High Levels of Uncertainty Exacerbate the Endowment Effect

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Abstract

We experimentally examine the impact on the endowment effect of a commonplace factor, uncertainty about maintaining one’s holdings. In “certainty treatments” we give participants one of two available items and offer them the opportunity to trade. We observe the classic result: too little trading. In “uncertainty treatments,” participants know that after trade requests are implemented, there is a pre-specified probability they will lose their holding. That is, if participants do not trade, they might lose the item they were given; if participants do trade, they might lose the item for which they traded. We observe that both small (1 in 6) and large (5 in 6) probabilities of losing one’s holding have little impact on reluctance to trade. However, given an intermediate probability (1 in 2) of losing one’s holding, reluctance to trade is more pronounced than in a standard, certainty treatment. Under the assumption that there is greater uncertainty with intermediate probabilities (i.e. 1 in 2) than extreme probabilities (i.e. 1 in 6 or 5 in 6), we conclude that high levels of uncertainty about maintaining one’s holdings exacerbate the endowment effect. This pattern supports some theories of the endowment effect and casts doubt on others.
The endowment effect is a bias towards keeping rather than parting with one’s holdings. In an early demonstration of the effect, Knetsch (1989) gave some participants a mug and some participants a fancy chocolate bar. He then had everyone choose between keeping the item they possessed versus trading it for the other item. Participants were reluctant to trade: about ninety percent elected to keep the item they had been given.

In this article, we experimentally examine the impact on the endowment effect of a commonplace but under-studied factor, uncertainty about whether one will maintain or lose one’s holding. Many settings that may induce endowment effects include such uncertainty. Consider homeowners in regions of Florida that are susceptible to hurricanes. After a storm or with one looming, a Florida homeowner may perceive substantial uncertainty about whether his or her residence will survive the next major hurricane. The possibility of losing one’s home will depress home prices in general, but how will it impact the endowment effect? When people are unsure about maintaining their holdings, will their reluctance to trade, in this case by selling one residence and purchasing another, be exacerbated, diminished, or perhaps unaffected?

Note that switching homes within susceptible regions of Florida does not eliminate the risk of losing one’s residence due to a future hurricane. As long as a person remains in a susceptible region, that risk is unavoidable. Our experiments parallel such circumstances. They also examine the impact of an unavoidable possibility of losing one’s possession. For instance, in one “uncertain possession” treatment each participant is endowed with one of two possible items; then, when participants are offered the opportunity to trade, they are also informed that after desired trades are consummated, a coin will be flipped to determine whether they keep or lose the item they hold at that time. If someone does not trade and simply keeps his or her original endowment, he or she might lose that endowment; likewise, if someone trades the endowment, then he or she might lose the item received via trade. Thus, a participant remains exposed to uncertainty, no matter what his or her keep/trade decision happens to be.

We present two experiments. In Experiment 1, our uncertain possession treatments all include a coin flip that implements a 1 in 2 chance of losing one’s holdings. In Experiment 2, our uncertain possession treatments employ the roll of a die to implement either a 1 in 6, 3 in 6, or 5 in 6 chance of losing one’s holdings. A simple measure of the level of uncertainty inherent in each treatment is the product of the probabilities of losing and maintaining one’s holdings.
This measure reflects the notion that there is greater uncertainty given intermediate rather than extreme probabilities for each possible outcome. It equals $5/36$ given a $1$ in $6$ or $5$ in $6$ chance of losing one’s possession; it is higher, equal to $1/4$, given a $1$ in $2$ or $3$ in $6$ chance of losing one’s possession. Thus, the $1$ in $2$ and $3$ in $6$ risks constitute a relatively higher level of uncertainty, while the $1$ in $6$ and $5$ in $6$ risks constitute a relatively lower level of uncertainty.

We find that compared to “guaranteed possession” treatments, which simply parallel Knetsch’s original methodology in which there is no uncertainty, a low level of uncertainty does not have much impact, but a high level of uncertainty exacerbates the endowment effect. To be precise, we observe that $1$ in $6$ and $5$ in $6$ risks yield about the same magnitude of reluctance to trade as guaranteed possession, but $1$ in $2$ and $3$ in $6$ risks yield greater reluctance to trade.

Returning to the Florida homeowner scenario, this finding suggests that given a low level of uncertainty (i.e., either a small or large probability of losing one’s home), Floridians tendency to switch residences within their region will match that of people who reside in benign climates. However, given a high level of uncertainty (i.e., an intermediate probability of losing one’s home), Floridians will be more reluctant to switch homes.

