A Reference Price Theory of the Endowment Effect

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ABSTRACT

Acquiring a good seems to increase its value to the owner, as consumers show reluctance to trade away their possessions for similarly valuable money or other goods. The established explanation for this endowment effect is that consumers evaluate potential trades with respect to their current holdings. From this perspective, selling prices exceed buying prices because owners of a good regard its potential loss to be more significant than non-owners regard its potential acquisition. In contrast to this "pain-of-losing" account, we propose a reference price theory which characterizes the endowment effect as the reluctance to trade on unfavorable terms. In this view, consumers evaluate potential trades with respect to salient reference prices, and selling prices (or trading demands) are elevated whenever the most common reference prices — typically market prices — exceed personal valuations. In seven experiments (and eight more summarized in appendices), we show that manipulations which reduce the gap between valuations and reference prices tend to reduce or eliminate the endowment effect. These results support our theory and suggest that the endowment effect is often best construed as an aversion to bad deals, rather than an aversion to losing possessions.

Keywords: Endowment effect, evaluation disparities, reference prices, loss aversion, transaction utility.

Buying and selling have a deep symmetry. When an apple is traded for an orange, there is no basis for even distinguishing the "buyer" from the "seller" — these labels can be uniquely assigned only when money is one of the "goods" being exchanged. Since economic theory treats buying and selling symmetrically (Stigler 1966), maximum buying prices and minimum selling prices are generally viewed as alternate expressions of a good's value, and are expected to coincide (Henderson 1941; Willig 1976).[1]

In practice, they don't. In their review of 59 studies involving ordinary market goods, Horowitz and McConnell (2002) report that selling prices are nearly three times higher than buying prices. Thaler (1980) termed this disparity the *endowment effect* and recognized it as a manifestation of loss aversion (Kahneman and Tversky 1979; Tversky and Kahneman 1991). By his account, consumers evaluate potential trades with respect to their current holdings. Selling prices exceed buying prices because owners of a good regard its potential loss to be more significant than non-owners regard its potential acquisition.

In contrast to this "pain-of-losing" account, we propose that the endowment effect is often better understood as the reluctance to trade on unfavorable terms. Consumers evaluate potential trades with respect to salient reference prices, and selling prices (or trading demands) are elevated because the most common reference prices (market prices) typically exceed valuations. In seven experiments, we show that manipulations which reduce the gap between valuations and reference prices tend to reduce or eliminate the endowment effect. These results suggest that the endowment effect is often best construed as an aversion to bad deals, rather than an aversion to losing possessions.[2]

VALUATIONS, REFERENCE PRICES AND TRANSACTION DISUTILITY

Thaler (1985) proposed that consumers consider not only the benefits from the good they might buy or sell, but also the perceived merits of the deal: whether the actual price is higher or lower than they expect. In one study, participants imagined sitting on a beach with a friend who had just offered to bring them back a bottle of their favorite beer. On average, participants authorized their companion to spend $2.65 when told that beer would be purchased from a fancy hotel, but just $1.50 when it came from a run-down grocery store. In other words, the *expectation* to pay less became a *willingness* to pay less. Analogously, participants who contemplated selling tickets to a hockey game they could no longer attend demanded more if the original purchase price was higher. These examples are supported by other research (Emery 1970; Monroe 1973; Winer 1986) suggesting that consumers tend to evaluate transactions with respect to reference prices, and that transactions which diverge from the reference price can invoke "transaction utility" (Thaler 1985). In particular, a potential transaction price that compares *unfavorably* to the reference price generates transaction *dis*utility, which diminishes the attractiveness of the contemplated trade.

We propose that the endowment effect is due in large part to transaction disutility, which typically acts to increase selling prices (though sometimes acts to reduce buying prices). A simple model will help us state our claim more precisely. Assume that a consumer's desire for any given good can be expressed in monetary terms as his valuation v, which indicates his expected benefits from using the good: his "consumption utility" (Koszegi and Rabin 2006). If this were all that mattered, the consumer's maximum buying price and minimum selling price would converge at v. But we propose that bids are distorted to alleviate the disutility that arises from the prospect of a "bad deal": that is, when trading at one's valuation is less favorable than

trading at some salient reference price, *r*. We therefore expect sellers to demand a price in excess of *v* when $r > v$, and buyers to be unwilling to pay as much as *v* when $r < v$. The larger the distance between *r* and *v*, the greater these distortions and the greater the divergence between buying and selling prices. Figure 1 illustrates this relation for a fixed *v* as *r* varies.

*** FIGURE 1 ABOUT HERE ***

This model is intended to encapsulate our theory of when and why buying and selling prices diverge. We make no attempt to incorporate every factor that affects such prices, but a few simplifications are worth noting. First, we omit any direct influence of reference prices on valuations themselves, as when price signals quality. This can of course occur, but does not shed much light on buyer/seller *disparities*. Second, we exclude *positive* transaction utility, i.e. any distortions resulting from the pleasurable prospect of trading at *v* when *v* compares *favorably* with *r*. We don't deny this possibility, but believe that its force, when present, is weak. Support for this belief can be found in the study of interpersonal utility functions (Loewenstein, Thompson and Bazerman 1989) showing that inequalities working in one's favor count much less than disadvantageous inequalities (see also Erdem, Mayhew and Sun 2001). As discussed in Appendix A, our predictions hold in a more general model that includes the effects of such positive utility, provided that this force is weaker (i.e., that consumers are loss averse in this sense). Finally, for convenience, we speak as though everyone adopts the intended *r*, though some heterogeneity can be expected even when we make a particular *r* salient.

Although transaction disutility can create price gaps by inflating selling prices or by depressing buying prices, the influence on selling prices is far more common in practice. The reason for this is that market prices, and therefore reference prices, tend to substantially exceed

valuations for an arbitrarily selected product (such as a coffee mug).). In other words, most people are typically unwilling to buy most products at their retail prices.[3] As a consequence, transaction disutility tends to distort selling prices upward, while buying prices tend to faithfully reflect valuations.

The pain-of-losing account presumes that selling and buying have fundamentally different psychologies: owners are thought to experience the act of selling as "losing" the item being sold, whereas buyers are not seen as experiencing an analogous loss. Tversky and Kahneman (1991, *p*. 1055), for example, suggest that "the buyers in these transactions do not appear to value the money they give up in a transaction as a loss." By contrast, we propose that there is no *inherent* difference in the psychology of selling versus buying. Though we also attribute most price gaps to sellers, we believe this is "only" because reference prices tend to exceed valuations. Although both theories explain the endowment effect in terms of loss aversion, they differ with respect to the reference point from which prospective gains and losses are evaluated. According to the pain-of-losing account, the relevant referent is endowment status (whether one currently possesses the good), whereas by our account it is the good's reference price.

The idea that reference price comparisons might be involved in the endowment effect has some support in recent research. When studying how consumers justify disparities between buying and selling prices, Brown (2005) found that explanations consistent with transaction disutility were very common, whereas explanations related to the pain-of-losing account were rare. Simonson and Drolet (2004) showed that buying prices were influenced by arbitrary anchors that referred to perceived value, whereas selling prices were influenced by anchors that referred to market prices. They concluded that personal value and market price both inform bids, but value is given more weight when buying, and market price more when selling. To our

knowledge, however, no prior work has offered a theoretical account of the endowment effect in terms of reference prices, nor conducted experiments designed to test the predictions of such an account against alternate theories. We turn to these empirical tests now.

EXPERIMENTAL TESTS THAT MANIPULATE REFERENCE PRICES

Most previous studies on the endowment effect cannot differentiate pain-of-losing and reference price accounts because they involve goods whose reference prices considerably exceed most consumers' valuations. This confounds the effect of endowment (sellers are endowed whereas buyers are not) with the effect of transaction disutility (which in such circumstances affects sellers but not buyers). To differentiate the two accounts, we manipulate both endowment status and reference prices. If the endowment effect is caused primarily by differences in ownership status, reference prices shouldn't matter. But if it is caused primarily by owners' aversion to making bad deals, the effect should shrink when the reference price is reduced to a level closer to typical valuations. Thus, our model makes two predictions: that the gap between buying and selling prices will diminish as a good's reference price is reduced from high to moderate, and that this convergence will be driven by lower selling prices. Manipulations of r over this range should have comparatively little effect on buyers.

It is important to clarify that our characterizations of reference prices as "low", "moderate," or "high" are made with respect to the typical consumer's valuation. Although valuations cannot be observed directly, we do observe buying and selling prices and from these can infer the relation between r and v. This inference can be made at the individual level, but we assign general characterizations by using average buying prices across all respondents in a given treatment, as shown below:[4]

Observation	Inference	Conclusion	Label for *r*
$r < B$	$B < v$	$r < v$	"low"
$r \approx B$	$B \approx v$	$v \approx r$	"moderate"
$r > B$	$B \approx v$	$v < r$	"high"

We stress that although these characterizations are *post* hoc, as we must observe buying or selling prices to conclusively label *r*, they are not *ad* hoc, because the data do not permit arbitrary labels. So while pretests can help verify that a particular reference price has the presumed relation to valuations, they are not required because the experimental data perform the same function. Note also that as long as there is some heterogeneity in consumers' valuations, $r \neq v$ for some people, indicating the potential for (and expectation of) a gap between buying and selling prices. Thus, we do not generally expect the gap to disappear at any reference price, but if valuations are clustered near a widely adopted reference price, the disparity should be small.

