Accepted Manuscript
Version of Record at: https://doi.org/10.1287/mnsc.2022.01175

The Prediction Order Effect:

People are More Likely to Choose Improbable Outcomes in Later Predictions

Jackie Silverman, Assistant Professor of Marketing, Lerner College of Business and Economics, University of Delaware, 118 Lerner Hall, Newark, DE 19716, USA.

Uri Barnea, Assistant Professor of Marketing, Bocconi University, 1 Via Roentgen, Milano, MI 20136, Italy.

Authors' Note

Both authors contributed equally; author order was determined via coin flip. The authors thank Adam Eric Greenberg, Sydney Scott, and the Wharton Decision Processes lab group for helpful comments, as well as Ella Kolln for research assistance.

Accepted Manuscript
Version of Record at: https://doi.org/10.1287/mnsc.2022.01175

ABSTRACT

People often need to predict the outcomes of future events. We investigate the influence of order on such forecasts. Six preregistered studies (N = 7,955) show that people are more likely to forecast improbable outcomes (e.g., that an "underdog" will win a game) for predictions they make later, versus earlier, within a sequence of multiple predictions. This effect generalizes across several contexts and persists when participants are able to revise their predictions, as well as when they are incentivized to make correct predictions. We propose that this effect is driven by people's assumption that improbable outcomes are bound to occur at some point within small sets of independent events (i.e., "belief in the law of small numbers"). Accordingly, we find that the effect is attenuated when the statistical independence of events is made salient to forecasters, both through the nature of the predictions themselves (i.e., when the events are from distinct domains) and through directly informing them about statistical independence. These findings have notable practical implications, as policy-makers and businesses have the ability to control the order in which people evaluate and predict future events.

Consider one of the millions of Americans who fills out a "March Madness" bracket to predict the winning teams of the annual NCAA basketball tournament (American Gaming Association, 2021). They must predict the outcomes of all games involved and submit them to a website (or the person in charge of the office pool) before any are played. Similarly, managers interviewing prospective employees must forecast their performance before making hiring decisions, and traders often need to predict the profitability of various stocks before the market opens. In these cases and others, individuals face the challenge of predicting the outcomes of multiple uncertain events. Notably, inaccurate forecasts in these contexts can lead to suboptimal outcomes; choosing a poorly performing sports team, employee, or stock can entail financial losses and/or emotional distress.

In this work, we examine how people's predictions of multiple future events are affected by a fundamental aspect of decision making: the *order* in which the predictions are made. In six experiments studying a variety of contexts (as well as five additional experiments reported in our Supplemental Materials), we find that people are more likely to forecast that an improbable outcome will occur for predictions that they make *later*, versus earlier, within a sequence of multiple predictions (e.g., for the third, versus the first, prediction). Consequently, they are more risk-seeking (i.e., more likely to predict a relatively improbable outcome) in their later forecasts, and are thus more likely to make an incorrect prediction for them. This tendency can carry negative consequences; for example, individuals may be more likely to bet that an "underdog" team will win in their March Madness bracket or invest in a risky stock in their later decisions, which could lead to reduced earnings or aversive experiences.

We theorize that this "prediction order effect" is driven by people's lay beliefs about statistics, namely their erroneous assumption that events outcomes are related even when they are in fact statistically independent. Understanding how order influences predictions is managerially important: not only are many organizational decisions made by individuals who might be susceptible to this bias, but also, in their roles as choice architects, organizations have the power to alter consumers' forecasts through their presented order. We elaborate on the theoretical and practical implications of this work in the General Discussion.

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Theoretical Background

Order is an integral element of decision-making. Simply put, if an individual is making more than one decision or engaging in more than one behavior, some entity – whether it be the individual themselves, an outside agent (like a company or algorithm), a common rule (like following alphabetical or chronological order), or even chance (like a coin flip) – must determine the order. It is therefore hardly surprising that order effects have received much attention in the management, marketing, and psychology literatures (e.g., Godes and Silva, 2012; Haugtvedt and Wegener, 1994; Hogarth and Einhorn, 1992). Indeed, the order in which people process information and make decisions affects key elements of their experiences, such as their attention and memory (Murdock, 1968, 1976; Neath, 1993) and use of reference points (Baucells, Weber, and Welfens, 2011). Consequently, order has been shown to affect myriad judgments and decisions, including individual preferences (Biswas et al., 2014; Dayan and Bar-Hillel, 2011; Li and Epley, 2009; Moore, 1999), brand valuations (Dawar and Anderson, 1994), donation allocations (Huber et al., 2011), and even election outcomes (Koppell and Steen, 2004; Miller and Krosnick, 1998).

Despite this extensive interest in the impact of order, an open question remains as to its implications for *predictions* of future events. This gap is surprising, given that ample research has explored other factors influencing predictions. For example, past work has investigated how individuals' predictions are affected by outcomes' framing (e.g., as losses vs. gains: Engelmann and Tamir, 2009; Yacubian et al., 2006) or mental "reachability" (e.g., through linguistic convention: Bar-Hillel, Peer, and Acquisti, 2014), the amount of time available to make a decision (Maule, Hockey, and Bdzola, 2000), and attitudes concerning risk and optimism (Eisenberg, Baron, and Seligman, 1998; Tanner and Carlson, 2009). Notably, this past research has generally focused on how heuristics and other factors affect what people choose in a *single* prediction (Fischhoff and Broomell, 2020; Mellers, Schwartz, and Cooke, 1998)[1]. Even the scant research specifically intended to investigate predictions of multiple events has

[1]Even when studies collect data regarding multiple predictions to increase generalizability and statistical power, data are often aggregated without examining the effect of order (e.g., Gaertig and Simmons, 2018).

Accepted Manuscript
Version of Record at: https://doi.org/10.1287/mnsc.2022.01175

primarily examined strategies for forecasting the overall distribution of outcomes across an entire set of events (e.g., probability matching: Gal and Baron, 1996; James and Koehler, 2011), rather than the more realistic case of making multiple predictions one after the other.

Current Research

How are people's forecasts affected by the order in which they are made? From a strictly probabilistic perspective, there should be no effect of order: in most cases, people should consistently forecast that the more probable outcome will occur when making multiple predictions, as this maximizes the likelihood of being correct[2]. However, as we know from the vast literature on judgments made under uncertainty, people often deviate from this optimal strategy for a wide variety of reasons. Broadly, predictions can be affected by many factors, including forecasters' attitudes towards risk (Conlisk, 1993), their emotions (Loewenstein et al., 2001), and extraneous information (e.g., anchors: Tversky and Kahneman, 1974; Mussweiler, Strack, and Pfeiffer, 2000). Here, we propose that order systematically biases people's predictions; specifically, people are more likely to predict *improbable* outcomes for forecasts they make *later*, versus earlier, within a sequence of multiple predictions.

To illustrate, consider again one of the abovementioned gamblers placing bets on several upcoming NCAA March Madness games. They must choose multiple times between betting on the team that is more likely to win (the "favorite") and the team that is less likely to win (the "underdog"). Since each game the gambler bets on is independent – meaning the outcome of one game should not influence the outcome of any other game – this gambler would maximize their likelihood of betting correctly by always forecasting that the more probable outcome will occur (i.e., that the favorite will win). In contrast, we hypothesize that the sequential nature of this gambler's bets increases the likelihood that they predict the improbable outcome – that the underdog will win – in later bets that they make.