Our experiments examine a specific but important form of uncertainty, about maintaining versus losing one’s endowment. Importantly, our findings are consistent with and build on prior work on another form of uncertainty, concerning items of random redemption value. Okada (2011) endowed some participants with coupons redeemable for candy. In a baseline treatment, a coupon entitled a participant to a single, pre-determined brand of candy. In a random-redemption treatment, a coupon entitled a participant to one of three randomly-selected brands of candy. A larger endowment effect emerged for the coupon with random redemption value. Similarly, Walasek, Wright, & Rakow (2014) examined a virtual balloon task. At each step of the task, participants could either pump some air into the balloon or stop pumping. With each pump, they accrued money but also risked popping the balloon. Moreover, they lost all accrued money if the balloon popped, but they received their money if they stopped pumping with the balloon un-popped. Participants given little diagnostic information about the point at which the balloon would pop evinced a larger endowment effect than participants given more diagnostic information (related results are provided by Roca & Maule, 2009; Pachur & Scheibehenne, 2012; Trautmann & Schmidt, 2012).
Bar-Hillel & Neter (1996; see also Casey, 1995; Knetsch & Sinden, 1984; Maimaran, 2001; Risen & Gilovich 2007; van Dijk & Knippenberg, 1996, 1998; van de Ven & Zeelenberg, 2011) established that anticipatory regret may contribute to endowment effects for items of random redemption value. These authors endowed participants with lottery tickets and offered them the opportunity to trade their ticket for another ticket. Participants were reluctant to trade, because they were especially averse to the possibility of giving up a ticket that turned out to be a winner for a ticket that turned out to be a loser. In considering their studies, Okada and Walasek et al discuss a hedging mechanism in much the same spirit. The holder of an item of random redemption value may be especially averse to trading it away and then having the randomness resolved in a favorable way. On the flip side, someone who can trade for an item of random redemption value may be especially averse to trading for it and then having the randomness resolved in an unfavorable way. Both parties may hedge by avoiding trade (related logic is raised by Isoni, 2011; see also Weaver & Frederick, 2012).

Our work builds on research concerning items of random redemption value in four distinct ways. First, and to reiterate, we study a different form of uncertainty, about maintaining versus losing one’s possession. This form of uncertainty has much pragmatic relevance. Second, our experiments span the probability space, examining zero, low, intermediate, and high likelihoods of losing one’s holding. Prior work contrasted either no uncertainty with some uncertainty (as in Okada’s Study 2) or relatively lower and higher levels of uncertainty (as in Walasek et al’ studies). Third, our experiments may provide some insight about the mechanisms by which uncertainty – of any form – can exacerbate the endowment effect. In particular, we implement experimental treatments that rule out anticipatory regret but that nevertheless yield an impact of uncertainty. Put differently, though anticipatory regret may play a role in many circumstances, it cannot explain our findings. Fourth, our results inform extant explanations of the standard endowment effect under certainty. In the concluding section we discuss how our findings can be accounted for by modifications and additions to leading theories of the endowment effect. We next present our two experiments.
Experiment 1: Standard, One Coin Flip, and Two Coin Flips Treatments

Method

Undergraduates in several sections of a management course at a large, private U.S. university were endowed with either a mug decorated with the university logo or a pack of Bic highlighters. We employed a transparently random endowment procedure: experimenters walked by students’ desks and alternately gave each student either a mug or highlighters. They also handed out written instructions that were subsequently read aloud.

Each section of the course was assigned to one of four treatments. Because sections varied in size, sample sizes differed across treatments. In the baseline, guaranteed possession treatment ($n = 102$), there was no uncertainty whatsoever; participants were sure to go home with either the item with which they were initially endowed and opted to keep or the alternative item for which they opted to trade their endowment. To indicate their keep/trade decision, participants circled one of these options on their instruction sheet. Trades were conducted with the experimenter – participants did not trade with one another. Once all participants had made their decision, requested trades were immediately implemented.

The two coin flips uncertainty treatment ($n = 75$) differed from the baseline treatment as follows. Prior to making their keep/trade decision, participants were informed that after all requested trades were consummated, two coins would be flipped, one for the mug and one for the highlighter. The mug coin flip would apply to participants holding a mug at that time (either because they kept the mug with which they were endowed or because they opted to trade a pack of highlighters for a mug) and would determine whether these participants kept or lost their mug. Likewise, the highlighter coin flip would determine whether those holding a pack of highlighters after all trades had been consummated would keep or lose their highlighters. The coin flips were carried out after trades were completed; the mugs and highlighters were kept by participants when the coin flip turned out well but taken back by the experimenter when the coin flip turned out badly.

