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Fast optimism, slow realism? Causal evidence for a two-step model of future thinking

Hallgeir Sjåstad [a,*], Roy F. Baumeister [b]

[a] Norwegian School of Economics, Norway
[b] University of Queensland, Australia

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ABSTRACT

Many researchers report that people have an optimistic bias when making predictions, but sometimes cautious realism is found. One resolution is that future thinking has two steps: The desired outcome is imagined first, followed by a sobering reflection on potential difficulty of getting there. Five experiments supported this two-step model (USA and Norway; $N = 3213$; 10,433 judgments), showing that intuitive predictions are more optimistic than reflective predictions. Participants were randomly assigned to rely on fast intuition under time-pressure or slow reflection after time-delay. In Experiment 1, participants in both conditions thought positive events were more likely to happen to them than to other people and that negative events were less likely, replicating the classic finding of "unrealistic optimism". Crucially, this optimistic tendency was significantly stronger in the intuitive condition. Participants in the intuitive condition also relied more on heuristic problem-solving (CRT). Experiments 2–3 found that participants in the intuitive condition thought they were at lower health risk than participants in the reflective condition. Experiment 4 provided a direct replication, with the additional finding that intuitive predictions were more optimistic only for oneself (and not about the average person). Experiment 5 failed to identify any intuitive difference in perceived reasons for success versus failure, but observed intuitive optimism in binary prediction of a future exercise habit. Experiment 5 also found suggestive evidence for a moderating role of social knowledge: Reflective predictions about oneself became more realistic than intuitive predictions only when the person's base-rate beliefs about other people were fairly accurate.

1. Introduction

Personal optimism has been described as "the engine of capitalism" (Kahneman, 2011), creating positive expectations to what is likely and possible. Empirical research in psychology has documented optimistic biases in multiple contexts (Alicke, 1985; Markus & Nurius, 1986; Taylor & Brown, 1988; Kruger & Dunning, 1999; Newby-Clark & Ross, 2003; Sharot, 2011). In the domain of *prospection* (Gilbert & Wilson, 2007; Schacter, Benoit, & Szpunar, 2017), meaning how people think about the future, optimism can be observed in overly favorable prediction patterns. In some situations, people tend to overestimate the probability that positive events will occur to them and underestimate personal risk of negative events (e.g., Jansen et al., 2011; Rothman, Klein, & Weinstein, 1996; Waters et al., 2011; Weinstein, 1980), commonly described as "unrealistic optimism" (for reviews, see Shepperd, Klein, Waters, & Weinstein, 2013; Shepperd, Waters, Weinstein, & Klein, 2015). In related research on the planning fallacy, people show an optimistic tendency to underestimate the time and resources needed to complete future tasks (Buehler, Griffin, & Ross, 1994; Kahneman & Tversky, 1979; Peetz & Buehler, 2009). Recent work has found that people may neglect their worst-case scenario in romantic relationships and political elections, making future predictions that are practically identical to their best-case scenario (Sjåstad & Van Bavel, 2023). Why do people think this way?

Before proceeding to our proposed explanation, it is important to note that people are not *always* optimistic. In the specific literature on unrealistic optimism there have also been mixed results and alternative interpretations, both regarding measurement issues and the value of motivational explanations (Harris, de Molière, Soh, & Hahn, 2017; for critical reviews, see Harris & Hahn, 2011; Krizan & Windschitl, 2007). In other cases, pessimism may occur. For instance, some studies have found that common events are overestimated in self-prediction, but at

* Corresponding author at: Department of Strategy and Management, Norwegian School of Economics, Helleveien 30, 5030 Bergen, Norway.
E-mail address: hallgeir.sjastad@nhh.no (H. Sjåstad).

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the same time, that rare events including positive ones are underestimated (e.g., Chambers, Windschitl, & Suls, 2003; Kruger & Burrus, 2004). Research on the "hard-easy effect" is another exception, where one finding is that people wrongly believe to be worse than others on difficult tasks and better than others on easy tasks (Moore & Healy, 2008). Monroe, Ainsworth, Vohs, and Baumeister (2017) had people first ponder their future for 10 min, and then make financial decisions. Instead of the predicted optimistic pattern (high-risk, high-payoff), their choices turned out to be more *risk-averse* than the control group. Moreover, a review by Sweeney, Carroll, and Shepperd (2006) found several examples of a "shift from optimism", typically in cases of high stakes, when a negative outcome was easy to imagine, or when immediate feedback was anticipated.

In light of these conflicting findings, there is a need for a testable explanation for why future optimism may occur some of the time but not always. Previous work has focused on the role of different tasks and study paradigms, which can account for some of the variation (Moore & Healy, 2008). The current research does not attempt to explain the full range of diverse findings, but it offers one important hypothesis for when future optimism is especially likely to occur: When people make personal predictions based on *fast intuition*, as opposed to a delayed process of slow reflection.

In the current research, we simply define 'optimism' as higher subjective probability that positive events will occur, and lower subjective probability that negative events will occur. Assessment of 'realism' (i.e., accuracy) and 'bias' (i.e., systematic deviation from accuracy) is more challenging to do than typically acknowledged, and claims about inaccurate bias should be reserved for cases where there exists a statistical benchmark for comparison (e.g., base-rate frequency of the given outcome). Whereas the first experiments in this paper rely on a common but relatively weak standard of accuracy, assessing so-called 'comparative unrealistic optimism' (judgments of oneself compared to judgments of the average person), the final experiment (Experiment 5) was designed to provide an estimate of statistical realism as well, assessing 'absolute unrealistic optimism' at the group level through comparison with base-rate data (Shepperd et al., 2013, 2015; for alternative and critical reviews, see Harris & Hahn, 2011; Krizan & Windschitl, 2007). By combining minor design variations and different response scales of subjective probability, our primary goal is to provide a first test of the *intuitive-optimism hypothesis*, in its most basic form.

1.1. A two-step model: fast optimism, slow realism

The current investigation began by embracing the varying findings in prior research of both optimism and pessimism. We reasoned that these represent two distinct steps in prospection. First, one thinks of what one would like to happen, which typically resembles a best-case scenario. Then one starts to think about how to get there, given sufficient time and attention, whereupon the obstacles and pitfalls become apparent. The resulting two-step model features an optimistic first step and a cautious second step, as proposed in the framework of pragmatic prospection theory (Baumeister, Maranges, & Sjåstad, 2018; Baumeister, Vohs, & Oettingen, 2016). In the language of judgment and decision research, this process may consist of a first step of *fast and optimistic anchoring* ("what do I want?"), which only later is followed by a second step of *slow and strategic adjustment* ("how can I get there?").

In our view, adaptive foresight might be characterized by completion of both of stages in the two-step model: The first step generates positive expectations that motivate behavior towards desirable goals, whereas the second stage operates as a corrective procedure by identifying alternative scenarios, potential restraints, and the typical ratio between success and failure. If true, completing both stages of future thinking might reduce the intuitive tendency to lean in an optimistic direction. At present, however, this account of future optimism has not been tested empirically.

According to our two-step model, prior findings of pervasive optimism may arise because people tend to rely only on the first step of intuitive prospection, so that the average prediction does not take into account how to actually achieve the goal, typical base-rates for success, and what might go wrong. If so, engagement in slow reflection at the second step should modify and reduce this initial optimism. To test this idea experimentally, the present research compared immediate predictions relying on intuition with reflective predictions coming after a time delay. The two-step model of future thinking is informed by the dual-process framework of judgment and decision-making (Evans & Stanovich, 2013; Kahneman, 2003), and pragmatic theory on the interplay between human consciousness and prospection (Baumeister et al., 2016; Baumeister et al., 2018). It is often *assumed* that future optimism is driven by the psychology of intuition (e.g., Kahneman, 2011), but to the best of our knowledge, this possibility has not been tested directly.

1.2. Related literature on intuition and reflection

To be sure, the current idea of intuitive optimism and self-correcting reflection is far from obvious. Although recent studies have found compatible results in other domains, in which slow reflection leads to reduced present-bias and more far-sighted decisions in intertemporal choice (Imas, Kuhn, & Mironova, 2022) and better ability to separate true from false information in the news media (Bago, Rand, & Pennycook, 2020), some studies suggest that the opposite result might occur in different situations. When people evaluate ambiguous scientific evidence, there is some research showing that high cognitive reflection as an individual trait may operate in a self-serving manner to *increase* partisan bias – in which people engage in "motivated reasoning" to persuade themselves that appealing but false things are true (Kahan et al., 2012; Kahan, Peters, Dawson, & Slovic, 2017). According to this view, the individual decision-maker might actually be better suited to arrive at a fairly accurate conclusion when relying on their intuitive gut feelings rather than thinking about it more carefully (see also Wilson, 2002).

Questions about the possible connection between cognitive processing mode and different types of bias are still up for debate and empirical inquiry. Early work on the mere-thought effect (Tesser, 1978), for instance, suggests that more time to think leads to attitude polarization by producing more attitude-consistent thoughts, rather than a directional main effect. A more recent study on belief updating (Kappes & Sharot, 2017), found no robust evidence for a causal role of motivated reasoning. Although participants placed consistently lower importance on negative than positive news on subsequent updating and learning parameters, indicating optimistic belief updating, this optimistic bias was observed from the first moment new evidence was presented and was equally strong during cognitive load and time pressure as in the control condition. That is, the basic finding of optimistic updating bias was robust, but the strength of this effect was very similar in the intuitive condition and the control condition (which gave participants more time to think). This result is consistent with our intuitive-optimism hypothesis in the sense that cognitive reflection was not *necessary* for optimism to occur. It is different by focusing on belief updating, and importantly, for finding no consistent difference between intuition and reflection in the strength of the updating effect.