Study 1: Candy

Method. Participants (N=125) were recruited for laboratory sessions from two universities. The good was a large box of candy of the kind sold at theater concession stands. All our participants first examined four candy options (Raisinets, Milk Duds, Goobers, and Jelly Belly Sours) and indicated their favorite. Then, using a 2×2 between-subjects design, we manipulated whether respondents were endowed with a box of their preferred candy (yes or no), and the reference price we suggested (high or moderate). For the high *r* condition, which reflected the good's typical consumption context, respondents were told: "As a point of reference, the Harvard Square Theater sells this candy for $4.00 per box." For the moderate *r* condition, they were told: "As a point of reference, the Target store in Watertown sells this candy for $1.49 per box." Both statements were true.

Next we elicited minimum acceptable selling prices from candy owners and maximum buying prices from non-owners, using an incentive-compatible procedure to discourage under- or overbidding (Becker, DeGroot and Marschak 1964; hereafter "BDM"). To avoid introducing additional reference prices, we did not reveal the range from which the random BDM price would be drawn (in fact, it was $0–$5). Written and oral instructions emphasized that the outcomes would be enforced and that it was in participants' best interest to bid honestly. A computer program randomly generated a transaction price for each participant, which we then revealed along with the outcome it implied: non-owners whose bids exceeded their BDM price bought candy, and owners whose bids were below the BDM price sold their candy back to the researcher. Finally, all trades were executed. Purchase prices were deducted from a show-up fee.

Results. As predicted, reducing the reference price reduced the endowment effect. In the high *r* condition, the average selling price significantly exceeded the average buying price ($S = \$2.88$ vs. $B = \$1.54$, $t_{62} = 4.05$, $p = .0001$ by a two-tailed test), but in the moderate *r* condition, the gap was not significant ($S = \$1.58$ vs. $B = \$1.20$, $t_{59} = 1.53$, $p > .13$); see Table 1. Also as we expected, manipulating the reference price significantly affected the bids of sellers ($t_{53} = 3.62$, $p < .001$), but not buyers ($t_{68} = 1.45$, $p > .15$). An ANOVA ($F_{3,121} = 12.11$, $p < .0001$) indicates main effects of endowment ($t = 4.13$, $p < .0001$), reference price ($t = 3.95$, $p = .0001$) and their interaction ($t = 2.30$, $p < .03$). Note that the average buying (and selling) prices confirm that the $4.00 is indeed a "high," and $1.49 a "moderate," reference price. For the full distributions of individual-level data, see Appendix B.

*** TABLE 1 ABOUT HERE ***

Study 2: Mechanical Pencils

While the candy study supports our hypotheses, it presents a potential confound because the reference price manipulations might also have suggested different consumption contexts (eating candy at the movies vs. at home after purchasing at Target). Though this does not readily explain the observed results, we attempted to replicate our results using a different good and a design that does not have this confound.

Method. With the promise of a $10 show-up fee, we recruited 155 participants to attend experimental lab sessions at a local university. The focal good in this study was a Pentel mechanical pencil. As in Study 1, we varied endowment status and reference price in a 2×2 between subjects design. Here, following a reviewer's suggestion, we manipulated *r* by varying the sticker price attached to the product, which we affixed with the kind of "pricing gun" commonly used by retailers. For the high *r* condition, we specified the pencil's actual retail price of $2.29; for moderate *r* we used 79¢ — much lower, but still a plausible retail price.

In the endowed sessions, all participants received pencils which they were told they could keep. In sessions in which participants were not endowed, we passed around samples for inspection which were then collected. This procedure both familiarized participants with the product and exposed them to its reference price. Subjects then privately recorded their reservation prices. After these were collected, we publicly drew a price at random using a "bingo ball" cage which contained balls representing prices from 30¢ to $3.00 in 30¢ increments. (As in the candy study, this range was not revealed.) This "BDM price" determined the actual transaction price for all participants in the session. The full instructions, which borrow in part from Burson, Faro and Rottenstreich (2011), are shown in Appendix C.

Results. The results, summarized in Table 2, broadly reproduce those of Study 1. In the high *r* condition, selling prices substantially exceeded buying prices (S = \$1.51 vs. B = 68¢, $t_{82} = 3.51$, $p = .0004$); but for moderate *r*, the difference was not significant (S = 82¢ vs. B = 92¢, $t_{69} = 0.47$, $p = .63$). As in the candy study, manipulating *r* significantly affected selling prices ($t_{75} = 2.49$, $p < .02$) but not buying prices ($t_{76} = 1.47$, $p > .14$). An ANOVA again reveals a significant interaction effect between endowment and reference price ($t = 2.90$, $p < .005$). Appendix D summarizes similar results in three other studies involving the manipulation of (or selection on) reference prices.

*** TABLE 2 ABOUT HERE ***

BUYER-DRIVEN PRICE DISPARITIES

Because reference prices are usually high relative to consumer valuations, the prospect of transacting at *v* is typically perceived as a bad deal by sellers, but not by buyers. The first two studies suggest that lowering the reference price to approximate *v* reduces the endowment effect by alleviating the transaction disutility that sellers experience. However, when *r* is lowered further, to be below *v,* our model makes different predictions. In such cases, transacting at *v* becomes a bad deal for *buyers*, and we should observe depressed buying prices. By contrast, manipulating *r* over this range should not significantly affect selling prices.

These collective predictions yield a surprising implication: if *r* can be credibly varied over a sufficiently wide range, the relation between *r* and the endowment effect will be U shaped. . Price disparities will be significant if *r* is very low (because it depresses buying prices) or very high (because it inflates selling prices), but much smaller when *r* is intermediate and close to *v*. This prediction further distinguishes our reference price theory from the prevailing pain-of-

losing account, which neither cites reference price as an important factor in the endowment effect, nor offers an explanation for the U-shaped pattern we observe in the next two studies.

Study 3a: Lottery Ticket

Extending our model to low reference prices is challenging, because it is difficult to find a good which can be assigned an *r* that is both credible and below most of our participants' valuations. For familiar goods, consumers have sufficient price knowledge that low values of *r* are unlikely to be plausible; yet for unfamiliar goods, reference prices may serve as strong quality signals, such that a low *r* might depress *v* as well and thereby reduce the gap we intend to create. Our solution was to use a gamble as our target good, which nearly everyone should value, yet which supports a wide range of (partially) legitimate reference prices.

Method. The procedure and instructions were very similar to those for the mechanical pencil study. We explained that the good under consideration was a "lottery ticket" that had a 1/3 chance of winning $2.50 and otherwise paid nothing. Participants in the endowed condition were told that the piece of paper containing the task's instructions was itself the lottery ticket, and was theirs to keep if they so chose. Just above the space in which subjects entered their buying or selling prices, the instructions included one of three statements designed to suggest different reference prices.

Low *r*:	Remember that if you buy [keep] this ticket, there is a 2/3 chance that it will be worth $0.
Moderate *r*:	Note that if you had many lottery tickets just like this one, on average each one would win 83¢.
High *r*:	Remember that if you buy [keep] this ticket, you can win as much as $2.50.

Using the bingo ball cage, we generated a BDM price from the interval \$0 to \$2.50. For participants who acquired or retained tickets (i.e., buyers who bid above the BDM price or sellers who bid below it), we conducted a second random draw to determine if they won their gamble, and paid them accordingly.

Results. Table 3a shows the mean buying and selling prices for each reference price (total N=159). In the low *r* treatment, selling prices are roughly twice buying prices ($t_{60} = 3.51$, $p < .001$). For moderate *r*, the difference is negligible ($t_{46} = 0.25$, $p > .80$). But for high *r*, the endowment effect re-emerges, with selling prices again exceeding buying prices by a factor of nearly two ($t_{47} = 3.93$, $p < .0003$). Thus, the endowment effect exhibits the predicted U-shaped relation with *r*. The specific pattern of bids further supports our model. Buying prices are significantly lower in the low *r* condition than in the moderate and high *r* conditions, and selling prices are significantly higher in the high *r* condition than in the low and moderate conditions (*p's* < .05 by Tukey-Kramer HSD tests). These findings are consistent with our hypotheses that transaction disutility depresses buyers' bids when the reference price falls below valuations, and inflates sellers' bids when the reference price exceeds valuations. Note also that this study shows why use of the term "endowment effect" as a synonym for price gaps can be misleading: for low references prices, the disparity is driven by *non*-owners who are reluctant to bid their full valuations.[5]

*** TABLE 3 ABOUT HERE ***

We could not guarantee, or even subsequently confirm, that any given participant adopted the reference price that we suggested. In this study especially, it seems likely that some respondents rejected the extreme reference prices we proposed, or perhaps averaged them with other reference prices which came spontaneously to mind. Indeed, between the low and high *r*

conditions, a total of nineteen participants bid exactly the expected value, though that was not mentioned in those conditions. The presence of other possible reference prices certainly weakened our manipulations, yet the patterns our theory predicts nevertheless emerged.