The one-coin flip uncertainty treatment ($n = 117$) was identical to the two-coin flip treatment except that only one coin was flipped. This coin flip determined whether all participants kept or lost the item they were holding after trades had been completed. Examining both one and two coin flip treatments allows us to assess whether anticipatory regret is necessary.
for an impact of uncertainty. Given two coin flips, a participant might be reluctant to trade in part because he or she is especially averse to the possibility of trading an item whose coin flip turns out well for an item whose coin flip turns out badly. But such fears cannot rise when a single coin flip applies to both items. In other words, if anticipatory regret plays a major role in our setting, reluctance to trade should be greater under two coin flips than under one coin flip.

Finally, we implemented a background uncertainty treatment \( (n = 109) \). In this treatment, participants were not exposed to uncertainty concerning the items subject to trade. Instead, they were exposed to uncertainty that was in some sense background to their keep/trade decision. In particular, every participant was endowed with two items, either a mug and a set of Post-Its or a pack of Bic highlighters and a set of Post-Its. As in our guaranteed possession treatment, participants were offered the opportunity to make a mug/highlighter trade, and they were guaranteed to go home with whichever of the mug or highlighters they selected. They could not trade Post-Its. However, after desired mug/highlighter trades were completed, a coin flip determined whether participants kept or lost their Post-Its.

Examining this last treatment allows us to see if the mere presence of uncertainty exacerbates reluctance to trade, irrespective of what the uncertainty is about. Uncertainty sometimes induces feelings of discomfort, anxiety, or the like that cause people to “freeze up” or “do nothing” (cf. Loewenstein, Weber, Hsee, & Welch, 2001; Luce, 1998; Luce, Bettman, & Payne, 1997; Shafir & Tversky, 1992; Slovic & Peters, 2006). Such feeling and reactions may or may not impact reluctance to trade.

**Results**

To interpret Figure 1, note that given guaranteed possession 17% of mug holders traded and 62% of highlighter holders traded. The sum of these proportions is 79%, and their average is 40%. Calculating average trading rates points to an important preliminary finding: all four treatments exhibited a significant endowment effect. The 40% average trading rate given guaranteed possession is significantly different from the 50% implied by the null hypothesis \( (\chi^2=5.3, p=.02) \). The average trading rate given background uncertainty was 38% \( (\chi^2=5.9, p < .01) \). The average trading rates given one and two coin flip uncertainty were each 26% \( (\chi^2=24.2, p < .001 \text{ given one flip}; \chi^2=16.3, p < .001 \text{ given two flips}) \).
More critically, background uncertainty had virtually no impact on the endowment effect, but one and two coin flip uncertainty exacerbated the endowment effect almost identically. Planned contrasts indicated that average trading rates were lower given either one or two coin flips than under certainty \((p \leq .03, d > .32\) in each case). Furthermore, looking within-items, mug holders and highlighter holders each traded less under one- and two-coin flip uncertainty than under guaranteed possession and under background uncertainty. All four treatments revealed a bias for the mug over the highlights. Nevertheless, though only 17% and 16% of mug holders traded under guaranteed possession and background uncertainty respectively, the proportion trading was even lower given two coin flips, 11%, and one coin flip, 8%. Likewise, 62% and 60% of highlighter holders traded under guaranteed possession and background uncertainty respectively, but only 41% traded given two flips and 44% given one flip. Thus, one and two coin flip uncertainty consistently engendered greater reluctance to trade than guaranteed possession and background uncertainty.

In sum, it appears that uncertainty linked to the items subject to trade can exacerbate the endowment effect whether or not it allows for anticipated regret and that background uncertainty does not exacerbate the endowment effect.

**Experiment 2: Varying the Probability of Losing One’s Holding**

*Method*

Undergraduates at a large, public university received course credit for participating in our experiment and several subsequent, unrelated tasks at one of the university’s behavioral labs. Prior experience suggested that one week’s worth of lab sessions would yield an appropriate number of participants. The experiment was thus conducted during one Monday through Friday school week in sessions of between 5 and 16 participants. Each session was randomly assigned to one treatment. Since the number of participants varied across sessions, sample sizes differed across treatments.

