How People Value Sets of Opportunities

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Working Paper — Updated June 2025

Link to preregistrations, materials, data, and code:

https://researchbox.org/2112&PEER_REVIEW_passcode=HXYGEO

Link to Supplemental Material:

https://www.dropbox.com/scl/fi/qj21mqize4av4nqmm78ul/Geiser-Evers-Supplemental-Material.pdf?rlkey=7dkj281j25r4sau221j1sbl45&st=agcqjk5x&dl=0

Abstract

When pursuing multiple opportunities in parallel (e.g., financial investments, research projects), people often have to make tradeoffs between the number of opportunities they pursue and the likelihood of each individual opportunity succeeding. Ten preregistered studies (total $N = 6{,}220$) investigate how people make such tradeoffs. Our evidence suggests that people tend to prioritize having a high probability of success per opportunity over pursuing many opportunities. Specifically, people frequently prefer to pursue smaller sets of higher-probability opportunities (e.g., two investments, each with a 50% chance of succeeding) even when larger sets of lower-probability opportunities (e.g., 15 investments, each with a 10% chance of succeeding) are expected to yield better outcomes. We suggest that this tendency arises not merely because people mistakenly expect sets of higher-probability opportunities to yield more total successes, but also because they care about achieving a high *proportion* of successes. Consistent with this account, many participants continued to undervalue large sets of low-probability opportunities even when shown cumulative probability information that made it clear which set of opportunities would be expected to yield better outcomes. Moreover, once outcomes were revealed, participants assigned to receive smaller sets of higher-probability opportunities reported feeling more satisfied than those assigned to receive larger sets of lower-probability opportunities, even if they ended up with fewer successes in total.

Keywords: decision making, opportunities, risk, probability, emotions

Significance Statement

This research demonstrates that people often prefer to pursue smaller sets of opportunities in which each individual opportunity has a high probability of succeeding, even if they could achieve better outcomes by pursuing larger sets of lower-probability opportunities. This pattern emerged across a wide variety of contexts, including decisions about which financial investments to make, decisions about which projects to pursue, and decisions about which prosocial actions to take. Our findings suggest that decision makers prioritize having a high probability of success per opportunity over taking many opportunities in part because they care about achieving a high proportion of successes. This tendency may lead individuals and organizations to make suboptimal decisions about which sets of opportunities to pursue. Decision makers could achieve better outcomes if they were more willing to take many low-probability opportunities.

Introduction

People often pursue multiple opportunities in parallel. For example, a researcher might pursue multiple projects (each of which may or may not result in a published paper), an investor might fund multiple startups (each of which may or may not succeed), and a charity might solicit donations across multiple channels (each of which may or may not boost donations).

In these contexts, decision makers with limited resources may have to make tradeoffs between the *number of opportunities* they pursue and the *likelihood of each individual opportunity succeeding*. For example, a researcher might decide whether to spread their efforts across many different projects, each with a low chance of being published, or to concentrate their efforts into a few projects, each with a high chance of being published. Similarly, an investor might decide whether to fund a larger set of early-stage startups, each of which is unlikely to succeed, or a smaller set of later-stage startups, each of which is more likely to succeed.

This research investigates how people make such tradeoffs: When deciding which set of opportunities to pursue, do people prefer to take many opportunities that are individually less likely to succeed, or to take fewer opportunities that are individually more likely to succeed? Although both strategies can yield similar aggregate outcomes, previous research suggests that people may have a systematic tendency to prefer one over the other. Consider, for example, an investor who is deciding whether to fund a set of 10 early-stage startups, each of which has a 10% chance of succeeding, or two later-stage startups, each of which has a 50% chance of succeeding. On average, each set of startups is expected to yield one success, which means that (holding the payout for each successful investment constant) the investor can expect to earn just as much from the larger set of early-stage startups as from the smaller set of later-stage startups. However, if they overweight low probabilities (Gonzalez & Wu, 1999) or simply find

probabilities hard to evaluate (Hsee, 1996), they may prefer the larger set of startups even if this means each startup has a lower chance of succeeding. On the other hand, if they underestimate how likely it is for the larger set of lower-probability investments to yield *any* successes (Bar-Hillel, 1973), then they may prefer the set of startups with a higher probability of success, even if this means investing in fewer startups. In short, previous research on risky decision making does not make a clear prediction about how people will decide which set of opportunities to pursue.

Of course, in reality, people rarely make such explicit tradeoffs between the number of opportunities they pursue and the probability of each opportunity succeeding. For instance, they may not know exactly how likely it is for each opportunity to succeed, or they may expect the magnitude of each success to vary depending on which set of opportunities they take. However, in our studies, we sought to isolate this tradeoff by presenting participants with stylized choices between larger sets of lower-probability opportunities and smaller sets of higher-probability opportunities in which the magnitude of each successful outcome was held constant. We manipulated which set would be expected to yield more successes on average, which allowed us to examine how often participants were willing to incur a cost to take more opportunities versus to have a higher likelihood of success per opportunity, all else equal. If people prioritize having a high probability of success per opportunity, they should be more willing to incur a cost to have a higher probability of success per opportunity than to take more opportunities. By contrast, if people care primarily about pursuing many opportunities, they should be more willing to incur a cost to take more opportunities than to have a higher probability of success per opportunity.

How Do People Value a Set of Opportunities?

Although people often have to decide *which* set of opportunities to pursue, existing research has largely focused on how people value a set of opportunities (e.g., a 50% chance of

$1, played out 100 times) relative to a single opportunity (e.g., a 50% chance of $1, played out once). In general, though most people behave in risk-averse ways when deciding whether to take a single opportunity, they tend to be more risk-tolerant when deciding whether to take multiple opportunities at once (Benartzi & Thaler, 1995; Kahneman & Lovallo, 1993; Keren & Wagenaar, 1987; Read et al., 1999; Redelmeier & Tversky, 1992). This suggests that people appreciate the benefits of taking many opportunities—at least to some extent—but it does not answer the question of how people value a set of opportunities relative to *other* sets of opportunities. Specifically, existing work does not address how people weigh the value of taking many opportunities against the value of having a high likelihood of success per opportunity.

A straightforward baseline assumption is that when deciding which set of opportunities to pursue, people simply choose whichever set of opportunities they expect to yield the best outcomes (i.e., the greatest number of successes). However, judging how many opportunities will succeed in the aggregate can be complicated, given that it requires people to consider both the number of opportunities and the probability of success per opportunity simultaneously. Depending on how each of these factors is incorporated into the overall judgment, decision makers may be systematically biased towards valuing large sets of low-probability opportunities either more or less than smaller (but equally valuable) sets of higher-probability opportunities.

There are at least two reasons to expect that people may prefer to pursue many lower-probability opportunities over pursuing fewer higher-probability opportunities. First, previous research suggests that decision makers tend to overweight low probabilities (Gonzalez & Wu, 1999; Kahneman & Tversky, 1979). This means that people may overestimate how likely it is for each low-probability opportunity to succeed, which may lead them to expect that a large set of lower-probability opportunities will yield more overall successes than a small set of higher-

probability opportunities, even if both are equally valuable in expectation. Second, people may simply find probabilities hard to evaluate in the first place. Whereas people may readily understand what it means to pursue a given number of opportunities (e.g., investing in 10 startups vs. 2 startups), they may find it harder to evaluate just how promising it is for each of those opportunities to have a particular probability of succeeding (e.g., a 10% vs. 50% probability of success per startup). As a result, they may be relatively insensitive to the probability of each individual opportunity succeeding, instead focusing primarily on the total number of opportunities (Hsee, 1996; Hsee et al., 1999; Hsee & Zhang, 2010). This is consistent with the idea that people are especially sensitive to the categorical distinction between an event that has *no* chance of occurring and an event that has *some* chance of occurring (Hsee & Rottenstreich, 2004; Rottenstreich & Hsee, 2001). At the extreme, they may simply try to pursue as many opportunities as possible without considering how likely it is for each to succeed.

On the other hand, there are also reasons to expect that decision makers may prefer to pursue fewer higher-probability opportunities over pursuing many lower-probability opportunities. In particular, previous research suggests that people may misjudge the relationship between the probability of each individual opportunity succeeding and the chances of one or more opportunities succeeding in the aggregate. Cumulative probability judgments tend to be systematically biased in the direction of individual components' probabilities (Holtgraves & Skeel, 1992; Slovic et al., 1978; Wang et al., 2023), which means that the less likely it is for each individual opportunity to succeed, the less likely it may seem for *any* opportunities to succeed (Bar-Hillel, 1973). For example, someone who is asked to judge how likely it is for four coin tosses to yield at least one heads might start at 50% and adjust insufficiently upward, thus underestimating the true value (93.75%). Because the gap between individual probabilities and

cumulative probabilities grows even larger for larger sets of events, we should expect people to underestimate the cumulative chances of success even more so for a larger set of lower-probability opportunities than for a smaller set of higher-probability opportunities (Gneezy, 1996). This means that people may expect to end up with more successes if they take fewer higher-probability opportunities than if they take many lower-probability opportunities.

Anticipated Outcome Satisfaction

Although existing research largely focuses on biases in probability judgment, decision makers may not only care about what they expect to happen; rather, they may also take into account how they expect to *feel* about this outcome (Bell, 1985; Loewenstein et al., 2001; Loomes & Sugden, 1982; B. A. Mellers et al., 1997, 1999). Even if people believe that, on average, they will end up with just as many successes regardless of whether they take many low-probability opportunities or fewer high-probability opportunities, they may expect this outcome to be more or less satisfying depending on which set of opportunities it originated from. For instance, an investor who funds 10 startups with a 10% chance of success per startup can expect the same number of successes, on average, as an investor who funds two startups with a 50% chance of success per startup. However, even if both investors end up with exactly as many successes as anticipated (i.e., one), they may feel differently about this outcome depending on whether it originated from a larger or smaller set of investments and/or whether each individual startup initially seemed likely or unlikely to succeed. In other words, the same objective outcome might seem subjectively better or worse depending on which set of opportunities it arose from. From this perspective, when people make choices that appear suboptimal, they may not necessarily be doing so because they have the wrong expectations about the consequences of

their choices, but instead because of how they subjectively evaluate those consequences (even while holding expectations themselves constant).

We propose that the degree to which people expect to feel satisfied with the outcome of a set of opportunities depends not just on the total number of opportunities that succeed, but also on the proportion of opportunities that succeed. Even in contexts where people *should* care only about absolute quantities, they are often highly sensitive to proportions (Bartels, 2006; Hsee & Leclerc, 1998; Slovic et al., 2004, 2007). For instance, people tend to prefer life-saving interventions that can save a higher proportion of those at risk, even if this means fewer lives will be saved in total (Baron, 1997; Fetherstonhaugh et al., 1997; Jenni & Loewenstein, 1997). Therefore, when deciding which set of opportunities to take, people may expect to feel better about sets of opportunities that are expected to yield a higher proportion of successes, and thus may prioritize having a high probability of success per opportunity over taking many opportunities. Moreover, people may even expect the exact same number of successes to feel worse if they arrive at this outcome after taking a larger number of opportunities. For instance, an investor might feel worse about the possibility of ending up with one successful investment if they made a total of 10 investments than if they made just two investments.

Our proportional satisfaction account assumes that decision makers take into account how they will feel about the aggregate outcome of each set of opportunities, and not merely how they will feel about each individual opportunity as it unfolds (e.g., Wang et al., 2023). People may reasonably expect to feel better about each opportunity in isolation when it has a higher chance of succeeding, given that success feels better than failure. However, if decision makers prefer to take fewer higher-probability opportunities over taking many lower-probability opportunities solely because they are myopically focused on how they will feel about each

individual opportunity, then they should not necessarily be sensitive to the total number of opportunities they took when evaluating their outcomes in the aggregate. By contrast, our account suggests that people may continue to prefer smaller sets of higher-probability opportunities over larger sets of lower-probability opportunities even after they know exactly how many opportunities succeeded. Because a given number of successes represents a lower proportion of successes if it originated from a larger set of opportunities, people may feel less satisfied with the exact same outcome the more opportunities they took.

In sum, we expect that decision makers will prioritize having a high probability of success per opportunity over taking many opportunities—not merely because they misjudge how each of these factors contributes to their aggregate outcomes, but also because they subjectively prefer outcomes in which a high proportion of opportunities succeed. Several predictions follow from this account. First, decision makers will be more willing to incur a cost to have a higher probability of success per opportunity than to pursue a larger number of opportunities. As a result, they may sometimes prefer to take fewer high-probability opportunities over taking many low-probability opportunities even if the latter is expected to yield objectively better outcomes. Second, this pattern will persist even when decision makers are provided with objective information on the number of opportunities that are expected to succeed in total. Third, decision makers will value information about the probability of success per opportunity more than they value information about aggregate outcome probabilities. Finally, people will feel more satisfied with the outcomes of smaller sets of higher-probability opportunities than with the outcomes of larger sets of lower-probability opportunities, even if the latter yielded just as many (or even more) successes in total.