Study 3b: Lottery Ticket Redux

In this study, 368 members of a university-sponsored website evaluated a lottery ticket that conferred a 1/3 chance of winning $250 and a 2/3 chance of paying nothing. The study was intended to test whether we would again observe the U-shaped relation between reference price and the endowment effect using different stakes and a slightly different design.

Method and Results. As in the prior study, we used a 2×3 between subjects design, manipulating whether participants were buyers or sellers, and whether they received a low, moderate, or high reference price. Reference price was manipulated by directing attention to either the modal willingness to pay from a pretest (low *r*), the mean willingness to pay from a pretest (moderate *r*), or the expected value (high *r*), which the pretest suggested would considerably exceed most respondents' valuations. Specifically, respondents were told one of the true facts below, and then indicated whether they would buy [sell] at that price, before stating their maximum willingness to pay [minimum compensation demanded].

Low *r*:	In a prior study, the most common amount that participants would pay for this ticket was $5.
Moderate *r*:	In a prior study, the average amount that participants would pay for this ticket was $24.
High *r*:	Lottery tickets like this one pay out an average of $83.

It may seem peculiar that we used the gamble's expected value as the moderate reference price in the small stakes study, but the high reference price in this one. However, based on prior

research examining the effect of stakes on risk aversion (see, e.g., Hershey and Shoemaker 1980; Green, Myerson and Ostazewski 1999; Rachlin, Brown and Cross 2000; Weber and Chapman 2005), we expected respondents to be approximately risk neutral for the small stakes study, such that the expected value (83¢) would be similar to valuations. (Table 3 confirms this expectation, as 83¢ is very close to both buyers' and sellers' average bids.) But risk aversion is generally greater for larger amounts, and we learned from a pretest that $83 substantially exceeded most valuations. This information guided our use of $83 as the high reference price, and our selection of a moderate reference price that was well below the gamble's expected value.

The results, summarized in Table 3b, replicate the pattern of results in the small-stakes lottery. The U-shaped relation between reference prices and the endowment effect predicted by our theory was again observed. Moreover, as before, buying prices differed significantly between the low and moderate r groups ($t_{120} = 3.07$, $p < .01$), but not between the medium and high r groups ($t_{118} = 0.75$, $p > .45$). Conversely, among sellers, the low and medium groups did not differ ($t_{125} = 1.07$, $p > .29$), but the medium and high groups did ($t_{125} = 7.50$, $p < .0001$).[6]

EXPERIMENTAL TESTS THAT MANIPULATE VALUE

The gap between valuations and reference prices depends, of course, on both quantities. In the first set of studies, we tested our theory of the endowment effect by manipulating r. An alternative approach is to manipulate v. For the typical situation in which $r > v$, introducing factors that enhance perceived value should affect buying prices more than selling prices, because buying prices equal v, whereas selling prices are a weighted average of v and r.[5] As a consequence, increasing v should reduce the endowment effect.

Study 4: Gourmet Chocolate Bars

For our first test, we manipulated value by offering one of two flavors of Vosges chocolate bars: "Wooloomooloo," made with milk chocolate and coconut; or "Oaxaca," with dark chocolate and chili pepper. Pretests indicated that the sweet and salty Wooloomooloo bar was generally preferred to the bitter and spicy Oaxaca bar. For each student, we elicited *both* maximum buying and minimum selling prices.

Method and Results. Forty students in a graduate marketing course examined the two flavors of chocolate bars. Their original price tags ($7.50) were clearly visible, though we did not direct attention to them. We asked each student to report four reservation prices: for each flavor, her maximum buying price and minimum selling price (assuming having received a bar). To motivate participants to reveal their true bids, we explained that the BDM procedure would be used to enforce the decisions of four randomly selected students (one buyer and one seller for each flavor). Once all responses were collected, we chose the students, randomly generated the BDM price, and executed the transactions (or not) according to the specified rules.

Maximum buying prices were significantly higher for the Wooloomooloo bar ($3.59 vs. $2.75, $t_{39} = 2.05$, $p < .05$), but flavor had no effect on minimum selling prices ($5.18 vs. $5.28, $t_{39} = .27$, n.s.). Correspondingly, the endowment effect was smaller for the "high-value" (Wooloomooloo) bar than the "low-value" (Oaxaca) bar. This follows from our model, because both flavors share a high reference price, and consumer valuations should, on average, be closer to this r for the tastier bar. Since we elicited both buying and selling prices for each respondent, here we could also directly test whether the ratio of selling to buying prices tends to be smaller for the more highly-valued product. This prediction was confirmed: the average endowment effect ratio is 2.50 for Oaxaca vs. 1.69 for Wooloomooloo ($z = 2.04$, $p < .05$).[8]

Note that this result does not readily follow from the "pain-of-losing" account: if the endowment effect results from an aversion to parting with possessions, we might expect this aversion to be stronger for the more highly valued possession. Nor is it consistent with an alternative explanation proposed by Carmon and Ariely (2000). According to their "focus on the forgone" account, sellers set their reservation prices according to the utility they will forgo by giving up the good. On the contrary, our show that variations in utility affect buyers more than sellers.

*** TABLE 4 ABOUT HERE ***

Study 5: Rubik's Cube Key Rings

To further verify our model, we conducted a second value manipulation test in which we varied the evaluation context rather than product attributes. We also used the more typical between-subjects design, and responses were consequential for all respondents (as opposed to probabilistically real in the Vosges study). Finally, to evaluate whether our theory of the endowment effect extends to situations in which reference prices remain implicit, here we provided no reference price upon which respondents might be expected to converge: no price tags were shown, nor did we disclose the product's actual retail price ($5.59).

Method and Results. To manipulate value, we borrowed a procedure from Bushong et al. (2010), who found that valuations for a good are increased when physical barriers are removed. For example, willingness to pay was higher when a product was taken out of its package and placed in close proximity than when the same item was behind a glass barrier or merely represented in a photograph. We applied one of their manipulations using a small Rubik's Cube attached to a key ring as our focal good. In each lab session, all participants were designated as

either buyers or sellers and were shown the good in one of two forms: as an image on a computer screen (intended to evoke relatively low valuations) or as the actual product, unpackaged and placed in front of them (our high *v* condition). We then solicited bids using the BDM mechanism to deter strategic bidding.

As Table 5 shows, the results are consistent with our findings for gourmet chocolate bars. Maximum buying prices were greater for the tangible, unpackaged product than for the mere image (\$1.21 vs. 51¢, $t_{54} = 2.49$, $p < .02$), but presentation format did not significantly affect minimum selling prices (\$1.95 vs. \$1.53, $t_{42} = .91$, $p = .36$). Thus, the endowment effect is substantial for the image condition ($t_{52} = 3.46$, $p < .002$), but weaker and statistically insignificant for the tangible condition ($t_{44} = 1.65$, $p = .11$).

*** TABLE 5 ABOUT HERE ***

We also wanted to test the proposition that in the absence of an explicit reference price, consumers spontaneously generate a reference price from their estimate of the market price. Although we did not solicit such estimates from participants, we did with an independent sample in a follow-up study. Among this group, the mean estimate of the key ring's retail price was \$3.62. This is well above the average buying price in our study (97¢, pooling across conditions), confirming our expectation that most "self-generated" reference prices exceed participants' valuations for the item. Thus, this study suggests that self-generated reference prices invoke transaction disutility and distort bids much as public reference prices do. (In Appendix D, we summarize two other studies in which we solicit bids and market price estimates, using the latter as a proxy for each respondent's reference price.)

Summary of Study Results Comparing S/B Ratios

Figure 2 shows the endowment effects, measured as the ratio of the mean compensation demanded (selling price) to mean willingness to pay (buying price), in Studies 1-5. As explained above, in Study 4 we used a within-subjects design which enabled us to confirm that these ratios differed significantly between conditions. The obstacle to conducting similar tests for the remaining studies is that those *S/B* ratios exist only as summary statistics, not as individual level data. To construct appropriate hypotheses tests, we need a way to estimate their variances.

One solution to this problem, proposed by a reviewer, is the Delta method, which uses Taylor series expansions to approximate variances. The Taylor series expansion for our purposes includes a measure of the correlation between the two random variables that comprise the ratio of interest (i.e. *B* and *S*). Again, excepting Study 4, this correlation cannot be computed directly. However, our model, as well as common sense, indicate that *B* and *S* are positively correlated because both are determined in part by underlying valuations. To guide our estimate of their correlation, we looked to within-subjects data sets for which the relevant correlation is reported: Brown (2005) reports a median correlation of .49; Frederick (2011) found correlations averaging .62; and in our own Study 4, the correlation is .52 for the Oaxaca bar and .73 for Wooloomooloo. Informed by these data, we estimated $\rho(B, S) = .5$ (we chose this value to be conservative, as the resulting test statistic increases with the correlation estimate).

