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COGNITIVE BIASES AND DISPOSITIONS IN LUCK ATTRIBUTIONS

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Luck is a deep current in human culture. In ancient Greece and Rome luck was personified as a fickle and indifferent deity. Astride the wheel of fortune, she would raise those at the bottom of society to the top and capriciously drop those at the pinnacle of success back down to penury. The ancients approached luck in one of three ways. The first was to propitiate Fortuna or redirect her ill luck to others and capture her good fortune for ourselves, through charms, curses, or talismans. Petronius, a Roman courtier during the reign of Nero, described a dinner party at which a small statue with an amulet around its neck was placed on the table to bring the diners good luck.[1] Sigmund Freud, as one might expect, claimed that lucky charms are all easily recognized as genital or sexual symbols.[2]

The second approach was the Stoic strategy of defying the power of Fortuna by refusing to recognize things in the outside world as having any hold over us. A Stoic sage is insulated from misfortune because he does not value the objects of the external world, and believes it is virtue alone that ensures the good life. In his *Moral Epistles* Seneca advised that

> the wise man is sufficient unto himself for a happy existence, but not for mere existence. For he needs many helps towards mere existence; but for a happy existence he needs only a sound and upright soul, one that despises Fortuna.
>
> *Seneca 1917: IX*

The final ancient tactic was to deny the power of luck by insisting that all is fated to occur. The idea that we are powerless to avoid our ineluctable destiny is a theme seen in *Oedipus Rex*, the prophesied betrayal of Jesus, and the myth of Sisyphus, among other places. If everything happens by design, then nothing happens by luck.

Little advance was made in the mastery and understanding of luck until the Renaissance and the invention of probability theory. Gambling was directly responsible for the development of probability theory—if there is anyone who wants to subjugate luck, it is gamblers. Numerous mathematicians, including Cardano, Pascal, Fermat, de Moivre, and Bernoulli developed the mathematics of probability in order to solve gambling puzzles. By the 18th century they declared victory over luck. Pierre Rémond de Montmort wrote in his *Analytical Essay on Games of Chance* (1708):

> [Most men] believe that it is necessary to appease this blind divinity that one calls Fortune, in order to force her to be favorable to them in following the rules which they have imagined. I think therefore it would be useful, not only to gamesters but to all men in general, to know that chance has rules which can be known.
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> *David 1962: 144*

Montmort and others were sure that they had worked out these rules and there was little more to be said on the topic.

By the 20th century it became clear that the mathematicians might not have the final word on luck,[3] and that such a ubiquitous and multifaceted concept is best approached with tools from several disciplines. Our interest is in how psychology and philosophy can work together to help explain the nature of luck. Previous psychological work on luck has tended to be somewhat piecemeal, even venturing into pop-psych/self-help territory. For example, Richard Wiseman's *The Luck Factor: Changing Your Luck, Changing Your Life: The Four Essential Principles* promises "a scientifically proven way to understand, control, and increase your luck" (Wiseman 2003: xiii). His four principles are maximize your chance opportunities, listen to your lucky hunches, expect good fortune, and turn your bad luck into good (Wiseman 2003: 161–162).

When people think of luck, they generally think of good luck. The line "Lord, if it wasn't for bad luck, I wouldn't have no luck at all" from Lightnin' Slim's 1954 song "Bad Luck Blues" is clever because it draws attention away from the familiar dichotomy of good vs. bad luck to the contrast between any kind of luck vs. no luck at all. In what follows, we will argue that there are results from experimental psychology that show that ordinary people are systematically irrational in how they interpret the same event as being a bit of good luck or bad luck. We show first that framing effects strongly determine the assignment of good luck or bad, and second we show that one's personal inclinations toward optimism or pessimism also affect whether one interprets an event as being lucky or unlucky. Philosophical theories of luck have two aims: (1) to properly delineate between good/bad luck and non-luck, and (2) to correctly distinguish between events that are lucky (in the sense of good luck) and unlucky. We argue that, due to the results of our psychological studies, no theory of luck is able to achieve the second aim.