Research Overview

We report 10 preregistered studies (seven in the main manuscript and three in the Supplemental Material; total $N = 6{,}220$) that examine how people trade off the number of opportunities they pursue against the probability of each opportunity succeeding. Study 1 finds that across a wide range of domains, people frequently choose to pursue fewer high-probability opportunities even when it would be more optimal to pursue many lower-probability opportunities, which suggests that they prioritize having a high probability of success per opportunity over taking many opportunities. Study 2 replicated this pattern in an incentive-compatible context involving choices between real monetary gambles. Studies 3a and 3b found that people were more willing to pursue many low-probability opportunities when provided with both individual and cumulative success probabilities, rather than individual probabilities alone; however, people still undervalued larger sets of lower-probability opportunities relative to smaller sets of higher-probability opportunities. Study 4 found that presenting only cumulative probabilities reduced this tendency further, which suggests that individual-probability information itself can lead decision makers astray. Yet in Study 5, most participants still actively chose to see individual rather than cumulative probabilities, which implies that they cared about having a high probability of success per opportunity for its own sake and did not simply misjudge the aggregate chances of success. Finally, Study 6 found that people prefer smaller sets of higher-probability opportunities even after outcomes are revealed. Participants assigned to receive a large set of low-probability opportunities reported feeling less satisfied than those assigned to receive a smaller set of higher-probability opportunities, even when they achieved objectively better outcomes. Altogether, our evidence supports the idea that people prefer to pursue smaller sets of higher-probability opportunities in part because they (correctly) anticipate that they will feel more satisfied if they achieve a higher proportion of successes.

All studies were preregistered on AsPredicted, and all sample sizes were specified in advance in our preregistrations. We report all manipulations, measures, and exclusions. All of our study materials, data, code, and preregistrations are available on ResearchBox. This research was determined to be exempt from IRB review.

Study 1

In Study 1, we investigated whether people value having a high probability of success per opportunity more than they value taking many opportunities. Participants made a series of choices, each between pursuing a larger set of lower-probability opportunities and pursuing a smaller set of higher-probability opportunities. In some cases, participants could expect to end up with more successes on average if they chose the larger set of lower-probability opportunities, whereas in other cases they could expect to end up with more successes if they chose the smaller set of higher-probability opportunities. We expected that participants would prioritize having a high probability of success per opportunity over taking many opportunities, and that they may choose to pursue a smaller set of higher-probability opportunities even when pursuing a larger set of lower-probability opportunities would yield objectively better outcomes.

Method

Participants

We requested 400 U.S.-based participants from Amazon Mechanical Turk (MTurk) via CloudResearch and received 401 complete submissions. Consistent with our preregistration, we excluded all submissions from participants who opened the survey more than once under the same participant ID or IP address (n = 14). Our final sample included 387 participants.

Procedure

Participants made a series of eight decisions about which sets of opportunities to pursue, each in a different domain. These eight decisions involved choosing (1) which audience to show a digital ad to, (2) which set of malaria interventions to deliver to a particular region, (3) which group of people to solicit petition signatures from, (4) which set of projects to pursue, (5) which set of raffle tickets to buy, (6) which set of scholarships to apply to, (7) which set of vegetable seedlings to plant, and (8) which set of startups to invest in. The eight decisions were presented in random order, with one decision on each page.

Each decision offered a choice between two options: a larger set of lower-probability opportunities (e.g. "Invest in 40 startups, each of which has a 5% chance of succeeding") and a smaller set of higher-probability opportunities (e.g., "Invest in 4 startups, each of which has a 25% chance of succeeding"). The exact pair of probabilities varied across domains, but in every domain the higher-probability opportunities were between 2.5 and 5 times as likely to succeed as the lower-probability opportunities.[1] We randomized which option appeared on which side of the page, with the option on the left labeled "Option A" and the option on the right labeled "Option B." Across all domains, participants were told that each success was equally valuable and that both options required the same total amount of time, money, and effort.

Table 1 shows the details of both sets of options for each domain. In every decision, one option was expected to yield twice as many successes as the other and thus had a higher expected value. Between-subjects, separately for each domain, we manipulated whether the optimal choice was the larger lower-probability option or the smaller higher-probability option. We did so by

[1] Given that larger sets of lower-probability opportunities tend to have greater outcome variability than smaller sets of higher-probability opportunities, one potential concern is that our predicted pattern of results may arise simply due to an aversion to high-variance options. In the Supplemental Material, we report two commonly used measures of outcome variability, the standard deviation (SD) and the coefficient of variation (CV), for each option in each study. Altogether, our findings do not appear to be driven entirely by an aversion to high-variance outcomes.

varying the number of opportunities in each option (while holding the probabilities constant). For example, in the investment domain, some participants chose between (a) 40 startups with a 5% chance of success per startup (i.e., 2 expected successes) and (b) 4 startups with a 25% chance of success per startup (i.e., 1 expected success), whereas others chose between (a) 20 startups with a 5% chance of success per startup (i.e., 1 expected success) and (b) 8 startups with a 25% chance of success per startup (i.e., 2 expected successes).

Table 1
Details of Each Option for All Decisions in Study 1

Domain	***Larger Set of Lower-Probability Opportunities***	***Smaller Set of Higher-Probability Opportunities***
Digital ads	Show the ad to **7,500** [**3,750**] people, each of whom has a **2%** chance of clicking	Show the ad to **1,250** [**2,500**] people, each of whom has a **6%** chance of clicking
Malaria interventions	Deliver an intervention with a **10%** success rate to **400** [**200**] recipients	Deliver an intervention with a **40%** success rate to **50** [**100**] recipients
Petition signatures	Reach out to **400** [**200**] people, each of whom has a **6%** chance of signing	Reach out to **40** [**80**] people, each of whom has a **30%** chance of signing
Projects	Launch **60** [**30**] projects, each of which has a **15%** chance of succeeding	Launch **10** [**20**] projects, each of which has a **45%** chance of succeeding
Raffle tickets	Buy **40** [**20**] tickets for a raffle in which each ticket offers a **7%** chance of winning	Buy **5** [**10**] tickets for a raffle in which each ticket offers a **28%** chance of winning
Scholarships	Apply to **20** [**10**] scholarships and have a **20%** chance of winning each one	Apply to **4** [**8**] scholarships and have a **50%** chance of winning each one
Seedlings	Plant **300** [**150**] seedlings, each of which has a **12%** chance of reaching harvest	Plant **50** [**100**] seedlings, each of which has a **36%** chance of reaching harvest
Startups	Invest in **40** [**20**] startups, each of which has a **5%** chance of succeeding	Invest in **4** [**8**] startups, each of which has a **25%** chance of succeeding

Note: Participants made one decision in each domain. In all decisions, one option was expected to yield twice as many successes as the other, and we manipulated (between-subjects) whether it was optimal to choose the larger lower-probability option or the smaller higher-probability option by varying the number of opportunities in each set. Brackets indicate the version of each decision in which the smaller higher-probability option was the optimal choice.

Below each set of options, participants were asked which of the two options they would choose: "Which option would you choose?" (*Option A* or *Option B*).

Results and Discussion

The dependent variable for each decision was whether participants made a suboptimal choice—that is, whether they chose the option that would be expected to yield fewer successes on average. Each participant provided eight observations (i.e., one for each decision). We conducted a mixed-effects logistic regression with a variable indicating whether participants chose suboptimally (1 = yes, 0 = no) predicted by whether the suboptimal choice was the larger lower-probability option or the smaller higher-probability option (-0.5 = larger lower-probability option, +0.5 = smaller higher-probability option), with fixed effects for each domain. We included participant-level random intercepts to account for the non-independence of observations from the same participant.

We expected that people would value having a high probability of success per opportunity more than they value taking many opportunities, and thus that they would be more likely to make a suboptimal choice when this would allow them to take fewer higher-probability opportunities as opposed to many lower-probability opportunities. Indeed, when it was optimal to choose the smaller set of higher-probability opportunities, participants chose suboptimally (i.e., chose the larger set of lower-probability opportunities) only 7.3% of the time, but when it was optimal to choose the larger set of lower-probability opportunities, they chose suboptimally (i.e., chose the smaller set of higher-probability opportunities) 62.0% of the time, $b = 3.79$, odds ratio (OR) = 44.31, $SE = 0.15$, $z = 25.42$, $p < .001$. In other words, many participants preferred to pursue smaller sets of higher-probability opportunities even when pursuing larger sets of lower-probability opportunities would double the number of expected successes.

As shown in Figure 1, similar patterns emerged across all eight domains. For instance, participants were more likely to choose the less valuable of two ad campaigns when this meant each individual person would be more likely to click on the ad, $b = 1.87$, odds ratio (OR) = 6.47, $SE = 0.26$, $z = 7.31$, $p < .001$, and they were more likely to choose the less valuable of two sets of projects when this meant each individual project would be more likely to succeed, $b = 3.76$, odds ratio (OR) = 43.06, $SE = 0.33$, $z = 11.31$, $p < .001$. They also showed a similar tendency when deciding which of two sets of malaria interventions to pursue, $b = 3.05$, odds ratio (OR) = 21.19, $SE = 0.31$, $z = 9.71$, $p < .001$; which group of people to solicit petition signatures from, $b = 2.83$, odds ratio (OR) = 16.90, $SE = 0.30$, $z = 9.45$, $p < .001$; which set of raffle tickets to buy, $b = 3.62$, odds ratio (OR) = 37.25, $SE = 0.36$, $z = 10.08$, $p < .001$; which set of scholarships to apply to, $b = 3.25$, odds ratio (OR) = 25.91, $SE = 0.37$, $z = 8.77$, $p < .001$; which set of vegetable seedlings to plant, $b = 3.08$, odds ratio (OR) = 21.80, $SE = 0.34$, $z = 8.98$, $p < .001$; and which set of startups to invest in, $b = 3.33$, odds ratio (OR) = 27.88, $SE = 0.32$, $z = 10.48$, $p < .001$.

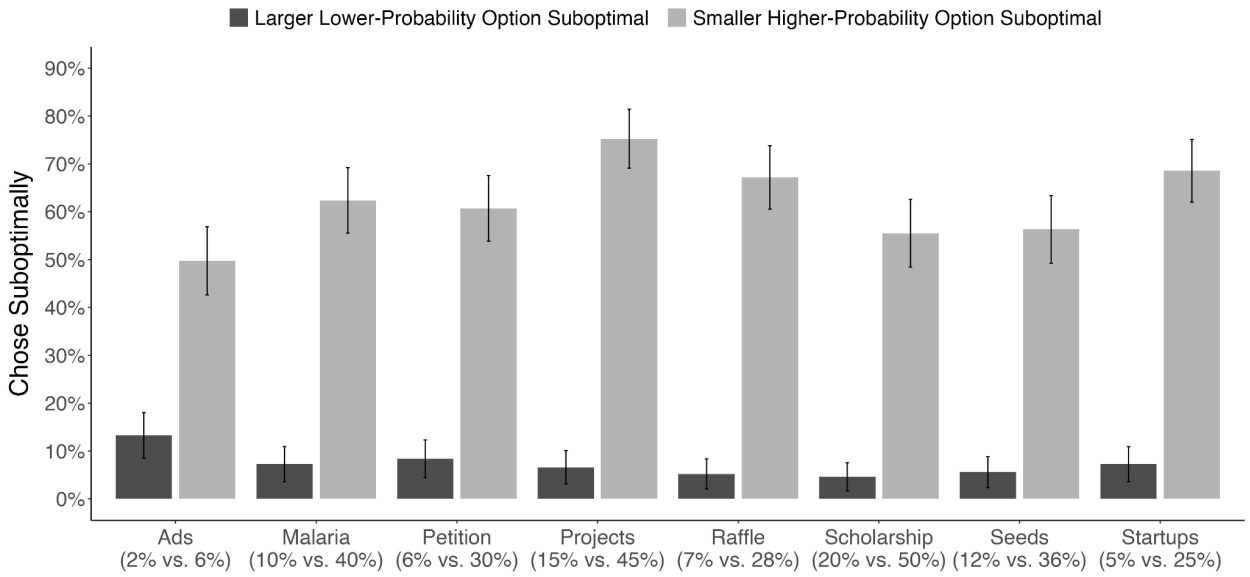

Fig. 1. Results from Study 1: Proportion of participants who chose the option that would be expected to yield fewer overall successes in each domain as a function of whether it was suboptimal to choose the larger set of lower-probability opportunities or the smaller set of higher-probability opportunities. Error bars represent 95% confidence intervals.

