Contextual Gambles Bias Odds in Sports Betting Markets

Andrew Meyer, Yale University, USA
C. Sean Hundtofte, Yale University, USA
Shane Frederick, Yale University, USA

We increase demand for a focal gamble by adding a lower-payout gamble to a menu of bets. We then show that odds in actual sports betting markets are biased by this same context effect: gambles were less profitable to the bettor when lower return bets were salient during betting.

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**SESSION OVERVIEW**

The tenet that preferences are constructed underlies much of consumer behavior research and marketing practice. Consumer preferences for goods and services can be influenced through advertising, the choice context, the way preferences are elicited, etc. Consumer preferences for risk, in contrast, are typically treated as consistent. Consumers are either assumed to be risk-averse or to follow the fourfold pattern of risk aversion suggested by prospect theory (Tversky & Wakker 1995). Neither risk preference pattern, however, can account for some consumers actively seeking risk in some domains (e.g., recreation, gambling, finance) and at the same time avoiding risks of similar magnitude and consequences in other domains (health, safety, social; cf., Weber, Blais & Betz 2002; Blais & Weber 2006). The proposed session provides evidence that revealed risk preferences—like preferences for goods and services—are malleable, and hence inconsistent (as has been argued by Loewenstein et al. 2001). Three papers demonstrate inconsistent risk preferences, and the fourth paper shows a novel instance of inconsistent preferences under risk.

The first paper by Meyer, Hundtofte, and Frederick demonstrates that risk preferences are context dependent. Using historical odds from multiple sports betting markets, the authors show that independent gambles within a reference class, for example two bets involving a heavy and a slight underdog, are perceived as too similar. As a result, market betting returns are biased such that returns of bets on heavy (slight) underdogs are too low (high). The second and third paper show that consumers can be risk-seeking and risk-averse for the same risky prospect. Moon and Nelson demonstrate that participants are willing to pay less for a risky prospect than for its worst outcome (i.e., the uncertainty effect, Gneezy, List & Wu 2006), but at the same time expect to enjoy the risky prospect as much as its best outcome, a pattern consistent with risk seeking. Vosgerau and Peer show that consumers are willing to pay (WTP) and ask to be paid (WTA) to take on the same risk. Such opposing revealed risk preferences are shown for hypothetical and real gambles, and when WTP and WTA are manipulated within-subjects and are elicited incentive-compatible. The fourth paper by Paolacci and Vosgerau shows that probability of occurrence not only affects consumers’ valuation of a risky prospect, but also the valuation of the prospect’s outcomes.

Less likely outcomes are valued less, leading to preference reversals when valuing risky and riskless outcomes.

Together, the four papers demonstrate new conditions under which risk preferences and preferences under risk are inconsistent. Risk preferences are influenced by the context (Meyer et al.), and consumers can be risk-seeking and risk-averse for the same risky prospects (Moon & Nelson, Vosgerau & Peer). Finally, risk not only affects valuations of risky prospects but also valuations of their constituent outcomes (Paolacci & Vosgerau). The findings deepen our understanding of how consumers evaluate risk, and may contribute to designing new interventions in marketing and public policy aimed at influencing how consumers evaluate health, environmental, and financial risks.

**Contextual Gambles Bias Odds in Sports Betting Markets**

**EXTENDED ABSTRACT**

We examine historical odds on sporting events in multiple markets and find that the valuations of independent gambles within a reference class are too similar to one another. We argue that this compression of odds within a reference class reflects an effect of irrelevant context on gambler choice: comparisons to the returns of other similar and salient gambles make a particular gamble seem more or less appealing.

We presented participants with two independent sporting events and asked them to place a hypothetical bet on each. For each event, participants chose whether to bet on the “favorite” or on the “underdog.” The odds on the second event were fixed across conditions while the odds on the first event varied by experimental condition.

Participants were more likely to bet on the favorite in competition 2 when the favorite in competition 1 offered a $110 return than when the favorite in competition 1 offered a $170 return. We assume that the “favorite” and “underdog” column headers in the experimental materials created two “reference classes” within-which participants judged the appropriate returns for members of the class; $130 seems like a good return for a favorite when compared to $110, but a bad return for a favorite when compared to $170.

