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Risk is Weird: The Weirdness of Risky Transactions Causes 'Risk' Aversion

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Abstract
What causes risk aversion? Here we propose a novel explanation: transactions involving risky prospects tend to be "weird," containing unfamiliar, unexplained, or unusual characteristics, which the riskless counterparts do not, and people are weirdness averse. We report results from five experiments relying on the uncertainty effect paradigm, where valuations of binary gambles are compared to valuations of their worst outcome. We manipulate risk and weirdness independently and observe that the impact of weirdness is of the same order of magnitude of, and in many cases accounts for the entirety of, the effect previously attributed to uncertainty.

What causes risk aversion? Why are people willing to accept a lower expected value in exchange for lower variance? The dominant explanations, Expected Utility Theory and Prospect Theory, propose that risk aversion occurs because outcomes impact utility non-linearly (e.g., $200 doesn't feel twice as valuable as $100), and because subjective probabilities differ from objective ones (e.g., a one in a thousand chance feels more likely than it is). These explanations are unable to account for extreme instances of risk aversion, such as the "uncertainty effect" (Gneezy, List, & Wu, 2006), where people are so risk averse that they value a risky prospect below its worst possible outcome. In falsifying predictions by these leading theories, the uncertainty effect may hold the key to a more complete understanding of risk aversion.[1] Alternative accounts of risk aversion propose that emotions experienced while making decisions (Loewenstein, Weber, Hsee, & Welch, 2001), the subjective sense of ignorance when thinking about them (Fox & Tversky, 1995; Frisch & Baron, 1988), and the intrinsic value of uncertainty itself (see e.g., Diecidue, Schmidt, & Wakker, 2004) may cause risk aversion.[2]

In the spirit of these non-consequentialist accounts, we propose a novel explanation for the uncertainty effect in particular and for risk aversion more generally: people may be averse to the underlying mechanisms that cause uncertainty. We consider the possibility that people

[1] The uncertainty effect has been replicated by several independent research teams (Andreoni & Sprenger, 2011; Newman & Mochon, 2012; Simonsohn, 2009; Wang, Feng, & Keller, 2013; Yang, Vosgerau, & Loewenstein, 2013). Keren and Willemsen (2009) report results where the uncertainty effect is not observed when comparing average valuations. Gideon Keren shared the raw data from that article with us. We analyzed it as in Simonsohn (2009), comparing the entire distributions of responses, and find that a substantial share of participants do show the effect. Rydval, Ortmann, Prokosheva, and Hertwig (2009) provide the only failure to replicate the uncertainty effect that we are aware of, their favored explanation is that participants in other experiments misunderstood the task and/or payoffs.

[2] The term "risk" is sometimes used to describe situations where the distributions of possible outcomes are known, and "uncertainty" when they are unknown. Like Gneezy, List and Wu (2006), who refer to an effect involving risk as the "*Uncertainty* Effect," we treat risk and uncertainty as synonyms.

have an aversion to engaging in "weird" transactions, those involving unfamiliar, unexplained, or unjustified characteristics.

To study the relationship between weirdness aversion and risk aversion, we rely on the aforementioned uncertainty effect paradigm (Gneezy et al., 2006), where participants provide their willingness-to-pay for a risky prospect with two possible outcomes, or for its worst outcome obtained with certainty. The uncertainty effect occurs when the certain (but inferior) prospect is valued more than the risky one. Specifically, Gneezy et al. (2006) found that people were willing to pay an average of $26 for a $50 Barnes and Noble gift card but only $16 for a gamble where participants were guaranteed to win either a $50 or $100 gift card, each with a 50% probability.

Because this paradigm pits valuations of a risky option against valuations of a riskless one, the risky option requires a mechanism that introduces risk, while the riskless option does not. For example, researchers have generated risky prospects by asking participants to buy coin-flips, lottery tickets, unlabeled envelopes, and gift cards of unknown value, and have compared participants' valuations of these transactions to that of buying a gift card outright. While these mechanisms do generate risk, they also make the transaction more unusual, confounding risk with "weirdness."