Taken together, these results support the idea that people value having a high probability of success per opportunity more than they value taking many opportunities. Across a wide range of domains, from risky financial decisions to prosocial actions, participants frequently chose to pursue a smaller set of higher-probability opportunities even when pursuing a larger set of lower-probability opportunities would yield twice as many successes on average.

Study 2

In Study 2, we sought to test whether the pattern that we observed in Study 1 persists when real money is at stake. We presented participants with a series of choices, each between a larger set of lower-probability gambles and a smaller set of higher-probability gambles. As in Study 1, we varied which option would be expected to yield more successes in total. If people value having a high probability of success per opportunity more than they value taking many opportunities, as implied by the results of Study 1, then they may be willing to incur a monetary cost to pursue smaller sets of opportunities in which each opportunity is more likely to succeed.

Method

Participants

We requested 400 U.S.-based participants via Prolific and received 399 complete submissions. Consistent with our preregistration, we excluded all submissions from participants who opened the survey more than once under the same participant ID or IP address (n = 5) and from those who failed either of two comprehension checks administered at the start of the study and described in the Procedure section (n = 35). Our final sample included 359 participants.

Procedure

Participants made a series of four decisions, each between two sets of risky prospects. Each prospect (“investment”) offered a chance to receive $1, and each set (“investment

portfolio") included two or more investments. Participants learned that one of their four decisions would be randomly selected to count for real, in which case they would actually receive a $1 bonus for each successful investment. To ensure that participants understood that it was possible for more than one investment in a portfolio to succeed (and thus that it was possible to receive a bonus larger than $1), we asked them two comprehension-check questions at the start of the survey, before they received information about any particular portfolios. Specifically, participants were asked (1) how much they would earn if their chosen portfolio yielded two successful investments (i.e., $2) and (2) how much they would earn if their chosen portfolio yielded zero successful investments (i.e., $0).

In each trial, participants chose between a larger portfolio in which each investment had a lower probability of succeeding (e.g., 20 investments with a 5% chance of success per investment) and a smaller portfolio in which each investment had a higher probability of succeeding (e.g., 6 investments with a 25% chance of success per investment). We constructed each pair of portfolios such that one option would be expected to yield more successes than the other, and thus offered a higher expected value. Specifically, the more valuable portfolio in each pair was always expected to yield an average of 1.5 successful investments (expected value: $1.50), while the less valuable portfolio was expected to yield an average of one successful investment (expected value: $1). Within-subjects, across trials, we manipulated whether the optimal choice was the larger lower-probability portfolio or the smaller higher-probability portfolio by varying the number of investments in each portfolio (while holding the probabilities constant). We also manipulated across trials whether the larger lower-probability (smaller higher-probability) portfolio offered a 5% (25%) chance of success per investment or a 10% (50%) chance of success per investment. Figure 2 shows examples of the two decisions

involving a choice between having a 10% chance of success per investment and having a 50% chance of success per investment: In one case, the smaller higher-probability portfolio had the higher expected value, while in the other, the larger lower-probability portfolio had the higher expected value. Table 2 summarizes the details of all four pairs of portfolios.

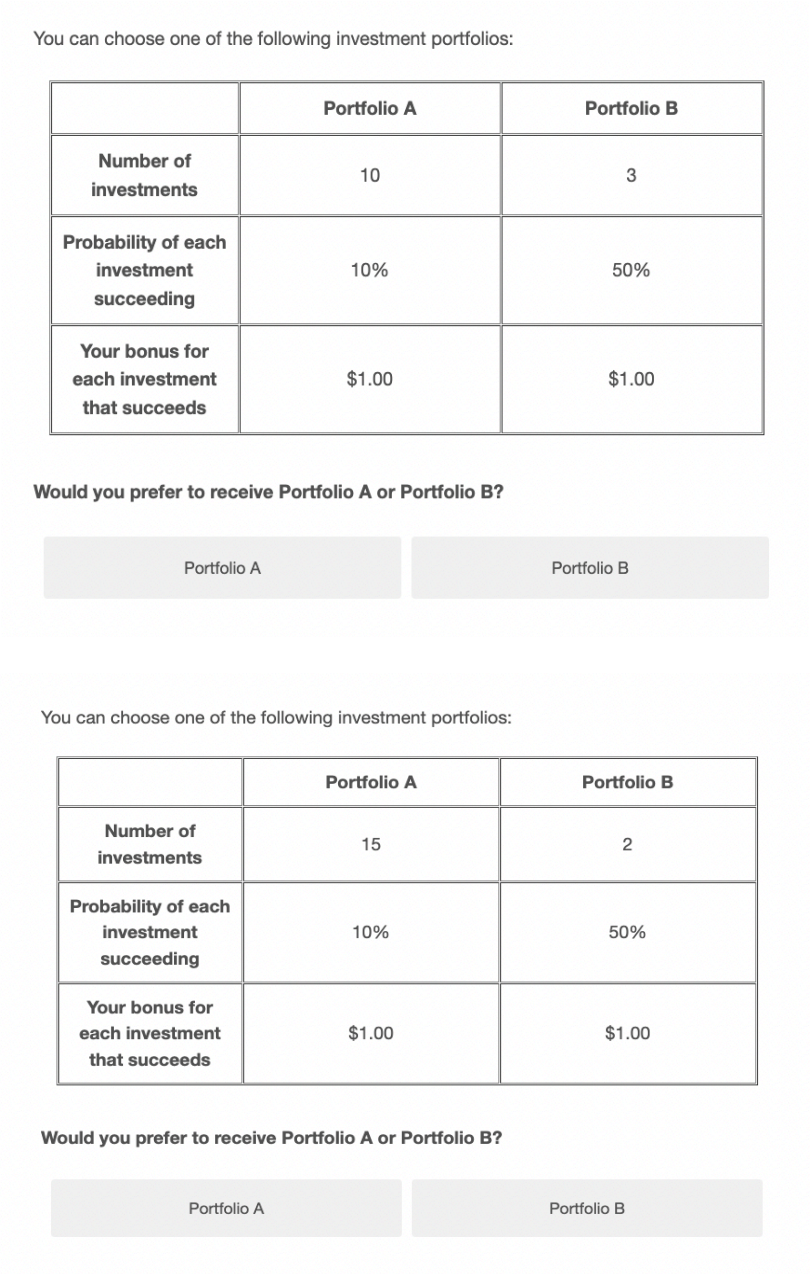

Fig. 2. Screenshots of two examples of decisions from Study 2. The top panel shows a decision in which it was optimal to choose the smaller higher-probability portfolio, and the bottom panel shows a decision in which it was optimal to choose the larger lower-probability portfolio.

For each decision, we provided participants with a table of information on both portfolios. We randomized which portfolio appeared on which side of the page. Participants were told how many investments each portfolio offered, the probability of each individual investment in the portfolio succeeding, and the payout for each successful investment (i.e., a $1 bonus). They were then asked which of the two portfolios they preferred to receive (e.g., "Would you prefer to receive Portfolio A or Portfolio B?").

Results and Discussion

The dependent variable for each decision was whether participants made a suboptimal choice—that is, chose the portfolio that would be expected to yield fewer successes on average. If people value having a high probability of success per opportunity more than they value taking many opportunities, as the results of Study 1 suggest, then they should be more willing to incur a monetary cost to receive a smaller set of higher-probability investments than to receive a larger set of lower-probability investments.

Each participant provided four observations (i.e., one for each decision). We conducted a mixed-effects logistic regression with a variable indicating whether participants chose suboptimally (1 = yes, 0 = no) predicted by (1) whether the suboptimal choice was the larger, lower-probability portfolio or the smaller, higher-probability portfolio (-0.5 = larger portfolio, +0.5 = smaller portfolio), (2) the specific pair of probabilities involved (-0.5 = 5% and 25%, +0.5 = 10% and 50%), and (3) the two-way interaction between (1) and (2). We included participant-level random intercepts to account for the non-independence of observations.

Consistent with the idea that people value having a high probability of success per opportunity more than they value taking many opportunities, participants were significantly more willing to incur a cost to make fewer higher-probability investments than to make many lower-

probability investments. When it was optimal to choose the smaller set of higher-probability investments, participants made a suboptimal choice (i.e., chose the larger set of lower-probability investments) 13.0% of the time, but when it was optimal to choose the larger set of lower-probability investments, they made a suboptimal choice (i.e., chose the smaller set of higher-probability investments) 59.0% of the time, $b = 2.27$, odds ratio (OR) = 9.72, $SE = 0.14$, $z = 15.73$, $p < .001$. Participants made suboptimal choices just as often when deciding between a 10% and 50% chance of success per investment (34.8%) as when deciding between a 5% and 25% chance of success per investment (37.2%), $b = -0.14$, $OR = 0.87$, $SE = 0.13$, $z = -1.07$, $p = .285$. The two-way interaction was non-significant, $b = 0.06$, $OR = 1.06$, $SE = 0.27$, $z = 0.22$, $p = .830$, indicating that the difference in how often participants suboptimally chose the smaller higher-probability option versus the larger lower-probability option did not depend on the specific pair of probabilities involved. Table 2 shows the results for each pair of portfolios.

Altogether, the results of this study suggest that people do not value taking many opportunities as much as they value having a high probability of success per opportunity. Participants tended to prefer smaller sets of higher-probability investments over larger sets of lower-probability investments even when this meant that, on average, they would end up with fewer total successes and worse monetary outcomes. In other words, many people were willing to incur a monetary cost to have a higher probability of success per opportunity, but far fewer were willing to incur a similar cost to pursue more opportunities.

Table 2
Proportion of Participants who Chose Each Option for Each Pair of Portfolios in Study 2

Pair	*Options*		*Preference for Each Option*	
	Larger Set of Lower-Probability Investments	***Smaller Set of Higher-Probability Investments***	***Chose Larger Portfolio***	***Chose Smaller Portfolio***
1	*20 investments with a 5% chance of success per investment*	6 investments with a 25% chance of success per investment	*13.9%*	86.1%
2	30 investments with a 5% chance of success per investment	*4 investments with a 25% chance of success per investment*	39.6%	*60.4%*
3	*10 investments with a 10% chance of success per investment*	3 investments with a 50% chance of success per investment	*12.0%*	88.0%
4	15 investments with a 10% chance of success per investment	*2 investments with a 50% chance of success per investment*	42.3%	*57.7%*

Note: Participants made one decision for each pair of portfolios (four decisions in total). In all decisions, the payout for each successful investment was a $1 bonus. Each pair of portfolios included a suboptimal choice (with an expected value of $1) and an optimal choice (with an expected value of $1.50). Italics indicate which portfolio in each pair was the suboptimal choice.

In Supplemental Study 1 (reported in the Supplemental Material), we tested whether a similar pattern emerges in decisions about *whether* to pursue a given set of opportunities, as opposed to *which* set of opportunities to pursue. Participants started with a $0.75 endowment, which they could either keep or spend on a set of investments. They separately decided whether to purchase each of the eight investment portfolios used in Study 2, and one of these decisions was selected to count for real. The results supported the idea that people value having a high probability of success per opportunity more than they value taking many opportunities. In line with the results of Study 2, participants were more willing to invest in smaller higher-probability portfolios than in larger lower-probability portfolios, even in cases where the latter would be

expected to yield better outcomes. For instance, 55.4% of participants were willing to spend $0.75 to receive two investments with a 50% probability of success per investment (expected value: $1), whereas only 24.9% were willing to spend the same amount to receive 15 investments with a 10% probability of success per investment (expected value: $1.50).

One possible alternative explanation for both sets of results is that people focus primarily on the probability of success per investment because they fail to appreciate the full range of possible outcomes. For example, participants may not have realized that it was possible for more than one investment in a portfolio to succeed, and thus that they could earn more than $1. In Supplemental Study 2, we provided some participants with more detailed information on the distribution of probabilities for each possible outcome (e.g., the probability that each portfolio would yield exactly one success, exactly two successes, etc.), while providing others with individual probabilities only. We found that those who saw the full distribution of possible outcomes undervalued sets of low-probability opportunities just as much as those who received individual probabilities only, which suggests that they did not simply fail to appreciate the possibility that larger portfolios could yield more successes than smaller ones. In Studies 3a and 3b, we examined whether people respond differently when provided with *cumulative* probability distributions, which make it clearer which portfolio is expected to yield better outcomes overall.