Sports betting markets are an ideal real-world context in which to document this effect on actual consumer choices. If actual gamblers were influenced by contextual gambles in the way that our experimental participants were, demand for a bet would increase when it was presented alongside similar bets offering lower returns, and decrease when it was presented alongside similar bets offering higher returns. In response, bookmakers would lower potential returns when a bet was presented alongside similar bets offering lower returns, and raise potential returns when a bet was presented alongside similar bets offering higher returns. Within a reference class, these adjustments would cause high return bets not to be high enough, and low return bets not to be low enough. All returns within the reference class would be slightly compressed toward the center of the class. The actual rates of outcomes provide fundamental values against which to measure this pricing bias, and the dates on which competitions take place allow us to create a proxy for the reference point.

In addition to laboratory demonstrations of the context effect, we examine two historical datasets of market closing odds: one on 3,597 Mixed Martial Arts (MMA) fights scheduled to take place...
Inconsistent Preferences Under Risk

from June of 2007 to February of 2013, and one on 94,221 European soccer games scheduled to take place from June of 2000 to January of 2013. In the MMA dataset, notational differences between the presentation of favorite and underdog odds suggest comparisons within those types of bets. In the Soccer dataset, the layout of the betting card suggests three types: home team, away team, and draw. In both cases, we assume that bettors compare odds to bets of the same type from the previous week. This proxies for the reference class. We then take the median odds within the reference class to proxy for the reference point.

Consistent with the bookmaker’s best response to the experimentally observed bias, we find that within a reference class, high return bets are particularly unprofitable for the bettor, and low return bets are more profitable than they should be. Incorporating our class compression framework into a simple out-of-sample test of a betting strategy can lead to positive returns approaching 5% per bet placed. Our estimates are robust to controls for the well-known longshot bias, in which high return bets are particularly unprofitable without respect to reference class (see Griffith, 1949; Snowberg & Wolters, 2011).

In addition to the primary compression, our causal hypothesis makes a number of secondary predictions. Compression toward bets likely to have been presented to bettors within the same time period should be greater than compression toward a historical class midpoint, and compression toward the odds on past gambles should be greater than compression toward future gambles. We find support for both. Further, compression should be greater when the reference class is clearer. For example, in Soccer, we follow the layout of the betting card to assume win-bet reference classes of Home and Away. But some bettors may instead (or also) be comparing favorites to favorites and away teams to away teams. Because these two comparisons sometimes predict cancelling biases, we should find smaller estimates of compression for these win bets than for bets to draw, where there is only one reasonable reference set: other bets to draw. We find this as well.

The prices that we observe are set by a bookmaker. But we assume that the observed pricing bias reflects a response to a bias in bettor choice, rather than a biased bookmaker himself. In the MMA dataset, we observe market opening prices before bettor demand can influence price. We find no evidence of compression there, suggesting that bettor demand is necessary to create the bias. Further, we directly observe compression over the course of the market: mean absolute distance from the assumed reference point falls by over 17% from market open to market close.

We follow up with more laboratory experiments, showing that the bias on gambler choice can be easily moderated by slight changes to the experimental materials. Two simple changes each halve the effect of the referent: presenting the referent return in different units than the focal return, and employing different syntax to describe the referent gamble than to describe the focal gamble.

In conclusion, we demonstrate that sport market betting odds are biased by simple context effects. Bookmakers respond to the effect of context on betting volumes, which leads to biased returns in the market place.

When and Why Do Consumers Devalue Risky Prospects?

EXTENDED ABSTRACT

In 2006, Gneezy, List, and Wu discovered a perplexing phenomenon they called the “uncertainty effect” (UE): people valued lotteries less than their worst possible outcomes. In particular, participants were asked to report their willingness-to-pay (WTP) for either: (1) a $50 Barnes & Noble (B&N) gift certificate, or (2) a lottery ticket that would for sure provide them with a reward of a $50 B&N gift certificate or a $100 B&N gift certificate with equal probability. Participants were WTP around $38 on average for the $50 gift certificate, but surprisingly, they were only WTP around $28 for the lottery between the $50 and the $100 gift certificates. This effect held in both hypothetical and real-stakes scenarios, with other goods (e.g., a field experiment with baseball trading cards) and notably, using other elicitation (i.e., choice between the prospect and $25 in cash).