[2]We study predictions for events where one outcome is more probable than the other. Of course, there are situations where this is not the case (e.g., flipping a fair coin; rolling a fair die). For these types of predictions, other factors may influence individuals' initial and subsequent predictions (e.g., linguistic cues: Bar-Hillel, Peer, and Acquisti, 2014).

We propose this prediction order effect is driven by people's lay beliefs concerning outcomes of uncertain events. In particular, they (erroneously) assume that small samples of events will exhibit their expected outcome rates, e.g., that ten coin tosses will result in five heads and five tails (i.e., "belief in the law of small numbers:" Oskarsson et al., 2009; Rabin, 2002; Tversky and Kahneman, 1971). We posit that this belief systematically biases people's later predictions within a sequence. That is, when people make several predictions, they approach the first one as they would a single prediction; they simply rely on relevant information, such as the outcome likelihoods (Zsambok and Klein, 2014), and are thus more likely to choose the more probable outcome. However, when making subsequent predictions, people are aware of – and therefore consider – their previous choices. Because they have already predicted the more probable outcome will occur, and they believe that both probable and improbable outcomes are bound to happen, people are more likely to predict an improbable outcome will occur for forecasts that they happen to make *later* within a sequence of predictions. Thus, rather than following the rational strategy of consistently predicting the more probable outcome, over time, people become more likely to forecast that improbable outcomes will occur.

By studying the influence of order on sequential predictions, this work makes two key theoretical contributions. First, our research adds to literature on lay beliefs concerning probabilities. In particular, past research on the belief in the law of small numbers (Tversky and Kahneman, 1971) has investigated its role in forecasts following known outcome sequences (e.g., gambler's fallacy: Chen, Moskowitz, and Shue, 2016; Clotfelter and Cook, 1993; Tversky and Kahneman, 1974) and predicted distributions of outcomes across sets of events (probability matching: Gal and Baron, 1996; James and Koehler, 2011). In this work, we propose a different consequence of this important heuristic that arises in an understudied context: sequential predictions of multiple future events. Second, we contribute to research on order effects, which has investigated the role of order in various outcomes like people's preferences (e.g., Moore, 1999) and memory (e.g., Murdock, 1976). We extend this literature by studying how order influences forecasts of future events.

Study Overview

In six experiments, we investigate how the order in which people make forecasts about multiple independent events influences their choices (e.g., which teams will win real upcoming sports games; which color balls will be drawn from different jars). We provided participants with information about each outcome's likelihood (e.g., team rankings; percent of each color within the jars) and compared the proportion of participants choosing the more improbable outcome (e.g., the underdog team; the less prevalent color) for *earlier* versus *later* predictions in a sequence.

The first two studies demonstrate the prediction order effect in sports (Study 1) and stylized lotteries (Study 2). The next two studies further generalize the effect. Specifically, we find that the effect holds when people are incentivized to make correct predictions (Study 3) and when they are free to revise their forecasts (Study 4). Finally, by moderating the effect in two studies, we provide evidence for our proposed mechanism and demonstrate practical implications of the effect. Following from our theory that people expect small sets of events to mirror their expected probabilities, we show that the effect is attenuated when people predict the outcomes of events that are from different distributions of expected outcomes (i.e., from two different domains, like lotteries and basketball games), rather than from the same distribution (i.e., from the same domain, like only basketball games; Study 5). Further, we find that the prediction order effect is reduced when forecasters are provided with information about statistical independence before making their predictions (Study 6).

To help ensure internal validity, we controlled several aspects of the predictions that participants made in the studies. Specifically, participants made all of their predictions *sequentially*, meaning each prediction appeared on a separate page in the survey. Participants' predictions were also *unchangeable*, meaning they could not revise their previous choices (although in Study 4, we relaxed this requirement). Additionally, participants' predictions were *naïve*, meaning they were made without knowledge of any outcomes or feedback about their choices. Finally, participants received either *constant or no rewards* for making correct predictions (e.g., in Study 3, participants earned a $0.05 bonus for each correct prediction regardless of the outcome likelihoods). We discuss these design choices further in the General Discussion.

We determined the sample sizes for Studies 2 and 4, which were run in university behavioral labs, based on the number of individuals who signed up for behavioral lab sessions. We determined in advance the sample sizes for Studies 1, 3, 5 and 6, which were run on Amazon Mechanical Turk (MTurk), to provide at least 80% power to detect the focal effect in each study based on preliminary effect size estimates from pilot studies. In all studies, we analyze all complete responses from unique participants; any exclusions are due to duplicate or incomplete responses, as preregistered. We collected basic demographics at the end of each study. We report all measures and conditions, and all studies reported in the manuscript, as well as five supplemental studies, were preregistered. All data, materials, preregistrations, and Supplemental Materials are available here: https://researchbox.org/211.

STUDY 1: THE PREDICTION ORDER EFFECT FOR SPORTS GAMES

Study 1 tested our hypothesis that people are more likely to predict improbable outcomes for later predictions. Participants made three consecutive predictions about which sports team would win in an upcoming game, with the order in which these predictions were made counterbalanced across participants. We examined the proportion of participants who forecasted that the worse-ranked team would win each game, expecting that this proportion would be higher for their later (i.e., third) prediction than their earlier (i.e., first) prediction.

Methods

We recruited 3,001 participants (M_{age} = 41.41, SD = 12.73; 52.02% female, 1.10% other/prefer not to say) from MTurk[3]. Participants read that they would be making several predictions about the outcomes of basketball games (we did not specify how many). Participants saw an example game – "#1 team vs. #16 team" – and were informed that the numbers provided represented the rank of the team within the league, with 1 being the best team and 16 being the worst team.

[3]As preregistered, we collected data in three waves, as data collection via CloudResearch (a third-party tool) is more efficient for samples of 1000 or less via the HyperBatch option. Respondents could not participate in more than one wave.

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Version of Record at: https://doi.org/10.1287/mnsc.2022.01175

All participants predicted which team would win in three games – #4 vs. #7, #8 vs. #11, and #12 vs. #15 – that were presented in random order. We counterbalanced the order in which the teams were presented within each game (e.g., whether the game was "#8 team vs. #11 team" or "#11 team vs. #8 team"). We also referred to each team simply by their ranking, rather than using real team names, to preclude any potential effects of participants' prior knowledge about actual basketball teams' abilities or upcoming game schedules. These design choices also helped eliminate potential "variety seeking" across choices; due to the complete randomization of the choice options, any observed effect of order cannot be explained by participants wanting to switch their choice's position on the screen. In this and all subsequent studies, we coded predicting the improbable outcome as "1" and the probable outcome as "0."

Results

As predicted, a repeated-measures fixed-effects logistic regression revealed a significant positive effect of the order in which the predictions were made (order variable coded as 1 = first choice, 2 = second choice, 3 = third choice; $b = 0.17$, SE = 0.04, $Z = 4.61$, $p < .001$), indicating that the proportion of participants choosing the team that was less likely to win increased with subsequent choices.

Separate McNemar's tests investigating pairwise differences in predictions within the set were consistent with these results. Our primary preregistered analysis found that the proportion of participants forecasting that the worse-ranked team would win increased from 8.70% in the first prediction to 11.90% in the third prediction ($\chi^2(df = 1, N = 3001) = 21.04$, $p < .001$; $OR = 1.42$, 95% CI = [1.20, 1.68]). Secondary analyses found that the proportion of participants forecasting that the worse-ranked team would win also significantly increased from the first prediction to the second prediction (11.20%; $\chi^2(df = 1, N = 3001) = 11.70$, $p = .001$; $OR = 1.32$, 95% CI = [1.12, 1.57]); the increase from the second to third predictions was not significant ($\chi^2(df = 1, N = 3001) = 0.84$, $p = .36$; $OR = 1.07$, 95% CI = [0.91, 1.25]). See Figure 1.