Studies 3a and 3b

In Studies 3a and 3b, we began to investigate why people prefer to take fewer high-probability opportunities over taking many low-probability opportunities. One possibility is that people simply misjudge how many opportunities are likely to succeed in the aggregate, perhaps expecting larger sets of lower-probability opportunities to yield fewer successes. Assuming people care primarily about the total number of opportunities that succeed, they should no longer

prioritize having a high likelihood of success per opportunity over taking many opportunities when they are given information that makes it clear which set of opportunities is more likely to yield favorable outcomes in the aggregate. We tested for this possibility by providing one group of participants with individual probabilities only (as in Study 2), while providing another group with individual probabilities plus a distribution of cumulative probabilities for each possible number of total successes. If people choose which set of opportunities to pursue primarily based on how many opportunities they expect to succeed in total, then those who are provided with cumulative probability information that makes it clear how likely it is for each set of opportunities to yield successful outcomes in the aggregate should simply choose whichever option is expected to yield more successes. This means they should no longer undervalue large sets of low-probability opportunities (vs. smaller sets of higher-probability opportunities).

Method

Participants and Design

We requested 800 U.S.-based participants via Prolific for each study. We received 798 complete submissions for Study 3a and 799 complete submissions for Study 3b. Consistent with our preregistrations, we excluded all submissions from participants who opened the survey more than once under the same participant ID or IP address (n = 22 in Study 3a and n = 13 in Study 3b). Our final sample for Study 3a included 776 participants (mean age = 39.9 years; gender = 49.1% men, 48.6% women, 2.3% other identity), and our final sample for Study 3b included 786 participants (mean age = 38.0 years; gender = 49.2% men, 47.6% women, 3.2% other identity). In both studies, participants were randomly assigned to one of four conditions in a 2 (suboptimal choice: larger lower-probability portfolio vs. smaller higher-probability portfolio) by 2

(probability information: individual probabilities only vs. both individual and cumulative probabilities) between-subjects design.

Procedure

Participants in both studies were asked to consider a scenario in which they are an investor choosing which of two sets of startups to invest in. They were told that they would earn $1 million for each startup that succeeded and $0 for each startup that did not succeed. As a comprehension check, we asked participants how much money they would earn if two of their investments succeeded. Only those who correctly answered $2 million (out of three options) were allowed to continue with the study.

Participants then received information about the two sets of startups, which were presented side-by-side in a table. One option was a larger set of startups with a lower probability of success per startup, while the other option was a smaller set of startups with a higher probability of success per startup. In Study 3a, the lower-probability option offered a 10% chance of success per startup (e.g., 15 startups, each with a 10% chance of succeeding), and in Study 3b, the lower-probability option offered a 25% chance of success per startup (e.g., 6 startups, each with a 25% chance of succeeding). In both studies, the higher-probability option offered a 50% chance of success per startup (e.g., 2 startups, each with a 50% chance of succeeding). We counterbalanced which option appeared on which side of the page.

As in Studies 1 and 2, one set of startups was expected to yield more successes on average (1.5 successes; expected value: $1.5 million) than the other (one success; expected value: $1 million). We manipulated whether it would be optimal to choose the larger set of lower-probability investments or the smaller set of higher-probability investments by varying the number of startups in each set (while holding the probabilities constant).

We also manipulated whether participants received a distribution of cumulative probabilities for each option, which essentially conveyed how likely it would be for each set to yield each possible number of total successes. One group of participants saw only the number of startups in each set, the probability of each individual startup succeeding, and the payout for each successful investment ($1 million). Meanwhile, another group of participants received all of this information plus a distribution of cumulative probabilities for each possible outcome of each portfolio (e.g., the probability of zero startups succeeding, one or more startups succeeding, etc.). In all cases, the portfolio with the higher expected value was also the one that would be more likely to yield any (i.e., one or more) successes. Table 3 shows examples of individual-probability and cumulative-probability information for each pair of portfolios in Study 3a.

Participants then indicated which set of startups they preferred: "Which set of startups would you invest in?" (1 = *Definitely Set A*, 2 = *Probably Set A*, 3 = *Probably Set B*, 4 = *Definitely Set B*).

Results and Discussion

We sought to test whether participants were more willing to choose suboptimally when it was optimal to choose the larger lower-probability portfolio (vs. the smaller higher-probability portfolio), and whether this tendency was less pronounced among those who saw cumulative probabilities. We recoded responses such that higher values would indicate a stronger preference for the suboptimal portfolio. We then regressed this variable on (1) whether the suboptimal choice was the larger lower-probability portfolio or the smaller higher-probability portfolio (-0.5 = larger lower-probability portfolio, +0.5 = smaller higher-probability portfolio), (2) which type of probability information participants received (-0.5 = individual probabilities only, +0.5 = both individual and cumulative probabilities), and (3) the two-way interaction between (1) and (2).

Table 3
Examples of Individual and Aggregate Probability Information for Each Portfolio in Study 3a

A. When the smaller set of higher-probability investments was optimal

	Larger Set of Lower-Probability Investments	***Smaller Set of Higher-Probability Investments***
Number of Investments	10	3
Probability of Each Investment Succeeding	10%	50%
Distribution of Probabilities for Each Possible Outcome	0 successes: 34.9% 1+ successes: 65.1% 2+ successes: 26.3% 3+ successes: 6.9% 4+ successes: 1.2% 5+ successes: 0.1% 6+ successes: 0.01% 7+ successes: 0.0009% 8+ successes: 0.00004% 9+ successes: 0.0000009% 10 successes: 0.00000001%	0 successes: 12.5% 1+ successes: 87.5% 2+ successes: 50% 3 successes: 12.5%

B. When the larger set of lower-probability investments was optimal

	Larger Set of Lower-Probability Investments	***Smaller Set of Higher-Probability Investments***
Number of Investments	15	2
Probability of Each Investment Succeeding	10%	50%
Distribution of Probabilities for Each Possible Outcome	0 successes: 20.6% 1+ success: 79.4% 2+ successes: 45.1% 3+ successes: 18.4% 4+ successes: 5.5% 5+ successes: 1.2% 6+ successes: 0.2% 7+ successes: 0.03% 8+ successes: 0.003% 9+ successes: 0.0003% 10+ successes: 0.00002% 11+ successes: 0.0000009% 12+ successes: 0.00000003% 13+ successes: 0.0000000009% 14+ successes: 0.00000000001% 15 successes: 0.0000000000001%	0 successes: 25% 1+ successes: 75% 2 successes: 25%

Note: The top portion of the table shows examples of individual and cumulative probability information for a pair of investment portfolios in which it would be optimal to choose the smaller set of higher-probability investments, and the bottom portion of the table shows examples of individual and cumulative probability information for a pair of investment portfolios in which it would be optimal to choose the larger set of lower-probability investments.

As preregistered, we also repeated the same set of analyses on a dichotomized version of the dependent variable, which indicates whether or not participants chose suboptimally (as opposed to how strong their preferences were). Because none of our key results hinge on which version of the dependent variable is used, we report all analyses of the dichotomous choice measure in the Supplemental Material.

As in Study 2, participants in both studies were more likely to make suboptimal choices when it was optimal to choose the larger lower-probability portfolio than when it was optimal to choose the smaller higher-probability portfolio. This main effect emerged in both Study 3a, in which the larger portfolio offered a 10% chance of success per investment and the smaller portfolio offered a 50% chance of success per investment, $b = 1.10$, $SE = 0.07$, $t(772) = 16.72$, $p < .001$, and Study 3b, in which the larger portfolio offered a 25% chance of success per investment and the smaller portfolio offered a 50% chance of success per investment, $b = 0.95$, $SE = 0.06$, $t(778) = 16.35$, $p < .001$. Participants were less likely to choose suboptimally when they were provided with cumulative-probability information, both in Study 3a, $b = -0.28$, $SE = 0.07$, $t(772) = -4.28$, $p < .001$, and in Study 3b, $b = -0.31$, $SE = 0.06$, $t(778) = -5.27$, $p < .001$. Of particular interest, the two-way interaction was significant in both Study 3a, $b = -0.46$, $SE = 0.13$, $t(772) = -3.46$, $p < .001$, and Study 3b, $b = -0.63$, $SE = 0.12$, $t(778) = -5.41$, $p < .001$. This means that participants' tendency to make more suboptimal choices when it was optimal to choose the larger lower-probability portfolio (vs. the smaller higher-probability portfolio) depended on which type of probability information they received (Fig. 3).

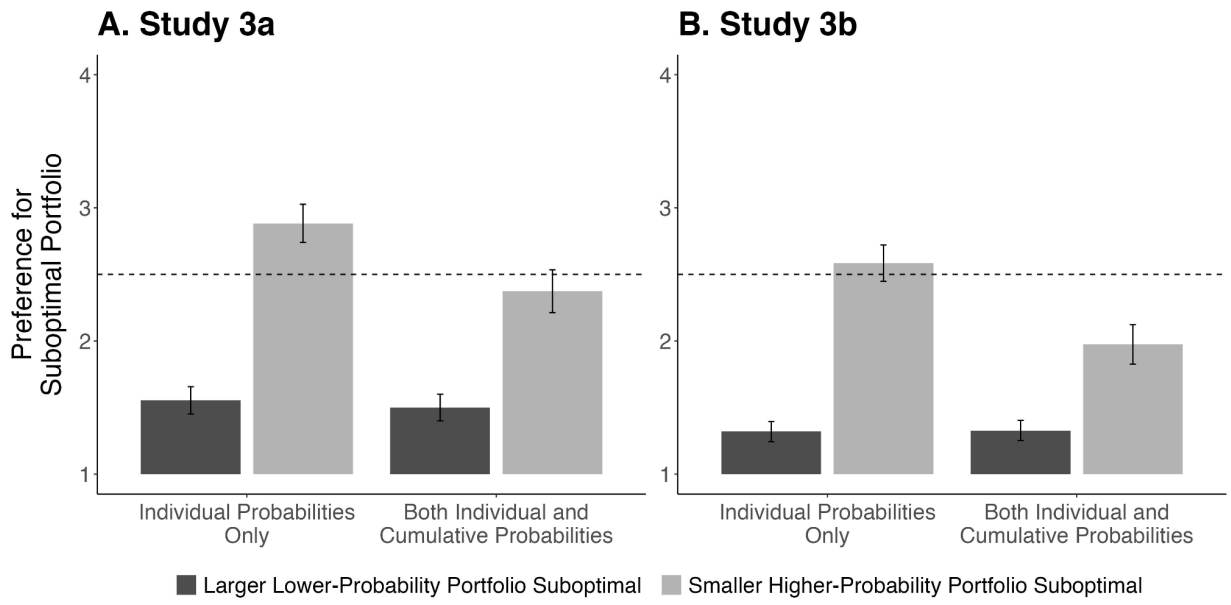

Fig. 3. Results from Studies 3a and 3b: Strength of participants' preference for the suboptimal portfolio (1 = *Definitely [Higher-EV Portfolio]*, 2 = *Probably [Higher-EV Portfolio]*, 3 = *Probably [Lower-EV Portfolio]*, 4 = *Definitely [Lower-EV Portfolio]*) as a function of which type of probability information they received and whether it was suboptimal to choose the larger set of lower-probability investments or the smaller set of higher-probability investments. In Study 3a, each investment in the larger lower-probability portfolio had a 10% chance of succeeding, and in Study 3b, each investment in the larger lower-probability portfolio had a 25% chance of succeeding. In both studies, each investment in the smaller higher-probability portfolio had a 50% chance of succeeding. The dotted line represents the scale midpoint (i.e., the point of indifference between the two portfolios). Error bars represent 95% confidence intervals.

In both studies, participants who were only provided with individual probabilities were more likely to choose suboptimally when it was optimal to choose the larger lower-probability portfolio (Study 3a: $M = 2.88$, $SD = 1.03$; Study 3b: $M = 2.58$, $SD = 0.97$) than when it was optimal to choose the smaller higher-probability portfolio (Study 3a: $M = 1.55$, $SD = 0.73$; Study 3b: $M = 1.32$, $SD = 0.55$). This simple effect was significant in both Study 3a, $b = 1.33$, $SE = 0.09$, $t(772) = 14.31$, $p < .001$, and Study 3b, $b = 1.26$, $SE = 0.08$, $t(778) = 15.46$, $p < .001$. Participants who also received cumulative probability distributions for each possible number of successes were still more likely to choose suboptimally when it was optimal to choose the larger lower-probability portfolio (Study 3a: $M = 2.37$, $SD = 1.13$; Study 3b: $M = 1.97$, $SD = 1.06$) than

when it was optimal to choose the smaller higher-probability portfolio (Study 3a: $M = 1.50$, $SD = 0.71$; Study 3b: $M = 1.33$, $SD = 0.54$). This simple effect was significant in both Study 3a, $b = 0.87$, $SE = 0.09$, $t(772) = 9.36$, $p < .001$, and Study 3b, $b = 0.64$, $SE = 0.08$, $t(778) = 7.70$, $p < .001$. In other words, although providing cumulative-probability information led participants to undervalue large sets of low-probability opportunities less, it only reduced the size of this effect by about one-third in Study 3a and by about one-half in Study 3b.