In the case of future thinking, the important thing is that these examples show that "intuitive optimism" is not the only hypothesis out there, and even if it were, that causal evidence for this specific effect is lacking. Prior to the current investigation, it has remained an open question whether intuitive predictions actually are more optimistic than reflective ones.

1.3. Research overview

Informed by a two-step model of future thinking, we conducted five experiments to test the *intuitive-optimism hypothesis*. A combined sample

of 3213 participants from USA and Norway were randomly assigned to rely on fast intuition under time-pressure or slow reflection under time-delay, and then made future predictions about personal events. The experimental manipulation was adapted from previous research on the psychology of judgment and decision-making (Lawson, Larrick, & Soll, 2020; Suter & Hertwig, 2011) and cooperation (Rand, 2016). The outcome measure in the first four out of five experiments consisted of different rating scale judgments of specific events, derived from the literature on "unrealistic optimism" (Shepperd et al., 2013; Weinstein, 1980). Whereas we used mixed events in Experiment 1 (positive and negative), Experiments 2–4 focused on likelihood judgments of future health risk (e.g., getting a heart attack or developing diabetes). Experiment 5 focused on the positive but challenging goal of establishing a daily exercise habit, assessing a binary prediction of the most likely outcome one year from now (succeeding or failing). Across all five experiments, participants provided a total of 10,433 predictions of future events.

To maximize statistical power under available economic resources, we only operated with two conditions in four out of five experiments, to ensure a sufficiently large sample per cell. Moreover, the outcome measure consisted of a series of individual predictions in four out five experiments, to reduce measurement error and avoid relying on a single data point per participant. We defined 'optimism' broadly, as higher subjective probability that positive events will occur and lower subjective probability that negative events will occur. In our final experiment (Experiment 5), participants made a binary prediction of the most likely outcome for a specific positive goal, for which there is a statistical benchmark for accuracy (base-rate frequency of daily exercise in the general population). This enables a more informative estimate of *realism* as well.

All five experiments were pre-registered in advance of each data collection. Explorative analyses and deviations are noted explicitly in the method and results sections. We also report a power sensitivity analysis for each experiment. The results provided consistent support for the intuitive-optimism hypothesis: On average, predictions in the fast-intuition condition were more optimistic than similar predictions in the slow-reflection condition. Interestingly, however, this effect was only found for judgments about the self.

2. Experiment 1: intuitive optimism in comparative judgment of future events

In Experiment 1, Norwegian participants were randomly assigned to make probability judgments by relying either on fast intuition or slow reflection. Unlike the remaining experiments, the items included both positive and negative events on different topics. Each judgment was made in direct comparison to "the average person", which also enabled an assessment of so-called comparative unrealistic optimism at the group level (Weinstein, 1980; Shepperd et al., 2013; see Harris & Hahn, 2011 for an alternative explanation).

2.1. Method

The hypothesis was that participants in the intuitive condition would think that positive events were more likely to happen to them and that negative events were less likely, as compared to participants in the reflective condition. Hereafter, we refer to this general expectation of rapid predictions being especially favorable to the self as the *intuitive-optimism hypothesis*.

The hypothesis, method, and statistical analysis were pre-registered (PDF: https://aspredicted.org/jt9bb.pdf). We recruited 286 participants from a Norwegian student sample (*M age* = 23.5 years, 158 women), who all passed a simple attention check (responding with the number 0 on a scale from −3 to +3 about the likelihood for rainy weather on the next day). We used the same type of attention check across all five experiments. A sensitivity analysis showed that this sample size provided statistical power corresponding to an 80% chance to detect a true effect of $d = 0.33$ or larger ($p < .05$, two-tailed).

Participants were randomly assigned between two conditions in a between-subjects design, in which the experimental manipulation consisted of fast intuition versus slow reflection. In the intuitive condition, participants were instructed to respond in less than <10 seconds or as quickly as they could, and to rely on their gut feeling and provide the first answer that came to mind. Above each question (presented one at the time), they saw the text "Respond as quickly as you can!", and a visible timer that counted downwards from 10 to 0 seconds. In the reflective condition, participants were instructed to wait for at least 15 seconds before responding, and ignore their gut feelings while taking their time to think more deliberately about each question. Above each question (presented one at the time), they saw the text "Stop and think for at least 15 seconds before you respond!", and a visible timer that counted upwards from 0 to 15 seconds.

The outcome measure was the average level of future optimism across six items. Based on previous assessments of "unrealistic optimism" in comparative judgment (Shepperd et al., 2013; Weinstein, 1980), the participants in Experiment 1 used a 7-point scale to rate how likely they thought it was that each event would happen to them as compared to the average person (−3 = *Much less likely*, 0 = *As likely as the average person*, +3 = *Much more likely*). Prior to making these judgments, the participants were instructed to think of an "average person" of the same age and gender as themselves, who was also a student at the same university as them. The specific items were derived from previous optimism research (Shepperd et al., 2013; Weinstein, 1980), and included three positive events (Living past age 80; Like their first job after graduation; Get a child with high IQ) and three negative events (Develop a drinking problem; Get a heart attack before age 40; Fail to graduate/drop-out). Sample wording: "How like do you think it is that you will live past age 80?" (−3 = *Much less likely,* 0 = *As likely as the average person,* +3 = *Much more likely*) To test the primary hypothesis, the general index of future optimism was created by reversing the three negative events and calculating an average score across all six events.

As non-registered manipulation checks, we recorded average response time per question, and at the end of the survey, the degree to which participants relied on a problem-solving heuristic when responding to a single item from the cognitive reflection test ("CRT": Frederick, 2005): "A ball and a bat cost $1.10 in total, and the bat costs $1.00 more than the ball. How much does the ball cost?" Just like the prediction items for the dependent variable, participants were still assigned to a fast-intuition or slow-reflection condition while responding to the ball-and-a-bat problem. The heuristic but incorrect answer is 10 cents, whereas the reflective and correct answer is 5 cents. Thus, providing the correct answer to this question normally requires cognitive overriding of the intuitive response that first comes to mind, followed by a process of slow reflection to arrive at the correct solution.

2.2. Results

First, we successfully replicated the classic effect of comparative unrealistic optimism (Shepperd et al., 2013; Weinstein, 1980). The group average in both conditions were optimistically biased from the zero-midpoint of the scale (i.e., "the average person"), both for positive and negative events ($p < .001$). As illustrated in Fig. 1, the participants thought it was more likely that good things would happen to them than to the average person, and less likely that bad things would happen to them than to the average person.

In line with the intuitive-optimism hypothesis, an independent *t*-test showed that participants in the intuitive condition were significantly more optimistic than participants in the reflective condition (general optimism index, all six events combined: $t(282) = 4.44$, $p < .001$, $d = 0.53$, [95% $d = 0.29, 0.77$]). We then divided the analysis into positive and negative events, using the average of the three events in each category, to examine whether intuitive optimism would manifest

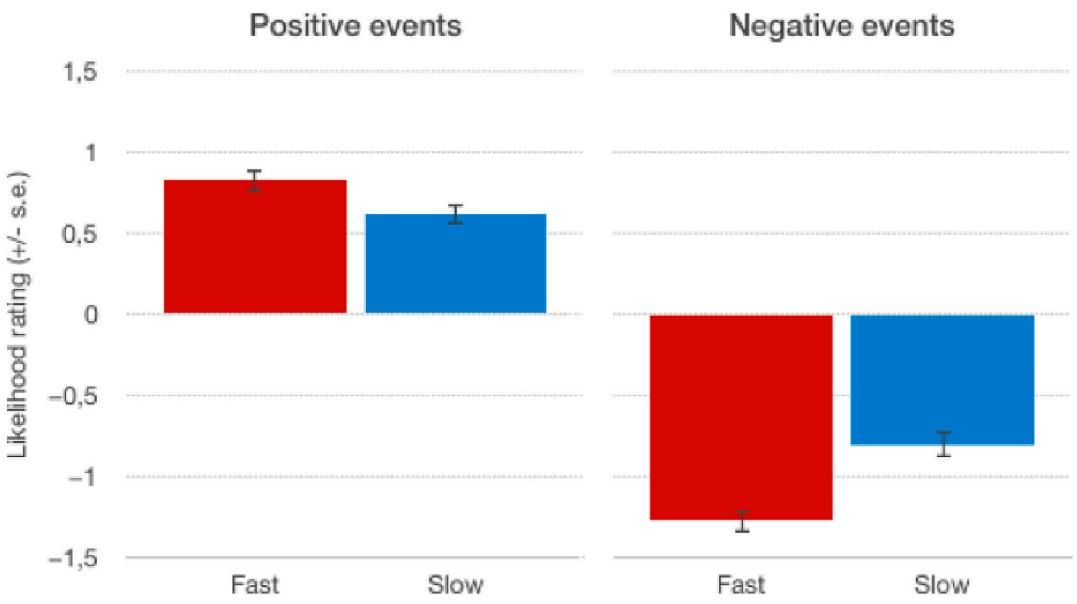

Fig. 1. The intuitive-optimism effect, Experiment 1 ($N = 286$, Norway).
The bar chart illustrates the degree of comparative unrealistic optimism in the fast-intuition and slow-reflection condition, as the average likelihood rating of 3 positive and 3 negative events. Both groups were positively biased from the "average person" value of zero, but participants who made their predictions based on fast intuition (vs. slow reflection) thought positive events were even more likely to happen to them (p = .015, d = 0.29), and that negative events were less likely ($p <$ .001, d = 0.51). All ratings were made on a 7-point scale from −3 (much less likely), to 0 (as likely as the average person), to +3 (much more likely). Error bars indicate standard error.

regardless of valence. In comparison to the "average person" (value: 0), participants in the intuitive condition had a stronger tendency to think that it was more likely that positive events would happen to them ($M_{intuition} = +0.83$, $SD = 0.79$ vs. $M_{reflection} = +0.62$, $SD = 0.67$, $t(284) = 2.46$, $p = .015$, $d = 0.29$), and that it was less likely that negative events would happen to them ($M_{intuition} = -1.27$, $SD = 0.89$ vs. $M_{reflection} = -0.80$, $SD = 0.93$, $t(282) = 4.28$, $p < .001$, $d = 0.51$). Thus, engagement in slow reflection led to a substantial decrease in optimistic bias, although it did not eliminate it completely.