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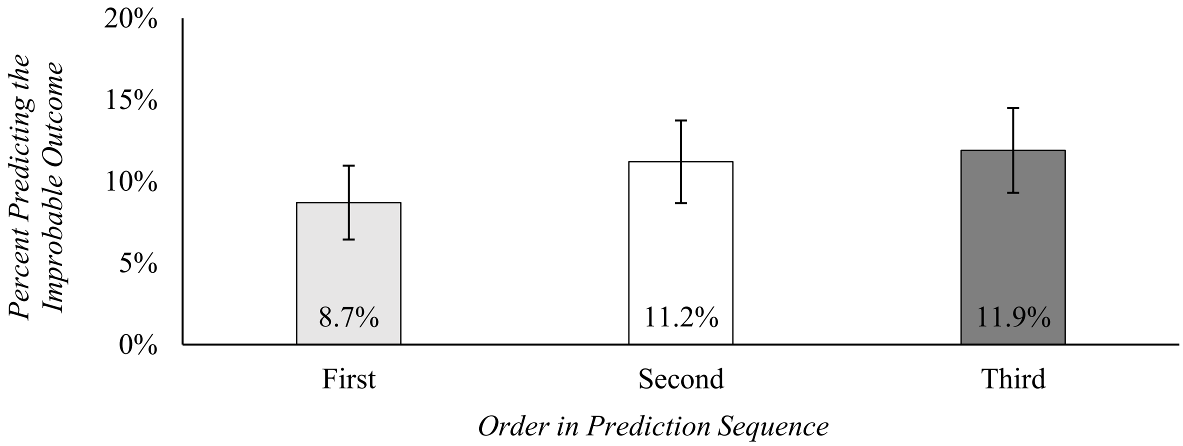

Fig. 1. The percent of participants in Study 1 who predicted that the improbable outcome would occur (i.e., that the worse-ranked team would win) based on the randomized order in which they made their predictions. Error bars are 95% confidence intervals.

Discussion

Study 1 provided preliminary support for our hypothesis. Participants predicted the outcomes of three hypothetical basketball games where one team was ranked better than the other. Although the outcomes of these games were independent and their order was random, participants were more likely to forecast that the underdog team would win for predictions they happened to make *later* in the sequence. Two additional preregistered studies (Study S1a, N = 596; Study S1b, N = 402) replicated these results using similar stimuli (logistic regressions: *b*s > 0.15, *Z*s > 3.60, *p*s < .001); see Supplemental Materials for full methods and results.

In this study, we observe a larger effect for a) the first versus second predictions and b) the first versus third predictions, relative to the second versus third predictions. One potential explanation for this pattern is heterogeneity in when people switch from predicting the probable to the improbable outcome. People's perceptions of each outcome’s likelihood might play a role in that decision point; in this study, participants who interpreted the teams as being closer to evenly matched (e.g., a 45% chance of the worse-ranked team winning) may have chosen the improbable outcome earlier in the sequence (i.e., second), whereas those who interpreted the matchups as being more lopsided (e.g., a 35% chance of the worse-ranked team winning) may have chosen the improbable outcome later (i.e., third). Once participants chose the improbable outcome, they may have switched back to predicting the probable outcome, which works against the general trend one might expect, where the likelihood of predicting the improbable outcome increases as the sequence progresses (see General Discussion for further consideration). Accordingly, we preregistered the contrast between the first and last (3rd) predictions as our primary comparison, with the understanding that other comparisons (namely, 2nd vs. 3rd) might be more readily influenced by contextual factors and/or individual differences. Notably, the design of the next study helps control for such heterogeneity.

STUDY 2: THE PREDICTION ORDER EFFECT FOR LOTTERIES

In Study 1 (and two replications in the Supplemental Materials), all participants made predictions for a set of events presented in random order. In the next study, we instead manipulated the order of the predictions *between-subjects* by randomly assigning participants to forecast the outcome of one specific "focal" event either first or last within the sequence. That is, all participants again made predictions for the same set of three events, but we manipulated whether they predicted the outcome of the focal event before or after two other "non-focal" events.

This controlled design was intended to reduce heterogeneity across predictions, increasing the size of the predicted effect and the statistical power to observe it (Hales, Wesselmann, and Hilgard, 2019; Meyvis and Van Osselaer, 2018). Specifically, for the non-focal events in the set, one outcome was much more likely to occur (e.g., a jar with 82% of the balls in one color and 18% of the balls in another color). Since we expected almost all participants to choose the probable outcome for these events, this order manipulation helped ensure that the vast majority of participants in the *last* condition predicted the outcome of the focal event after having already predicted a probable outcome for two preceding events. For the focal event, however, both outcomes were similarly – but not equally – probable (e.g., a jar with 54% of the balls in one color and 46% of the balls in another color), which meant that a large portion of participants would consider the improbable outcome as a viable choice.

Using this between-subjects design, Study 2 tested whether people are more likely to predict the improbable outcome in a later (versus earlier) prediction in a new context: stylized lotteries.

Consequently, rather than using relative rankings (as in Study 1), in this study, participants learned the exact outcome likelihoods via percentages.

Methods

We recruited 178 participants (M_{age} = 20.05, SD = 1.52; 60.23% female, 0.57% other/prefer not to say) in a behavioral lab at a university in the United States. All participants were informed that they would be predicting which color ball would be drawn from three different jars. For each prediction, participants saw an image of a jar with 50 black and red balls visible inside. The corresponding number and percent of balls in each color were listed underneath the jar.

Participants were randomly assigned to one of two between-subjects conditions (*focal prediction position: first* or *last*) which dictated the order in which they saw the jars. In the *first* condition, participants first predicted which color ball would be drawn from the focal jar (containing 46% black balls and 54% red balls) and made their predictions for the other two non-focal jars afterwards. In the *last* condition, participants made their prediction for the focal jar last, after predicting the outcomes of the two non-focal jars (see Figure 2 for the order in which jars were presented in each condition).

After making these three predictions, participants answered three exploratory items about the focal jar and the second jar that they saw (see Supplemental Materials).

Results

Unsurprisingly, most participants forecasted for both non-focal events that the more probable outcome would occur (i.e., that a red ball would be drawn), regardless of condition (*first*: 94.38% vs. *last*: 92.13%; $\chi^2(df = 1, N = 178) = 0.36$, $p = .55$). Therefore, as intended, most participants in the *last* condition made their focal prediction after forecasting twice that the probable outcome would occur.

As expected, a chi-square test revealed that for the focal lottery, more participants in the *last* condition predicted that the less probable outcome would occur (i.e., that a black ball would be drawn) than in the *first* condition (42.70% vs. 5.62%; $\chi^2(df = 1, N = 178) = 33.39$, $p < .001$; $OR = 12.51$, 95% CI = [4.63, 33.85]). See Figure 2.

There were no differences by condition in participants' predictions for the two non-focal lotteries (χ^2s < 2.10, *p*s > .10). We report analyses concerning the non-focal predictions in subsequent studies in the Supplemental Materials.