We report results from four experiments that disentangle the effects of risk and weirdness. We add conditions to the uncertainty effect paradigm that also involve an unusual transaction, but for a *riskless* option—for example, purchasing a token that can, with certainty, be traded for a gift card of known value. Across these four studies, we observe that the impact of weirdness is of the same order of magnitude of, and in many cases accounts for the entirety

of, the effect previously attributed to uncertainty. In a fifth experiment we directly measure perceive weirdness of different transactions. For all experiments, we report how we determined our sample sizes, all data exclusions (if any), all manipulations, and all measures that were collected. All of the data we collected, except for identifying information, and the original materials are available at http://osf.io/x8cqm.

Study 1: Opening the Box

We modified the traditional uncertainty effect paradigm to manipulate risk and weirdness independently. In the uncertain condition, participants imagined opening a box with two *unlabeled* gift cards; they would need to select one without knowing which of the two it was. To eliminate risk (while holding weirdness constant), we merely *labeled* the gift cards inside the box. In both conditions, then, participants would pay to open a box and take something out of it (an unusual transaction), but only one condition would involve an uncertain outcome. In the third condition, participants indicated their willingness-to-pay to purchase a gift card outright, a scenario without risk and without weirdness.

Methods

For Studies 1-3 we decided in advance to obtain 100 observations per cell. Any deviations from this goal were caused by Mechanical Turk (MTurk) or Qualtrics software. For Study 1 we randomly assigned 603 MTurk participants to one of six conditions in a

3 (*context*: riskless and weirdless; riskless and weird; risky and weird) x 2 (*store pair:* Amazon and Barnes & Noble; Target and Walmart) between-subjects design.[3]

In this experiment, then, some participants valuated transactions involving $50 gift cards for Target and Walmart, and others for Amazon and Barnes & Noble. In Studies 2-4 we included only Target and Walmart cards. For greater comparability across studies, we report the results for Amazon and Barnes & Noble separately, in footnote 6.

Participants saw one of the following three scenarios:

Weirdless & Riskless condition:
"We want to know how much you would be willing to pay for two different items, a $50 Walmart gift card and a $50 Target gift card. If you could buy only the $50 Walmart gift card, what is the most you would pay for it? ___ If you could buy only the $50 Target gift card, what is the most you would pay for it? ___"

Weird & (*Riskless*/*Risky*) conditions:
"Imagine that you are standing in front of a table that has a locked box on it. The box has two gift cards inside: a $50 Walmart and a $50 Target gift card. You can pay to open the box and choose a gift card, which will be yours to keep. The gift cards do (*not*) have the names of the stores printed on them, so you will (*not*) know which gift card is which. What is the most you would be willing to pay to open the box? ___"

Results

Replicating the uncertainty effect, participants valued the risky (& weird) prospect, choosing an unlabeled gift card from a box (M = $23.48, SD = $15.06), less than the least-valued gift card in the riskless (& weirdless) condition, purchasing the gift card outright (M = $36.96, SD = $13.91), $t(198) = 6.58$, $p < 0.001$.[4] Because these two conditions differ both on their

[3] We also collected data on self-reported average expenditures in other purchases to use as covariates, but they were uncorrelated with the dependent variable. Therefore, we did not use them in Study 1 analysis, nor did we collect covariates in Studies 2-4. We collect gender and age in all studies for record keeping purposes. The publicly available dataset includes all of these variables.

[4] The reported mean, M = $36.96, is the average valuation of the lower value card for each participant (15% valued the Target card less, 33% the Walmart card and 52% valued both equally).

riskiness and weirdness, we need the riskless & weird condition to disentangle the cause of this difference.

Specifically, if the observed difference occurs because people dislike the *uncertainty* over the gift card they are choosing, eliminating the uncertainty should eliminate the effect. Choosing labeled gift cards from a box should be valued similarly to buying the preferred one outright. If, on the other hand, this effect occurs because of an aversion to unusual transactions, eliminating the uncertainty should not eliminate the effect: choosing *labeled* gift cards inside a box should be valued similarly to choosing *unlabeled* ones.

In Figure 1 we report the results for the first three studies. The black bars, depicting results for Study 1, show that choosing a *labeled* gift card (M = $27.58, SD = $15.28) is valued less than buying the worst gift card outright (M = $36.96, SD = $13.91), $t(199) = 4.55$, $p < 0.001$, but similarly to the *unlabeled* one (M = $23.48, SD = $15.06), $t(199) = 1.92$, $p = 0.057$. Figure 2 shows that the two weird transactions (risky & riskless) have similar distributions, differing markedly from that of the riskless & weirdless valuation.