The first manipulation check confirmed that participants in the intuitive condition did respond faster to the prediction questions than participants in the reflection condition ($M_{intuition} = 6.69$ s per question, $SD = 1.42$ vs. $M_{reflection} = 21.5$ s per question, $SD = 12.40$, $p < .001$, $d = 1.68$). Second, the results from the bat-and-ball problem (CRT: Fig. 2) showed that participants in the intuitive (vs. reflective) condition were 34 percentage points less likely to provide the correct answer of 5 cents ($M_{intuition} = 41\%$ vs. $M_{reflection} = 75\%$, $p < .001$, $\chi^2 = 34.01$), and 29 percentage points more likely to provide the heuristic but incorrect answer of 10 cents ($M_{intuition} = 46\%$ vs. $M_{reflection} = 17\%$, $p < .001$, $\chi^2 = 26.67$). This suggests that the experimental manipulation was successful in promoting a combination of fast responding and greater reliance on intuitive heuristics, in contrast to slow and reflective responding – which is something different than simply increasing the error rate in a blind or non-systematic way in the intuitive condition.

3. Experiment 2: intuitive optimism in comparative judgment of health-related risk

Experiment 2 randomly assigned American participants to rely either on fast intuition or slow reflection when making comparative judgments of health-related risk. Like Experiment 1, each prediction was made in direct comparison to "the average person".

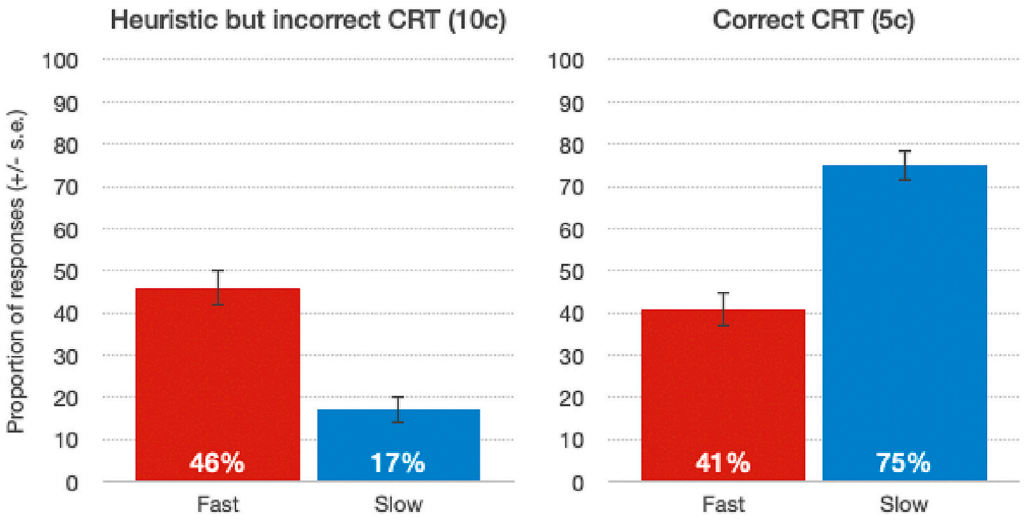

Fig. 2. CRT performance, Experiment 1 ($N = 286$, Norway).
The bar chart illustrates the average performance on the bat-and-a-ball problem from the cognitive reflection test (CRT: Frederick, 2005), in the fast-intuition and slow-reflection condition. Participants who responded based on fast intuition (vs. slow reflection) were more likely to provide the heuristic but incorrect answer ($p < .001$, $X^2 = 26.67$), and less likely to provide the correct answer ($p < .001$, $X^2 = 34.01$).

3.1. Method

Guided by the intuitive-optimism hypothesis, the central prediction was that participants in the intuitive condition would think that they were at lower risk for developing future health problems than participants in the reflective condition.

The hypothesis, method, and statistical analysis were pre-registered (PDF: https://aspredicted.org/rd83p.pdf). We recruited 300 attentive participants (160 women, 140 men, $M_{age} = 35$) from an American online sample at Amazon's Mechanical Turk ("Mturk"). An upper age limit of 50 was specified so we could ask questions about future health risks starting at age 50. The current sample provided statistical power corresponding to an 80% chance to detect a true effect of d = 0.32 or larger ($p < .05$, two-tailed).

Participants were randomly assigned to respond by fast intuition or slow reflection. The experimental manipulation was identical to that of Experiment 1, with the only difference that participants in the intuitive condition were instructed to respond in less than 5 seconds or as quickly as they could. This minor change was made to further increase the chances that the majority of participants in this condition actually provided their first and initial response to each question.

The outcome measure was the average level of health-related risk across four items, in which a lower value would indicate greater optimism. As in Experiment 1, the participants rated how likely they thought it was that each event would happen to them as compared to the average person (−3 = *Much less likely*, 0 = *As likely as the average person*, +3 = *Much more likely*). Prior to making these judgments, the participants were instructed to think of an "average person" of the same age and gender as themselves, who was also a participant at Mturk. The specific items were derived from previous research on future optimism (Shepperd et al., 2013; Weinstein, 1980): Get diabetes before age 50; Get a heart attack before age 50; Develop a drinking problem before age 50; Live past age 75 (reversed). Sample wording: "How likely do you think it is that you will get a heart attack before age 50?"

As background measures at the end of the experiment, we measured self-reported physical health (single item: 1–7), general happiness (single item: 1–7), and trait optimism (average of 6-item scale from 1 to 7, Scheier, Carver, & Bridges, 1994).

3.2. Results

Providing a second replication of comparative unrealistic optimism (Weinstein, 1980), we found that the average response in both conditions indicated "below-average risk" for developing future health problems across the four items ($p < .001$).

Turning to the primary test in this experiment, the intuitive-optimism hypothesis was supported. An independent *t*-test showed that participants in the intuitive condition predicted a significantly lower likelihood of future health problems than participants in the reflective condition ($M_{intuition} = -0.98$, $SD = 1.14$ vs. $M_{reflection} = -0.66$, $SD = 1.13$, $t(298) = 2.45$, $p = .015$, $d = 0.28$, [95% $d = 0.05$, 0.51]). When analyzing the proportion of all judgments that concluded with "below-average risk" (X out of 4 possible), 60% percent of judgments made by participants in the fast condition concluded with lower risk than the average person, whereas only 51% of judgments in the slow condition arrived at the same conclusion.

As a non-registered manipulation check, the average response time per question confirmed that participants in the intuitive (vs. reflective) condition made faster predictions ($M_{intuition} = 4.61$ s, $SD = 1.87$ vs $M_{reflective} = 21.8$ s, $SD = 20.7$, $p < .001$, $d = 1.19$).

The background measures were significantly correlated with the outcome measure of health-related risk in the expected direction (i.e., people with high trait optimism, good physical health and high general happiness predicted a lower chance for getting future health problems), but these measures did not moderate the causal effect of intuitive versus reflective responding. These results are reported in Table 1.

4. Experiment 3: intuitive optimism in isolated judgment of health-related risk

Experiment 3 changed the response format. Experiment 1 and 2 required participants to compare their future with that of an average person. This measure has been criticized insofar as differences could reflect pessimism about the hypothetical average person rather than optimism about oneself. It also arguably requires complex thought, in order to make two judgments at once (one's own future, and the average person's). Moreover, some studies indicate that there are psychometric problems with comparative optimism scales (Harris & Hahn, 2011), sometimes producing an inflated estimate of optimism and interfering with the theoretical interpretation of results.

To avoid common method-bias by testing the intuitive-optimism hypothesis with only a single type of outcome measure, Experiment 3 made a shift from comparative to isolated judgment. This was done by simply asking people to rate how likely they thought it was that future health problems would occur to themselves on a scale from 0 to 10, ranging from extremely unlikely to extremely likely (for a similar scale, see e.g., Rose, Endo, Windschitl, & Suls, 2008; Windschitl, Kruger, & Simms, 2003). In this experiment, no reference was made to other people or "the average person". Across experiments, we provided no further explanation for the precise meaning of "likely", assuming that evaluating a future event as more or less likely on a rating scale makes sense to most participants in the current cultural context.

4.1. Method

The hypothesis, method, and statistical analysis were pre-registered (PDF: https://aspredicted.org/ug5sb.pdf). We recruited 700 participants that were below 50 years old from an American online sample at Amazon's Mechanical Turk, aiming for 600 attentive participants. After excluding 149 participants who failed the attention check in the beginning of the survey (responding with the number 5 on a rating scale from 0 to 10), the final sample consisted of 551 participants (295 women, 256 men, $M_{age} = 34$). This sample provided statistical power corresponding to an 80% chance to detect a true effect of $d = 0.24$ or larger.