First Condition

Presentation order:	**1st**	**2nd**	**3rd**
Stimuli:	**Focal** 27 Red, 23 Black Balls	**Non-focal A** 41 Red, 9 Black Balls	**Non-focal B** 42 Red, 8 Black Balls
Share selecting the improbable outcome:	**5.62%**	**2.25%**	**4.49%**

Last Condition

Stimuli:	**Non-focal B** 42 Red, 8 Black Balls	**Non-focal A** 41 Red, 9 Black Balls	**Focal** 27 Red, 23 Black Balls
Share selecting the improbable outcome:	**2.25%**	**6.74%**	**42.70%**

Fig. 2. The order in which jars were presented in Study 2 based on *focal prediction position* condition, and the share of participants predicting the improbable outcome would occur (i.e., that black would be drawn) for each lottery.

Discussion

Study 2 replicated the prediction order effect found in Study 1 in a different paradigm; for the exact same event, participants were more likely to forecast that the improbable outcome would occur when they made the prediction later, rather than earlier, in the set of predictions. Taken together, these studies showed that the prediction order effect holds a) in multiple prediction contexts, b) for different ways of conveying outcome likelihoods (including when exact probabilities are stated), and c) whether or not forecasters know in advance how many predictions they will make.

Two additional preregistered studies further demonstrate the robustness of the effect. Study S2 (N = 293) found that the effect holds for weather forecasts – specifically, predicting whether it would rain in three different cities (*first* = 10.88% vs. *last* = 26.71%; $\chi^2(df = 1, N = 293) = 12.04, p < .001$; $OR = 2.98$, 95% CI = [1.58, 5.63]). Study S3 (N = 332) showed that the effect generalizes beyond people's own predictions to a new context: their recommendations of what *others* should predict. Specifically, the prediction order effect replicated whether participants were making their own predictions (*first* = 14.46% vs. *last* = 52.38%; $\chi^2(df = 1, N = 167) = 26.94$, $p < .001$; $OR = 6.51$, 95% CI = [3.08, 13.73]) or recommendations (*first* = 2.41% vs. *last* = 18.29%; $\chi^2(df = 1, N = 165) = 11.26$, $p < .001$; $OR = 9.07$, 95% CI = [2.00, 41.06]). See Supplemental Materials for full methods and results of both studies.

Although the manipulation employed in Study 2 has the benefit of reducing noise, it also allows for a potential "contrast effect" on perceptions of outcomes' likelihoods. That is, it is possible that the improbable outcome in the focal event was seen as more likely following the non-focal events where its likelihood was much smaller (i.e., a 46% chance of drawing black may be perceived as larger after seeing a 16% and 18% chance). To explore this possibility, we ran a post-test using the same order manipulation for the same three events as in Study 2, but instead of predicting the outcomes, participants evaluated the likelihood of the improbable outcome. We captured this evaluation using two different dependent variables, both on 0-100 scales; participants either reported how many black balls they thought were in each jar or how likely it was that a black ball would be drawn from each jar. If a contrast with earlier events within the *last* condition was driving the effect, participants' evaluations should have been affected by the order manipulation (i.e., they should have perceived the improbable outcome as more likely in the *last* condition); however, we did not observe a significant effect of order on either the estimated percentage of black balls ($M_{first} = 43.77$, SD = 5.41 vs. $M_{last} = 43.19$, SD = 9.52; $t(152) = 0.46$, $p = .65$, $d = -0.07$, 95% CI [-0.39, 0.24]) or the perceived likelihood that one will be drawn ($M_{first} = 45.24$, SD = 8.89 vs. $M_{last} = 47.49$, SD = 12.42; $t(148) = 1.28$, $p = .203$, $d = 0.21$, 95% CI [-0.53, 0.11]; see Supplemental Materials for full methods and results). While null effects are difficult to interpret and cannot decisively eliminate the possibility of a contrast effect, this finding (along with the results of Study 1) suggests that this alternative does not solely account for the prediction order effect. See General Discussion for further consideration.

STUDY 3: ROBUSTNESS TO INCENTIVIZED PREDICTIONS

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Version of Record at: https://doi.org/10.1287/mnsc.2022.01175

To further demonstrate the robustness and external validity of the prediction order effect, in Study 3, we examined whether the effect holds when participants are financially incentivized to make correct predictions; participants could earn a $0.05 bonus for each correct prediction that they made. Study 3 also extends the previous studies by testing participants' behavior in a longer sequence of five predictions.

Methods

We recruited 400 participants (M_{age} = 38.83, SD = 10.73; 41.50% female, 1.00% other/prefer not to say) from MTurk. Participants were informed that they would be making several predictions about the outcomes of real upcoming cricket games in the 2022 T20 Men's World Cup for Cricket. They saw an example game which included each team's International Cricket Council ranking and were told that teams with lower ranks had better records, and therefore had a higher expected chance of winning.

As in Study 2, we manipulated whether participants made their focal prediction (in this case, whether Zimbabwe, ranked 11^{th}, or Ireland, ranked 12^{th}, would win) first or last within the sequence of five predictions (see Figure 3 for the order of predictions in each condition). Importantly, we incentivized participants to make accurate forecasts by informing them that they would receive a bonus of $0.05 for each correct prediction. Once all games were played, participants received bonuses based on their predictions.

Results

Replicating previous studies, a chi-square test revealed that for the focal game, more participants predicted that the more improbable outcome would occur (i.e., that Ireland would win) in the *last* condition (55.28%) than in the *first* condition (31.34%; $\chi^2(df = 1, N = 400) = 23.34$ $p < .001$.; $OR = 2.71$, 95% CI = [1.80, 4.07]). See Figure 3.

Presentation order:	**1^{st}**	**2^{nd}**	**3^{rd}**	**4^{th}**	**5^{th}**
			First Condition		
Stimuli: *Share selecting the improbable outcome:*	**Focal** Zimbabwe (11^{th}) vs. Ireland (12^{th})	**Non-focal A** Sri Lanka (8^{th}) vs. Netherlands (18^{th})	**Non-focal B** India (1^{st}) vs. Bangladesh (9^{th})	**Non-focal C** England (2^{nd}) vs. Afghanistan (10^{th})	**Non-focal D** West Indies (7^{th}) vs. Scotland (15^{th})

	31.34%	**13.93%**	**5.47%**	**3.98%**	**12.44%**

Last Condition

	Non-focal A	**Non-focal B**	**Non-focal C**	**Non-focal D**	**Focal**
Stimuli:	Sri Lanka (8th) vs. Netherlands (18th)	India (1st) vs. Bangladesh (9th)	England (2nd) vs. Afghanistan (10th)	West Indies (7th) vs. Scotland (15th)	Zimbabwe (11th) vs. Ireland (12th)
Share selecting the improbable outcome:	**5.53%**	**6.03%**	**1.51%**	**11.06%**	**55.28%**

Fig. 3. The order in which games were presented in Study 3 based on *focal prediction position* condition, and the share of participants predicting the improbable outcome would occur (i.e., that the worse-ranked team would win) for each game.

Discussion

In Study 3, the prediction order effect held when participants were incentivized to make correct predictions. Besides demonstrating the robustness of the effect to more consequential decisions, this study provided a highly conservative test of the effect; as the incentive amount was constant regardless of the likelihood of winning, the expected value for predicting the better-ranked team would win was higher than for the worse-ranked team. To further examine the generalizability of the effect, we conducted another preregistered study (Study S4, N = 576) where participants had the opportunity to earn a $10 bonus via a lottery: they received one entry into the lottery for each correct prediction of which team would win real upcoming Women's National Basketball Association games. The prediction order effect replicated (*first* = 25.52% vs. *last* = 38.28%; $\chi^2(df = 1, N = 576) = 10.77$, $p = .001$; $OR = 1.81$, 95% CI = [1.27, 2.58]). See Supplemental Materials for full methods and results.