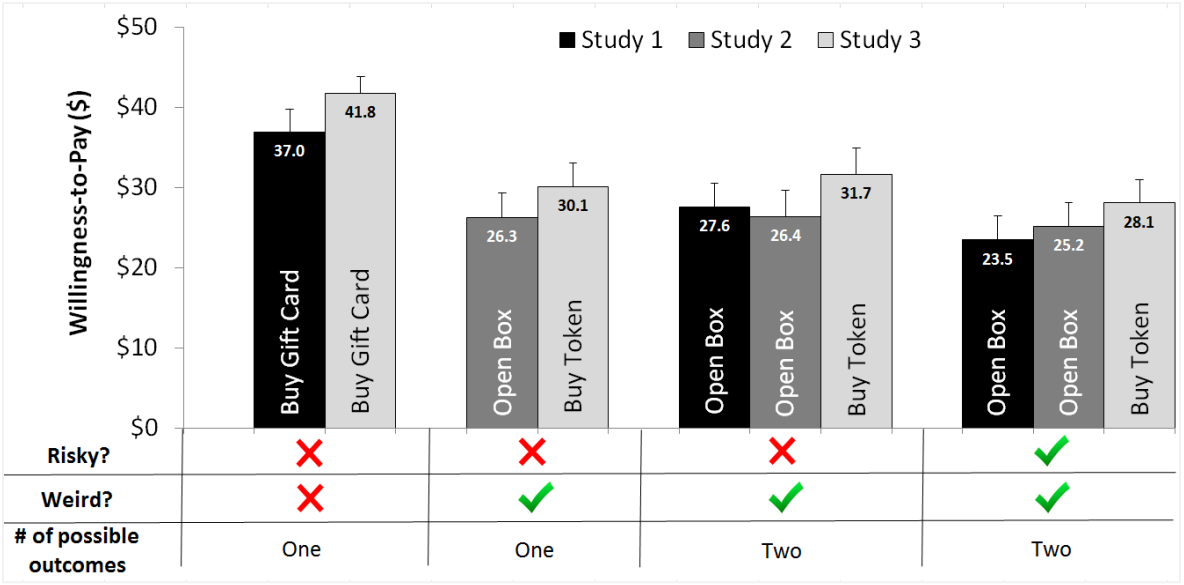

Fig. 1. Average valuations in Studies 1-3 as a function of risk and weirdness

Hypothetical valuations for $50 gift cards. Risk involves whether it is for Target or Walmart, operationalized via opening a box and selecting one of two *unlabeled* envelopes (Studies 1 & 2), or purchasing a token exchangeable for one of the two gift cards, determined by flipping the token (Study 3). Weird but riskless involves labeled envelopes (Studies 1 & 2), or participants *choosing* what to redeem the token for (Study 3). Transactions with one outcome (bottom row) involve box with 1 gift card (Study 2) or token with predetermined value (Study 3). Vertical bars are 95% confidence intervals.