We used the differences in mean ratios and the variances estimated using the Delta method to construct z-statistics which test the significance of these differences. The results, shown in Table 6, support the conclusions reached earlier using more familiar analyses: the endowment effect is significantly different in every case predicted by our model (though only marginally so in Study 5; $p < .06$).

*** FIGURE 2 AND TABLE 6 ABOUT HERE ***

CAN TRANSACTION DISUTILITY EXPLAIN THE RELUCTANCE TO TRADE ONE GOOD FOR ANOTHER?

The endowment effect typically refers to the disparity between buying prices and selling prices. But purchase and sale transactions are special cases of a general class of exchanges which need not involve money, and these have also been cited as examples of the endowment effect. For example, in a classic study, Knetsch (1989) found that 89% of people endowed with a coffee mug preferred to keep it rather than trade for a candy bar, whereas 90% of those endowed with a candy bar preferred to keep it rather than trade for a mug.

Viewed in terms of the pain-of-losing account, the reluctance to trade one good for another is almost self-explanatory. The result is less obvious from the perspective of our theory, but not hard to reconcile. Consider a participant who receives a chocolate bar valued at $2, with a $10 price tag prominently displayed. As we've demonstrated, the comparatively high reference prices increase the amount of money participants demand in exchange for that chocolate. But this result presumably extends to *whatever* form of compensation is offered in exchange for that chocolate. If high reference prices elevate the compensation demanded above valuations, then — essentially by definition — *anything* of comparable value (e.g., two dollars, seven oranges, or a coffee mug) will be insufficient to induce a trade. This analysis suggests that trade rates will be increased by reducing reference prices. We test this next.

Study 6: Highlighters and Cord Straps

To test the applicability of our theory to trades not involving money, we needed two products of comparable attractiveness whose reference prices could be plausibly manipulated. We chose a package of Bic highlighter pens in various colors, and a package of Velcro "cord straps" used to organize computer cables and power cords.

Method. Study participants were recruited to attend one of several laboratory sessions, each of which was designated to one of four experimental conditions in which we manipulated initial endowment (highlighters or cord straps) and reference price (high or moderate). Reference prices in the high condition were the actual retail prices ($4.29 for the highlighters, $3.89 for the cord straps). For the reduced *r* condition, we chose $1.19 and 99¢ respectively. As in the mechanical pencil study, these reference prices were communicated using stickers from a pricing gun, which we affixed to each package. Across all sessions, there were 133 participants.

In each lab session, we began by giving each participant the appropriate initial endowment, explaining that it was theirs to keep if they so chose. We then passed around samples of the alternate item for inspection and to ensure exposure to the alternate good's reference price. Each person then privately indicated his preference: either keep the item he had been given, or trade it for the alternative. Finally, requested trades were executed. (The instructions we used are reproduced in Appendix C.)

Results. Figure 3 shows the proportion of people who ultimately chose the highlighters in each group. An endowment effect is evident if this proportion is higher among those given highlighters (who chose them by declining to trade) than among people endowed with cord straps (who chose them by requesting a trade).

When the items carried their actual (high) retail prices, choice depended heavily on initial endowment ($\chi^2_1 = 10.37$, $p < .002$). But for reduced *r*'s, which are presumed to more closely approximate valuations, the proportion of people who preferred highlighters was about equal regardless of which item they were initially given ($\chi^2 = 0.17$, $p = .68$).

*** FIGURE 3 ABOUT HERE ***

Applying a logit model shows a main effect of endowment ($z = 2.59$, $p = .01$) and of the interaction between endowment and reference prices ($z = 2.13$, $p < .04$). In this model there is no main effect of reference price ($z = 0.63$, $p = .53$), but if we instead use the decision to trade or not trade as the dependent variable, reference price manifests as a main effect (again with $z = 2.13$, $p < .04$ as for the first model's interaction term). That is, reducing reference prices increases willingness to trade regardless of which item the consumer initially receives. In fact, 49% of the moderate *r* group chose to trade, very close to the 50% expected if there is no preference for initial endowments. Collectively, these tests support the idea that the reference price theory may be relevant not only to transactions involving money, but also to exchanges between non-monetary goods.

A recent study by Apicella and colleagues (2011) involving the Hadza hunter-gatherers of Northern Tanzania found that the endowment effect (as measured by trade reluctance for biscuits and lighters) was greater among Hadza who lived in a village frequented by Western tourists than among those who were geographically remote and hence isolated from market activities. These results provide additional support for our model, because they suggest that exposure to modern markets may be a prerequisite of the endowment effect, perhaps by imparting notions about reference prices and fair exchange rates. Interestingly, List (2003) reported that increased

experience trading sports cards and collector's pins *attenuated* the endowment effect. Although these findings appear to contradict each other, we propose the following reconciliation: the isolated Hadza, because they had no prior exposure to markets, *lacked the notion* of a reference price that might dissuade a trade. List's subjects, by contrast, were acutely familiar with this notion, and their extensive experience might have imparted the lesson that some reference prices are irrelevant with respect to what can be expected in exchanges.

DISCUSSION

Seven experiments support our contention that the endowment effect is often better understood as an aversion to transacting on unfavorable terms than as an aversion to parting with objects one possesses (or imagines possessing). We emphasize that our reference price theory does not preclude the possibility that pain-of-losing can contribute to the endowment effect. But for the variety of products, experimental designs, and other stimuli we have investigated, the phenomenon is readily explained in terms of transaction disutility resulting from comparisons to reference prices, but not by the anticipated discomfort associated with the prospect of relinquishing goods. Thus, in our view, the traditional characterization of the endowment effect as "the tendency to place a larger value on an item when it is in one's possession" (Brenner et al., 2007) is, at best, incomplete.

Of course, any account of the endowment effect faces a very large set of experimental data to address, and none is likely to explain it all. For example, Strahilevitz and Loewenstein (1998) found that people who possessed a coffee mug for 20 minutes demanded more to sell than did others who had just received a mug. They also offered more to reacquire mugs that were taken away from them. This result appears more consistent with the pain of losing account than with

our theory of reference prices. In light of such results, a reasonable conclusion is that our theory should supplement rather than supplant the prevailing view.

Our model does, however, comfortably accommodate results that chafe other accounts. For example, it is common to find *no* endowment effect for money or monetary tokens, for the exchange of close substitutes, for goods exchanged "as intended" (e.g. merchants selling retail goods), or for money spent on routine purchases. To reconcile these results, proponents of the pain-of-losing account must treat them as exceptions (Tversky and Kahneman 1991; Novemsky and Kahneman 2005). But such results follow naturally from our model, because these are all instances in which v and r converge (as illustrated in Figure 1). For example, there is no endowment effect for a five-dollar bill because $5 is both the valuation and the reference price for all buyers and sellers. Similarly, merchants experience no loss aversion because they sell at or above the two most likely reference prices (retail and wholesale prices).[9]

Our model also informs the debate over whether buyers experience loss aversion for the money given up in purchases (see Bateman et al. 1997; Bateman et al. 2005; Novemsky and Kahneman 2005; Tversky and Kahneman 1991). We assume that buyers experience loss aversion only when buying at prices exceeding their adopted reference price. In experimental tests of the endowment effect, these circumstances arise rarely. However, Carmon and Ariely (2000) provide one such example, which happens to also help differentiate our reference price account from their "focus on the forgone" account. They propose, as a general principle, that manipulations of reference price will affect buyers (who are focused on the opportunity costs of the purchase) more than sellers (who are focused on the forgone utility from consuming the good). In apparent support, they show that as they increased the stated face value of basketball tickets to the Final Four tournament from $15 to $45, buying prices increased from about $65 to

about $95, whereas selling prices remained essentially unchanged at $175. Note, however, that their highest reference price condition would be characterized as "low" by our model, since $45 was well below typical buying prices, and, thus, well below valuations. Note further that our model predicts that manipulations of *r* will influence buyers more than sellers when *r* is below *v*. Importantly, however, the two accounts make opposite predictions when $r > v$. In contrast to their account, our model predicts that manipulations of reference price will affect sellers more than buyers. That prediction is confirmed by the first three studies we present, and by five more summarized in Appendix E.

Non-Market Goods

Our model is not readily applicable to public or non-market goods, such as environmental quality, in which reference prices are unstated and difficult to impute. Yet such goods usually exhibit a very large endowment effect (see e.g., Boyce et al., 1992; Brown and Gregory, 1999). We suggest that many such bids are intended as protest responses to avoid implied endorsement of a transaction regarded as offensive or illegitimate. This behavior reflects elements of both the reference price and pain-of-losing accounts: the adoption of a buying or selling role entails an assumption regarding current entitlement or ownership, but executing the specified transaction can be a source of "disutility" (i.e., discomfort, resentment, indignation, outrage).[10]

Implications for Practice

The prevailing account of the endowment effect conjures the image of consumers who "become attached to objects that are in their possession and are reluctant to part with them, even if they would not have particularly liked the objects had they not been endowed with them" (Van Boven, Loewenstein and Dunning 2003). This characterization provides a rationale for the common marketing practice of offering free or low-cost trials. But our research suggests that the benefits of consumers' desire to maintain their entitlements might be overwhelmed by the negative impact of suggesting a very low (sometimes even zero) reference price. Marketers might be better off restructuring free trials as money-back guarantees, or emphasizing the post-trial price rather than the customary practice of relegating this information to the fine print.