Why does the UE occur? Although Gneezy et al. (2006) hypothesized that the effect is due to risk aversion, a plethora of other explanations have been tested and ruled out, such as: (1) disappointment aversion (Newman & Mochon, 2012), (2) joint evaluations in the lottery versus separate evaluations in the certain conditions (Simonsohn, 2009), and (3) misunderstanding of instructions (Simonsohn, 2009; Rydval et al., 2009; Keren & Willemesen, 2009). Therefore, despite numerous alternative explanations that have been proposed for the UE, without clear-cut opposing evidence, the default explanation is that of “direct risk aversion” (coined by Simonsohn [2009]). Specifically, people simply dislike uncertainty which leads them to devalue risky prospects.

Seemingly contrary to this explanation, Yang, Vosgerau, and Loewenstein (2013) found that when the uncertain prospects were framed as uncertain gift cards, people were WTP just as much for the uncertain prospect as the lowest possible outcome. Furthermore, they found that this framing influenced WTP but not willingness-to-accept (WTA). Yang et al. (2013) proposed that the UE was explained by an aversion to bad deals, which led buyers to be more sensitive to cues of risk (e.g., lottery rather than gift card) than sellers. Though this explanation is not entirely incompatible with the direct risk aversion explanation, it provides another explanation as to why the UE may occur.

In several studies, we provided more direct tests of both the direct risk aversion and the bad deal aversion accounts of the UE. To test the direct risk aversion account, Studies 1A, 1B, and 2 examined how uncertainty influenced expected enjoyment. To test the bad deal aversion account, Study 3 examined whether eliminating the bad deal aspect of a risky prospect would also eliminate the UE.

Study 1A. 201 undergraduates watched trailers for two upcoming movies and ranked them. After being randomly assigned to one of two conditions: Certain (told which movie they would watch) or Uncertain (not yet told which movie they would watch), participants rated their expected enjoyment of the movie.

Inconsistent with the UE, Uncertain participants expected to enjoy the movie (M=4.83, SD=1.29) as much as those who were told that they would watch the movie they ranked higher (M=5.18, SD=1.32; t(154)=1.61; p=.11), and significantly more than those who were told they would be watching the movie they ranked lower (M=3.78, SD=1.54; t(144)=4.30, p<.001).

Study 1B. Using a similar procedure as Study 1A, Study 1B replicated the UE with WTP using these stimuli (N=156).

Study 2. 303 MTurk participants completed an online study using a 3 (Certainty: Certain – Match vs. Certain – Mismatch vs. Uncertain) x 2 (DV: Enjoy vs. WTP) between-subjects design. After watching trailers for two movies and ranking them, participants were randomly assigned to one of three certainty conditions: Certain - Match (asked about movie they liked), Certain - Mismatch (asked about movie they did not like), or Uncertain (asked about a lottery between the two). Participants either reported their expected enjoyment or WTP.

Replicating Study 1A, Uncertain participants expected to enjoy the movie (M=5.78, SD=1.15) just as much as Certain – Match
participants ($M=5.79$, $SD=1.14$, $t(105)=.05$, $p=.96$, and significant -
ly more than Certain – Mismatch participants ($M=3.74$, $SD=1.68$; $t(92)=6.95$, $p<.001$ and $t(97)=7.22$, $p<.001$, respectively).

Replicating the UE, Uncertain participants were WTP less ($M=$$2.25$, $SD=$$2.10$) than Certain – Mismatch participants ($M=$$5.48$, $SD=$$2.98$; $t(107)=6.26$, $p<.001$).

Study 3. 203 MTurk participants completed an online study using a 2 (Certainty: Certain vs. Uncertain) x 2 (Refundable: Non-
Refundable vs. Refundable) between-subjects design. The Non-
Refundable conditions were the same as those of the original UE. The Refundable conditions stated that there was a 30-day return policy; for the Uncertain Refundable condition, the return policy allowed the consumer to return the lottery ticket even after finding out the outcome. This should considerably reduce the worry of paying for a bad deal. Participants first stated their WTP for the prospect, then they rated how worried they were about the prospect being a bad deal on a 7-point Likert scale (1 = Not At All, 7 = Extremely).

For ratings of bad deal, there was a significant interaction effect, $F(1, 199)=6.65$, $p=.01$. There was no effect of refundability for the Certain conditions; however, there was an effect for the Uncer-
tain conditions: the lottery was deemed less of a bad deal when it was refundable ($M=2.59$, $SD=1.56$) than when it was not ($M=3.84$, $SD=2.08$).