Scholarly work has investigated the connection between study subjects' beliefs in luck and various psychological traits such as depression, anxiety, optimism, neuroticism, attribution style, self-esteem, and irrational beliefs. Day and Maltby (2003) measured subjects' beliefs in luck and found a significant correlation between a belief in personal good luck and optimism and the holding of irrational beliefs. In particular, they argue that a belief in one's own luckiness produces optimistic traits and a reduced level of irrational beliefs. Depressed, anxious people tend to have irrational beliefs that diminish their self-worth. Believing that one is lucky counteracts those tendencies. Other work has focused on the psychology of gamblers. The more subjects believe in luck as a fungible quality or personal power, the more they will gamble. Their belief in this kind of luck tends to lead to an illusion of control over gambling results and thence to gambling addiction (Lim & Rogers 2017; Kim et al. 2015; Wohl & Enzle 2002).

Pritchard and Smith (2004) survey the psychological literature on luck and conclude that it has been hampered by insufficient clarity about the nature of luck. While Pritchard and Smith's literature review is a bit dated, their conclusion remains current. Karl Teigen is one of the few psychologists whose work bears on understanding luck itself. He has supported a modal account of luck, arguing that people view themselves as lucky or unlucky based upon counterfactual outcomes that they see as salient alternatives to their actual histories (Teigen 2005; Teigen & Jensen 2011). Near disasters trigger feelings of good luck and near successes lead to feelings of bad luck. In our own work, we have conducted studies that aim to move the ball downfield to a more satisfactory theory of the nature of luck. Unless we understand what luck is—and what it is not—luck research risks resembling alchemy more than chemistry. Both philosophy and psychology can contribute to this understanding.

In the past several years we have specifically investigated how cognitive biases, or systematic errors in thinking, influence people's attributions of good and bad luck. By better understanding how cognitive biases influence luck attributions, we hope to contribute to contemporary philosophical theories of luck and introduce the possibility that luck does not exist but is instead a cognitive illusion. In our studies, we present participants with scenarios (e.g., "A severe snowstorm hit the town. Half of the town's residents never lost their power") and ask the participants to judge the luckiness of the scenario on a scale with four options: *unlucky*, *somewhat unlucky*, *somewhat lucky*, *lucky*. In our first study, we investigated how framing affects luck attributions (Hales & Johnson 2014).

The influence of framing in human decision making was made famous through the studies of Amos Tversky and Daniel Kahneman (1981, 1986). Framing refers to how a situation is presented; for example, a single situation can be framed as a gain or as a loss, a positive outcome or a negative outcome. Framing has been shown to influence a variety of human judgments in experimental settings including purchasing choices, gambling risks, and medical decisions. In a typical research study, a problem is presented to participants who are then offered two possible solutions to the problem. Statistically speaking, the two solutions are identical. Therefore, if respondents show systematic patterns in choosing one option over another, the framing of the outcome has led to a cognitive bias in decision making.

Below is an example Tversky and Kahneman (1986) borrowed from McNeil and colleagues regarding lung cancer treatment options. Participants were asked to choose either the surgery or the radiation therapy based on the statistical information provided below.

> **Surgery Option:**
> Of 100 people having surgery, 90 live through the post-operative period, 68 are alive at the end of the first year, and 34 are alive at the end of five years.
>
> **Radiation Therapy Option:**
> Of 100 people having radiation therapy, all live through the treatment, 77 are alive at the end of one year and 22 are alive at the end of five years.

When given the treatment options in a *survival* frame, as shown above, only 18% of respondents preferred the radiation treatment. It seems that most participants were swayed by the 34% five-year survival rate offered by the surgery over the 22% five-year survival rate offered by the radiation therapy. This was in spite of the immediate and one-year survival rates being higher for the radiation therapy.

When the statistically identical treatment options were presented in a *mortality* frame, as shown below, participants' preferences shifted.

> **Surgery Option:**
> Of 100 people having surgery, 10 die during surgery or the post-operative period, 32 die by the end of the first year, and 66 die by the end of five years.
>
> **Radiation Therapy Option:**
> Of 100 people having radiation therapy, none die during treatment, 23 die by the end of one year, and 78 die by the end of five years.

Compared to the 18% who chose the radiation therapy when presented in the survival frame, 44% favored the radiation treatment when presented in the mortality frame. In this case, the surgery's heightened chance of immediate death compared to the radiation therapy (10% versus 0%) and death within one year (32% versus 23%) seemed to convince more people to choose the latter option. Even

when these scenarios were presented to experienced physicians and business students knowledgeable in statistics the same framing effect was found. This example and many like it show just how pervasive and robust this cognitive bias is in human decision making.