Digital goods are particularly vulnerable to transaction disutility because consumers perceive (usually correctly) that the goods' marginal cost is near zero, and may use this as their reference price (see Nunes, Hsee and Weber 2004). This, in turn, would depress willingness to pay well below valuations, and contribute to the popularity of Napster and its many quasi-legal successors, towards which otherwise law-abiding citizens flock to avoid paying the comparatively "outrageous" market prices. In response, some recording artists (Radiohead, Nine Inch Nails) have begun publishing "special editions" of their music, which contain glossy photographs, and apparently expensive packaging, to help justify their non-zero price.

Another important impediment to purchase is the fear of a subsequent discovery that one got a bad deal. Firms can minimize the influence of this anticipated transaction disutility through price guarantees: find a lower price elsewhere and we'll refund the difference. The travel website Orbitz goes one step farther by *automatically* giving a refund if another customer later buys the

same itinerary at a lower fare. To allay bidders' concerns about overpaying, auction websites can post information about past transaction prices for similar products.

Our reference price theory of the endowment effect is also pertinent to legal analysis. Since efficient allocation and entitlement decisions require a consensual measure of value, economic and legal scholars writing about the endowment effect frequently raise the question of whether valuations are better represented by buying prices or selling prices. However, outside of law journals, this important question is rarely raised and never answered.

Following Korobkin (2003), we suggest that the answer must depend, in part, on the reasons those measures diverge. To illustrate, suppose that widgets are valued at $0 by buyers and $2 by owners. Should they be produced for $1? Perhaps, if widgets have a surprisingly pleasant texture that owners discover upon physical (and, perhaps, mental) possession. However, if the elevated selling prices derive not from any experienced tactile utility but only from anticipated sadness accompanying loss, their production would not seem justified -- after all, why expend resources creating objects capable only of causing pain.

Most discussions of the endowment effect seem to either blend or alternate between these two different conceptions, and, thus, provide no clear justification for choosing one metric over the other. By contrast, we believe our model and data *do* permit such a conclusion: specifically, that buying prices are the superior measure of valuation. If one treats valuation as an underlying construct informed by various related observations (expressions of liking, interest, and knowledge, buying prices, selling prices, the number of hours one would wait to obtain the good, etc.) data can speak to the degree to which any specific measure correlates with that construct (e.g., the degree to which it loads onto the principle component of a factor analysis). This conception provides a criterion for defining a particular metric as better or worse – much as one

might conclude that an item on an IQ test is good or bad, depending on its degree of correlation with the overall test score.

In the studies summarized in Appendix E, we collected, from each respondent, not just buying or selling prices, but at least one other measure plausibly correlated with valuation (e.g., gender, measure of baseball knowledge, liking of fossils, etc.). In all such cases, these alternate measures of valuation correlated more highly with buying prices than with selling prices, providing initial presumptive evidence that buying prices are the superior measure.

CONCLUSION

Our research builds on recent attempts to dissect loss aversion and better understand its role in the endowment effect (Ariely, Huber, and Wertenbroch 2005; Camerer 2005; Novemsky and Kahneman 2005; Knetsch and Wong 2009). Any conception of loss aversion requires a reference point against which gains and losses are defined. However, despite the considerable body of research on reference prices (Mazumdar, Raj and Sinha 2005), the idea that they be the most central component of the endowment effect been largely overlooked, and certainly underdeveloped. Notably, many relevant field studies can be understood in terms of transaction disutility arising from departures from reference prices, including brand choice (Winer 1986), real estate sales (Genesove and Mayer 2001; Einiö, Kaustia and Puttonen 2008), real estate rentals (Simonsohn and Loewenstein 2006), stock divestment decisions (Odean 1998), and a general tendency to evaluate transactions in nominal rather than real monetary terms (Shafir, Diamond and Tversky 1997). All of these examples reflect a reluctance to trade on terms that are unfavorable relative to a reference price as much as they reflect a reluctance to part with endowments.

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ENDNOTES

[1] Income effects and transaction costs permit some disparity between the two measures, but typically only a small fraction of the observed effect.

[2] Thaler (1980) uses "endowment effect" to refer both to the finding that selling prices tend to exceed buying prices, and to the theoretical explanation of the aversion to giving up endowments for that finding. We use the term only in reference to the empirical phenomenon.

[3] This asymmetry is reliably reflected in experimental data. For example, in Experiment 1 of Kahneman, Knetsch and Thaler (1990), the average participant was willing to pay just $2.25 for a coffee mug priced at $6.00, and just 75¢ for ballpoint pens priced at $3.98.

[4] Equivalent rules can be defined in terms of *S* (the average selling price).

[5] Casey (1995) makes a similar observation regarding his own finding of buyer-driven price disparities.

[6] One disanalogy between the two studies is that the endowment effect remained substantial (*S/B* = 2.0) in study 3b even at moderate *r*. In terms of our model, this result implies a greater average distance between *v* and *r*. Although the distribution of buying and selling prices indicate that *v* was *not* more variable in the higher stakes study, *r* (which we assumed, but did not measure) might well have been. The comparatively low values of *v* necessitated choosing something other than the gamble's expected value as our "moderate" reference price. However, this decision created multiple plausible reference points for participants in that condition. Some may have adopted the reported mean valuation ($24), as we intended, but others might have relied on the expected value ($83) or possibly even some combination of those two.

[7] The more strongly consumers experience transaction disutility, the more strongly this prediction will hold. When transaction disutility is felt with extreme intensity, variations in *v* below *r* should not affect selling prices at all. Appendix A provides an elaboration of this point.

[8] Four people declared a maximum buying price of $0 for one flavor. To retain these respondents while avoiding division by zero, we added 50¢ to every response. This transformation is conservative in the sense that it reduces the difference in mean ratios.

[9] Koszegi and Rabin (2006) propose an expectations-based theory of reference dependent preferences, in part, to accommodate, such results. By their account, merchants do not encode a sale as a loss of inventory and buyers do not assess a purchase as a loss of money *if* those transactions were *intended* in one's recent past. Their model "makes the extreme assumption that the reference point is fully determined by the expectations a person held in the recent past." (p. 1141). By contrast, expectations play no special role in our account and it remains unclear how our manipulations (of reference price or valuation) would influence expectations about ownership. Thus, their account does not seem to explain – much less entail – our results.

[10] For many public goods (e.g., endangered species), transaction disutility is thrust upon those pressed into the role of sellers (because stating any non-infinite selling price implies the presumption that the good is theirs to sell) or buyers (because stating any non-zero buying price implies an acceptance of responsibility for the good in question). Such respondents face a fate akin to visitors to the website www.SaveToby.com, who encounter an adorable rabbit ("Toby") which is threatened to be killed unless his owner receives $50,000. Avowing "God as my witness, I will devour this little guy," his owner emphasizes the threat by posting the recipe that will be used, which includes instructions to "cut 1 Toby into bite sized pieces." The website provoked outrage, and PayPal was besieged with requests to shut down the "donations" link. We doubt these requests came from people who wanted Toby to die, and thus, they must be understood as a repudiation of the legitimacy of the transaction they were forced to contemplate. Toby's execution has been stayed several times, and his current welfare is unknown.

TABLES

Table 1: Mean reservation prices (with standard errors as subscripts) for movie candy, according to the suggested reference price and ownership status (sellers had been endowed with a box of candy; buyers had not).

	Reference Price	
	Moderate	**High**
Sellers	$1.58 $_{(18¢)}$	$2.88 $_{(31¢)}$
Buyers	$1.20 $_{(17¢)}$	$1.54 $_{(17¢)}$

Table 2: Mean reservation prices for mechanical pencils.

	Reference Price	
	Moderate	**High**
Sellers	82¢ $_{(16¢)}$	$1.51 $_{(22¢)}$
Buyers	92¢ $_{(13¢)}$	68¢ $_{(10¢)}$

Table 3: Mean reservation prices for 1 in 3 chance of $2.50 in real study and $250 for hypothetical study).

3A: SMALL STAKES	**Reference Price**		
	Low	**Moderate**	**High**
Sellers	91¢ $_{(12¢)}$	87¢ $_{(11¢)}$	$1.45 $_{(12¢)}$
Buyers	44¢ $_{(6¢)}$	82¢ $_{(12¢)}$	84¢ $_{(9¢)}$

3B: LARGE STAKES	**Reference Price**		
	Low	**Moderate**	**High**
Sellers	$38 $_{($4.20)}$	$44 $_{($3.02)}$	$85 $_{($4.53)}$
Buyers	$12 $_{($2.05)}$	$22 $_{($2.52)}$	$25 $_{($3.84)}$

Table 4: Mean reservation prices for gourmet chocolate bars with one of two flavorings. The "higher" and "lower" value characterizations are based on pre-test opinions.