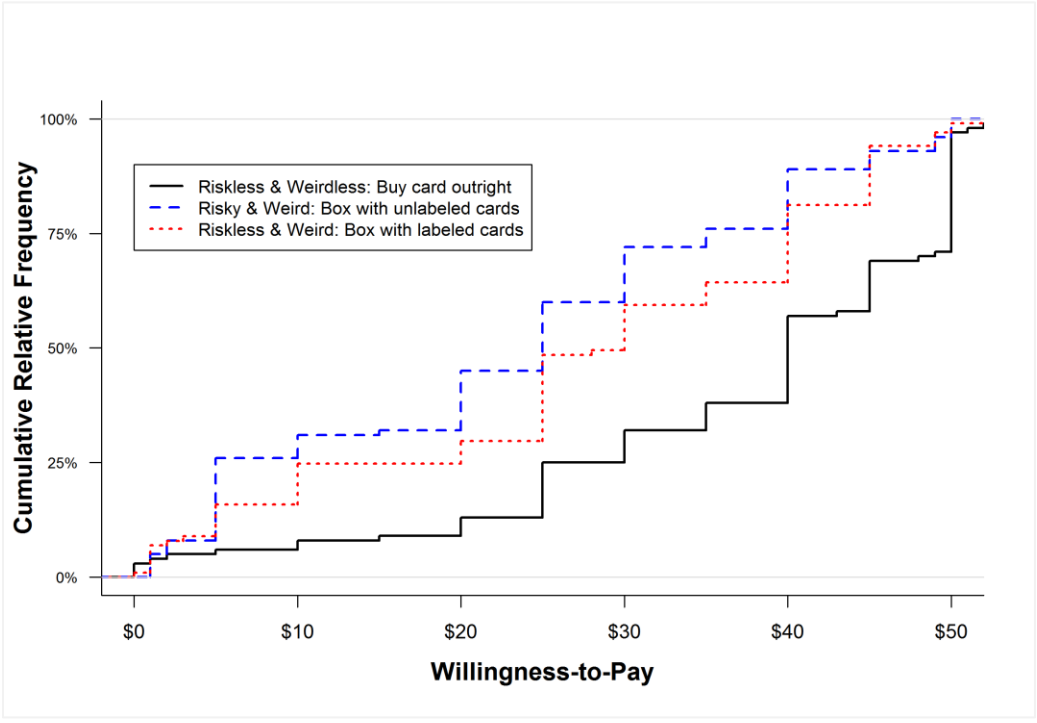

Fig. 2. Cumulative Distributions of Valuations in Study 1

Notes: Valuations for $50 gift cards for Target or Walmart across three conditions (N=301). Participants imagined buying a $50 card outright, opening a box and choosing between a Walmart and Target card knowing which one was which (Weird & Riskless) or not knowing (Weird & Risky). Valuations in the Riskless & Weirdless condition are for least-valued outcome.

The total difference between buying a gift card outright and buying the risky prospect is $36.96-23.48=$13.5. Weirdness accounts for over two-thirds of this difference ($36.96-27.58=$9.4), while uncertainty contributes the remaining third ($27.58-23.48=$4.1). Some of this residual effect attributed to uncertainty, however, may be caused by other factors. First, when choosing labeled gift cards, participants would presumably choose their preferred card, increasing the expected value of the transaction. Second, adding risk to an already weird transaction may also add weirdness.[5]

Study 2: Changing the Number of Possible Outcomes

In this study we sought to address a confound in Study 1. In particular, the weird scenarios (paying to take one of two gift cards from a box) had two possible outcomes, while the weirdless scenario had only one. Therefore, it is possible (and was our belief when designing Study 2) that the differences in valuations between the weird and weirdless conditions were driven by the presence of that second outcome (e.g., because of an aversion to giving up an option). We addressed this concern by creating a condition where the box contained only one gift card (either a Target or a Walmart card). Participants in this condition valued both gift cards (first one card was inside, then the other) in counterbalanced order and not knowing ahead of time that they would be conducting a second valuation.

[5] For the Barnes & Noble and Amazon gift cards, the means are $35.91 (riskless & weirdless), $27.77 (riskless & weird), and $22.30 (risky & weird). The total uncertainty effect amounts to $36-$22=$14, with weirdness accounting for half and uncertainty for the other half.

Methods

We randomly assigned 308 MTurk participants to one of three between-subject conditions—the new condition just described and the two weird conditions from Study 1. In Studies 2-4, we did not allow participants with a MTurk ID used in a previous study.

Results

As shown in Figure 1, the WTP in both the one- and two-option weird & riskless conditions are nearly identical, t(204)=0.06, p = 0.96, suggesting that our hypothesized aversion to giving up an option is not behind the Study 1 results.[6]

Study 3: Replication with Tokens, a Different Weird Transaction

To address the possibility that the results from Studies 1 and 2 are caused by idiosyncratic features of the stimuli (paying to open a box), we developed a different unusual transaction, purchasing a token that can be exchanged for a gift card.[7]

Methods

We randomly assigned 403 MTurk participants to one of four between-subject conditions:

> **Condition 1: Weirdless and Riskless (One Outcome)**
> "What is the highest amount you would be willing to pay for a $50 [Walmart/Target] gift card?"
> *(Target and Walmart counterbalanced within subjects)*

[6] In the one outcome condition participants provided two valuations in counterbalanced order. Order did not significantly affect valuations M = $28.23 vs M = $27.46, t(102) = 1.35, p = .180.

[7] Ideally one would run a large number, say 20, of different stimuli (Wells & Windschitl, 1999), but it proved difficult to identify other mechanisms that introduce uncertainty, can easily be implemented in a riskless way, and do not create blatant confounds. Therefore, we only added one more stimulus. We did not run any studies with other operationalizations of uncertainty.