The participants were randomly assigned to intuitive versus reflective responding. They then predicted how likely it was that they would develop future health problems across four items: Getting diabetes before age 50, getting a heart attack before age 50, developing a drinking problem before age 50, and living past age 75 (reversed). Sample item: "How likely do you think it is that you will get diabetes before age 50?" The only method difference from Experiment 2 was that the sample size was about 80% larger to provide higher test sensitivity, and that we changed the response scale from relative judgment (compared to the average person) of future health risk to isolated judgments about oneself (0 = *Extremely unlikely,* 10 = *Extremely likely*).

4.2. Results

In line with the intuitive-optimism hypothesis (see Fig. 3), an independent *t*-test showed that participants in the intuitive condition predicted it was significantly less likely that they would develop future health problems than participants in the reflective condition ($M_{intuition} = 2.88$, $SD = 1.66$ vs. $M_{reflection} = 3.56$, $SD = 1.82$, $t(549) = 4.58$, $p < .001$, $d = 0.39$, [95% $d = 0.22$, 0.56]).

Yet again, the background measures were significantly correlated with the outcome measure of health-related risk in the expected direction (i.e., people with good physical health, high income, high trait optimism and happiness thought on average that they were at lower risk for developing future health problems), but neither of these measures moderated the causal effect of intuitive versus reflective responding on the degree of health-related optimism (see Table 1).

Based on the average response time per question, a non-registered

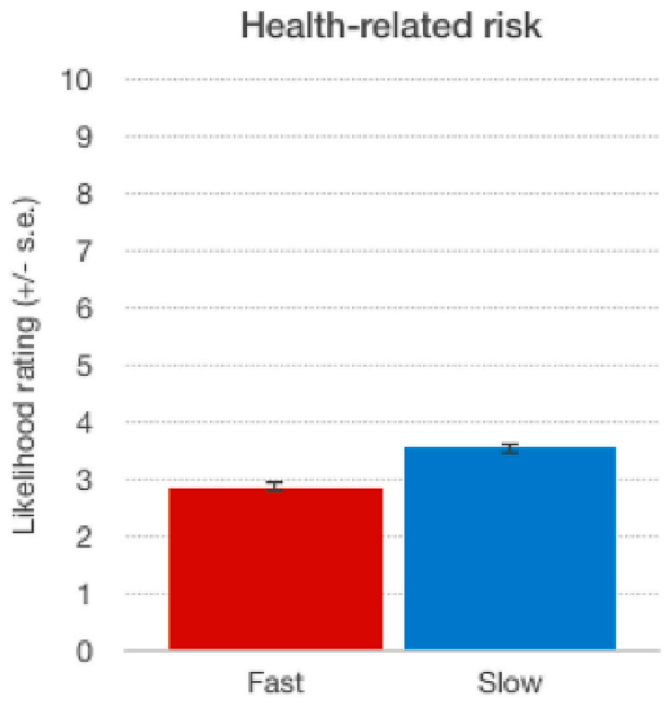

Fig. 3. The intuitive-optimism effect, Experiment 3 ($N = 551$, USA).
The bar chart illustrates the degree of future optimism in the fast-intuition and slow-reflection condition, as the average likelihood rating of 4 outcomes. Participants who made their predictions based on fast intuition (vs. slow reflection) thought it was less likely that they would develop future health problems ($p < .001$, $d = 0.39$). All ratings were made on a scale from 0 (extremely unlikely) to 10 (extremely likely). Error bars indicate standard error.

manipulation check confirmed that participants in the intuitive (vs. reflective) condition made faster predictions ($M_{intuition} = 4.86$ s, $SD = 1.74$ vs $M_{reflection} = 22.1$ s, $SD = 20.4$, $p < .001$, $d = 1.22$).

5. Experiment 4: intuitive optimism for the self vs. average person

Experiment 4 was a direct replication of Experiment 3 with one crucial extension: Intuitive versus reflective judgments of future health risk were made either on behalf of oneself or on behalf of the average person. This made it a factorial 2 × 2 design with four conditions, between-subjects.

The design of Experiment 4 enabled a more precise test of whether intuitive optimism is an ego-centric effect, or whether it may also occur when people make similar judgments about others. If intuitive predictions are always more optimistic than reflective predictions, that would be impossible to detect with a response scale where the participant must directly compare herself to the average person, which was used in Experiment 1 and 2 in the current paper and has also been used in previous research on the role of cognitive load in social self-enhancement (Beer, Chester, & Hughes, 2013).

In contrast to that possibility, our two-step model of prospection would suggest that the first stage creates a wanting-based anchor that typically resembles a best-case scenario for the person making the prediction. If so, intuitive optimism should only occur in cases where the person has a strong motive to hope for a positive outcome. Presumably people are more motivated to hope for positive outcomes for themselves than for the average person. The alternative prediction would be that intuitive responding should increase future optimism both for oneself and others. By using separate measures for judgments of self and others, Experiment 4 enables a test of competing versions of the intuitive-optimism hypothesis, which may identify the underlying mechanism with greater precision.

5.1. Method

The hypothesis, method, and statistical analysis were pre-registered (https://aspredicted.org/un7vr.pdf). We recruited 1100 attentive participants under the age 50 from an American online sample at Amazon's Mechanical Turk, after automatically excluding 162 additional participants who failed an attention check in the beginning of the survey. 21 participants failed to complete the survey, which left a final sample of 1079 participants (444 women, 631 men; $M_{age} = 33$). This sample provided statistical power corresponding to an 80% chance to detect a simple main effect of d = 0.24 or larger ($p < .05$, two-tailed).

Participants were randomly assigned to intuitive versus reflective responding, and then predicted how likely it was that future health problems would occur across the four items (0 = *Extremely unlikely,* 10 = *Extremely likely*). The only method difference from Experiment 3, was that the participants were also randomly assigned to make these predictions on behalf of themselves (like before) *or* on behalf of the average person.

5.2. Results

A two-way ANOVA examined the effect of response style (fast-intuition vs. slow-reflection) and prediction target (self vs. average person) on the average judgment of health-related risk. This analysis revealed a significant interaction, $F(2,1075) = 8.88$, $p = .003$, partial $\eta^2 = 0.008$).

To unpack this interaction (see Fig. 4), we conducted a follow-up analysis of simple main effects. When the judgments were made about oneself, participants in the intuitive condition predicted that future health problems were significantly less likely than participants did in the reflective condition ($M_{intuition} = 2.87$, $SE = 0.09$ vs. $M_{reflection} = 3.29$, $SE = 0.09$, $p = .006$, $d = 0.24$, [95% $d = 0.07$, 0.41]). However, when similar judgments were made about the average person, there was no significant difference between intuitive and reflective predictions $M_{intuition} = 4.39$, $SE = 0.09$ vs. $M_{reflection} = 4.24$, $SE = 0.09$, $p = .194$, $d = 0.11$, [95% $d = -0.06$, 0.28]). Thus, the results provided further support to the intuitive-optimism hypothesis, but the effect only occurred in judgment of one's own personal future, not when similar predictions were made on behalf of someone else.

A second analysis of simple main effects replicated the standard self-other effect as well, this time between-subjects (unlike the comparative judgment scale used in Experiment 1 and 2), as participants generally thought that future health problems were much less likely to happen to themselves than participants who made similar predictions for the average person (intuition condition: $p < .001$, $d = 0.99$, [95% $d = 0.82$, 1.18], reflection condition: $p < .001$, $d = 0.60$, [95% $d = 0.43$, 0.77]). Note that predictions made for oneself was more optimistic than predictions for the average person in both the intuitive and reflective condition, but importantly, that the observed effect size in the reflective condition was only 60% of the optimistic self-other effect in the intuitive condition ($d = 0.60$ vs. 0.99). Thus, mirroring the within-analysis of direct comparative judgment in Experiment 1 and 2, this result from Experiment 4 shows that engaging in slow reflection led to a substantial decrease in personal optimism, but that it did not eliminate it. Finally and more generally, future optimism in personal health-risk prediction was correlated but not moderated by self-reported current health, income, trait optimism, perceived control, and general happiness (see Table 1).

Across the self and other condition, a non-registered manipulation check confirmed that participants in the intuitive (vs. reflective) condition made faster predictions ($M_{intuition} = 5.02$ s, $SD = 2.22$ vs $M_{reflective} = 21.1$ s, $SD = 27.3$, $p < .001$, $d = 0.83$).

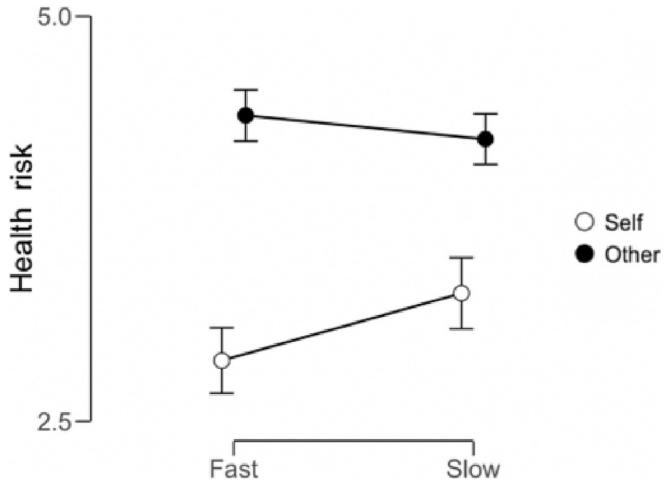

Fig. 4. The intuitive-optimism effect, Experiment 4 ($N = 1079$, USA). The figure illustrates the interaction effect between response mode and prediction target on the average likelihood rating of four adverse health outcomes ($F = 8.88$, $p = .003$). Relying on fast-intuition (vs. slow-reflection) led to lower judgments of health-related risk, but only when the prediction was made about oneself (vs. the average person). All ratings were made on a scale from 0 (extremely unlikely) to 10 (extremely likely). Error bars indicate standard error.