	Lower Value: Oaxaca	**Higher Value: Wooloomooloo**
Sellers	\$5.28 (43¢)	\$5.18 (41¢)
Buyers	\$2.75 (29¢)	\$3.59 (35¢)

Table 5: Mean reservation prices for Rubik's Cube key rings. The tangible presentation format was designed to increase the product's perceived value.

	Lower Value: Image Presentation	**Higher Value: Tangible Presentation**
Sellers	\$1.53 (30¢)	\$1.95 (37¢)
Buyers	51¢ (12¢)	\$1.21 (27¢)

Table 6: Statistical tests of differences in endowment effect (as defined by the ratio of Selling to Buying prices) using the Delta method.

Study		**Treatments Compared**	**Significant Difference**		
			Expected?	**Actual?**	**z Score**
S1:	Movie candy	High vs. Mod *r*	Yes	Yes	2.08
S2:	Pencils	High vs. Mod *r*	Yes	Yes	3.75
S3a:	Lottery, small stakes	High vs. Mod *r*	Yes	Yes	2.91
		Mod vs. Low *r*	Yes	Yes	3.20
		High vs. Low *r*	No	No	1.08
S3b:	Lottery, large stakes	High vs. Mod *r*	Yes	Yes	2.76
		Mod vs. Low *r*	Yes	Yes	2.18
		High vs. Low *r*	No	No	0.48
S4:	Gourmet chocolate	Lower vs. Higher *v*	Yes	Yes	2.04*
S5:	Rubik's key ring	Lower vs. Higher *v*	Yes	Marginal ($p < .06$)	1.92

* This test did not rely on the Delta method; see Study 4 Method and Results for details.

FIGURES

Figure 1: An illustration of the hypothesized effect of reference prices, *r*, on stated buying and selling prices, for an individual with (unobserved) valuation *v*. When reference prices are "high" ($r > v$), selling prices will be elevated above valuations. When reference prices are "low" ($r < v$), buying prices will be depressed below valuations. When reference prices equal valuations ($r = v$), buying and selling prices should converge (i.e., there is no endowment effect).

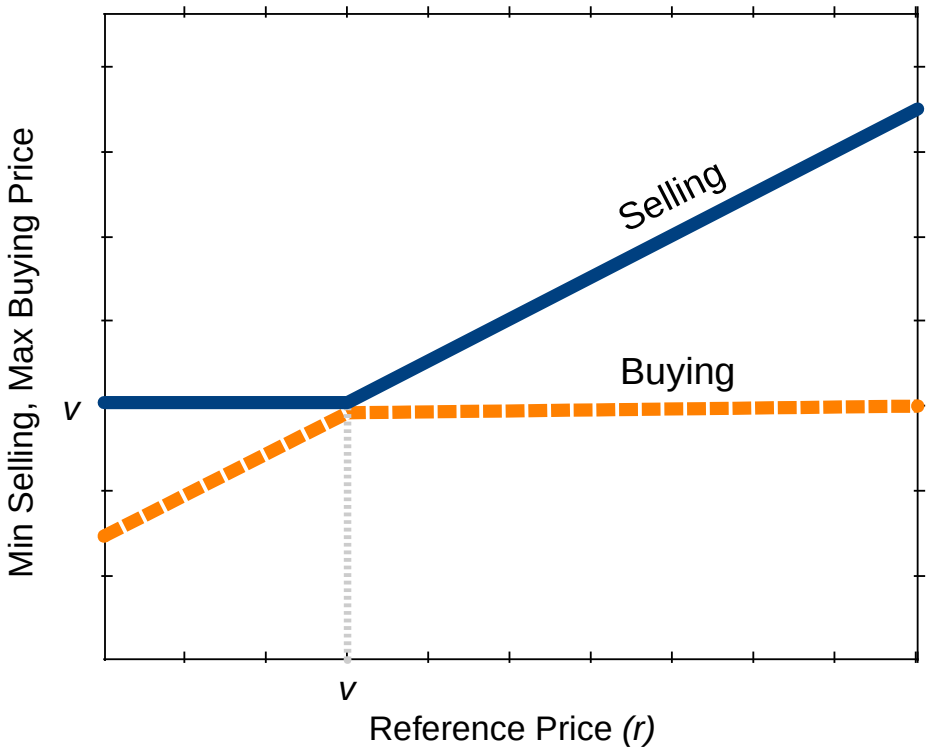


Figure 2: Endowment effects (ratios of selling to buying prices) in Studies 1-5.

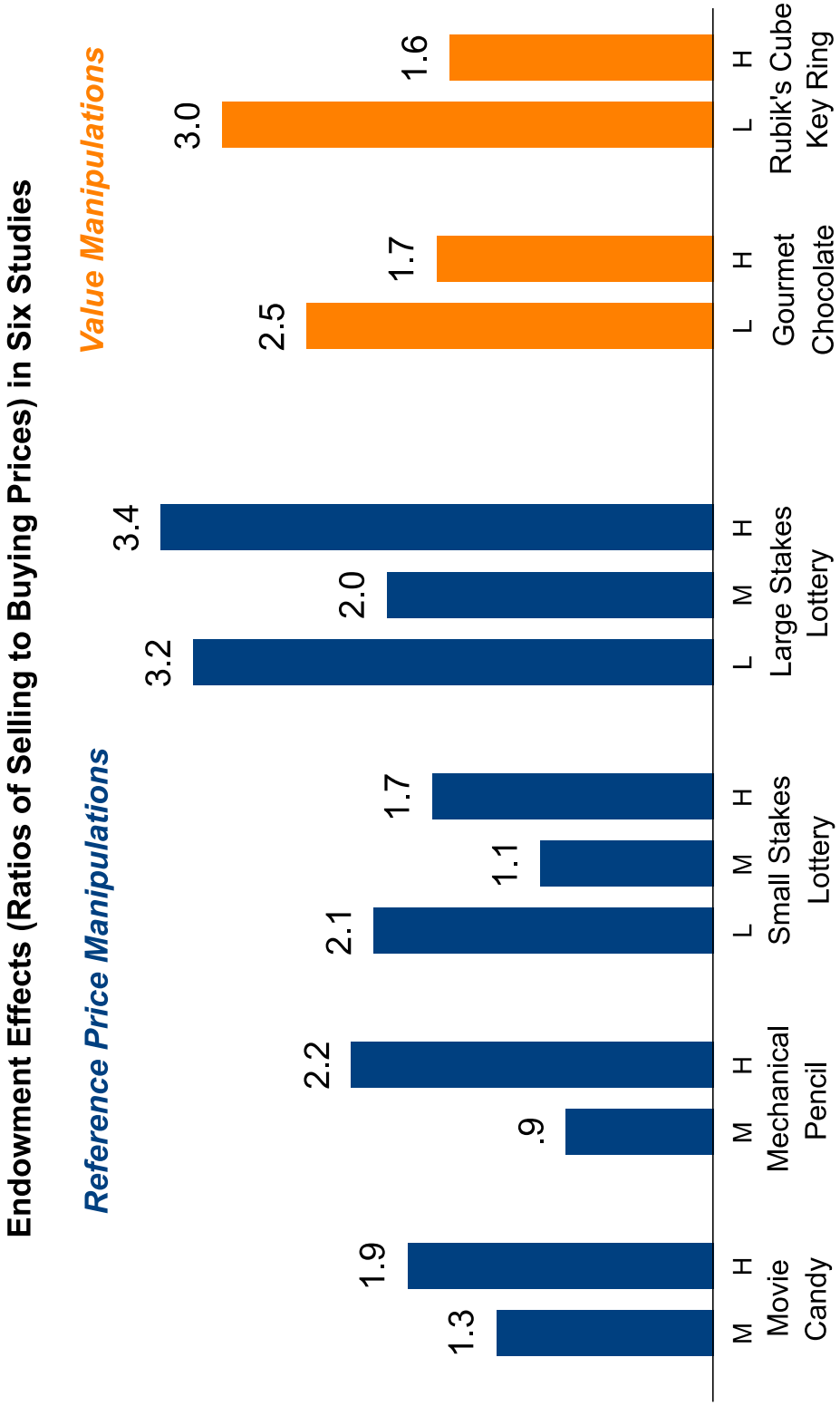
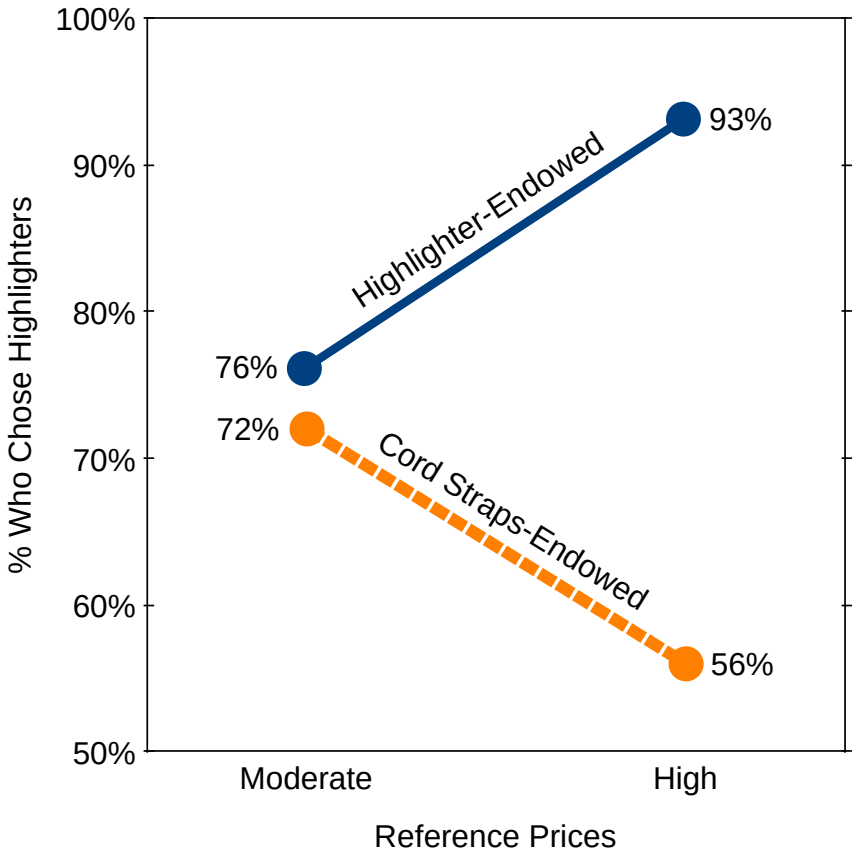