Participants were endowed with either a single-serving pack of Peanut M&Ms or two small packs of Post-Its using the same procedure as in Experiment 1: an experimenter walked by participants’ stations and alternately gave each participant either M&Ms or Post-Its along with instructions that were later read aloud. We paired one pack of M&Ms with two packs rather than
just one pack of Post-Its because of input from informal pre-testing. Un-endowed participants were roughly equally likely to choose M&Ms and two packs of Post-Its but overwhelmingly preferred M&Ms over one packs of Post-Its.

We studied four treatments. In the baseline, guaranteed possession treatment \( (n = 76) \), there was no uncertainty, so participants were sure to go home with either the item they kept or the item for which they traded. In the uncertain possession treatments, participants were exposed to the roll of a die. Depending on the specific treatment, this die roll implemented either a 1 in 6 chance that participants’ would lose whatever item they had after all desired trades had been consummated \( (n = 81) \), or a 3 in 6 chance \( (n = 69) \), or a 5 in 6 chance \( (n = 65) \). There was just one die roll in each uncertainty treatment; it applied to all participants, no matter what item they held after requested trades had been completed.

Results

Figure 2 shows that under certainty 18% of M&Ms holders traded and 58% of Post-Its holders traded. The sum of these proportions is 76%, and their average is 38%. This average trading rate is significantly different from the 50% implied by the null hypothesis \( (\chi^2=4.89, p = .027) \). The average trading rates given a 1/6 probability of loss and a 5/6 probability of loss, both of which correspond to a low level of uncertainty, were similar, 39% and 40% respectively \( (\chi^2=5.01, p = .025, \text{ given low likelihood}; \chi^2=2.97, p = .084, \text{ given high likelihood}) \). The average trading rate given a ½ probability of loss, which corresponds to a high level of uncertainty, was only 26% \( (\chi^2=15.92, p < .0001) \).

Most importantly, a clear pattern emerged. First, each of the low uncertainty treatments yielded virtually identical reluctance to trade as guaranteed possession. Second, relative to guaranteed possession and a low level of uncertainty, a high level of uncertainty significantly exacerbated the endowment effect, both in terms of average trading rates \( (p = .045, d = .20) \) and by individual item. Only 18%, 20%, and 15% of M&Ms holders traded under certainty, 1/6 probability of loss, and 5/6 probability of loss respectively, but given a ½ probability of loss, the proportion of M&M holders who traded was even lower: 10%. Likewise, 58%, 57%, and 55% of Post-Its holders traded under certainty, 1/6 probability of loss, and 5/6 probability of loss respectively, but only 42% of Post-Its holders traded given a ½ probability of loss.
Conclusion

We have investigated the impact of unavoidable uncertainty about maintaining holdings that are subject to trade. In two experiments, we observed that a sufficiently high level of such uncertainty exacerbates the endowment effect. This result does not appear to be attributable to anticipated regret nor to a generalized “freezing up” associated with the mere presence of uncertainty.

As we have mentioned, understanding the impact of uncertainty may inform extant explanations of the standard endowment effect under certainty. We next discuss implications of our results in relation to four leading theories of the endowment effect: recent connection-based accounts, the classic model put forward by Thaler (1980) and Tversky & Kahneman (1981, 1986), an extension of the classic model by Koszegi & Rabin (2006), and a notion of preference-imprecision best articulated by Loomes, Orr, & Sugden (2009).

Many researchers have suggested that psychological connections to possessions underlie the endowment effect. Such connection-based accounts are largely of two forms. Some propose that receiving an item induces a minimal but immediate emotional attachment to it (Ariely, Huber, and Wertenbroch 2005; Peck and Shu 2009; Peters, Slovic, & Gregory, 2003; Reb & Connolly, 2007; Smith, Faro, and Burson, 2012). Others propose that receiving an item engenders an association of it with the self (Beggan, 1992; Morewedge, Shu, Gilbert, & Wilson, 2009). In these accounts endowment effects arise because people are averse to breaking connections.

The results we report may point to an interaction of attachments and associations. Connection-based accounts can explain our results only if the connection to an item tends to be equivalently strong given certainty, a 1/6 probability, or a 5/6 probability of maintaining the item yet significantly weaker given a ½ probability of doing so. Such a pattern could result if (i) greater likelihood of maintaining possession yields greater association of an item with the self, but (ii) emotional attachments are most salient when maintaining possession is least likely, (iii) and at least one of these relationships shows appropriate non-linearity.
The classic model of the endowment effect (Thaler 1980; Tversky and Kahneman 1981, 1986) assumes reference-dependence, the notion that people assess choice options by evaluating the changes these options entail from a reference point. It then attributes the endowment effect to loss aversion, the notion that negative changes have greater impact than corresponding positive changes. Consider the guaranteed possession treatment in Experiment 1 with participants’ reference points being their initial holding. From the reference point of mug holders, a trade yields two simultaneous changes, loss of the mug and gain of highlighters. On the flip side, from the reference point of highlighter holders, a trade yields loss of highlighters and gain of a mug. If losses loom larger than gains, then across all participants, a simultaneous gain and loss is, on average, a net negative. In contrast, because not trading induces no change from the status quo, it is a net zero. People are thus reluctant to trade.