Moreover, this study replicated the effect within a longer sequence of predictions than in previous studies (five instead of three). We consider how the effect might change for even longer sequences in the General Discussion.

STUDY 4: ROBUSTNESS TO REVISABLE PREDICTIONS

Thus far, we have demonstrated that the prediction order effect holds in several contexts where people's predictions were *unchangeable*. However, in practice, people often have the opportunity to

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Version of Record at: https://doi.org/10.1287/mnsc.2022.01175

revise their predictions. Therefore, Study 4 used the paradigm employed in Study 1 to investigate the effect of order on predictions when people are able to review and change their predictions after they have been made.

Methods

We recruited 375 participants (M_{age} = 20.08, SD = 1.16; 39.57% female, 1.07% other/prefer not to say) from a behavioral lab at a university in the United States. This study's design and stimuli were very similar to Study 1: participants predicted which team would win – either the better-ranked team or the worse-ranked team – in three randomly ordered hypothetical basketball games. Unlike Study 1, however, after making their predictions, all participants then had the opportunity to revise them. Specifically, participants saw all three games on one page and were reminded of their predictions. They then actively chose whether to keep or change each prediction.

After making their initial predictions and having the opportunity to revise them, participants answered one exploratory item about how much they knew about basketball.

Results

Initial predictions. Replicating the results of Study 1, a repeated-measures logistic regression revealed a significant positive effect of the order in which the predictions were made (order variable coded as 1 = first choice, 2 = second choice, 3 = third choice; $b = 0.21$, SE = 0.06, $Z = 3.38$, $p < .001$), indicating that the proportion of participants predicting that the improbable outcome would occur (i.e., choosing the team that was less likely to win) increased with subsequent choices.

Separate McNemar's tests were consistent with these results. Our primary preregistered analysis found that the proportion of participants forecasting that the worse-ranked team would win increased from 29.07% in the first prediction to 38.40% in the third prediction ($\chi^2(df = 1, N = 375) = 11.04$, $p < .001$; $OR = 1.52$, 95% CI = [1.12, 2.06]). Our secondary analyses found that the proportion of participants forecasting that the worse-ranked team would win also increased (albeit with marginal significance) from the first to the second prediction (34.41%; $\chi^2(df = 1, N = 375) = 3.51$, $p = .061$; $OR = 1.28$, 95% CI =

[0.94, 1.74]) and from the second to the third prediction (χ^2(*df* =1, *N* = 375) = 2.71, *p* = .100; *OR* = 1.24, 95% CI = [1.00, 1.54]).

Revised predictions. Most participants did not revise their predictions; only 16.00% of participants changed their first prediction, 13.07% changed their second prediction, and 10.95% changed their third prediction. Participants were more likely to change their prediction to the improbable outcome (69.33% of revisions).

Again, a repeated-measures logistic regression revealed a significant positive effect of the order in which the predictions were made (*b* = 0.16, SE = 0.05, Z = 2.64, *p* = .008). McNemar's tests found that the proportion of participants predicting that the worse-ranked team would win increased from 36.00% for their first prediction to 43.47% for their third prediction (χ^2(*df* =1, *N* = 375) = 6.88, *p* = .009; *OR* = 1.37, 95% CI = [1.02, 1.83]). The proportion of participants forecasting that the worse-ranked team would win increased (although not significantly) from the first to the second prediction (37.90%; χ^2(*df* =1, *N* = 375) = 0.39, *p* = .53; *OR* = 1.28, 95% CI = [0.94, 1.74]); this increase was marginally significant from the second to the third prediction (χ^2(*df* =1, *N* = 375) = 3.83, *p* = .050; *OR* = 1.26, 95% CI = [0.94, 1.69]).

Finally, a repeated-measures logistic regression with order and whether the prediction was the participants' initial or revised prediction as factors replicated the main effect of order (*b* = 0.18, SE = 0.05, *Z* = 3.39, *p* < .001). This model also found a main effect of revision (*b* = 0.22, SE = 0.05, *Z* = 4.40, *p* < .001), such that participants were more likely to choose the worse-ranked team in their revised predictions (39.11%) than their initial predictions (33.96%). Importantly, an additional model including a variable for the interaction between order and revision did not reveal a significant interaction (*b* = 0.05, SE = 0.06, *Z* = 0.92, *p* = .36; see Figure 4).

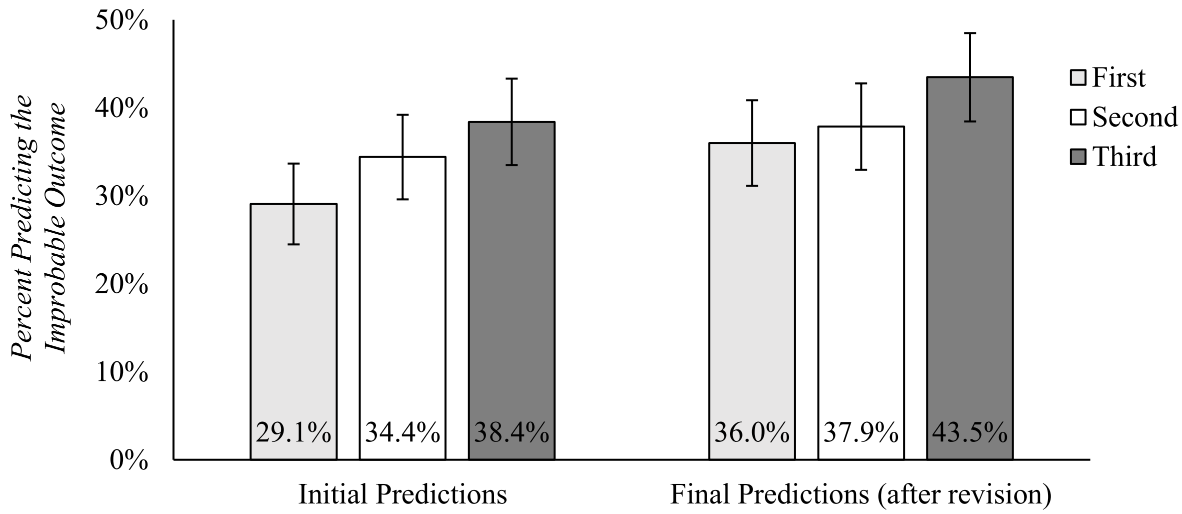

Fig. 4. The percent of participants in Study 4 who predicted that the more improbable outcome would occur (i.e., that the worse-ranked team would win) based on the order in which they made their predictions. We report both participants' initial predictions and their final predictions after having the chance to revise. Error bars are 95% confidence intervals.

Discussion

Replicating previous studies, participants in Study 4 were more likely to predict that the improbable outcome would occur for later, versus earlier, events in a prediction sequence. This effect persisted even when participants could revise their predictions. These results substantiate the external validity of our findings, as people can often review and change their predictions after they have been made.

Moreover, these results are also consistent with our proposed theory; even when participants are encouraged to think more carefully about their predictions through the opportunity to revise them, they neglect to overcome this bias. In our final two studies, we investigate moderators of the prediction order effect to gain further insight into the mechanism.

