our predictions and previous research, the absolute

amount of money involved had little to no impact on decisions overall, or within handedness groups.

General Discussion

Decision researchers typically report their results at the aggregate level of analysis. It is only recently that decision researchers have begun to systematically identify and study individual differences in relation to common decision biases and heuristics. We argue that real progress in understanding and theorizing about decision behavior will come only when we use individual difference indices to account for significant variation in our data. Our notion that strength of handedness could be a predictor of decision processes is rather unique. However, evidence for handedness differences has been provided in domains as disparate as sensory illusions, musical performance, Stroop interference, and autobiographical memory, which suggests the existence of a far-reaching and stable dimension of individual difference. More important, evidence for handedness differences has now been provided in a variety of judgment and decision making tasks ranging from anchoring to framing to risk perception and risk taking (Christman, Jasper, Sontam, & Cooil, 2007; Jasper & Christman, 2005; Jasper et al., 2009).

In the present paper, we extend this to both inaction inertia and sunk cost effects. In Experiment 1, we revealed that mixed-handers are more likely to pass up a deal if one has already passed on a better deal. In Experiment 2, we demonstrated that mixed- and strong-handers differ in their likelihood to terminate what appears to be a failed radar-blank plane project, with mixed-handers exhibiting more sunk cost behavior than strong-handers. In Experiment 3, we showed that decreasing the amount of money invested increases the likelihood that individuals will terminate a failed migraine medicine project. However, it was clear that this manipulation had far less of an impact on mixed-handers than strong-handers. The proportional

amount of money invested didn't seem to matter; mixed-handers chose to continue their investment at a higher rate than strong-handers across all three sunk cost conditions. Experiment 4 demonstrated that the sunk cost effect can be moderated by adding more information designed to increase the comparative advantage of terminating rather than continuing a failed project. More importantly, it revealed that handedness differences can be eliminated with the addition of this information, suggesting that mixed-handers may simply require more salient information to segregate the past from the future and terminate a project than strong-handers.

All four experiments are supportive of the claim that mixed-handers are more distressed by decisions associated with losses and show a different proclivity to update beliefs than strong-handers. In addition, the results of Experiment 4 suggest that mixed-handers are more likely than strong-handers to pursue sunk costs when the future fate of the project is not clear; when additional information is provided, unambiguously indicating that the project will fail, the handedness difference in sunk costs disappears.

This also raises the important issue of how subjects in sunk cost studies interpret the information provided in the experimental scenarios. The implicit assumption in such studies is that the project is doomed to fail. However, the specific phrasing used in these scenarios (e.g., "it is *apparent* that their plane is much faster and far more economical", "there is an *apt* possibility that their medicine will outperform yours") leaves room for ambiguity, as words like "apparent" and "apt" can be interpreted as indicating a non-zero probability of the project actually succeeding. Future research on the sunk cost effect should consider varying not just the amounts invested, but also the explicit probability of the project succeeding or estimates of future returns (see, e.g., Tan & Yates, 1995).

In closing, our results have important theoretical and practical implications. In terms of theory, our results suggest that inaction inertia and sunk cost effects may result from similar mechanisms. Although seemingly different, both effects involve, at least implicitly, a past and a current decision as well as significant inertia – inaction in the former and action in the later case. Most importantly, both seem to be connected by a focus on losses, the negative thought one tries to avoid. This raises the question whether other forms of inertia, such as status quo (see, for example, Samuelson & Zeckhauser, 1988), are related mechanistically and would show similar handedness effects.

From a practical standpoint, the finding that decisions in both inaction inertia and sunk cost contexts may be predicted by handedness suggests that including handedness (measured for strength, not direction) in decision making research may prove fruitful in explaining otherwise unaccounted for variance. Even for researchers who are not interested in individual differences, including handedness as a factor in analyses will likely lead to variability moving from the error term to an effect term, thereby providing greater power to detect other effects of interest. At best, including strength of handedness as a variable could shed light on theoretical issues concerning how different components of a task that are lateralized to opposite hemispheres interact, since such components are more likely to operate independently in strong-handers. It is becoming increasingly clear that strength of handedness is a major determinant of individual differences across a wide variety of perceptual and cognitive domains, and including it in decision making research is likely to help shed further light on our attempts to understand human reasoning and decision making.

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Footnotes

1. The original amounts were $500,000 and 1.5 million fl. These were changed to $200,000 and $800,000, respectively. Our thinking was twofold: 1) 500,000 is perceptually too high for the LSC (which Van Dijk & Zeelenberg argue led to no difference between the LSC and HSC conditions), and 2) we thought participants might get confused as to why the 1.5 million (current investment) is greater than the 1 million (future investment), i.e. they might interpret 1 million as total investment.