For WTP, there was only a main effect of Certainty, such that participants in the Certain condition were WTP significantly less ($M=$$40.80$, $SD=$$10.35$) than participants in the Certain condition ($M=$$29.33$, $SD=$$21.77$), $F(1, 199)=22.8$, $p<.001$. Even when the lottery was less of a bad deal, people were not WTP as much as the worst possible outcome.

Across several studies, we tested two different accounts of the UE. Studies 1A, 1B, and 2 demonstrated that though people are less WTP for risky prospects, they expect to enjoy the same risky pros-
pects, which provides evidence that consumers may not dislike un-
certainty. Study 3 found that even when uncertain prospects are not “bad deals,” people still exhibit the UE. Taken together, these studies suggest that another explanation for the UE is needed. We offer some alternative accounts based on our studies.

Malleability of Revealed Risk Preferences

EXTENDED ABSTRACT
All theories of decision making under risk presume (revealed) risk preferences to be stable such that for identical risky prospects, people are either risk seeking or risk averse. Classical expected utility models, for example, assume general risk aversion expressed by the diminishing marginal utility of wealth (Rubin 2000). In prospect theory, a four-fold pattern of risk seeking/aversion emerges from the interplay of the subjective value and probability weighting functions (Tversky & Wakker 1995). In the perceived relative argument model (PRAM) by Loames (2010), risk preferences are determined by the comparison of risky prospects’ outcome and probability ratios.

Weber, Blais, and Betz (2002), however, suggest that people can be risk seeking in one domain (e.g., finance) and risk averse in another (e.g., social). We argue that risk preferences—like preferences for riskless prospects—are to a large extent constructed (cf., Ariely, Loewenstein, & Prelec 2006; Loewenstein et al. 2001), and may thus be inconsistent even within the same domain. In six experiments with hypothetical and real gambles, we show that people ask to be paid (WTA) and at the same time are willing to pay (WTP) to play the same gamble. All six experiments involved gambles with a 60% chance of winning $X$, and a 40% chance of losing $X$. Both the stake $X$ in the gamble and whether WTA or WTP were elicited was manipulated between- and within-subjects.

In Experiment 1 ($N=308$, MTurk), participants indicated their WTA or WTP for two hypothetical gambles, where $X=10$ (small stake) or $X=100$ (large stake; WTA/WTP and stakes were manipu-
lated btw-sbj.). For both small and large stake gambles, over 85% of participants asked to be paid (i.e., indicated a WTA > $0$), and over 68% were willing to pay (i.e., indicated a WTP > $0$) to play the gambles. Thus, participants were more risk-averse in the WTA conditions (over 85% indicated WTA > $0$) than in the WTP conditions (only 32% indicated WTP = $0$; all $p<.001$), indicating that risk-preferences differed across WTA/WTP conditions. Such risk preference reversals were observed for both small and large stake gambles. Experiment 2 ($N=149$, MTurk, hypothetical) replicated these findings with stakes manipulated within-participants.

Since the WTA/WTP measures are truncated at $0$ (i.e., any amount greater than $0$ is interpreted as evidence for a risk pref-
ereence change), our results may not necessarily indicate true risk preference reversals but represent a demand effect or stem from participants’ misunderstanding of the scales/instructions. We tested this possibility by a) manipulating WTA/WTP within-participants, b) playing gambles for real, and c) setting the WTA/WTP default to $0$ and reminding participants that they can set their WTA/WTP to $0$.

In experiment 3 ($N=485$, MTurk, hypothetical), we manipu-
lated WTA/WTP within-participants, thereby exposing participants to opposing experimental demands. Each participant indicated her WTA for the low stake and her WTP for the high stake gamble (same gambles as in experiment 1) or vice versa (order was counterbal-
anced). Again, the majority of participants asked to be paid (> 85%) and was willing to pay (> 70%) to play the gambles, demonstrating more risk-aversion in the WTA (over 85% indicated WTA > $0$) than the WTP conditions (only 30% indicated WTP = $0$; all $p<.001)$. Furthermore, WTA and WTP correlated positively ($r = .49$, $p<.001$), the more participants asked to be paid to take on risk, the more they were also willing to pay to take on risk. Note that if risk preferences were based on a stable underlying construct, WTA and WTP should have correlated negatively.