STUDY 5: MAKING PREDICTIONS FOR DIFFERENT TYPES OF EVENTS ATTENUATES THE EFFECT

Study 5 investigated the mechanism driving the prediction order effect by testing whether it is moderated when people make predictions for different types of events. Our theory posits that the prediction order effect is due to people's assumption that a sample of events will exhibit its expected outcome rate. Notably, this assumption is relevant to people's predictions only to the extent that they perceive the events to have the same outcome generating process. In other words, this bias should be present only if forecasters assume that the events are related and drawn from the same distribution (Roney and Trick, 2003). But if the events' outcomes are transparently from different distributions, people should be more likely to (correctly) deduce that the outcomes are unrelated and statistically independent. Our theory predicts that in such cases, people will follow the rational strategy of predicting the more probable outcome even for their later predictions, thereby attenuating the effect.

To test this reasoning, in Study 5, we examined whether the effect is moderated by the *domain* (i.e., type) of predicted events. Specifically, we tested if the effect is attenuated when predicted events are from multiple distinct domains (i.e., two sports events and one lottery; two lotteries and one sports event), versus from the same domain (i.e., three lotteries; three sports events).

Methods

We recruited 2001 participants (M_{age} = 40.62, SD = 12.70; 51.32% female, 0.75% other/prefer not to say) from MTurk. Participants were randomly assigned to one of four conditions in a 2 (*focal prediction position: first* or *last*) by 2 (*focal prediction domain: same* or *distinct*) between-subjects design. As in Study 2, all participants made three sequential predictions: a focal prediction where both outcomes were similarly (but not equally) probable, and two non-focal predictions where one outcome was much more likely to occur than the other. Again, we manipulated the order of the predictions, such that participants made the focal prediction either before (*first* condition) or after (*last* condition) making the two non-focal predictions.

In this study, we also manipulated whether the domain of the focal prediction was the same or different from the two non-focal predictions. Half of the participants made predictions for three events within the same domain, as in previous studies (*same domain* condition). Specifically, they either forecasted the outcomes of three lotteries (as in Study 2) or three hypothetical basketball games (as in Studies 1 and 4). The other half of participants made predictions for three events from two different

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domains: lotteries *and* basketball games (*distinct domain* condition). In particular, the focal prediction was from one domain, and the two non-focal predictions were from the other domain. We made the instructions and page breaks as similar as possible across conditions to control for inferences about the number of predictions that remained or potential partitioning effects (e.g., Cheema and Soman, 2008; see Supplemental Materials for exact stimuli). As preregistered, we aggregated across stimuli, allowing us to analyze the data in line with our 2 (*position*) x 2 (*domain*) experimental design.

After making their three predictions, participants answered two manipulation check questions on 1-7 scales ("How much did these predictions feel like they were part of the same set?" and "How similar were these predictions to each other?") and one exploratory item.

Results

Manipulation check. Independent samples t-tests confirmed that the *domain* manipulation affected how the sets of events were perceived: participants who made all predictions for events from the same domain perceived the events as more similar to each other ($M = 5.18$, SD = 1.50) and part of the same set ($M = 4.93$, SD = 1.65) than participants who made predictions for events from different domains ($M_{similar} = 4.37$, SD = 1.69; $M_{set} = 4.00$, SD = 1.71; ts > 11.40, ps < .001, ds > 0.50).

Focal prediction. A binary logistic model with *order*, *domain*, and their interaction as factors found a significant interaction ($b = 0.23$, SE = 0.07, *Wald* $\chi^2 = 11.37$, $p < .001$; see Figure 5). Replicating the previous studies, participants who made all three predictions for events within the same domain were more likely to forecast the improbable outcome when they made the focal prediction last (27.40%) versus first (10.42%; $\chi^2(df = 1, N = 999) = 46.94$, $p < .001$; $OR = 3.24$, 95% CI = [2.29, 4.59]). However, we did not observe the prediction order effect when the focal prediction was from a different domain than the non-focal predictions (*last* = 12.15% vs. *first* = 9.60%; $\chi^2(df = 1, N = 1002) = 1.68$, $p = .195$; $OR = 1.30$, 95% CI = [.87, 1.94]). Put another way, while the domain manipulation had no observable effect among participants who made the focal prediction first ($\chi^2(df = 1, N = 999) = 0.19$, $p = .67$; $OR = 1.10$, 95% CI = [0.72, 1.66]), it did affect predictions among participants who made the focal prediction last; in that condition, those whose predictions were all within a single domain were more likely to forecast that the improbable outcome would occur than those who made predictions for events from multiple domains (χ^2(*df* = 1, *N* = 1002) = 36.74, *p* < .001; *OR* = 2.73, 95% CI = [1.96, 3.80])[4].

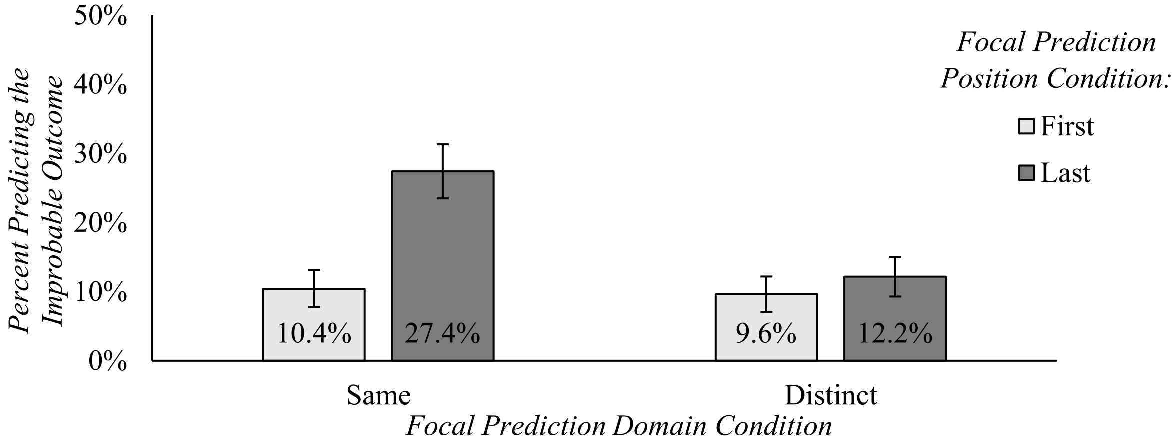


Fig. 5. The percentage of participants in Study 5 who predicted that the improbable outcome would occur for the focal event based on whether they made that prediction first or last, and whether the focal event was in the same or different domain as the non-focal events. Error bars are 95% confidence intervals.

Discussion

Study 5 again replicated the effect of order on predictions. Moreover, supporting our theory, we found that the effect attenuated when participants made predictions for events from distinct domains (e.g., one lottery and two basketball games), relative to events from the same domain (e.g., three lotteries). This moderation suggests that people apply their "belief in the law of small numbers" to a lesser degree when making judgments for events whose outcomes are clearly drawn from different distributions and therefore are more apparently statistically independent.

STUDY 6: PROVIDING FORECASTERS WITH INFORMATION ABOUT STATISTICAL INDEPENDENCE ATTENUATES THE EFFECT

Building off the results of the previous study, Study 6 explored another potential moderator of the prediction order effect: knowledge of statistical independence. If, as we theorize, people's preconceptions

[4]An additional model without the interaction term found two main effects (*order:* *b* = 0.40, SE = 0.07; *Wald* χ^2 = 36.79, *p* < .001; *domain:* *b* = 0.33, SE = 0.07, *Wald* χ^2 = 25.47, *p* < .001).

concerning outcomes of uncertain events drive the effect, we would expect it to attenuate when people learn that the event outcomes are independent. To test this prediction, and to investigate a possible intervention to reduce this bias, in Study 6, we examined whether providing such information – specifically, by explaining the meaning of statistical independence – moderates the prediction order effect.