Extending the classic model to explain the impact of unavoidable uncertainty may require conceptualizing risk as a component of a person’s holdings. Note that risk, in the sense of a possible loss of one’s possessions, is presumably aversive. In this light, consider two changes: (a) the positive change of dispensing with the risk associated with one’s endowment, by trading the endowment away, and (b) the negative change of acquiring the risk associated with an alternative item, by obtaining that item. Our results are consistent with the latter having more impact than the former; that is, our results are consistent with the notion that “taking on risk looms larger than parting with risk.” Note a critical difference between this hypothesis and one concerning anticipatory regret. The present hypothesis implies that it is the taking on of risk that people find especially aversive not the anticipatory regret that the held risk may turn out badly.

Koszegi & Rabin’s (2006) influential model of stochastic reference points cannot explain our results and, in fact, predicts the opposite of our findings. The model treats guaranteed possession much like Kahneman and Tversky do. It supposes that not trading has an advantage over trading, because not trading is framed as “no change,” while trading is framed as a simultaneous gain and loss that by loss aversion are on average a net negative. Critically, under unavoidable uncertainty, the model emphasizes neither dispensing with risk nor acquiring risk. It instead highlights the impact of (c) maintaining exposure to a particular risk. Specifically, the model implies that under unavoidable uncertainty not trading is framed not merely as “no
change” but in part as “leaving one exposed” to the risk of losing one’s initial holding. This exposure reduces the attractiveness of not trading and thus diminishes the endowment effect.

Loomes, Orr, & Sugden (2009) offer an explanation of the endowment effect based on the notion of imprecise preferences. Suppose a person cannot specify an exact subjective valuation of some item; he or she knows only that the subjective value lies within some interval \([x, y]\). Confronted with a trade that offers an item whose subjective value may also lie within \([x, y]\), the person may have difficulty making a choice and “by default” opt for the status quo.

Extensions of this logic may help explain the impact of uncertainty. Perhaps with all else equal, as the number of potential outcomes increases, the greater is the tendency towards preference-imprecision. In Okada’s (2011) study, people may be able to precisely value a coupon redeemable for any one particular candy but not a coupon redeemable for a randomly-selected candy. In our setting, people may be able to precisely value a mug they hold with certainty but not a mug they could soon lose. Note, however, that fully explaining our results begs two questions concerning not the number of potential outcomes but their probability. Would we expect a \(\frac{1}{2}\) probability of losing one’s item to yield greater preference-imprecision than \(\frac{1}{6}\) or \(\frac{5}{6}\) probabilities? And would we expect \(\frac{1}{6}\) and \(\frac{5}{6}\) probabilities of losing one’s item to yield about the same level of preference-imprecision as a zero probability?

Some papers attempt to close an issue, by providing a definitive answer to an extant research question. We view our paper as helping to open up an issue, thereby hopefully suggesting possibilities for future research. Though we cannot conclusively isolate a specific causal mechanism for our results, our data are consistent with some extant theories of the endowment effect and indeed suggest modifications and additions to these theories. We hope future work further investigates just how and why uncertainty can exacerbate the endowment effect as well as potential implications for the endowment effect under certainty. Another potentially important avenue is to investigate how people trade between uncertain holdings and certain holdings (Sprenger, 2014). For instance, if some participants were endowed with a mug only uncertainly and others were endowed with highlighters with certainty, would reluctance to trade be exacerbated relative to a relevant baseline?
References


Figure 1. The proportion of participants electing to trade, by initial endowment, in each treatment of Experiment 1. The null hypothesis of no endowment effect implies that within each treatment the sum of trading rates should equal 100% and the average trading rate should equal 50%.
Figure 2. The proportion of participants electing to trade, by initial endowment, in the four treatments of Experiment 2. The null hypothesis of no endowment effect implies that within each treatment the sum of trading rates should equal 100% and the average trading rate should equal 50%.