Taken together, the results of Studies 3a and 3b suggest that many people still undervalue sets of low-probability opportunities even when they are given information that makes it clear how likely each set is to yield successful outcomes in the aggregate. Participants were more willing to incur a cost to have a higher probability of success per investment than to make more investments, and providing information on the cumulative probability of each possible number of successes only partially alleviated this tendency. In other words, many people preferred to take fewer higher-probability opportunities over taking many lower-probability opportunities even when it was clear that this strategy would be expected to yield worse outcomes. This suggests that decision makers may care not just about how many opportunities succeed in the aggregate, but also about how likely each opportunity is to succeed individually.

Study 4

In Study 4, we examined how people decide which set of opportunities to pursue when they are not explicitly told how likely each individual opportunity is to succeed. Our previous studies revealed that when people have access to both individual and cumulative probability information, many still prioritize having a high probability of success per opportunity over taking many opportunities—even if this means they are likely to end up with fewer successes in total. In this study, we provided one group of participants with only cumulative-probability information,

another group with only individual-probability information, and another group with both. If people ultimately care about achieving as many successes as possible, they should rely primarily on cumulative-probability information when it is available, regardless of whether individual-probability information is also present. In other words, knowing how likely each individual opportunity is to succeed should not make their decisions any worse. However, if people care about having a high probability of success per opportunity for its own sake, then they may rely heavily on individual-probability information even when cumulative-probability information is also available, and thus they may choose between sets of opportunities even *more* optimally when they are not told how likely each opportunity is to succeed.

Method

Participants and Design

We requested 1,200 U.S.-based participants via Prolific and received 1,196 complete submissions. Consistent with our preregistration, we excluded all submissions from participants who opened the survey more than once under the same participant ID or IP address (n = 19). Our final sample included 1,177 participants (mean age = 39.2 years; gender = 48.4% men, 50.0% women, 1.6% other identity). Participants were randomly assigned to one of six conditions in a (suboptimal choice: larger lower-probability portfolio vs. smaller higher-probability portfolio) by 3 (probability information: individual probabilities only vs. both individual and cumulative probabilities vs. cumulative probabilities only) between-subjects design.

Procedure

As in Study 3b, participants were asked to consider a scenario in which they are an investor choosing which of two sets of startups to invest in. They were told that each set of startups would cost $600,000 total, and that they would earn $1 million for each successful

startup and $0 for each unsuccessful startup. As an attention check, we asked participants how much money they would earn if two of their investments succeeded. Only those who correctly answered $2 million (out of three options) were allowed to continue with the study.

Participants then received information about the two sets of startups, which were presented side-by-side in a table. One set included more startups with a lower probability of success per startup (e.g., 6 startups, each with a 25% chance of succeeding), while the other set included fewer startups with a higher probability of success per startup (e.g., 2 startups, each with a 50% chance of succeeding). We counterbalanced which set appeared on which side of the page. As in previous studies, one set of startups was always expected to yield more successes on average (1.5 successes; $1.5 million expected value) than the other (one success; $1 million expected value). We varied the number of startups in each set to manipulate whether it was optimal to choose the larger lower-probability option or the smaller higher-probability option.

We also manipulated which type of probability information participants received. One group of participants saw the number of startups in each portfolio, the total cost of the portfolio ($600,000), the payout for each successful investment ($1 million), the probability of each individual startup succeeding, and the distribution of cumulative probabilities for each possible number of total successes. Another group saw all of the same information except for the cumulative probability distributions; that is, the only probability information these participants saw was the probability of each individual startup succeeding. Meanwhile, a final group of participants saw all information except for the probability of each individual investment succeeding; that is, the only probability information these participants received was the distribution of cumulative probabilities for each possible outcome.

Participants then indicated which set of startups they preferred using the same scale we used in Studies 3a and 3b: "Which set of startups would you invest in?" (1 = *Definitely Set A*, 2 = *Probably Set A*, 3 = *Probably Set B*, 4 = *Definitely Set B*).

Results and Discussion

We sought to test whether the tendency to undervalue large sets of low-probability opportunities (vs. smaller sets of higher-probability opportunities) is more or less pronounced when people are only told how likely each option is to yield successful outcomes in the aggregate, relative to when they are told how likely each individual opportunity is to succeed (either instead of or in addition to cumulative-probability information). We first recoded responses such that higher values would indicate a stronger preference for the suboptimal portfolio. As preregistered, we repeated the same set of analyses on both this continuous preference measure (which reflects how strongly participants preferred the suboptimal portfolio) and a dichotomized version of this measure (which indicates whether or not participants chose suboptimally). Because none of our key results hinge on which version of the dependent variable is used, we report analyses of the dichotomous measure in the Supplemental Material.

First, we sought to replicate the results of Study 3b by testing how participants' choices differed when they received individual probabilities only (vs. both individual and cumulative probabilities). As in Study 3b, participants were overall more willing to choose suboptimally when it was optimal to choose the larger lower-probability portfolio than when it was optimal to choose the smaller higher-probability portfolio, $b = 1.11$, $SE = 0.06$, $t(779) = 17.89$, $p < .001$, and less willing to choose suboptimally when they received both types of probability information rather than individual probabilities only, $b = -0.26$, $SE = 0.06$, $t(779) = -4.12$, $p < .001$. The tendency to choose less optimally when it was optimal to choose the larger lower-probability

portfolio (vs. the smaller higher-probability portfolio) was less pronounced among participants who saw both individual and cumulative probabilities (vs. individual probabilities only), b = -0.50, SE = 0.12, $t(779)$ = -3.99, $p < .001$.

Next, we compared the choices of participants who received cumulative probabilities only to the choices of participants who received both individual and cumulative probabilities. We regressed participants' preferences for the suboptimal portfolio on (1) whether it was suboptimal to choose the larger lower-probability portfolio or the smaller higher-probability portfolio (-0.5 = larger lower-probability portfolio, +0.5 = smaller higher-probability portfolio), (2) which type of probability information they received (-0.5 = cumulative probabilities only, +0.5 = both individual and cumulative probabilities), and (3) the two-way interaction between (1) and (2). Again, participants made more suboptimal choices when it was optimal to choose the larger set of lower-probability investments than when it was optimal to choose the smaller set of higher-probability investments, b = 0.62, SE = 0.06, $t(779)$ = 10.27, $p < .001$. Overall, participants who only received cumulative-probability information chose more optimally than those who received both individual and cumulative probabilities, b = -0.16, SE = 0.06, $t(779)$ = -2.59, p = .010. However, of particular interest, participants who received only cumulative probabilities (vs. both individual and cumulative probabilities) were less sensitive to whether the optimal choice was the larger lower-probability portfolio or the smaller higher-probability portfolio, b = -0.49, SE = 0.12, $t(779)$ = -4.07, $p < .001$. In other words, taking away individual-probability information led people to make *better* choices overall, and it also reduced their tendency to undervalue large sets of low-probability opportunities (vs. smaller sets of higher-probability opportunities). This suggests that the mere presence of individual-probability information led some people astray.

Figure 4 shows how strongly participants preferred the suboptimal portfolio in each condition as a function of which type of probability information they received. Participants who were only told how likely each individual investment was to succeed made more suboptimal choices when it was optimal to choose the larger set of lower-probability investments (M = 2.80, SD = 1.09) than when it was optimal to choose the smaller set of higher-probability investments (M = 1.44, SD = 0.63), b = 1.36, SE = 0.09, $t(392) = 15.16$, $p < .001$. When shown both individual and cumulative probabilities, participants still made more suboptimal choices when it was optimal to choose the larger set of lower-probability investments (M = 2.29, SD = 1.06) than when it was optimal to choose the smaller set of higher-probability investments (M = 1.43, SD = 0.56), but this tendency was weaker, b = 0.86, SE = 0.09, $t(387) = 10.04$, $p < .001$. However, when participants were only provided with cumulative probabilities and were not told how likely each individual investment was to succeed, they were even less likely to make suboptimal choices when it was optimal to choose the larger set of lower-probability investments (M = 1.89, SD = 0.95) versus when it was optimal to choose the smaller set of higher-probability investments (M = 1.52, SD = 0.71), b = 0.37, SE = 0.08, $t(392) = 4.42$, $p < .001$.

This study built on our previous studies in two ways. First, replicating Study 3b, we found that participants were less likely to undervalue large sets of low-probability investments (vs. smaller sets of higher-probability investments) when provided with cumulative-probability information that made it clear which set would be expected to yield more successes in total. Second, participants were even *less* likely to do so when they were not told how likely each individual investment was to succeed. In theory, if people care primarily about how many opportunities succeed in the aggregate, information about the likelihood of each individual opportunity succeeding should be irrelevant, which means that taking away this information

should not change their preferences. However, we found that people made even *more* optimal choices about which sets of opportunities to pursue when they were not told how likely each individual opportunity was to succeed. This suggests that some decision makers may prioritize having a high probability of success per opportunity over taking many opportunities not because they mistakenly believe this will yield better outcomes, but instead because they intrinsically care about having a high probability of success per opportunity.

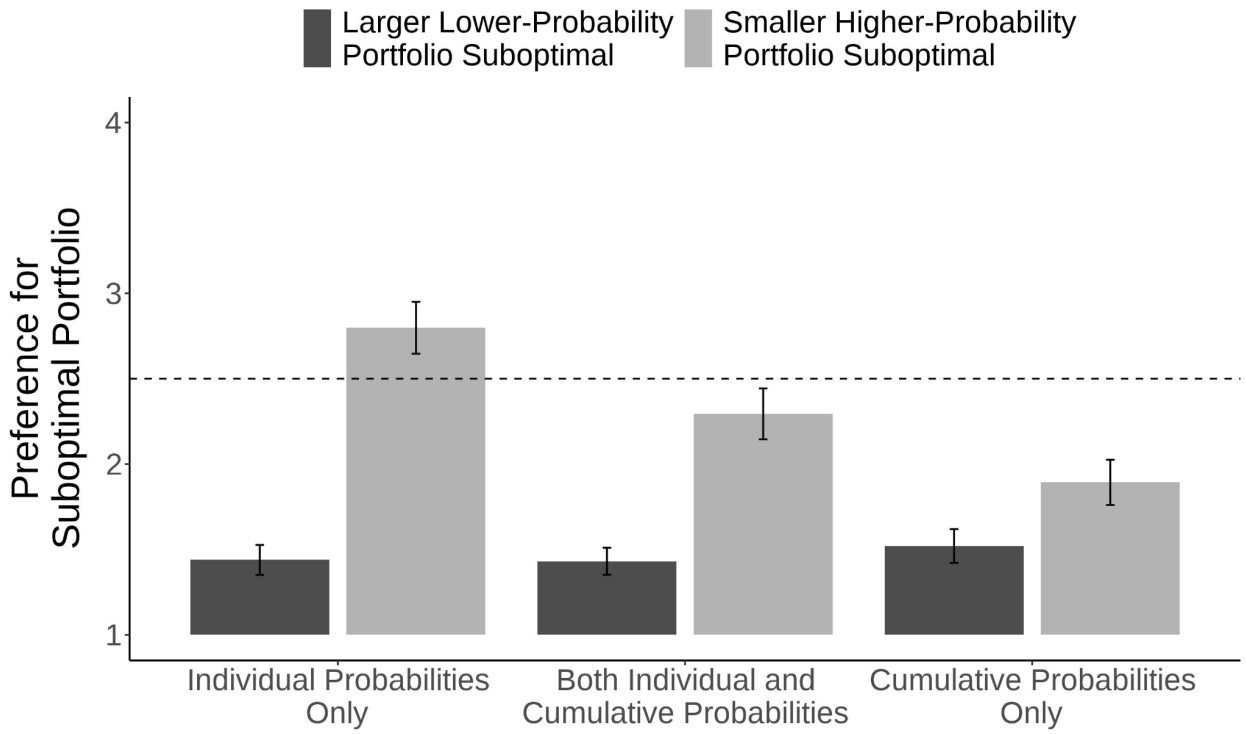

Fig. 4. Results from Study 4: Strength of participants' preference for the suboptimal portfolio (1 = *Definitely [Higher-EV Portfolio]*, 2 = *Probably [Higher-EV Portfolio]*, 3 = *Probably [Lower-EV Portfolio]*, 4 = *Definitely [Lower-EV Portfolio]*) as a function of which type of probability information they received and whether it was suboptimal to choose the larger set of lower-probability investments versus the smaller set of higher-probability investments. The dotted line represents the scale midpoint (i.e., the point of indifference between the two portfolios). Error bars represent 95% confidence intervals.