Methods

We recruited 2,000 participants (M_{age} = 38.63, SD = 12.15; 50.90% female, 0.35% other/prefer not to say) from MTurk. All participants read the same instructions as in Study 2. In this study, participants were randomly assigned to one of four conditions in a 2 (*focal prediction position: first* or *last*) by 2 (*statistics information: control (absent)* or *provided*) between-subjects design. Again, we manipulated the order of the predictions, such that participants made the focal prediction either before (*first* condition) or after (*last* condition) making two non-focal predictions.

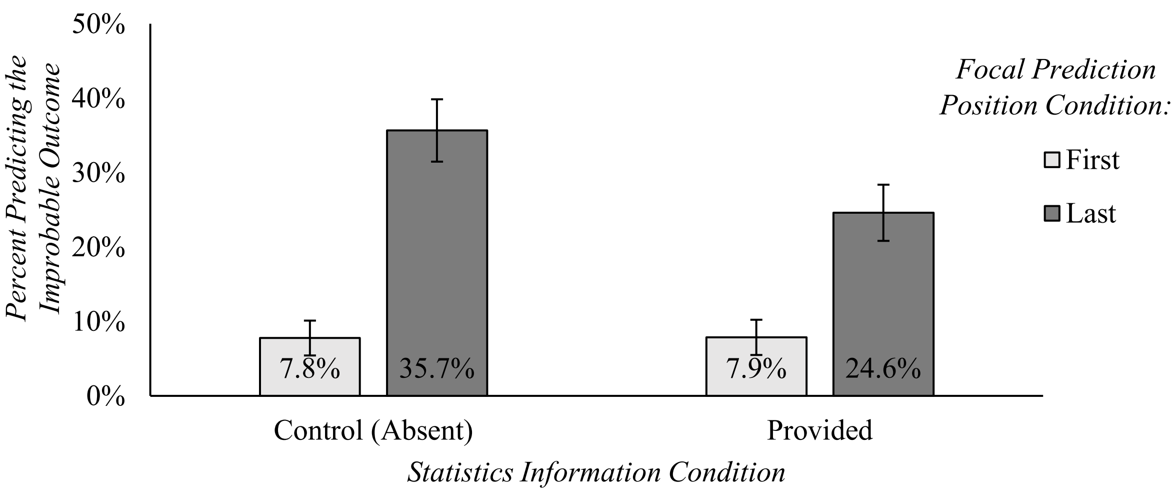
In this study, we also manipulated whether participants were provided information about the concept of statistical independence. Like in Study 2, half of the participants were simply told that they would be making predictions of which color ball would be drawn from different jars and then proceeded to make those predictions (*control* condition). The other half first read a short paragraph explaining that in general, the outcome of one event does not necessarily affect the outcomes of other events (*statistics information provided* condition). Then, they answered a question testing their understanding of the concept of statistical independence (90.66% of participants answered the question correctly; see Supplemental Materials for exact stimuli). After reading this information, they proceeded to make the same predictions as in the *control* condition.

Results

A binary logistic regression with *order*, *statistics information*, and their interaction as factors revealed a significant interaction (b = 0.14, SE = 0.07, *Wald* χ^2 = 3.92, p = .048; see Figure 6). A chi-square analysis revealed that the prediction order effect replicated within the *control* condition (*last* = 35.66% vs. *first* = 7.77%; $\chi^2(df = 1, N = 1004) = 114.84$, $p < .001$; *OR* = 6.64, 95% CI = [4.56, 9.67]).

Importantly, this effect was smaller for participants who were given statistics information (*last* = 24.60% vs. *first* = 7.86%; $\chi^2(df = 1, N = 996) = 51.21$, $p < .001$; *OR* = 3.82, 95% CI = [2.60, 5.62]). Consistent with our proposed mechanism, this attenuation was driven by participants who made the focal prediction last. For participants who made the focal prediction first, there was no effect of providing statistical information ($\chi^2(df = 1, N = 998) < 0.01$, $p = .96$; *OR* = 0.99, 95% CI = [0.62, 1.57]). However, for participants who made the focal prediction last, reading about statistical independence (versus not) reduced the likelihood of predicting the improbable outcome ($\chi^2(df = 1, N = 1002) = 14.55$, $p < .001$; *OR* = 1.70, 95% CI = [1.29, 2.23])[5].

Fig. 6. The percentage of participants in Study 6 who predicted that the improbable outcome would occur for the focal event based on whether they made that prediction first or last, and whether they read



information about statistical independence in the instructions or not. Error bars are 95% confidence intervals.

Discussion

Study 6 again replicated the prediction order effect. Furthermore, explaining to participants that events are statistically independent attenuated the effect, supporting our theory that the effect is driven by people's belief that a small set of independent events will result in both probable and improbable outcomes (i.e., belief in the law of small numbers). Notably, this study also demonstrates an important

[5] An additional model without the interaction term found two main effects (*order:* $b = 0.82$, SE = 0.07; *Wald* $\chi^2 = 36.79$, $p < .001$; *statistical information:* $b = 0.20$, SE = 0.06, *Wald* $\chi^2 = 10.60$, $p = .001$).

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practical implication: a simple intervention – providing people with information about statistical independence – can reduce this bias.

GENERAL DISCUSSION

In this research, we found that when people make multiple predictions, they are more likely to forecast that events will result in improbable outcomes for their later (versus earlier) predictions. This prediction order effect was robust to multiple domains, including real sports games and stylized lotteries. Furthermore, it persisted when we rewarded participants for making correct predictions and allowed them to review and revise their predictions.

We propose that this effect is driven by people's lay beliefs about the probability of uncertain events, namely, their assumption that a sample of events will reflect their expected outcomes, even if they are statistically independent. This assumption creates an expectation that an improbable outcome is bound to occur at some point within a set of events, which plays out in later predictions. That is, because people typically predict that the more probable outcome will occur for their first forecast (as they would for a single prediction), they are more likely to predict the improbable outcome later. We found supportive evidence of this theory in two studies. Specifically, the prediction order effect was attenuated when participants viewed the event outcomes as being drawn from distinct distributions, which we operationalized by having the predicted events coming from two different domains (basketball games and lotteries) rather than just one domain (e.g., only lotteries). Additionally, the effect was attenuated when participants were explicitly informed of the definition of statistical independence.

Theoretical Contributions

This research makes several notable contributions. First, we add to a robust literature on order effects. Past research has shown that the order in which people process stimuli and make choices has considerable outcomes. For instance, order affects people's product evaluations (e.g., Moore, 1999), choices (e.g., Li and Epley, 2009), and even voting decisions (e.g., Koppell and Steen, 2004; Miller and Krosnick, 1998). Notably, many established order effects are driven by the fact that people tend to have better memory of stimuli presented first (i.e., a primacy effect) or last (i.e., a recency effect; Murdock 1968, 1976; Neath, 1993). Here, we document a different mechanism by which order affects judgments and choices: a (flawed) understanding of statistics influences people's predictions of future events based on the order in which they are made.

Second, we contribute to research on heuristics in forecasting by extending the literature on lay beliefs concerning probabilities. Past research has shown that the belief in the law of small numbers can lead people to expect that, following a string of one particular outcome, the other outcome will occur (gambler's fallacy: e.g., Tversky and Kahneman, 1974), as well as to predict that the rate of outcomes of a set of events will mirror the expected likelihoods (probability matching: e.g., James and Koehler, 2011). We add to this body of research by studying how this heuristic affects judgment in a common and natural context: predictions of multiple future events made sequentially. That is, our findings diverge from this past work by documenting how the belief in the law of small numbers influences multiple sequential predictions, rather than a single prediction of one event following past outcomes (gambler's fallacy) or a prediction of a collective set of events (probability matching).