In experiment 4 ($N=101$) and 5 ($N=53$), WTA/WTP (btw-
sbj.) were elicited with the Becker, De Groot, and Marschak (1964) incentive-compatible procedure, and gambles were played out for real. In experiment 4, $X$ = $0.10$ or $X$ = $1.00$ (btw-sbj.), in experi-
ment 5 $X$ = $7$. In both experiments (and in all stake conditions), risk preferences reversed, participants were more risk averse in the WTA (over 85% set their WTA > $0$) than the WTP conditions (max 50% set their WTP = $0$; all $p<.01$).

Experiment 6 tested a boundary condition for the observed risk preference reversals. In the WTA conditions, WTA can be used to hedge against a potential loss. At the extreme of setting WTA = $X$ (the stake in the gamble) the decision maker is completely insured against the possibility of losing $X$. As a consequence, WTA should increase proportionally to increases in $X$. The opposite holds for the WTP conditions, the higher WTP the more a decision maker hedges against a potential win, at the extreme setting WTP = $X$ which ‘in-
urses’ the decision maker completely against the possibility of winning $X$. Hence, as $X$ increases WTP will not increase proportionally but quickly reach a maximum. To test this, in experiment 6 ($N=425$, MTurk, hypothetical) WTA/WTP was manipulated between-
subjects. To make sure participants understood that they can enter any amount including $0$, participants were presented with a scale ranging from $0$ to $1000$, with the scale pointer positioned at $0$ by default. In addition, participants were reminded that they could in-
dicate $0$. The stake $X$ was manipulated within-subjects at three lev-
els: $10 vs. $100 vs $1000. Significant risk preference changes were again observed across the WTA/WTP conditions for all three levels of X (all $p < .001$). WTA increased almost linearly in X (X = $10$, Median$_{WTA}$ = $10$; X = $100$, Median$_{WTA}$ = $100$; X = $1000$, Median$_{WTA}$ = $709$; nonparametric $p < .001$), whereas WTP increased much less in X (X = $10$, Median$_{WTP}$ = $2$; X = $100$, Median$_{WTP}$ = $9$; X = $1000$, Median$_{WTP}$ = $14$; nonparametric $p < .001$). The results suggest that assessing consumers’ WTA/WTP does not make losses/gains or winning/losing probabilities more salient, or trigger avoidance/approach motivation. Rather, the WTA/WTP manipulation appears to truly change revealed risk preferences, risk-averse consumers become risk-seeking.

Less Likely Outcomes are Valued Less

EXTENDED ABSTRACT

A risk-neutral decision maker would—according to expected utility theory (Von Neumann & Morgenstern 1944)—value a 50% chance of obtaining a $50 gift certificate at $25. Both entities, probability and outcome, are assumed to be independent; the likelihood of occurrence does not depend on the desirability of the outcome, and the desirability of the outcome does not depend on the outcome’s likelihood. More recent theories of decision making under risk have relaxed the first assumption (e.g., Quiggin 1982; Tversky & Kahneman 1992), and can hence accommodate wishful thinking-type of anomalies where desirability of outcomes increases the subjective likelihood of their occurrence (cf., Krizan & Windschitl 2007; Vosgerau 2010). Interestingly, the opposite possibility of probabilities influencing the desirability of outcomes—first proposed by McGuire (1960)—has received scant attention. In the only empirical investigation to date, Pyszczynski (1982) found participants being less attracted to a prize when it was uncertain whether they would obtain it.

In four studies, we tested whether the mere presence of uncertainty reduces outcome valuations. Specifically, we tested whether such devaluation is observed a) when valuations are elicited incentive-compatible, b) for high, moderate, and low probabilities, and c) for gains and losses. The latter manipulation allowed us to test two competing explanations for the devaluation of outcomes, anticipated disappointment and psychological distance.