6. Experiment 5: intuitive optimism in binary prediction of habit formation

Experiments 1–4 provided empirical support to the intuitive-optimism hypothesis. The effect was observed repeatedly across comparative and isolated judgments, with a main focus on health-risk predictions in Experiment 2–4. Consistent with a motivational basis, the results from Experiment 4 indicated that intuitive optimism is an *ego-centric* effect, as it did not generalize from predictions for oneself to similar predictions for other people.

However, there are two important limitations in the experiments presented thus far, which could give rise to alternative explanations. First, most of the previous study events are *negative and very rare*, in which the generally correct statistical prior for the health-risk experiments (2–4) would be to expect that the specific event will not happen (e.g., getting diabetes or a heart attack before age 50). A possible alternative explanation for the apparent optimism in these experiments is therefore that intuitive predictions are leaning in the *most realistic direction* or the most realistic end of the scale, given the very low prevalence of some of these events, and then later adjusted towards the center of the scale through cognitive reflection. This alternative explanation presents a radically different interpretation of the observed results than the two-step prospection model. We will refer to it as the plausible-frequency account (for a similar perspective, see also Chambers et al., 2003; Harris et al., 2017; Harris & Hahn, 2011; Kruger & Burrus, 2004). Although the ego-centric effect observed in Experiment 4 seems difficult to reconcile with this logic, as it would predict a similar low-risk pattern for fast judgments about the average person as similar judgments made for oneself, this alternative explanation could still be a confounding factor for the theoretical interpretation of the other experiments.

To address this limitation empirically, our fifth and final experiment focused on the prediction of a positive and personally relevant outcome, for which the statistically most realistic answer is that the participant will *not* succeed at reaching the goal. Specifically, we asked participants to evaluate whether they would be able to establish a new health habit of exercising at least 30 minutes a day, one year ahead. Although daily exercise is a widely shared public health recommendation, due to numerous psychological and physiological benefits (e.g., Dahlen et al., 2021; Zhang & Chen, 2019), surveys show that only 23% of the American adult population is currently sustaining this habit in their life (US Census Bureau, 2020). Moreover, there is a rich literature on behavior change, the intention-behavior gap, new year's resolutions, and other attempts to form new habits, which shows that forming a lasting habit like a daily exercise routine is *possible but difficult* (e.g., Milkman, 2021; Wood, 2019). As a more conservative test of the intuitive-optimism hypothesis, we will therefore use the specific goal of establishing a daily exercise habit as the prediction scenario in Experiment 5. If a similar result should be observed in this setting, that should rule out the plausible-frequency account as an alternative explanation, and in consequence provide stronger evidence for the intuitive-optimism hypothesis.

A second limitation in the previous experiments concerns the underlying process mechanism. Although the observed results are consistent with our two-step model of prospection, there are currently not much data that can speak directly to *why* engaging in slow reflection leads to reduced optimism. As a start, Experiment 4 found that intuitive optimism was robust for predictions about oneself but did not generalize to predictions about the average person, which gives support to the motivated basis of a wanting-based first step in a two-step process. Still, it remains an open question how the change from strong to modest optimism can be explained in greater depth, as participants move from fast intuition to slow reflection.

To address that second limitation, we made two additional changes in our final experiment. First, we included a new outcome measure of perceived reasons to succeed versus fail, to test the possibility that slow reflection will reduce a positive difference between perceived reasons to succeed versus fail. Second, we included a new background measure about the subjective frequency of the event in question (Harris et al., 2017), which we refer to as *social base-rate beliefs*, by asking how common the participants think it is to have a daily exercise habit in the general public. This measure can help verify that our participants do perceive it to be uncommon to have a daily exercise habit for most people, in line with objective frequency data (US Census Bureau, 2020). This measure can also serve as a proxy for the perceived difficulty of reaching the goal, which might inform and interact with the realistic shift from fast to slow prediction.

6.1. Method

We recruited 1000 participants from age 20 to 65 from an American general population sample at Prolific Academic, which is more representative for the national population than the Mechanical Turk samples used in our previous experiments (Tang, Birrell, & Lerner, 2022) and have recently demonstrated higher data quality as well (Eyal, David, Andrew, Zak, & Ekaterina, 2021). To reach that sample size, 145 participants were automatically excluded from the study during data collection, as they failed a simple attention check at the beginning of the survey (not responding with the number 7 as instructed on a response scale from 0 to 10). Three additional participants dropped out soon after, before our outcome measures, which left a final sample of 997 attentive participants (495 women, 485 men; 17 preferring not to say; $M_{age} = 37$). That sample provided statistical power corresponding to an 80% chance to detect a simple main effect of $d = 0.18$ or larger with an independent *t*-test comparing two means on a rating scale ($p < .05$, two-tailed), or a difference in proportions of 9 percentage points or larger with a chi-square test comparing a binary choice between two groups ($p <$. 05, two-tailed).

The experiment was pre-registered prior to the data collection (PDF: https://aspredicted.org/da5ny.pdf). Due to a human error, the second outcome measure (H2: Likelihood judgment) was not included in the document. We will therefore deviate from the pre-registration on that part of Experiment 5, by reporting the results for both of our outcome variables: perceived reasons to succeed versus fail at establishing the new exercise habit, and the non-registered binary likelihood judgment

of success versus failure at reaching that goal. The planned sample size and the other variables in the design were collected as described in the pre-registration. The direction of the predicted optimism effect on the second outcome variable is in the same direction as our predicted main effect across all four preceding experiments in this paper.

6.1.1. Procedure and measures

At the beginning of the survey, participants were told that they would respond to a few questions about specific goals that they might want to achieve in the future, such as establishing a new habit to improve their health. Participants were then randomly assigned to intuitive versus reflective responding, in a between-subjects design with two conditions. They were either told to go with their gut feeling and respond with the first answer that came to mind in <10 seconds or as quickly as possible, or, to consider the possibility that the first answer that comes to mind might be wrong, and to take some time to think about each question for at least 20 seconds before answering. Like before, the headline above each question either stated "Respond quickly!" or "Stop and think for at least 20 seconds before you respond." The time limit for the visible timer was increased from 5 to 10 seconds in the intuitive condition due to a slightly longer word length of the questions in Experiment 5. The minimum time delay in the reflective condition was increased from 15 to 20 seconds for the same reason.

Before moving on to the outcome measures, participants confirmed that they had read the instruction and were ready to respond by using either intuition or reflection (adapted from Lawson et al., 2020). Intuitive condition: "Starting on the next screen, are you willing to start responding to each question as quickly as possible, with the first answer that comes to mind?" (Yes/No) Reflective condition: "Starting on the next screen, are you willing to start responding by being as thoughtful and reflective as you can, thinking about each question for at least 20 seconds before you respond?" (Yes/No).

As the first outcome variable, participants rated to what extent they could think of any good reasons why they would succeed or fail to establish a new habit of exercising 30 minutes a day, in two separate judgments (0 = *No good reason,* 10 = *Very good reasons*). "You make a plan to start exercising 30 minutes a day. Can you think of any good reasons why you would SUCCEED?", and "You make a plan to start exercising 30 minutes a day. Can you think of any good reasons why you would FAIL?" As the second outcome variable, presented on the next screen, participants were asked what they would consider to be the most likely outcome, as a binary prediction with two response options: "You make a plan to start exercising 30 minutes a day. What would be the most LIKELY outcome, one year later?" (Succeeding / Failing). Since participants responded to different questions about the specific possibility of establishing a daily exercise habit, using different response scales in the two outcome measures, we did not include several events in Experiment 5 to avoid repeated switching back-and-forth between reporting of reasons and making the final prediction.

At the end of the survey, after the experimental procedure was completed, we recorded the age and gender of all participants, before they answered three background measures that were directly connected to the habit in question: How many times a week (if any) they were currently exercising (0–7); how many out of 100 people of the same age, gender and nationality as themselves they thought were currently having a daily exercise habit (0−100); and to what extent a daily exercise habit was something they would appreciate to have in their own life, if they could (0 = not at all, 10 = Very much so).

6.2. Results

In line with our intention behind the new experiment design, 93% of the participant sample reported that they did not have a daily exercise habit, with an average number of exercise days per week of 2.87 (*SD* = 2.15). When asked to evaluate how many out of 100 people of the same age, gender, and nationality as themselves that had a daily exercise habit, as our measure of *social base-rate beliefs*, the average response was 35.9 (*SD* = 18.6), showing a strong left skew. Finally, on a scale from 0 to 10, the participants reported that they would highly appreciate having a daily exercise habit in their own life ($M = 8.51$, $SD = 2.01$).

Thus, the type of future goal selected for Experiment 5 was widely perceived as desirable but infrequent. In line with actual frequency data from public statistics, showing that only 23% of the US population currently have a daily exercise habit (US Census Bureau, 2020), this creates a scenario where the optimistic response would be to predict future success at reaching the goal whereas the more realistic response would be to predict failure. Like before, the average response time for the outcome measures confirmed that participants in the intuitive (vs. reflective) condition made faster responses to each question ($M_{\text{intuition}} = 5.12$ s, $SD = 2.25$ vs $M_{\text{reflection}} = 23.86$ s, $SD = 16.58$, $p < .001$).