Condition 2: Weird and Riskless (One Outcome)

"Imagine that you are at an event where there are tokens for sale. These tokens can be redeemed at a cashier for a $50 [Walmart/Target] gift card. What is the highest amount you would be willing to pay for one of these tokens?"

(Target and Walmart counterbalanced within subjects)

Condition 3: Weird and Riskless (Two Outcomes)

"Imagine that you are at an event where there are tokens for sale. These tokens can be redeemed at a cashier for your choice of either a $50 Walmart gift card or a $50 Target gift card. What is the highest amount you would be willing to pay for one of these tokens?"

Condition 4: Weird and Risky (Two Outcomes)

"Imagine that you are at an event where there are tokens for sale. These tokens can be redeemed at a cashier for either a $50 Walmart gift card or a $50 Target gift card. The cashier will flip the token, and if it lands on heads, you will receive the Walmart gift card. If it lands on tails, you will receive the Target gift card. What is the highest amount you would be willing to pay for one of these tokens?"

Results

Study 3 also replicated the uncertainty effect. Participants valued the gift cards in the risky (& weird) condition, where they purchase a token worth one of two possible gift cards (M = $28.10, SD = $14.62), less than in the riskless (& weirdless) condition, where they know the gift card they will be receiving (M = $41.77, SD = $10.55), $t(200) = 7.62$, $p < 0.001$. This comparison confounds weirdness and risk. Keeping risk constant, the valuation of this riskless & weirdless transaction was higher than the riskless & weird ones ($p < 0.001$). Keeping weirdness constant, these riskless transactions were valued similarly to the risky ones ($p = 0.34$ and $p = 0.10$, for the riskless valuations with 1 and 2 outcomes respectively). See Figure 1.[8]

Comparing averages, the total uncertainty effect is about $14, the difference between buying a gift card outright ($41.77) and buying the risky prospect ($28.10). Weirdness

[8] The results for each of those conditions: M = $30.11, SD = $15.02 for the least-valued single outcome, M = $31.70, SD = $16.55 for choosing between the two gift cards, $t(199) = 6.37$, $p < 0.001$ and $t(200) = 5.15$, $p < 0.001$ respectively.

contributes about $10 ($41.77-31.70), and uncertainty the residual $3.60 ($31.70-28.10). Again, at least some of this residual "uncertainty" effect may be caused by weirdness, if purchasing a token that is then flipped by a cashier to determine it value is perceived as weirder than purchasing a token of known value.

Study 4: More Risk

In the first three experiments, the risky prospects involved gift cards with the same face value ($50) for different stores (e.g., Target vs. Walmart). This allowed us to create weird & riskless conditions where participants could meaningfully choose between gift cards (weird & riskless), but may have inflated the importance of weirdness by minimizing the risk (i.e., variance) involved. In this experiment, we created risky prospects that had greater payoff variance.

Methods

We randomly assigned 604 MTurk participants to one of eight conditions, six involved riskless valuations, and conform to a 2 (*value*: $50 vs $100) x 3 (*transaction*: outright vs box vs token) between-subject design. Participants in the other two conditions valued prospects that were similar to the risky box and token scenarios from the previous experiments, except that the possible outcomes were $50 and $100 Target gift cards. We decided before starting data collection to obtain 120 observations from the buy outright cells and 60 from all other cells.[9]

Results

[9] We did this so that, when pooling the box and token conditions, the cells would be balanced at n=120.

Comparing means. Beginning with the token conditions, the uncertainty effect was again replicated. Participants valued the token of uncertain value $6.27 less than they did its worst possible outcome purchased outright (M = $37.23 and M = $43.50 respectively), t(179) = 2.70, p = 0.008. Keeping weirdness constant, comparing the risky token worth $50 or $100 with a token worth a $50 gift card with certainty, people paid $5.59 *more* ($37.23-31.64) for the risky prospect, eliminating the uncertainty effect. See the right-most columns in Table 1.