Study 5

The results of Study 4 suggest that when people are told how likely each individual opportunity is to succeed, they give this information more weight than information about how likely each set of opportunities is to yield successful outcomes in the aggregate—even if this means they will end up with fewer successes on average. Do people consciously prioritize having a high probability of success per opportunity, or are they simply led astray by the appeal of having a high likelihood of success per opportunity? To answer this question, we asked participants in Study 5 whether they wanted to receive information about individual or cumulative probabilities before making a decision about which of two sets of opportunities to pursue. If people ultimately care about achieving as many successes as possible and are simply led astray by individual-probability information, then they should prefer to receive information about cumulative outcome probabilities over information about individual probabilities when given the choice. However, if people value having a high likelihood of success per opportunity for its own sake, then they may prefer to receive individual-probability information even if this makes it harder for them to judge how many opportunities are likely to succeed in the aggregate.

Method

Participants and Design

We requested 600 U.S.-based participants via Prolific and received 596 complete submissions. Consistent with our preregistration, we excluded submissions from participants who opened the survey more than once under the same participant ID or IP address (n = 7). Our final sample included 589 participants (mean age = 37.6 years, gender = 47.5% men, 49.7% women, 2.7% other identity). Participants were randomly assigned to one of two conditions

(between-subjects): one in which the suboptimal choice was the larger lower-probability portfolio, and one in which the suboptimal portfolio was the smaller higher-probability portfolio.

Procedure

As in Studies 3a through 4, participants were asked to consider a scenario in which they are an investor choosing which of two sets of startups to invest in. They were told that each set of startups would cost $600,000 total, and that they would earn $1 million for each successful startup and $0 for each unsuccessful startup. As an attention check, we asked participants how much money they would earn if two of their investments succeeded. Only those who correctly answered $2 million (out of three options) were allowed to continue with the study.

Participants then received a subset of information about the two sets of startups they could choose from, which were the same as those used in Studies 3b and 4. As in previous studies, the two sets of startups were presented side-by-side in a table, and we counterbalanced which option appeared on which side of the page. One set always contained more startups than the other, and we varied the number of startups in each set to determine whether it would be optimal to choose the larger set of startups (each with a 25% chance of succeeding) or the smaller set of high-probability startups (each with a 50% chance of succeeding). Unlike in previous studies, however, we initially withheld all probability information and only told participants the number of startups in each portfolio, the total cost of each portfolio ($600,000), and the payout for each successful investment ($1 million). Two additional rows in the table were partially concealed. Participants were told that one of these rows contained information on the probability of success per startup and that the other contained information on the probability of each possible number of total successes. We told participants that they could receive only one of these pieces of information before deciding which set of startups to invest in. After we

explained both types of information in more detail, we asked participants: "Which piece of information do you choose to receive?" They chose from two response options ("Probability of success for each individual startup" and "Probability of each possible number of total successes"), which were presented in counterbalanced order.

Participants were then shown whichever type of probability information they had chosen. That is, everyone saw the same table of information that they had initially received, except that those who selected individual-probability information were also shown the probability of each individual startup in each set succeeding while those who selected cumulative-probability information were shown the cumulative probability of each possible number of total successes for each option. Participants indicated which set of startups they preferred using the same scale we used in Studies 3a through 4: "Which set of startups would you invest in?" (1 = *Definitely Set A*, 2 = *Probably Set A*, 3 = *Probably Set B*, 4 = *Definitely Set B*).

Results and Discussion

First, we examined which type of probability information participants sought out ex ante. Given a choice between receiving information on the probability of success per investment and the distribution of cumulative probabilities for each possible number of total successes, 64.0% of participants (95% CI: [60.0%, 67.9%]) chose to receive individual-probability information, which is significantly greater than 50% based on a binomial test, $p < .001$. This suggests that the majority of participants valued knowing how likely would be for each individual investment to succeed more than they valued knowing how likely it would be for each portfolio to yield successful outcomes in the aggregate.

Next, we examined whether participants' information preferences were predictive of their subsequent choices of which set of startups to invest in. We recoded responses such that higher

values would indicate a stronger preference for the suboptimal portfolio. We regressed this variable on (1) which type of probability information participants chose to receive (-0.5 = cumulative probabilities, +0.5 = individual probabilities), (2) whether it was suboptimal to choose the larger set of lower-probability investments or the smaller set of higher-probability investments (-0.5 = larger lower-probability portfolio, +0.5 = smaller higher-probability portfolio), and (3) the two-way interaction between (1) and (2).

On average, participants who chose to receive individual-probability information chose less optimally than those who chose to receive cumulative-probability information, $b = 0.64$, $SE = 0.07$, $t(585) = 9.31$, $p < .001$. As in previous studies, participants were more likely to choose suboptimally when it was optimal to choose the larger set of lower-probability startups than when it was optimal to choose the smaller set of higher-probability startups, $b = 0.85$, $SE = 0.07$, $t(585) = 12.35$, $p < .001$. In other words, people were more willing to incur a cost to have a higher probability of success per investment than to make more investments. However, this tendency was even more pronounced among participants who chose to receive individual-probability information than among those who chose to receive cumulative-probability information, $b = 1.13$, $SE = 0.14$, $t(585) = 8.23$, $p < .001$ (Fig. 5).

Participants who chose to receive individual-probability information expressed much stronger preferences for the suboptimal portfolio when it was optimal to choose the larger lower-probability portfolio ($M = 3.01$, $SD = 0.98$) than when it was optimal to choose the smaller higher-probability portfolio ($M = 1.60$, $SD = 0.54$), $b = 1.41$, $SE = 0.08$, $t(585) = 17.16$, $p < .001$. However, participants who chose to see the distribution of cumulative probabilities for each possible outcome of each portfolio had a much weaker tendency to choose less optimally when it was optimal to choose the larger lower-probability portfolio ($M = 1.81$, $SD = 0.92$) than when it

was optimal to choose the smaller higher-probability portfolio (M = 1.52, SD = 0.69), b = 0.28, SE = 0.11, $t(585) = 2.58$, p = .010. In other words, participants who sought out information about how likely each option would be to yield successful outcomes in the aggregate were less likely to undervalue large sets of low-probability investments (vs. smaller sets of higher-probability investments).

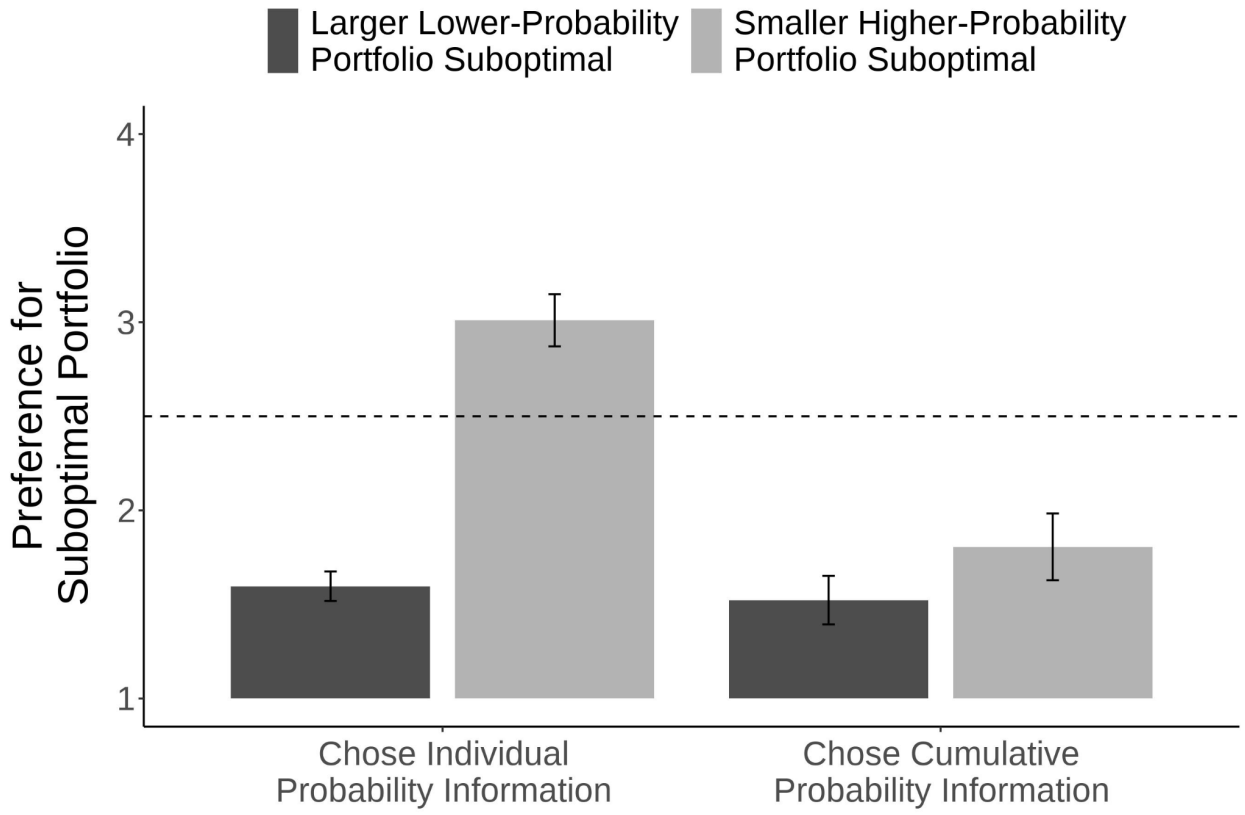

Fig. 5. Results from Study 5: Strength of participants' preference for the suboptimal portfolio (1 = *Definitely [Higher-EV Portfolio]*, 2 = *Probably [Higher-EV Portfolio]*, 3 = *Probably [Lower-EV Portfolio]*, 4 = *Definitely [Lower-EV Portfolio]*) as a function of which type of probability information they chose to receive and which portfolio was the suboptimal choice. The dotted line represents the scale midpoint (i.e., the point of indifference between the two portfolios). Error bars represent 95% confidence intervals.

Taken together, the results of this study demonstrate that many people value information about the probability of success per opportunity over information about cumulative outcome probabilities, even though the former tends to result in less optimal decisions about which sets of opportunities to pursue. This suggests that people who fail to take advantage of large sets of low-probability opportunities and instead choose to take smaller sets of higher-probability opportunities may do so not merely because they underestimate how likely it is for large sets of low-probability opportunities to yield successful outcomes in the aggregate, but rather because they value having a high probability of success per opportunity for its own sake.

Study 6

Taken together, the results of our previous studies suggest that when deciding which sets of opportunities to pursue, people often prioritize having a high probability of success per opportunity even when it is clear that this strategy is expected to yield suboptimal outcomes. Participants in Study 4 were even *more* likely to undervalue large sets of low-probability opportunities (vs. smaller sets of higher-probability opportunities) if they were told how likely it would be for each individual opportunity to succeed, and participants in Study 5 actively sought out individual-probability information instead of information about how likely each set of opportunities would be to yield successful outcomes in the aggregate. This suggests that people do not prefer smaller sets of higher-probability opportunities solely because they mistakenly expect larger sets of lower-probability opportunities to yield worse outcomes. Rather, many people seem to care about having a high probability of success per opportunity for its own sake.

Why might people prefer to have a higher probability of success per opportunity, even if this means they will likely end up with fewer successes in total? We propose that this is because people expect to feel more satisfied with outcomes in which a higher proportion of opportunities

succeed. After all, taking more low-probability opportunities (vs. fewer higher-probability opportunities) typically means that more opportunities will fail, even if just as many opportunities are expected to succeed. If people undervalue sets of low-probability opportunities in part because they subjectively prefer sets of opportunities that yield a higher proportion of successes, then they may continue to value smaller sets of high-probability opportunities more than they value larger sets of lower-probability opportunities even after learning how many opportunities succeeded. People may even feel *worse* about achieving the exact same number of successes if this outcome originates from a larger set of opportunities.

Study 6 tested for this possibility. Rather than choosing which set of opportunities to pursue, participants were assigned to receive either a larger set of lower-probability opportunities or a smaller set of higher-probability opportunities and then learned how many of their opportunities had succeeded. We expected that participants would feel more satisfied if a larger proportion of opportunities succeeded, and thus that those assigned to receive smaller sets of higher-probability opportunities would report feeling more satisfied than those assigned to receive larger sets of lower-probability opportunities—even if the former group ended up with fewer total successes and objectively worse monetary outcomes.

Method

Participants and Design

We requested 800 U.S.-based participants via Prolific and received 799 complete submissions. Consistent with our preregistration, we excluded all submissions from participants who opened the survey more than once under the same participant ID or IP address ($n = 2$) and those who failed either of two comprehension checks administered at the start of the study ($n = 83$). Our final sample included 714 participants (mean age = 42.1 years; gender = 49.2% men,

49.4% women, 1.4% other identity). Participants were randomly assigned to one of four conditions in a 2 (assigned portfolio: larger lower-probability portfolio vs. smaller higher-probability portfolio) by 2 (expected value: $0.10 vs. $0.15) between-subjects design.