6.2.1. Primary analysis: main effects

In the intuitive condition, participants reported that they could think of better reasons for why they would succeed rather than fail to establish the daily exercise habit (M = 6.87, SD = 2.71 vs. M = 5.58, SD = 3.05), suggesting an optimistic starting point. But in contrast to our first hypothesis, there was a similar positive discrepancy in the reflective condition (M = 6.90, SD = 2.77 vs. M = 5.68, SD = 2.96). Thus, the pre-registered independent *t*-test on the difference score between perceived reasons to succeed versus fail indicated no difference between the two conditions ($M_{\text{intuition}} = 1.29$, $SD = 4.67$ vs. $M_{\text{reflection}} = 1.22$, $SD = 4.59$, $t(995) = 0.025$, $p = .80$, $d = 0.02$, [95% $d = -0.11$, 0.14]).

In line with our second hypothesis, focusing on the binary prediction of what the most likely outcome would be one year into the future, a chi-square test showed that participants in the intuitive condition thought it was significantly more likely that they would succeed at establishing the new exercise habit than participants in the reflective condition ($M_{\text{intuition}} = 61\%$ vs. $M_{\text{reflection}} = 52.5\%$, $X^2(1, 997) = 7.22$, $p = .007$, $z = -2.69$. Thus, compared to both objective and subjective benchmarks for the realism of establishing a daily exercise habit, participants in both experiment conditions were leaning in an optimistic direction in their average predictions. In line with the intuitive-optimism hypothesis, however, the strength of this optimistic prediction was significantly reduced by 8.5 percentage points in the slow reflection condition (52.5% vs. 61%), moving the participants one step in a more realistic direction.

6.2.2. Secondary analysis: moderation

To learn more about the psychological process involved, we conducted an exploratory analysis of whether social base-rate beliefs might interact with the observed decline in future optimism from fast to slow prediction. If the second step of prospection is indeed a corrective process that takes into account external reality and potentially difficulty of reaching the goal, then one possibility could be that the reflective shift towards realism is informed by *social beliefs* about the base-rate frequency of daily exercise. Specifically, if the person believes that only a minority of the population is currently sustaining a daily exercise habit, then engaging in the second step of slow reflection will modify the initial hopeful response and lead to a less optimistic prediction. In contrast, if the person incorrectly believes that a majority of the population is successfully maintaining this habit — which implies that it would be quite easy to do something similar oneself — then engaging in slow reflection might not reduce future optimism at all.

To test this interaction hypothesis, we conducted an analysis using the 'medmod' module in the Jamovi software, including social base-rate beliefs as a potential moderator variable and the binary likelihood prediction as the outcome measure. The results showed a statistically significant interaction ($z = 0.2.51$, $p = .012$). Specifically, the intuitive-optimism effect was clearly present for participants with low (-1SD) social-base rate beliefs ($z = -3.52$, $p < .001$) and also for those with average base-rate beliefs (-2.47, $p = .014$), while there was no sign of an effect for participants with high (+1SD) base-rate beliefs ($z = 0.03$, $p = .978$). This interaction is illustrated in two different ways in the

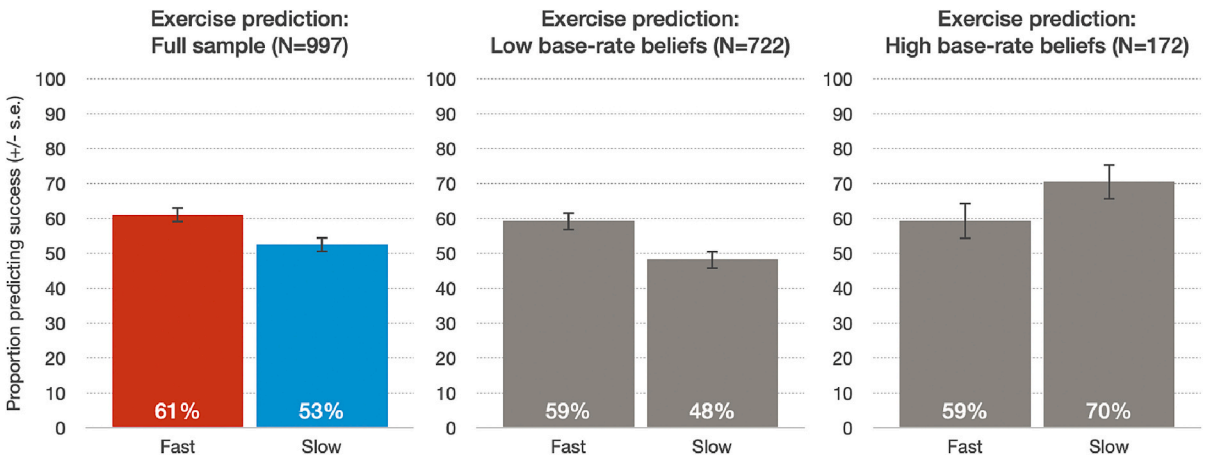

Fig. 5. The intuitive-optimism effect at different levels of base-rate beliefs, Experiment 5 ($N = 997$, USA). The figure illustrates the causal effect of fast-intuition (vs. slow-reflection) on the proportion of participants who predicted that being able to establish a daily exercise habit was the most likely outcome for them. The left panel shows this effect for the full sample. The center and right panel show this effect by dividing the sample into those who had low (<50%) versus high (>50%) social base-rate beliefs. Relying on fast-intuition (vs. slow-reflection) led to higher average success prediction across the full sample ($p = .007$) and for participants with low base-rate beliefs ($p = .004$), whereas a non-significant effect in the opposite direction was observed for participants with high base-rate beliefs ($p = .15$). The rating was made as a binary prediction of the most likely outcome: succeeding or failing. Error bars indicate standard error.

following figures. First (Fig. 5), by showing the simple main effect in the full sample, and then by splitting the moderator variable into low base-rate beliefs, here defined as under 50% (reflecting a belief that a minority of the population have a daily exercise habit), and high base-rate beliefs, defined as over 50% (reflecting a belief that a majority of the population have a daily exercise habit). Second (Fig. 6), by showing 'regions of significance' of the causal treatment effect across the full range of the moderator variable (0–100%), based on a Johnson-Neyman plot created in the R software.

Both ways of analyzing the moderation effect give rise to a similar result and a similar conclusion: The simple main effect is highly significant in the full sample, in which intuitive predictions are more optimistic than slow predictions, but the shift towards greater realism in the slow-reflection condition only occurs for participants who (correctly) believe that a *minority* of the population are actually sustaining a daily exercise habit. In our view, this is suggestive evidence that people have

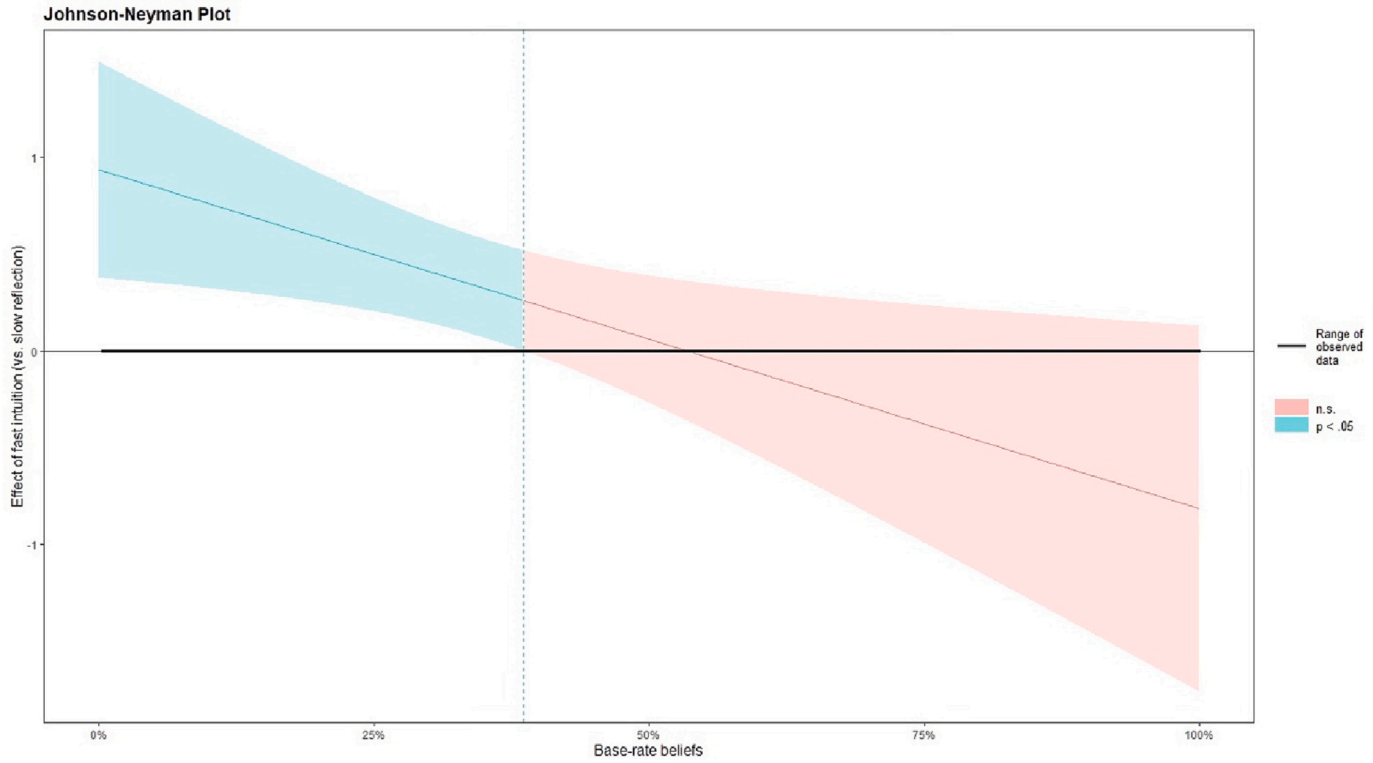

Fig. 6. Interaction analysis of intuitive optimism moderated by base-rate beliefs, Experiment 5 (N = 997).
The figure illustrates the interaction effect ($z = 2.51$, $p = .012$) between response mode (fast-intuition vs. slow-reflection) and social base-rate beliefs as a continuous moderator (0–100%), using the proportion of participants who predicted that being able to establish a daily exercise habit was the most likely outcome as the dependent variable. The estimated 'region of significance' goes from 0 to 39%, indicating that predictions made in the mode of slow-reflection were less optimistic than fast-intuition, but only when participants had a (correct) social belief that the specific health behavior is uncommon in the general population (<40%).