Figure 3: Preference for highlighters given initial endowment (highlighters or cord straps) and reference prices.



APPENDIX A: GENERALIZED MODEL

As in the simpler model described in the paper, we assume here that individual *i*'s value for a target good (v_i) is unaffected by endowment or the exchange being contemplated, but that maximum buying price and minimum selling price may deviate from *v* to reflect consideration of the reference price (*r*). We capture the degree of reference dependence with two "distortion weight" parameters, α_L and $\alpha_G \in [0,1]$:

α_L : The weight given to *r* when transacting at v_i would create a loss relative to *r*.
α_G : The weight given to *r* when transacting at v_i would create a gain relative to *r*.

The ratio α_L / α_G may be regarded as the coefficient of loss aversion. We model consumer *i*'s stated reservation price — defined as s_i for an owner/seller, and b_i for a non-owner/buyer — as a convex combination of *r* and v_i:

$$v_i \le r: \quad s_i = \alpha_L \cdot r + (1 - \alpha_L) \cdot v_i$$
$$b_i = \alpha_G \cdot r + (1 - \alpha_G) \cdot v_i$$

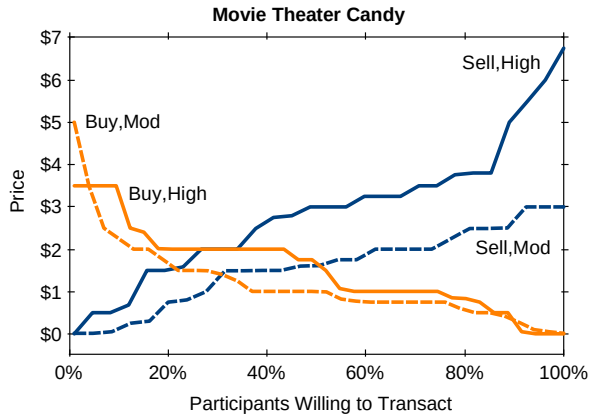
$$v_i > r: \quad s_i = \alpha_G \cdot r + (1 - \alpha_G) \cdot v_i$$
$$b_i = \alpha_L \cdot r + (1 - \alpha_L) \cdot v_i$$

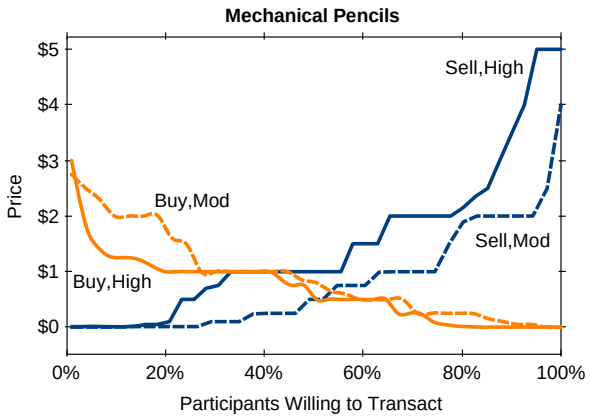
In contrast with the simpler model in our manuscript (in which we assume $\alpha_G = 0$ and $\alpha_L > 0$), we assume here only that $\alpha_L > \alpha_G$, i.e. that consumers are loss averse with respect to the departures from the reference point. With this assumption, $s_i > b_i$ for all combinations of v_i and *r* except when $v_i = r$, in which case $s_i = b_i$.

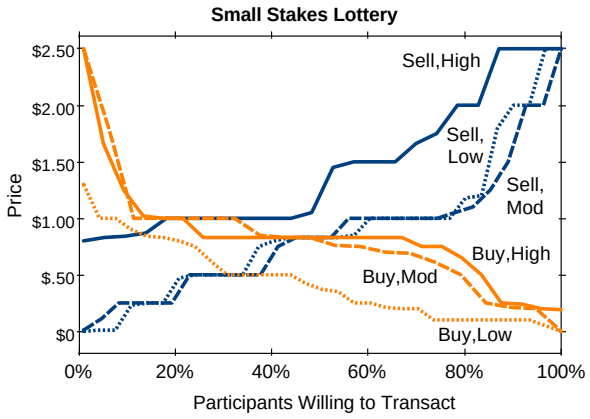
We could of course further generalize the model to permit distortion weights and reference prices that vary across individuals, or a non-linear functional form that reflects the diminishing sensitivity to departures from a reference point (Tversky and Kahneman 1991). Such enhancements would likely improve the fit of a predictive model that attempted to predict reservation prices from reference prices, but aren't necessary to describe the effect qualitatively, which is our interest here.

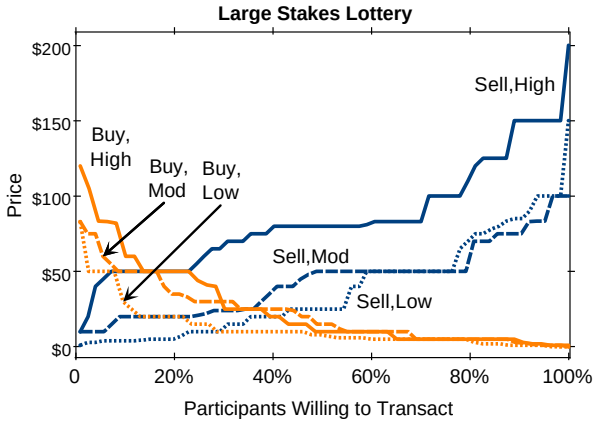
APPENDIX B: DISTRIBUTIONS OF REPORTED RESERVATION PRICES

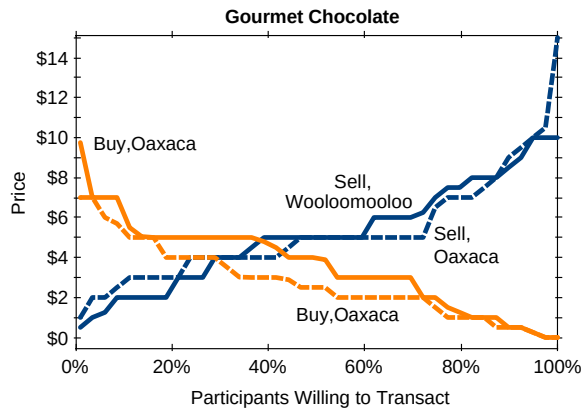
The graphs below show the supply and demand curves inferred from the minimum selling prices and maximum buying prices of our study participants. To normalize these curves across experimental cells with different Ns, the x-axis shows percentages rather than absolute numbers of individuals.

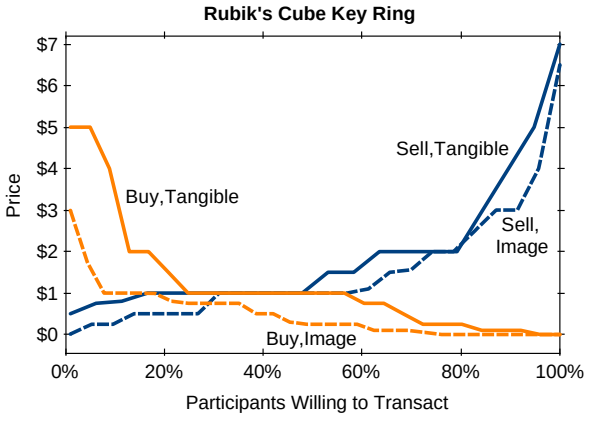












APPENDIX C: SAMPLE INSTRUCTIONS

Reservation Prices Elicitation (Study 2)

Not endowed condition:

Pentel Pencil

You have had a chance to examine a Pentel mechanical pencil.