In Study 1, participants (MTurk, N = 203, incentive-compatible) were informed that one participant would be selected at random and endowed with a $50 bonus payment. Willingness to pay (WTP) for an outcome was elicited incentive-compatible with the Becker, De Groot, and Marschak (1964; BDM) procedure. Participants were randomly assigned to one of two conditions. In the certain condition, participants were asked about the highest amount they were willing to pay for a $50 Amazon certificate. In the 10% probability condition, participants were told that there was a 10% probability that they would be eligible to buy a $50 Amazon certificate. Participants were then asked “If it turns out that you can buy the gift certificate, what is the highest amount you would be willing to pay for it?” As hypothesized, WTP was lower in the 10% probability condition (Median = $25.00) than in the certain condition (Median = $30.50; $p < .004; we report $p$-values of non-parametric tests throughout; results are qualitatively identical with parametric tests.)

In Study 2 (MTurk, N = 401, hypothetical), we employed a 2 (gift certificate: $80 Amazon vs. $100 Overstock) x 2 (uncertainty: certain vs. 10% probability) between-subjects design using the same (but hypothetical) scenario from Study 1. Replicating our previous result, participants valued both gift certificates less when probability of obtaining them was uncertain (Median$_{certain}$ = $70.00; Median$_{uncertain}$ = $51.00; $p < .001$). This led to preference reversals when purchase of one gift certificate was uncertain. Participants valued the Amazon gift certificate (Median$_{80-Amazon}$ = $70.00) more than the Overstock certificate (Median$_{80-Overstock}$ = $50.00; $p < .007$) when it was uncertain whether they could buy the latter. In contrast, participants valued the Amazon certificate (Median$_{80-Amazon}$ = $60.00) less than the Overstock certificate (Median$_{100-Overstock}$ = $75.00; $p < .001$) when it was uncertain whether they could buy the former.

In Study 3 (MTurk, N = 401, incentive-compatible), we varied between-subjects the probability of being eligible to purchase the $50 Amazon gift certificate (10% vs. 50% vs. 90% vs. 100%). WTP varied significantly across conditions (independent-samples Kruskal-Wallis test $p < .001$), with probability predicting WTP in a linear regression with robust error estimation ($B = 0.088$, robust SD = 0.021, $p < .001$; see figure, the dashed lines show 95% confidence intervals).

There are two possible explanations for the results of Studies 1-3. When valuing an uncertain outcome, people may anticipate the disappointment of not obtaining the outcome, and reduce this disappointment by decreasing the value of the outcome (Zeelenberg et al. 1998; 2000). Alternatively, uncertainty may increase the psychological distance to the outcome, which—like increases in temporal distance—would lead to lower valuations of the outcome (Prelec & Loewenstein 1991, Todorov et al. 2007, Weber & Chapman 2005; Chadrnan & Menon 2004). In Study 4, we tested these two competing explanations by manipulating the valence of the outcomes (gains versus losses). For gains, both theories predict that uncertainty will lead to lower valuations of outcomes. For losses, anticipated disappointment increases with the likelihood of the negative outcome occurring (van Dijkt & Zeelenberg 2006). As disappointment can be reduced by devaluing the outcome, WTP to avoid the loss should be lower the more likely the loss is. Probability as an instance of psychological distance, in contrast, predicts the opposite pattern. Because uncertain negative outcomes are perceived as less threatening (Chadrnan and Menon 2004), WTP to avoid a loss should be lower the lower the outcome’s probability is.

In Study 4 (MTurk, N = 401, hypothetical) employed a 2 (certain vs. uncertain) x 2 (gain vs. lose gift certificate) between-subjects design. We used the same gain scenarios as in Study 1. For losses, participants were told to imagine that they owned a $50 Amazon gift certificate, and were asked how much they were willing to pay to avoid losing it. We replicated the effect of uncertainty for gains (Median$_{certain}$ = $40.0$ vs. Median$_{uncertain}$ = $25.0$, $p < .001$). The same pattern was observed for losses, uncertainty reduced WTP to avoid losing the certificate (Median$_{certain}$ = $13.0$ vs. Median$_{uncertain}$ = $10.0$, $p < .022$). These results support the hypothesis that less likely outcomes are valued less because they are perceived as more remote.

Devaluation of certain (positive and negative) outcomes bears theoretical and practical implications. Theoretically, the extent of risk aversion in previous studies may have been underestimated if less likely outcomes are valued less. Practically, consumers’ reluctance to alter their behavior in face of potential negative outcomes (e.g., cancer due to smoking, sea-level rises and extreme weather due to pollution) may be partly driven by consumers believing these outcomes to be less severe as long as they are not certain.

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