Procedure

Participants were told that they would be randomly assigned to receive one of two investment portfolios, and that they could receive a bonus payment depending on the outcome of their assigned portfolio. Specifically, they learned that they would receive $0.10 for each investment that succeeded. As a comprehension check, before exposure to our manipulation, we asked them how much money they would receive if two of their investments succeeded and how much money they would receive if zero investments succeeded (both questions offered three response options: $0, $0.10, and $0.20). In line with our preregistration, only those who correctly answered $0.20 to the first question and $0 to the second question were included in analyses.

Participants then received information about both investment portfolios, which were presented side-by-side in a table. One portfolio offered more investments with a lower probability of success per investment (e.g., 15 investments, each with a 10% chance of succeeding), while the other portfolio offered fewer investments with a higher probability of success per investment (e.g., 2 investments, each with a 50% chance of succeeding). We counterbalanced which portfolio appeared on which side of the page. As in previous studies, one portfolio was always expected to yield more total successes (1.5 successes; $0.15 expected value) than the other (one success; $0.10 expected value). We varied the number of investments in each portfolio to manipulate whether it would be optimal to receive the larger lower-probability portfolio or the smaller higher-probability portfolio.

The key feature that distinguished this study from previous studies is that participants could not choose which portfolio to receive; instead, they were assigned to receive one of the two portfolios. After learning which portfolio they were assigned, they were told that the computer was randomly determining their investment outcomes. After five seconds, the page auto-advanced, and participants learned how many of their investments had succeeded (e.g., "In total, 1 of your 2 investments succeeded.") as well as the total bonus amount they would receive as a result (e.g., "You earned a bonus payment of $0.10."). Because each participant's outcome was randomly generated according to the true distribution of possible outcomes for their assigned portfolio, it was in theory possible for participants to end up with between 0 and 15 successful investments depending on condition. However, across all conditions, the payout for each successful investment ($0.10) was held constant. This meant, for instance, that any participant who ended up with two successful investments would earn a total of $0.20, regardless of which portfolio they were assigned.

Immediately after learning how many of their investments had succeeded and how much money they had earned, participants rated their satisfaction with their outcomes: "How satisfied are you with this outcome?" (1 = *Not at all*, 7 = *Extremely*). This measure served as our primary dependent variable. To explore how experience might influence subsequent decisions, we then reminded participants of the two portfolios they had seen earlier and asked which one they would have chosen if they had not known the outcome of either portfolio (*Portfolio A* or *Portfolio B*).

Results and Discussion

We first examined how satisfied participants were, on average, depending on which portfolio they received. If people care primarily about how many investments succeeded in total and thus how much money they earned, then their satisfaction should depend only on whether

they received the higher-expected-value or lower-expected value portfolio. As a sanity check, we first confirmed that participants' objective monetary outcomes were only influenced by the expected-value manipulation and not by whether they were assigned the larger lower-probability portfolio or the smaller higher-probability portfolio. Indeed, higher-expected-value portfolios yielded higher average payouts (M = \$0.15, SD = \$0.10) than lower-expected-value portfolios (M = \$0.09, SD = \$0.08), b = 0.06, SE = 0.01, $t(710) = 8.35$, $p < .001$. By contrast, the payouts of smaller higher-probability portfolios (M = \$0.12, SD = \$0.08) did not differ significantly from the payouts of larger lower-probability portfolios (M = \$0.12, SD = \$0.11), b = 0.01, SE = 0.01, $t(710) = 0.83$, $p = .408$. This means that our manipulations worked as intended.

Did participants' feelings of satisfaction with these outcomes follow the same pattern? We regressed participants' satisfaction ratings on (1) whether they were assigned to receive the larger portfolio with a 10% chance of success per investment or the smaller portfolio with a 50% chance of success per investment (-0.5 = larger lower-probability portfolio, +0.5 = smaller higher-probability portfolio), (2) whether the assigned portfolio was the one with the lower or higher expected value (-0.5 = suboptimal portfolio, +0.5 = optimal portfolio), and (3) the two-way interaction between these variables. As anticipated, participants who received portfolios that were expected to yield an average of \$0.15 reported feeling more satisfied (M = 4.19, SD = 2.13) than those who received portfolios that were expected to yield an average of \$0.10 (M = 3.35, SD = 2.21), b = 0.69, SE = 0.16, $t(710) = 4.38$, $p < .001$. However, participants' satisfaction with larger lower-probability portfolios versus smaller higher-probability portfolios deviated from the patterns we observed in their objective monetary outcomes: Participants who received smaller sets of investments in which each investment had a 50% chance of succeeding reported feeling more satisfied with their outcomes (M = 4.43, SD = 2.17) than participants who received larger

sets of investments in which each investment had a 10% chance of succeeding (M = 3.28, SD = 2.06), b = 1.16, SE = 0.16, $t(710) = 7.43$, $p < .001$. The size of this effect did not depend on whether the assigned portfolio was the one with the higher or lower expected value, b = -0.50, SE = 0.31, $t(710) = -1.60$, $p = .111$. In other words, participants who received larger sets of lower-probability investments felt less satisfied than those who received smaller sets of higher-probability investments, despite earning just as much money on average. In fact, being assigned a smaller higher-probability portfolio (vs. a larger lower-probability portfolio) led to an even larger boost in satisfaction than being assigned a portfolio with a 50% higher monetary payout.

When the smaller set of high-probability investments (3 investments with a 50% chance of success per investment) had a higher expected value than the larger set of low-probability investments (10 investments with a 10% chance of success per investment), participants who received the former reported feeling more satisfied (M = 4.65, SD = 2.15) than those who received the latter (M = 2.81, SD = 2.00), b = 1.85, SE = 0.22, $t(346) = 8.30$, $p < .001$. But this effect persisted even when the larger set of low-probability investments had a higher expected value (15 investments with a 10% chance of success per investment) than the smaller set of high-probability investments (2 investments with a 50% chance of success per investment): Participants who received the latter (M = 4.22, SD = 2.18) still reported feeling more satisfied than those who received the former (M = 3.74, SD = 2.02), b = 0.48, SE = 0.22, $t(364) = 2.18$, p = .031. In other words, people felt more satisfied with the outcomes of smaller sets of higher-probability opportunities than with the outcomes of larger sets of lower-probability opportunities regardless of which yielded more successes (and thus better monetary outcomes).

Given that we generated participants' outcomes according to the true distribution of possible outcomes for their assigned portfolio, we were also able to explore whether participants

were any more or less satisfied with a given number of successes depending on how many investments they started with. If people feel more satisfied when a higher proportion of opportunities succeed, then they may be less satisfied with the exact same number of successes if this outcome originated from a larger set of opportunities. For instance, people may feel worse about one out of 10 investments succeeding than about one out of two investments succeeding. We tested for such a pattern by examining how participants' satisfaction with a given outcome (e.g., one successful investment and a $0.10 bonus) varied as a function of the total number of investments they started with.

Figure 6 displays participants' average satisfaction ratings as a function of the number of investments that succeeded and the total number of investments they started with. Participants who ended up with zero successes and thus did not earn a bonus (n = 189) did not feel any more or less satisfied depending on how many investments they started with, $|t| < 1$. However, participants who ended up with one or more successes were sensitive to the total number of investments they started with. Participants who received one successful investment and a $0.10 bonus ($n$ = 277) were more satisfied if this outcome originated from a larger set of investments, b = -0.08, SE = 0.02, $t(275) = -4.80$, $p < .001$, as were participants who received two successful investments and a $0.20 bonus ($n$ = 193), b = -0.14, SE = 0.02, $t(191) = -8.13$, $p < .001$, and participants who received three successful investments and a $0.30 bonus ($n$ = 47), b = -0.13, SE = 0.03, $t(45) = -3.87$, $p < .001$. We did not detect such a pattern among participants who ended up with four (n = 4) or five (n = 4) successful investments, $|t|$s < 1. However, given that very few participants ended up with this many successes—and given that it was theoretically impossible for participants who were assigned portfolios that included only two or three investments to end up with more than three successes—we may have been underpowered to detect such effects.

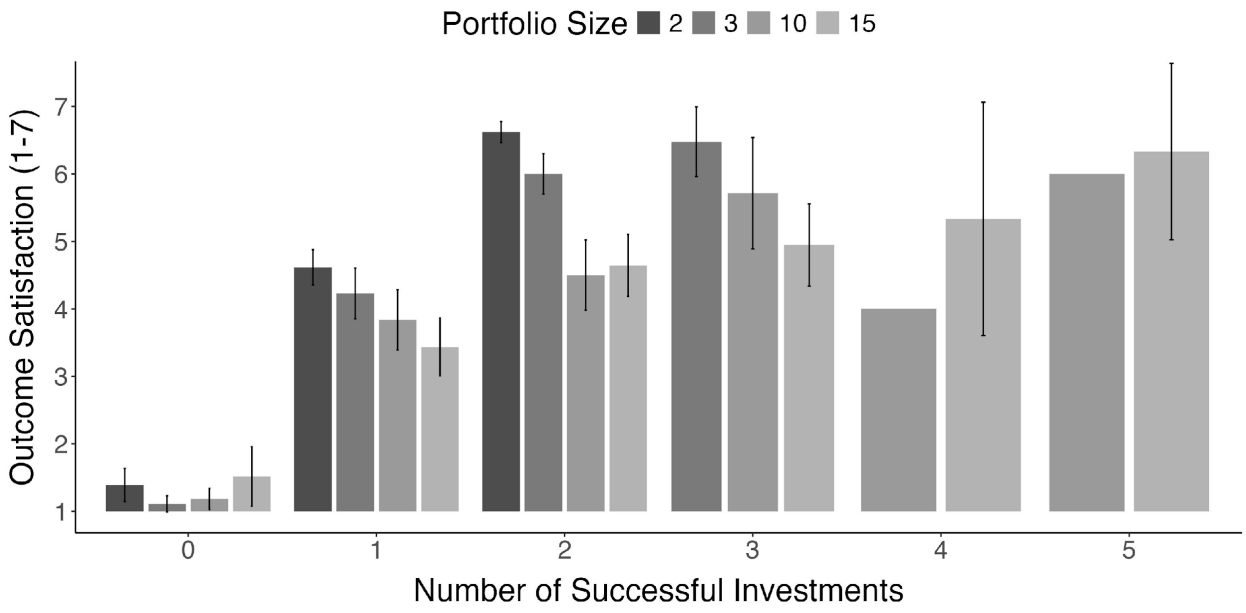

Fig. 6. Results from Study 6: Participants' reported satisfaction with the outcome of their assigned investment portfolio (1 = *Not at all*, 7 = *Very much*) as a function of how many investments succeeded and the total number of investments in the portfolio. All participants received $0.10 per successful investment. Error bars represent 95% confidence intervals.

In some cases, participants who received a smaller set of higher-probability investments and ended up with objectively worse outcomes reported feeling just as satisfied or even more satisfied than participants who received a larger set of lower-probability investments and ended up with better outcomes. For instance, participants who ended up with one successful investment out of a set of two (and received a $0.10 bonus) reported feeling just as satisfied as those who ended up with two successes out of 15 (and received a $0.20 bonus), $|t| < 1$, despite earning only half as much money. Similarly, participants who ended up with two successful investments out of two (and received a $0.20 bonus) reported feeling even *more* satisfied than participants who ended up with three successes out of 15 (and received a $0.30 bonus), $t(20.42) = 5.23$, $p < .001$, despite earning only two-thirds as much money.

After seeing how many of their investments actually succeeded, did participants still prefer smaller sets of higher-probability opportunities over larger sets of lower-probability

opportunities? To answer this question, we explored how often participants reported that they would have chosen the portfolio they were not assigned, had they not known the outcome of either portfolio. Unsurprisingly, participants who received the higher-expected-value portfolio were less likely to say they would have preferred the lower-expected-value portfolio (36.9%) than vice versa (69.0%), b = -0.34, SE = 0.03, $t(710)$ = -10.32, $p < .001$. Of particular interest, participants' preferences also depended on whether they were assigned the smaller higher-probability portfolio or the larger lower-probability portfolio. Among participants who were assigned the smaller higher-probability portfolio, only 36.6% said that they would have preferred the larger lower-probability portfolio. However, among those who were assigned the larger lower-probability portfolio from the start, 69.9% said they would have instead preferred the smaller higher-probability portfolio, b = -0.33, SE = 0.03, $t(710)$ = -9.97, $p < .001$. The size of this effect did not depend on which portfolio had a higher expected value, b = 0.06, SE = 0.07, $t(710)$ = 0.97, p = .331. In other words, people still preferred smaller sets of higher-probability investments over larger sets of lower-probability investments even after experiencing how one of these sets of opportunities turned out. This reinforces the idea that people do not decide which set of opportunities to pursue solely based on how many opportunities they expect to succeed.