You now have the option to buy one of these pencils if a price, which will be revealed later, is acceptable to you.

After you have completed this form, I will reveal the "Bingo Ball Price." The Bingo Ball Price is determined randomly and is NOT the same as the suggested retail price shown on the pencil.

- If your maximum price is more than the Bingo Ball Price, **you will buy a pencil at the Bingo Ball Price**.
- If your maximum price is less than the Bingo Ball Price, **you won't buy a pencil**.

Please indicate the maximum price you are willing to pay for a pencil:

I am willing to pay as much as $ _____ , but no more.

Endowed condition:

Your Pentel Pencil

You have received a Pentel mechanical pencil. You now own the pencil. It is yours to keep.

But you have the option to sell your pencil if a price, which will be revealed later, is acceptable to you.

After you have completed this form, I will reveal the "Bingo Ball Price." The Bingo Ball Price is determined randomly and is NOT the same as the suggested retail price shown on the pencil.

- If your minimum price is less than the Bingo Ball Price, **you will sell me your pencil at the Bingo Ball Price**.
- If your minimum price is more than the Bingo Ball Price, **you will keep your pencil**.

Please indicate the minimum price you are willing to accept for your pencil:

I am willing to sell for as little as $ _____ , but no less.

Trade Elicitation (Study 6)

Initially endowed with highlighters:

Your Highlighters

You have received a pack of Bic "Brite Liner Grip" highlighters.
These highlighters are yours to keep.
But if you prefer, you can trade them for a pack of Velcro cord straps.
Please place a check mark next to one of the options below.

_____ I will keep my highlighters.

_____ I will trade my highlighters for a pack of cord straps.

Initially endowed with cord straps:

Your Cord Straps

You have received a pack of Velcro "One-Wrap" cord straps.
These cord straps are yours to keep.
But if you prefer, you can trade them for a pack of Bic highlighters.
Please place a check mark next to one of the options below.

_____ I will keep my cord straps.

_____ I will trade my cord straps for a pack of highlighters.

APPENDIX D: THREE OTHER STUDIES DEMONSTRATING THE PREDICTED RELATION BETWEEN REFERENCE PRICE AND ENDOWMENT EFFECT

Our model predicts a smaller endowment effect among respondents who adopt a more moderate reference price, whether *r* is manipulated (directly or indirectly) or selected (by, say, soliciting estimates of market price). We summarize three additional studies below which support this prediction. Additional details are available upon request.

Impulse Toothbrush (Hypothetical; N=133): We described a high-tech toothbrush under development called Impulse (a product of our imaginations), which "promises to greatly improve oral health" with a brush head that "emits electromagnetic pulses that kill bacteria." Participants were randomly assigned to the role of buyer or seller and asked their reservation prices for this product. We then asked each respondent to estimate the Impulse's retail price when brought to market, which estimates we regard as proxies for self-generated reference prices that might distort bids away from valuations. The median estimate was $70; we performed a median split to define two reference price groups, moderate and high. The estimates of the moderate *r* group averaged $24, and the estimates of the high *r* group averaged $88.

Airline Vouchers (Hypothetical; N= 124): Picnickers waiting along the Boston Esplanade for the city's annual 4th of July fireworks display first stated the most they'd pay or least they would accept for two domestic tickets on American Airlines. Rather than providing a reference price, we later asked them to estimate the market price for such a pair, which, as in the toothbrush study, we used as proxies for the reference prices they adopted. We again defined moderate and high reference price groups relative to the median market price estimate ($300). The estimates of the moderate *r* group averaged $214, and the estimates of the high *r* group averaged $416.

Chess Set (Hypothetical; N= 135): We depicted a hand carved chess set and attempted to manipulate *r* indirectly by reporting that it took 20 [or 80] hours to produce. We intended this as an indirect manipulation of reference price, since artisans presumably charge more for things that take longer to make.

Good	Role	Reference Price	
		Moderate	High
Impulse Toothbrush	Sellers	$\$24_{30}$	$\$102_{34}$
	Buyers	$\$24_{37}$	$\$73_{32}$
	Ratio	1.0	1.4
Airline Vouchers	Sellers	$\$221_{25}$	$\$451_{34}$
	Buyers	$\$208_{26}$	$\$280_{35}$
	Ratio	1.1	1.6
Chess Set	Sellers	$\$166_{32}$	$\$329_{34}$
	Buyers	$\$79_{35}$	$\$82_{34}$
	Ratio	2.1	4.0

APPENDIX E: FIVE OTHER STUDIES DEMONSTRATING THE PREDICTED RELATION BETWEEN *VALUATIONS* AND ENDOWMENT EFFECT

The results from Studies 4 and 5 were extended in five other studies not reported above. These show that participants who care more about, know more about, or have greater interest in the focal good tend to exhibit a *smaller* endowment effect. In other words, however fandom is measured, "fans" tend to exhibit a smaller endowment effect than "non-fans." This appears counterintuitive from the pain-of-losing account, which suggests that people who most value a good highly will experience the most pain from giving it up. However, the results follow straightforwardly from our model, since fans have higher valuations, thereby reducing the distance between v and r, and the distortion caused by transaction disutility.

The "counterintuitive" prediction that fans of a product will exhibit a smaller endowment effect than non-fans drew support from five other studies, summarized below.

Wii (Hypothetical; N= 121): Participants indicated reservations prices for a Nintendo Wii video game system, and also reported the types of any video game systems they already owned, and the number of hours per week they played video games. All were told (truthfully) that the typical street price of the Wii was currently about $350. Respondents were coded as "fans" if they owned one or more video game systems and reported non-zero playing time. By this criterion, 44% of our respondents were fans.

Red Sox Tickets (Real; N= 101): Participants (drawn from areas near Boston's Fenway Park) indicated their reservations prices for an actual pair of tickets to a home game against the Yankees two weeks hence. All were told (truthfully) that we had paid $300 for that pair of tickets on StubHub.com. The survey showed the location of the seats within the stadium, and the view of the field from those seats. Each respondent was asked who the Red Sox defeated in the 2004 World Series – the team's first championship in 86 years. Those who produced the correct answer (The St. Louis Cardinals) were defined as fans. By this criterion, 68% of respondents were fans.

Ammonite Fossil (Real; N= 60; Within Subjects Design): Sixty MBA students at a private university in the Northeast indicated both maximum buying and minimum selling prices for a polished ammonite fossil, with actual purchases or sales conducted according to second price auctions. Fandom was measured by respondents' answer to the question: "How much do you like fossils?," which was placed at the end of the survey. Respondents reported this on a scale ranging from 0 (not at all) to 10 (I love them!). We defined fans those at or above the midpoint of the scale. By this criterion, just 25% of our respondents would be characterized as fossil fans. These data were presented for a different purpose in Frederick (2011).

Wicked Musical (Hypothetical; N= 578): Participants from two universities and an on line survey site indicated reservation prices for two center orchestra tickets to the musical *Wicked* at the Opera House in Boston. All were told (truthfully) that the face value of the *pair* of tickets was $175. Afterward, they were asked how much they enjoyed musical theater overall, answering on a seven point scale anchored at 1 (don't enjoy it at all) to 7 (enjoy it greatly). We

defined a fan as those at or above the midpoint of the scale. By this criterion, 72% of our respondents would be characterized as fans of musical theatre.

Vikings Voucher (Real; N= 249): Participants on an online survey site hosted by Yale University indicated reservation prices for a lottery ticket which paid a $50 Amazon.com voucher if the Minnesota Vikings defeated the New Orleans Saints in the NFC championship game. The Saints were favored by 3 in that game (and won, by 3, in overtime, 31-28). Since men tend to enjoy both football and gambling more than women, we defined men as fans and women as non-fans. Thirty-six percent of our respondents were men.

Good	Role	Average Interest level	
		Low (non-fans)	High (fans)
Wii	Sellers	$\$251_{37}$	$\$255_{24}$
	Buyers	$\$110_{31}$	$\$201_{29}$
	Ratio	2.3	1.3
Red Sox tickets	Sellers	$\$264_{18}$	$\$263_{34}$
	Buyers	$\$98_{15}$	$\$160_{34}$
	Ratio	2.7	1.6
ammonite fossil	Sellers	$\$27_{45}$	$\$14_{15}$
	Buyers	$\$5_{45}$	$\$8_{15}$
	Ratio	5.2	1.8
Wicked Musical tickets	Sellers	$\$108_{86}$	$\$159_{199}$
	Buyers	$\$61_{92}$	$\$131_{200}$
	Ratio	1.8	1.2
Vikings Voucher	Sellers	$\$27_{80}$	$\$24_{42}$
	Buyers	$\$13_{80}$	$\$19_{47}$
	Ratio	2.1	1.3