Table 1. Willingness-to-Pay to obtain Target gift cards in Study 4

	Weirdless		**Weird**					
	Buy card outright		*Pay to open box, take card*			*Buy token, trade for card*		
Value of card	$50	$100	$50	$100	Risky ($50/$100)	$50	$100	Risky ($50/$100)
Mean	$43.50	$86.49	$29.44	$51.47	$25.23	$31.64	$65.93	$37.23
(SD)	(9.31)	(19.54)	(15.45)	(28.74)	(17.73)	(16.71)	(31.54)	(21.88)
n	121	121	61	60	61	60	60	60

Notes: Each column reports results for a different between-subject condition. In the risky conditions participants did not know if the card was worth $50 or $100. See Table S1 in supplement for statistical tests performed on all relevant pairs of conditions.

The uncertainty effect was also replicated in the opening the box condition and was also attenuated, but here not eliminated, when accounting for weirdness. The total uncertainty effect is about $18 ($43.50-25.23); risk accounts for about $4, weirdness for about $14. In sum, using risky prospects with more risk (i.e., greater variance in possible outcomes), we obtain results similar to those of Studies 1-3: weirdness accounts somewhere between the preponderance and the totality of the uncertainty effect.

Beyond mean comparisons. When possible outcomes of the risky prospect differ substantially, as they do in Study 4, comparing average valuations of risky and riskless prospects is a conservative and possibly misleading test of the uncertainty effect. This is because the expected value of the risky prospect is substantially higher than that of the worst outcome. A

small number of risk neutral or moderately risk averse participants can raise the overall mean valuation above that of the worst prospect, potentially hiding extreme risk aversion in the vast majority of participants. Therefore, we also computed bounds for the share of participants exhibiting each effect (Simonsohn, 2009), and obtained qualitatively consistent results (see Supplement 3).

Studies 5: Measuring Weirdness

In Studies 1-4, gift cards obtained by purchasing a token or opening a box (what we call "weird" transactions) are valued less than buying the card outright. In Study 5 we test whether participants actually view these weird transactions as weirder. 298 MTurk participants ranked the relative weirdness of the three transactions from Studies 1-3: *buy gift card outright*, *buy token*, and *open box* (ranking: 1 = most weird, 3 = least weird). We chose this relative measure of weirdness over an absolute measure (e.g., "On a scale of 1-100, how weird is this?") because it is difficult to meaningfully provide ratings of weirdness in the absence of a comparison (for a strong version of this concern, see Birnbaum, 1999).

Participants were randomly assigned to one of three conditions, varying which specific token and box transactions were used. In one condition both were riskless with 1 outcome, in another both were riskless with 2 outcomes, and in the third both were risky. Consistent with a weirdness aversion account of the uncertainty effect, a majority of participants (P = 75% across all conditions) viewed the *buy outright* questions to be the least weird. This pattern held in each individual condition (ps<.01). We believe that this approach to comparing the weirdness of different conditions could be used in future research, unrelated to weirdness aversion, to ensure the absence of a weirdness confound.

General Discussion

In four experiments we find that mechanisms that generate risk, rather than risk per se, are the primary drivers of the extreme risk aversion observed in the uncertainty effect paradigm. These results contradict the leading explanation for the uncertainty effect—that people dislike uncertainty per se, "direct risk aversion" (Andreoni & Sprenger, 2011; Gneezy et al., 2006; Simonsohn, 2009; Yang et al., 2013).[10] In a fifth experiment, we show that average valuations of these prospects correspond with participants' rankings of how weird each transaction is.

The explanation proposed here, that people are averse to transactions with unexplained, unusual, or unfamiliar ("weird") characteristics, can be considered a generalization of ambiguity aversion, especially of explanations based on an aversion to missing information (Frisch & Baron, 1988) and to comparative ignorance (Fox & Tversky, 1995). An important distinction is that weirdness, as our experiments attest, can exist in the absence of risk, vastly expanding the type of situations where this basic preference may be consequential.

In many behavioral research studies, as it was with the uncertainty effect paradigm, researchers compare people's reactions to stimuli that, unintentionally, have varying levels of weirdness. Weirdness, in other words, could be behind additional effects currently incorrectly attributed to other causes. Researchers could run a version of our Study 5 to protect against this possibility.

Outside of the artifactual world of social science research, moreover, transactions naturally differ in how unusual, unjustified, or uncommon they are. The magnitude of the

[10] Yang et al. (2013) propose that merely framing a decision as risky lowers its valuation, which we consider to be an extreme form of direct risk aversion.

effects we document here suggest that considering such weirdness could substantially help social scientists and policy makers better explain and motivate behavior.

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