Finally, this work also informs existing literature on variety seeking. Interestingly, the prediction order effect could be defined as a form of variety seeking: over time, people shift from one prediction (the probable outcome) to another (the improbable outcome). By and large, research on variety seeking has focused on how repeated consumption episodes can lead to (physiological or psychological) satiation or boredom, which individuals alleviate through seeking a new experience, often by switching to an alternative product or brand (Kılıç, Van Tilburg, and Igou, 2020; Lauriola et al., 2014; Sevilla, Lu, and Kahn, 2019; Zaleskiewicz, 2001). We add to this area of literature by demonstrating that individuals can be driven to "seek variety" across their predictions for a different reason: their preconceptions concerning outcomes of uncertain events.

Practical Implications

Our findings have important implications for both individuals and organizations. Simply put, we show that when it comes to making multiple predictions, order matters. Because choosing the more improbable outcome increases the likelihood of making an incorrect prediction, errors are more likely in later predictions. Gamblers, investors, and managers, for example, may make riskier choices – like betting on an underdog, investing in a risky stock, or greenlighting an unproven project – for decisions that happen to occur later. As a result, for later forecasts, individuals and organizations alike face a greater possibility of a negative outcome. Such implications could be particularly consequential if the most important judgment is left for last (a common tactic: Habbert and Schroeder, 2020).

Moreover, our work indicates that companies can leverage the prediction order effect to influence individuals' behavior, as they often act as choice architects. That is, they have a great deal of control over how they display information to individuals; casinos choose the order in which upcoming sports games are shown to gamblers, and investment and trading companies like *Robinhood* and *eTrade* decide the order in which stocks are listed within their apps. Based on our findings, companies can subtly influence people's behavior through how they order relevant information, with the intent to maximize either company profit or societal welfare. As an example, a casino could strategically boost revenue by ending a set of bets with one where they would benefit the most from gamblers choosing the improbable outcome.

Finally, these results are also relevant to policy-makers and other organizations seeking to protect consumers from non-optimal decision making. In line with the findings of Study 6, organizations may be able reduce the prediction order effect with a simple, inexpensive intervention: informing people of events' statistical independence. For instance, requiring that casinos and gambling websites disclose that the events within sets of multiple gambles (e.g., parlay bets) are unrelated could reduce willingness to bet on the improbable outcome in later gambles. Additionally, given that the effect is attenuated when predictions are perceived as being from different domains (Study 5), companies could be encouraged to highlight the differences between types of predictions (e.g., explaining to consumers looking to save for retirement the distinctions between investment options, like IRAs and CDs), thereby lessening the effect.

Future Directions and Limitations

As our work is the first to document the prediction order effect, it opens several avenues for future research. Although we find that the effect held among participants who reported greater knowledge in relevant domains (see Supplemental Materials for details), future work may examine if it generalizes to more specialized populations. For example, it is possible that gamblers, investors, or professional forecasters exhibit the prediction order effect to a lesser degree given their expertise (Mellers et al., 2014; Satopää et al., 2021). Additionally, as our main goal in this work is to establish the prediction order effect and a key mechanism that drives it, we conducted our studies in controlled experimental settings. Future research might extend our work by analyzing secondary data (e.g., real March Madness brackets) or conducting field or lab experiments which relax some of the controlled aspects of our studies. For instance, in our studies, participants faced the same rewards for correct predictions, regardless of outcome likelihoods; it would be interesting to examine this effect for varied rewards which equate expected values, or even tip them in favor of the improbable outcome.

Here, we demonstrate the prediction order effect for sequences of up to five predictions. There remains an open question as to how order might influence sequences of dozens, or even hundreds, of predictions. It is possible that in such cases, individuals might exhibit a cyclical prediction pattern where, after a certain number of predictions in favor of the probable outcome, they switch to predicting the more improbable outcome once or twice, and then repeat. The "tipping point" at which such a cycle restarts might depend on a variety of factors. On the one hand, given that pattern recognition occurs for as few as three events (e.g., Carlson and Shu, 2007; Gao, Huang, and Simonson, 2014; Silverman and Barasch, 2023), these cycles might often span just three predictions. On the other hand, individuals might group all similar predictions together into one set (e.g., all 32 games within the first round of March Madness), potentially creating much longer sequences over which the effect might repeat itself. Furthermore, the repetition of this pattern might change over time; for instance, if given enough prediction opportunities, individuals might eventually realize their bias, leading to the effect "fizzling out."

These possibilities also beg the question of *when* within a sequence people exhibit this effect. Individual-level heterogeneity and contextual information may play an important role. For example, even within the same sequence of predictions, some individuals might feel it is appropriate to choose the more improbable option after just one instance of choosing the more probable option, whereas others might make such a decision after two or three instances. This variation could be further amplified by people's perceptions of each outcome's likelihood, especially if such information is communicated through ranks or other less precise means (as discussed in Study 1). Future research might further investigate the factors that influence variation in prediction patterns.

In this work, we provide evidence that people's lay beliefs about the relationships between event outcomes drive the prediction order effect. Future work might more deeply investigate this process and, in particular, explore how people mentally represent their predictions of future events. It is possible that people may not only consider their earlier predictions when making later predictions (as we hypothesize), but also functionally treat their earlier predictions as correct. That is, consistent with our theory, people might simulate or "play out" the event in their minds before making subsequent predictions.

Other mechanisms may also lead to a similar order effect within sequential predictions. One such driver could be boredom or satiation, consistent with literature on variety seeking. Prior work has shown that people sometimes seek variety in their choice *strategy* because they value change (i.e., variety) "for change's sake" (Drolet, 2002). Applied to our context, people may exhibit the prediction order effect because of a desire to change their forecasting strategy. That is, independent from beliefs of probabilities (as we theorize), people may also be motivated to choose the improbable outcome in later predictions because they wish to do something new. However, such an explanation cannot fully account for our findings (e.g., the attenuation of the effect when people learn about statistical independence observed in Study 6). Another driver could be variation in the perception of outcomes' likelihoods; people may choose the improbable option in later predictions in part because they *perceive* it as more likely after observing events with wildly different odds, akin to how the perceived size of an object depends on the size of other reference objects (e.g., Titchener circles: Pressey, 1977). Notably, we demonstrate the prediction order effect even when such an alternative is not applicable; the effect persists for events with consistent odds (Studies 1 and 4) and we do not find a significant effect of order on perceived likelihoods for events with varied odds (see the post-test discussed in Study 2). However, it is still possible that this alternative plays a role in at least some of our experiments, as we observe larger effect sizes within our "between-subjects" manipulation (where such a contrast effect is more likely to occur). Future research might uncover the influence of these and other potential mechanisms.

Finally, we have proposed that the prediction order effect depends on people's perception that the outcomes of the predicted events are all from the same distribution. We test this theory via moderation in Study 5, finding that the effect is attenuated when the events are within different domains, presumably because this operationalization helped participants correctly deduce that the outcomes are statistically independent. Other factors, such as waiting hours or days between predictions, the addition of physical partitions between predictions, or more differentiated visual characteristics of the stimuli, might similarly signal that predicted events are statistically independent, thus attenuating the effect. We hope future work will build on this research to further understand how contextual factors affect people's tendency to group (or ungroup) their judgments under uncertainty, and how such perceptions affect the quality of their forecasts and decisions.

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