In sum, participants were less satisfied with the outcomes of larger sets of lower-probability opportunities than smaller sets of higher-probability opportunities, even when the former yielded just as many (or more) successes in total. This suggests that decision makers may not necessarily be making a mistake when they choose to pursue fewer higher-probability opportunities over pursuing many lower-probability opportunities. Even if different sets of opportunities are expected to yield the same total number of successes, smaller sets of higher-probability opportunities tend to yield a higher *proportion* of successes. If people care about the

proportion of opportunities that succeed—and not just the absolute number—then it may be reasonable to give disproportionate weight to the probability of each opportunity succeeding (vs. the total number of opportunities) when deciding which set of opportunities to pursue.

Supplemental Study 3 tested whether a similar pattern arises when the outcomes of two different sets of opportunities are evaluated simultaneously, rather than separately. If participants in Study 6 felt more satisfied with portfolios that yielded a higher proportion of successes simply because they did not know how many investments in the other portfolio would have succeeded or simply forgot the details of the other portfolio, then such a pattern should not emerge when both portfolios' outcomes are presented side-by-side. However, if people genuinely expect to feel more satisfied when a higher proportion of opportunities succeed, as we have suggested, then it should not matter whether they evaluate the outcomes of different sets of opportunities simultaneously or separately. The results of Supplemental Study 3 were consistent with this idea: When presented with two sets of investments that yielded the exact same number of successes and identical monetary outcomes, participants still expected the outcome of the smaller set of higher-probability investments to feel more satisfying than the outcome of the larger set of lower-probability investments.

General Discussion

Decision makers in many domains—from investors allocating funds to job seekers applying for positions to researchers selecting projects—face tradeoffs between the number of opportunities they pursue and the likelihood of each individual opportunity succeeding. Evidence from 10 preregistered studies suggests that when making such tradeoffs, people tend to prioritize having a high probability of success per opportunity over taking many opportunities. Participants in our studies frequently chose to pursue smaller sets of higher-probability opportunities even

when larger sets of lower-probability opportunities would be expected to yield more successes on average (and, in some cases, better monetary outcomes). This suggests that many people are willing to incur a cost to have a high probability of success per opportunity.

We theorize that this tendency arises because decision makers care not only about the total number of opportunities that succeed, but also about the proportion of opportunities that succeed. Supporting this account, we found that people frequently preferred to take fewer higher-probability opportunities even when they were given cumulative-probability information that made it clear that taking many lower-probability opportunities would, on average, yield more successes. Moreover, when given the choice, many people explicitly preferred to receive information about the likelihood of each individual opportunity succeeding over receiving information about the likelihood of each possible number of successes in the aggregate, suggesting that they cared about having a high probability of success per opportunity for its own sake. Further supporting our account, people assigned to receive smaller sets of higher-probability opportunities reported feeling more satisfied with their outcomes than people assigned to receive larger sets of lower-probability opportunities, even if they ended up with fewer total successes (and worse monetary outcomes). This is consistent with the idea that people prioritize having a high probability of success per opportunity because they (correctly) anticipate that they will feel more satisfied if a higher proportion of opportunities succeed.

Theoretical Implications

Our findings suggest that when deciding which set of opportunities to pursue, people do not simply pursue whichever set of opportunities they expect to yield the best outcomes. Even when participants received cumulative-probability information that made it clear that taking many low-probability opportunities would be expected to yield more successes on average, they

still frequently chose to pursue smaller sets of higher-probability opportunities. The fact that people continued to prioritize having a high probability of success per opportunity over taking many opportunities even when it was clear that this strategy would be expected to yield fewer successes suggests that this tendency does not arise solely because people mistakenly expect smaller sets of higher-probability opportunities to yield better outcomes. Rather, for at least some decision makers, it seems to reflect a genuine preference.

By showing that people value having a high probability of success per opportunity above and beyond its impact on expected outcomes, this research also extends research on proportion dominance into a new domain. Previous research has shown that decision makers often give more weight to proportions than to absolute quantities when making prosocial choices (Baron, 1997; Bartels, 2006; Fetherstonhaugh et al., 1997; Friedrich et al., 1999; Jenni & Loewenstein, 1997; Slovic et al., 2002). For example, people might prefer to save one out of two lives at risk than to save one out of 100 lives at risk. We found a similar pattern in how people decided which sets of opportunities to pursue. Moreover, although it is often assumed that people simply use proportions as a proxy for absolute quantities (Hsee & Leclerc, 1998), our findings suggest that—at least in some contexts—people care about proportions for their own sake. For instance, participants in Supplemental Study 3 expected it to be more satisfying to have one out of two investments succeed than to have one out of 10 investments succeed, even though both outcomes were shown side-by-side. This suggests that people may not rely on proportions solely because they find absolute quantities hard to evaluate. Future research could explore whether such patterns emerge for different reasons in different contexts. Effects that arise due to the ease of evaluating absolute quantities should disappear in joint-evaluation contexts, but effects that reflect a genuine preference for higher proportions should persist in joint-evaluation contexts.

This research also contributes to the literature on the role of emotions in risky choice by suggesting that decision makers consider not just how they will feel in the moment as each opportunity unfolds, but also how they will feel about the number of opportunities that succeed relative to the total number of opportunities they took. Participants in our studies both anticipated and reported feeling more satisfied with identical monetary outcomes when those outcomes originated from smaller sets of higher-probability opportunities and thus represented a higher proportion of successes. Given that outcomes were revealed all at once and that differences in satisfaction emerged even after uncertainty was resolved, these patterns cannot be attributed to moment-by-moment fluctuations in how participants felt in response to each individual success or failure. Rather, our results suggest that people's actual feelings of satisfaction with their overall outcomes are influenced by the proportion of opportunities that succeed.

At first glance, choosing to pursue fewer high-probability opportunities over a larger and more valuable set of lower-probability opportunities may seem like a violation of normative standards. Yet our findings suggest that this tendency may—at least in some cases—reflect a genuine preference that people endorse upon reflection. First, when we offered participants a choice between two types of probability information, the majority of participants explicitly preferred to learn the probability of each individual opportunity succeeding even though this information tended to yield less optimal choices. Second, participants reported feeling more satisfied with the outcomes of smaller sets of higher-probability opportunities even when larger sets of lower-probability opportunities yielded more total successes. Both of these patterns would be difficult to explain if we assumed that everyone shares the goal of pursuing whichever set of opportunities they expect to yield the best outcomes. However, both patterns are consistent with the idea that some people intrinsically care about achieving a high proportion of successes.

More broadly, this research highlights the importance of distinguishing between choices that reflect mistaken beliefs versus subjective preferences. When people behave in ways that result in suboptimal outcomes, researchers might assume that such behavior is driven by cognitive shortcomings (e.g., misunderstanding, miscalculation) and that people would make different choices if they had more accurate expectations about the consequences of those choices. However, our findings suggest that people may sometimes behave in ways that appear to violate normative standards because they personally *want* to do so, even if they understand that such behavior will likely yield suboptimal outcomes. In other words, decision makers themselves may not necessarily view every choice that violates normative standards as a mistake. Our studies offer two possible strategies that can aid in distinguishing between mistakes and subjective preferences: examining which types of information decision makers seek out ex ante, and measuring how satisfied people feel upon learning the outcomes of particular decisions.

Practical Implications

In many real-world contexts, people who are unwilling to pursue opportunities that are individually unlikely to succeed may end up with suboptimal outcomes. Individuals and organizations often pursue goals that require them to take multiple actions in parallel (e.g., investments, projects, applications), each of which may or may not succeed. In these contexts, people may have to decide whether to concentrate their efforts into a few opportunities that are individually more promising or to spread their efforts across many opportunities that are individually less promising. Our findings suggest that decision makers may systematically undervalue the impact of taking many low-probability opportunities and thus may either make suboptimal choices about which sets of opportunities to pursue or simply fail to take advantage of low-probability opportunities altogether. For instance, a researcher who is only willing to take

on projects that have a high chance of succeeding from the start may neglect project ideas that seem riskier but that could nevertheless yield similar or better outcomes in the aggregate. Of course, in some cases, there may be additional costs (e.g., time, attention) associated with each additional opportunity one pursues, which could make it wiser for people to limit the number of opportunities they pursue to some extent. However, our findings suggest that people may still be reluctant to take many low-probability opportunities even in cases where doing so is no more costly than taking fewer higher-probability opportunities.

What are the most effective ways to encourage decision makers to take more low-probability opportunities? Perhaps the most straightforward strategy is to provide people with more detailed information about expected outcomes that makes it clear how likely a set of opportunities is to yield success in the aggregate. Our results suggest that this strategy may work at least in some cases, especially for people who only fail to take advantage of low-probability opportunities because they underestimate the cumulative chances of success. However, in the real world, decision makers often have a say in which information they seek out and rely on. If people fail to appreciate the value of cumulative-probability information (as in Study 5) or value achieving a high proportion of successes for its own sake (as in Study 6), then merely providing them with cumulative-probability information may not change their behavior—especially if they still have access to individual-probability information. Of course, for those who genuinely care more about the proportion of opportunities that succeed than about the total number of successes, it may sometimes be wise to prioritize having a high likelihood of success per opportunity even if this means fewer opportunities are expected to succeed overall. Before deciding whether and how to intervene, it is important to understand what is driving people's behavior.

Directions for Future Research

Our evidence suggests that people often prefer to take fewer higher-probability opportunities even when it is clear that they could achieve more successes by taking many lower-probability opportunities, which raises the question of whether people care about other factors besides material outcomes when deciding which sets of opportunities to pursue. For example, perhaps decision makers who concentrate their efforts into fewer higher-probability opportunities or who achieve a high proportion of successes are socially rewarded. This would be consistent with previous research demonstrating that decision makers who are susceptible to certain biases (e.g., gain-loss framing effects) are evaluated more positively by third-party observers (Dorison & Heller, 2022). To understand whether reputational concerns motivate people to prioritize having a high likelihood of success per opportunity over taking many opportunities, future research could investigate how such behavior is evaluated by observers. If people expect to be evaluated more positively when they pursue fewer higher-probability opportunities—or end up with a higher proportion of successes—then they may take these reputational consequences into account when deciding which sets of opportunities to pursue.

One limitation of our studies is that we hold the probability of success per opportunity constant within a given set of opportunities. In the real world, people may encounter sets of opportunities in which some opportunities are more likely to succeed than others. If decision makers care about achieving a high proportion of successes, as we suggest, then in some cases they may find a set of opportunities even *less* appealing when it is expanded to include additional opportunities that are very unlikely to succeed. For instance, people might prefer an investment portfolio that offers two investments with a 50% chance of succeeding over a portfolio that includes two investments with a 50% chance of succeeding plus two investments with a 1% chance of succeeding (which, despite being objectively more valuable, is expected to yield a

lower proportion of successes). This possibility would be consistent with research on opportunity neglect, which has shown that people often forgo individual opportunities that are very unlikely to succeed (e.g., a 1% chance of $99), even if there is little or no downside. Future research could explore whether adding extra low-probability opportunities to a set ever makes the set seem less valuable, and perhaps identify other conditions under which a desire to achieve a high proportion of successes might lead decision makers astray.

Although the present research focused on how people decide between sets of opportunities, future research could investigate whether similar patterns emerge in other contexts. First, we found that people preferred smaller sets of higher-probability opportunities even after uncertainty was resolved, which suggests that a similar pattern might also emerge when deciding between sets of riskless gains. For example, when choosing between two sets of discounts, consumers might prefer to receive a $5 discount per item on two of the 10 items they are purchasing over receiving a $1 discount per item on all 10 items. Such a tendency might reflect a more general tendency to prefer quality over quantity. Second, future research could explore how people decide between sets of potential losses, as opposed to potential gains. If people feel worse about negative outcomes that represent a higher proportion of losses—just as they feel better about positive outcomes that represent a higher proportion of successes—then they may prefer larger sets of lower-probability losses over smaller sets of higher-probability losses. By contrast, if people are not as sensitive to proportions in the loss domain, or if they consider additional factors when deciding between sets of negative outcomes that they do not consider when deciding between sets of positive outcomes, then their preferences in the loss domain may not simply be the mirror image of their preferences in the gain domain.

Constraints on Generality

All of our studies were conducted with U.S.-based adult participants recruited via online survey platforms (MTurk and Prolific). Although we do not have any theoretical reason to believe that our findings would be limited to these populations, it is possible that we would observe smaller effects in more numerate and/or highly educated samples, given that our findings seemed to be partly driven by probability misjudgment. Additionally, the stylized choice paradigms that we used allowed for clean experimental control but may not fully capture the complexity of real-world decisions, given that people rarely face such explicit tradeoffs between the number of opportunities they pursue and the probability of each opportunity succeeding. Future research could examine whether our findings generalize to more naturalistic contexts.

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