Table 1
The intuitive-optimism effect (total $N = 3213$). The table illustrates the causal effect of fast-intuition (vs. slow-reflection) across all five experiments, followed by correlational and moderation analyses (right column).

Study	Causal main effect	Correlation and Moderation
Experiment 1: $N = 286$ university students (Norway): Fast-intuition vs. Slow-reflection. DV: Average likelihood judgment of 6 mixed events (3 positive and 3 negative), as compared to the "average person".	Independent *t*-test: Intuitive predictions were more optimistic than reflective predictions ($p < .001$, d = 0.53).	
Experiment 2: $N = 300$ online participants (USA): Fast-intuition vs. Slow-reflection. DV: Average likelihood judgment of future health problems (4 health risks), as compared to the "average person".	Independent t-test: Intuitive predictions were more optimistic than reflective predictions ($p = .015$, d = 0.28).	Health-risk predictions were negatively correlated with current physical health ($p < .001$, $r = 0.46$), trait optimism ($p < .001$, $r = 0.33$), and happiness ($p < .001$, $r = 0.36$). The causal effect of intuitive optimism was not moderated by current health ($p = .86$, Z = 0.18), trait optimism ($p = .68$, Z = 0.42), or happiness ($p = .68$, Z = 0.42).
Experiment 3: $N = 551$ online participants (USA): Fast-intuition vs. Slow-reflection. DV: Average likelihood judgment of future health problems (4 health risks), in isolated framing (no comparison with others).	Independent t-test: Intuitive predictions were more optimistic than reflective predictions ($p < .001$, d = 0.39).	Health-risk predictions were negatively correlated with current physical health ($p < .001$, $r = 0.37$), income ($p < .001$, $r = 0.19$), trait optimism ($p < .001$, $r = 0.43$), and happiness ($p < .001$, $r = 0.29$). The causal effect of intuitive optimism was not moderated by current health ($p = .73$, Z = 0.35), income ($p = .36$, Z = 0.91), trait optimism ($p = .74$, Z = 0.33), or happiness ($p = .89$, Z = 0.14).
Experiment 4: $N = 1079$ online participants (USA): 2 (Fast-intuition vs. Slow-reflection) x 2 (Self vs. Average person). DV: Average likelihood judgment of future health problems (4 health risks), in isolated framing (no comparison with others, predictions were made for oneself OR the average person).	Two-way ANOVA: Observed interaction between intuitive (vs. reflective) responding and predictions for self (vs. the average person) ($F = 8.88$, $p = .003$). An analysis of simple main effects found that intuitive predictions were more optimistic than reflective predictions for oneself ($p = .006$, d = 24), but not for the average person ($p = .194$, d = 0.11).	Health-risk predictions were negatively correlated with current health ($p < .001$, $r = 0.38$), income ($p < .001$, $r = 0.18$), trait optimism ($p < .001$, r = 0.34), perceived control ($p < .001$, $r = 0.37$), and happiness ($p < .001$, $r = 0.27$). The causal effect of intuitive optimism was not moderated by current health ($p = .72$, Z = 0.37), income ($p = .63$, Z = 0.48), trait optimism ($p = .19$, Z = 1.30), perceived control ($p = .52$, Z = 0.65), or happiness ($p = .37$, Z = 0.91).
Experiment 5: N = 997 online participants (USA): Fast-intuition vs. Slow reflection. DV1: Perceived reasons to succeed vs. fail at establishing a future health habit. DV2: Binary judgment of the most likely outcome: succeeding or failing.	Independent t-test, DV1: Intuitive judgments did not show a greater positive difference between reasons to succeed vs. fail than reflective judgments ($p = .80$, d = 0.02). Chi-square test, DV2: Intuitive success predictions were more optimistic than reflective predictions ($p = .007$, $X^2 = 7.22$, Z = 2.69).	The causal effect of intuitive optimism on success prediction (DV2) was moderated by social base-rate beliefs ($p = .012$, Z = 2.51). Slow reflection reduced future optimism when participants (correctly) believed that sustaining the specific health habit was rare in the general population ($p < .001$, Z = 3.52), but not when it was believed to be common ($p = .978$, Z = -0.03).

access to their own beliefs about what other people are doing as a proxy for the difficulty of the goal, and that people take this information more into account when moving from intuitive to reflective prediction. For participants who believe that the goal is rarely achieved, the resulting pattern is that they become more realistic when engaging in slow reflection. For participants who believe that the goal is often and easily achieved, however, engaging in slow reflection does not correct or reduce their intuitive optimism.

7. General discussion

Prior to the current research, the intuitive nature of future optimism has remained a plausible but generally untested assumption. Related work on belief updating has found that optimism bias can occur very early in the evaluation process of new information, and therefore, that deliberate cognitive reflection is not necessary for that type of asymmetric learning to occur (Kappes & Sharot, 2017). However, it has remained an open question whether future predictions relying on fast intuition are *more optimistic* than similar predictions based on slow reflection.

7.1. Intuitive optimism: causal evidence

According to the theoretical framework of pragmatic prospection (Baumeister et al., 2016; Baumeister et al., 2018), future thinking is characterized by two stages: An initial step of intuitive optimism, focusing on what the person wants, followed by a second step of reflective realism, focusing on how to achieve the goal, how difficult the task is, and what can go wrong. Consistent with this two-step model, the current research provided causal evidence for the *intuitive-optimism hypothesis*: Across five experiments, people made more optimistic predictions when they relied on fast intuition rather than slow reflection. Apparently, a delay of 15 seconds can be sufficient to enable second thoughts and stimulate a drop in future optimism. Reflective predictions were still "unrealistically optimistic" at the group level, as defined in the classic literature on comparative judgment (Shepperd et al., 2013; Weinstein, 1980), but to a significantly lesser extent than intuitive responses.

Empirical support for the *intuitive-optimism effect* was found in both comparing oneself to the average person and in isolated judgments of one's own likelihood, in two different languages across two different countries (USA and Norway), and in one direct replication. All five experiments were pre-registered, and the total sample consisted of about 3000 participants making more than 10,000 predictions. The same basic

effect was found for positive and negative events, and when using continuous rating scales of subjective probability as well as binary prediction of the most likely outcome (success or failure). Correlational analyses showed that future optimism in health-risk prediction was stronger for individuals with good current health, high income, high trait optimism, high perceived control, and greater happiness. However, the causal effect of fast intuition on optimistic health-risk prediction was not moderated by any of these general background variables.

7.2. Mechanisms of intuitive optimism: mixed results

Searching for specific mechanisms that could provide a deeper understanding of the main effect of intuitive optimism, we obtained mixed support. Experiments 4 and 5 provided two positive results and one null result in that regard. In our view, all three of these findings should be taken into account when considering the possible nature of the underlying psychological process and the overall contribution.

To start with the null result: Experiment 5 found no significant difference between the intuitive and reflective conditions in terms of how readily participants could generate potential reasons for success or failure. Here, the specific hypothesis predicted that participants would start out with a positive gap, identifying more reasons to succeed than to fail at reaching the goal (i.e., establishing a daily exercise habit), but that this positive gap would be reduced during slow reflection. If true, this could serve as one illustration of how people become more attuned to obstacles and task difficulty when moving from fast intuition to slow reflection, as suggested by the two-step theory. This prediction was not supported. Although participants in the fast condition reported they could think of more good reasons for success than failure, the same difference obtained in the slow condition.

In retrospect, using the word "good" in the specific items may have been unfortunate, if participants associated good more with success than failure. This new measure may also have been insensitive for other reasons, and in particular participants did not list actual reasons but merely reported in a general way how easy it would be to think of them. Another possibility is that the current prediction difference between fast and slow thinking is more about the *weighting* of available reasons to succeed versus fail, rather than the number of reasons on each side. Focusing on this specific null finding alone, all these interpretations are plausible candidates. A critical reader might lean towards the interpretation that this part of the two-step theory is probably wrong.

We now turn to the two positive process findings. First, the differential optimism between intuitive and reflective predictions was found only for judgments about one's own future, not about the future of the average person (Experiment 4). This finding is consistent with a motivational basis for intuitive optimism, as suggested by a wanting-based first step of prospection: People seek a good future for themselves, and their initial response underscores that. They have a weaker motivational basis for caring about the future of strangers, so their intuitive predictions for strangers are less affected by wishful thinking.

It is possible to propose a non-motivational explanation as well, insofar as self-other differences can sometimes be explained based on having more and more accessible information about oneself than a stranger (e.g., Moore & Small, 2008). Indeed, that might be one part of the explanation for the broader literature on "better than average"-effects. To apply it to the present findings on intuitive optimism, some additional assumptions would be needed. For instance, when judging rare events, it could be the case that not only does one have more and more accessible information about the self than about a stranger, but also that optimistically biased information about the self is concentrated among the most accessible information. That would explain why fast predictions were more optimistic than slow ones about the self but not about the stranger. In our view, however, assuming that automatic and highly accessible self-information is especially optimistic again points to motivational bias as the most plausible explanation, though it is possible that a case could be made on purely cognitive grounds.