Table 1 *Number and percentage of subjects who chose to continue or terminate the radar-blank plane project in Experiment 1.*

	Arkes & Blumer (1985)	Present Study		
		Overall	SH	MH
Continue Project	41 (85.4%)	73 (70.9%)	40(63.5%)	33 (82.5%)
Terminate Project	7 (14.6%)	30 (29.1%)	23 (36.5%)	7 (17.5%)

SH = strong-handers; MH = mixed-handers

Table 2 *Number and percentage of subjects who chose to continue the migraine medicine project as a function of amount invested in Experiment 2.*

	Van Dijk & Zeelenberg,(2003)	Present Study
HSC	22 (71%)	46 (83.6%)
LSC	20 (65%)	26 (66.7%)
ASC	10 (32%)	29 (63.0%)
NSC	9 (29%)	23 (56.1%)

HSC = High Sunk Cost; LSC = Low Sunk Cost; ASC = Ambiguous Sunk Cost; NSC = No Sunk Cost

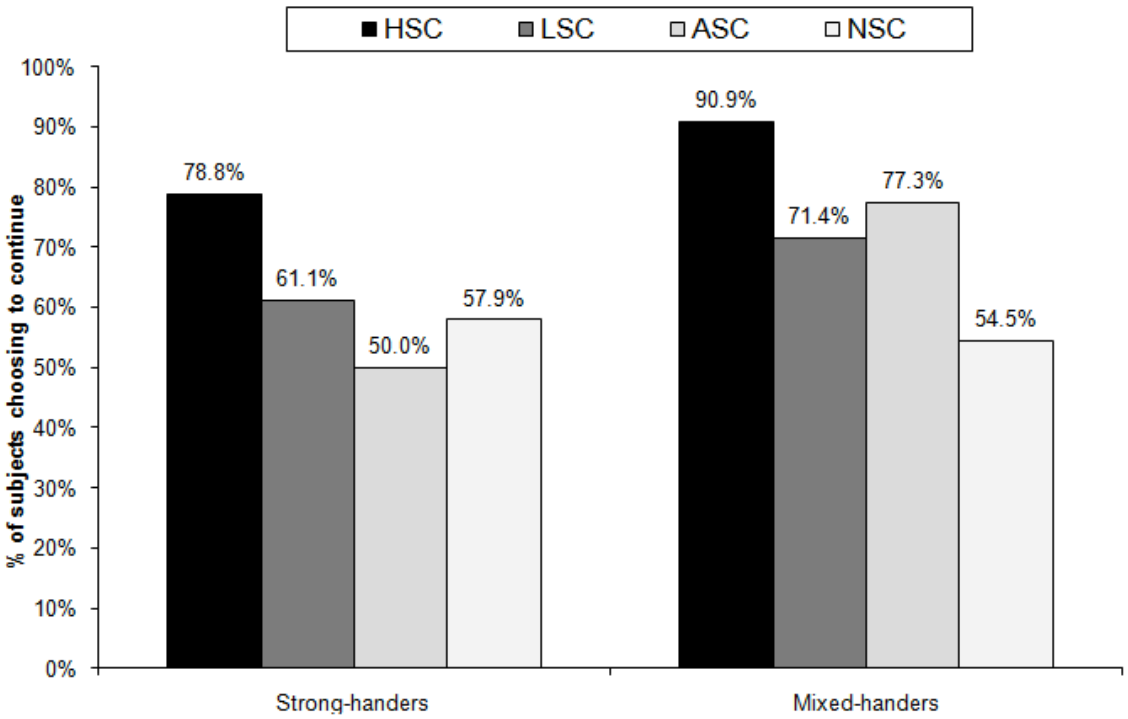
Table 3. *Percentage of subjects who chose to continue the migraine medicine project separated by handedness for both investment magnitude and information manipulations.*

	$1 Million		$10 Million	
	Low Info	High Info	Low Info	High Info
SH	61.9%	33.3%	46.2%	36.8%
MH	66.7%	27.8%	58.8%	27.3%
All	**63.9%**	**30.0%**	**53.3%**	**33.3%**

SH = strong-handers; MH = mixed-handers

Figure Caption

Figure 1: *Percentage of subjects who choose to continue the migraine medicine project as a function of investment condition and handedness group.*



HSC = High Sunk Cost; LSC = Low Sunk Cost; ASC = Ambiguous Sunk Cost; NSC = No Sunk Cost