The second positive mechanism finding pointed to the importance of what information gets integrated into the slow reflection process. Experiment 5 found that reflective predictions about the likelihood of forming a future exercise habit were less optimistic than intuitive predictions — but only when participants had fairly realistic beliefs about *social base-rates*. Participants who correctly believed that relatively few people can sustain a daily exercise habit reduced their optimistic predictions for their own exercise behavior when they had time to reflect. In contrast, among those who mistakenly believed that a majority of the population exercises every day, slow reflection did not reduce their future optimism at all.

This interaction with prior assumptions suggests a boundary condition for the corrective effect of reflective thinking: Slow reflection may not inherently be more accurate than fast intuition – it merely makes individual predictions more consistent with the person's *social beliefs* about the world and other people. Engaging in slow reflection about the future can make you more realistic *if* your pre-existing beliefs are fairly accurate. If your beliefs about what most other people are doing are poorly calibrated and severely underestimate the difficulty of reaching the goal, however, then reflection may not help. Thus, the usefulness of reflective thinking might partly depend on social knowledge.

Seen as a whole, we consider the current research as mostly supporting the two-step theory of prospection. Primarily, by finding novel and robust evidence for intuitive optimism in future prediction, across five experiments and more than three thousand participants in two different countries. In terms of mechanisms, one null finding and two positive findings provided deeper insight into the underlying process. The optimistic difference between fast and slow predictions was specific to predictions about oneself (and not about strangers), consistent with a wanting-based first step (Experiment 4). And the shift towards realistic prediction during the second step was only found when the reflection process had access to accurate beliefs about the difficulty of reaching a goal, not when participants had false and overly optimistic base-rate beliefs about other people (Experiment 5). Further exploration of these and other potential mechanisms of the intuitive-optimism effect remains for future research.

7.3. Limits of generalizability

Taking one step back, we will now review a critical discussion of some important limitations in the current research. These concern the question of generalizability, and the dominant theoretical interpretation of the core phenomenon of optimism.

Despite notable differences in language and culture between the USA and Norway (e.g., Almås, Cappelen, & Tungodden, 2020), all our experiments were conducted in western societies that also have many commonalities. As a first limitation, it remains a question for future research to what extent the current findings will generalize to even more different cultures. Ideally, this should be studied further in cross-cultural research, using high-powered experiments in nationally representative samples from a more diverse collection of countries.

By focusing on the importance of establishing a reliable experimental paradigm to test the intuitive-optimism hypothesis, we inevitably created a second limitation. The current strategy only permitted a small number of variations in the operationalization of the independent variable (intuitive vs. reflective, self vs. others) and the response format of the outcome measure (comparative vs. isolated predictions, likelihood judgments on rating scales vs. binary prediction of most likely outcome). It is therefore a question for future research to what extent the findings will generalize to different experimental manipulations and different outcome measures in conceptual extensions, which could also include a neutral baseline condition if the total sample size is sufficiently large (e.g., Lawson et al., 2020). That said, the intuitive-optimism effect appears to be a robust phenomenon in the cultural and methodological setting it was studied in the current paper, which included a direct and high-

powered replication.

7.4. Limits of interpretation

As a second limitation, the reader should be aware that there is much debate about the theoretical interpretation of realism and "unrealistic optimism" in prediction research, both regarding the explanatory value of motivational explanations (Harris et al., 2017; Krizan & Windschitl, 2007; Windschitl & Stuart, 2015) and the very existence of unrealistic optimism (Harris & Hahn, 2011). In our view, it is an uncontroversial interpretation of the current findings that fast intuition leads to *more optimistic predictions* than slow reflection, simply defined as a higher perceived likelihood that positive events will happen and a lower perceived likelihood that negative events will happen. It is less clear, however, whether such findings should be interpreted as optimistic *bias*, and whether reflective predictions are more *realistic*.

For instance, it has been shown that there are psychometric problems with comparative optimism scales, which creates a confound when inferring that above-average-effects in comparative judgment necessarily reveal unrealistic optimism (Harris & Hahn, 2011). In the current paper, providing a causal test of the intuitive-optimism hypothesis, we would therefore argue that convergent findings across different measurement scales is a strength. However, we would also suggest that above-average ratings in comparative judgment should only be treated as suggestive, and that inferences regarding statistical realism should be reserved for our final experiment (Experiment 5).

In Experiment 5, participants made a binary prediction of what they thought the most likely outcome would be: to succeed or fail at establishing a daily exercise habit. Given the low base-rate frequency of actually having this habit in the general population (23%: US Census Bureau, 2020), the even lower frequency in our own study sample (7%), and the well-documented challenges of changing one's behavior for the better by forming new habits (Milkman, 2021; Wood, 2019), we would argue that it is indeed a step in a more *realistic* direction that the proportion of participants predicting a future success was significantly reduced from 61% in the intuitive condition to 52.5% in the reflective condition.

According to the terminology offered by Shepperd et al. (2013, 2015), the finding from Experiment 5 would be an example of "unrealistic absolute optimism" at the group level, meaning that the average group-level estimate is more favorable than indicated by an objective group-level standard, such as epidemiological or base-rate data. To be sure, this finding suggests a shift towards greater realism *in expectation*, as we do not have longitudinal data on the actual long-term habits of the specific study participants. This means that we would consider it to be possible, but highly unlikely, to observe an average group increase from 7% (current sample) or 23% (general population) to the predicted levels of more than 50% having a daily exercise habit one year later. As a word of caution, there is evidence suggesting that some of this prediction gap may be accounted for by desirability bias, which is observed more frequently in binary judgments than in continuous likelihood judgments (e.g., Krizan & Windschitl, 2007; Windschitl, Smith, Rose and Krizan, 2010; Windschitl & Stuart, 2015; Park, Windschitl, Miller, & Smith, 2022).

As noted by Shepperd et al. (2013), the strongest criticism against claims of unrealistic optimism is most relevant to "comparative unrealistic optimism" at the group level, like the average-person rating scales we used in Experiments 1 and 2, rather than estimates for specific situations where the researcher can compare these predictions to a more objective standard, like we did in Experiment 5. We therefore hope that the reader will acknowledge the existing debate and methodological problems in this literature, while also appreciating the convergent evidence for intuitive optimism presented in the current experiments, combining different response formats and a different set of future events.

A final point to consider for future research is how to reconcile the two literatures showing optimistic bias in self-evaluation and future predictions (which the current paper is part of), with the robust and influential literature on loss aversion, risk aversion, and other forms of "negativity bias" (Baumeister, Bratslavsky, Finkenauer, & Vohs, 2001; Rozin & Royzman, 2001). Strikingly, one paper even found that negative events are more readily imagined than neutral outcomes (Risen & Gilovich, 2007), which appears to be in direct opposition to the empirical results in the current experiments. Simply put, these are two rather different research programs in psychology and social science, using different research methods and theoretical perspectives, finding opposite tendencies leaning in either a positive or a negative direction – without much attempt at integrating the two in a systematic manner.

Informed by a two-step model of prospection, the current research was conducted to provide a causal test of the intuitive-optimism hypothesis. Future work could take an even broader view on this intriguing area of human psychology, and ideally, try to review and combine the empirical findings of positivity and negativity bias into an integrated and testable theory, as a further guide for future research.

7.5. Implications and future directions

Inspired by recent work on cognitive debiasing (Sellier, Scopelliti, & Morewedge, 2019), the possible role of forced reflection time could be a promising direction in future research. In cases where future optimism is well-documented and likely to pose serious problems, such as project planning and personal spending (e.g., Buehler et al., 1994; Kahneman & Tversky, 1979; Peetz & Buehler, 2009), the current results suggest that people can discipline their optimism by slowing down the decision process. Indeed, a recent study from behavioral economics found a similar effect of waiting periods in the domain of intertemporal choice, in which participants became more willing to set aside money for future needs after increased deliberation (Imas et al., 2022).

Finally, the current findings might inform an ongoing debate on the nature of cognitive reasoning: Is it mainly truth-seeking or self-serving? At least in the domain of future thinking, the intuitive-optimism effect seems to favor a classic account of human judgment (Evans & Stanovich, 2013; Kahneman, 2003; Pennycook & Rand, 2019). The initial response is especially prone to self-serving biases, whereas active engagement with deliberate thinking can lead to reduced optimism and higher consistency with relevant base-rates. Ultimately, the corrective effect of slow reflection might rely on a key function of consciousness: The ability to simulate the future as a collection of *multiple possibilities* that may or may not occur (Baumeister et al., 2018; Phillips, Morris, & Cushman, 2019), including personal challenges and commonly neglected worst-case scenarios (Sjåstad & Van Bavel, 2023). An interesting direction for future research, can therefore be to critically examine the potential interplay between cognitive engagement (intuition vs. reflection), prior beliefs and motives, and the formation of future plans and predictions.

Open practices statement

Data and materials have been made available at OSF. In all five experiments, the hypotheses and statistical analyses were pre-registered in advance of the data collection: https://osf.io/4jcmp/?view_only=47ce8428dcb24a3a9983c71abe7d0a3e.

Explorative analyses and deviations from the pre-registration are noted explicitly.

Author contribution

Both authors were closely involved in developing the general idea, the theoretical framework, and the primary research hypothesis. Author 1 designed and conducted the experiments, and also conducted the statistical analyses. Both authors were involved in the interpretation of findings. Author 1 was in charge of writing the manuscript, while Author 2 made important contributions both in the beginning and the end of the writing process.

Data availability

Data and materials have been openly shared at the OSF link provided in the paper.

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