To our knowledge, no one had determined if framing influences attributions of good or bad luck. If we could show that luck attributions were susceptible to this cognitive bias, we thought we could provide evidence that might challenge contemporary philosophical theories of luck. We first created hypothetical scenarios that we deemed had a luck component to them. Examples of the scenarios included hitting five out of six numbers in a lottery, losing power after a storm, walking away from a life-threatening car accident, and just missing hitting a pedestrian with one's car (Hales & Johnson 2014). We first pilot tested the scenarios to make sure that other people considered them lucky or unlucky; they did. Then we set out to determine if people's attributions of good or bad luck to the scenarios could be influenced by framing.

To do this, we presented each of the hypothetical scenarios in either a positive frame or negative frame such as the example below.

Positive Frame:
A severe snowstorm hit the town. Half of the town's residents *never lost* their power.

Negative Frame:
A severe snowstorm hit the town. Half of the town's residents *lost* their power.

It is important to note that just as Tversky and Kahneman's survival-framed and mortality-framed treatment options were statistically identical, the outcomes of the positively and negatively framed luck scenarios were likewise identical. That is, in both versions of the scenario there was a 50% chance that a town resident lost his or her power. Yet we found that participants' luck attributions were significantly influenced by the framing. Sixty-eight percent of the participants who were presented the positively framed outcome judged it as *lucky* or *somewhat lucky* while only 4% of the respondents who were presented the negatively framed outcome judged it as *lucky* or *somewhat lucky*. This pattern was not unique to this particular scenario. Here is another that we presented to participants in our study.

Positive Frame:
Tara Cooper *hit five* out of six numbers in the Megabuck$ lottery.

Negative Frame:
Tara Cooper *missed one* out of six numbers in the Megabuck$ lottery.

In this case, 84% of the participants who were presented the positively framed scenario judged Cooper to be lucky; only 40% of respondents presented the negatively framed version judged Cooper to be lucky. Because the statistical probability of both occurrences is identical, differences in luck judgments must be attributed to the framing.

In total we presented participants with eight different luck scenarios; half of our participants judged the positively framed version and the other half judged the negatively framed version. We found a significant framing effect for each scenario with an average shift in luckiness of about 40%. That is, positively framed versions were judged lucky by 40% more of the participants compared to the statistically identical negatively framed versions. Attributions of good and bad luck are susceptible to framing just as we have seen in purchasing choices, gambling risks, and medical decisions in the work of Tversky and Kahneman (1981, 1986).

This pattern of findings was also evident when we presented the framed event in the context of longer stories such as those below (Hales & Johnson 2014).

Positive Frame:
"*I hit five out of six! I've never come anywhere close to hitting the big jackpot before!* It was just unbelievable," Cooper exclaimed, still stunned. Berwick bakery worker Tara Cooper stopped off at her usual place for a breakfast coffee and bagel, Brewed Awakening, and decided to pick up a lottery ticket before heading to first shift. "I don't usually play Megabuck$, and don't know why I did today." After work, she checked her numbers online. "I was like, oh my God!"

Negative Frame:
"*I missed the jackpot by one lousy number! Story of my life.* It was just unbelievable," Cooper exclaimed, still stunned. Berwick bakery worker Tara Cooper stopped off at her usual place for a breakfast coffee and bagel, Brewed Awakening, and decided to pick up a lottery ticket before heading to first shift. "I don't usually play Megabuck$, and don't know why I did today." After work, she checked her numbers online. "I was like, oh my God."

In fact, the pattern of results for this long version of the Cooper scenario was nearly identical to that seen for the short version. Eighty-four percent of respondents who were presented the positively framed story, whether long or short, judged her to be lucky; 41% of respondents who were presented the negatively framed long story judged her to be lucky (it was 40% of respondents who judged her to be lucky in the short version).

The same was true of the long version of the snowstorm scenario shown below.

Positive Frame:
"Half of the residents *never lost* their power," reported the mayor. "It *could have been a lot* worse. We *dodged a* bullet." Roads were slick for morning commuters and icy trees knocked out electrical lines after a major winter storm blanketed the area in snow and ice this past weekend. Forecasters had predicted that the town would take the brunt of the worst storm of the season.

Negative Frame:
"Half of the residents *lost* their power," reported the mayor. "It *can't get much* worse. We *weren't able to dodge this* bullet." Roads were slick for morning commuters and icy trees knocked out electrical lines after a major winter storm blanketed the area in snow and ice this past weekend. Forecasters had predicted that the town would take the brunt of the worst storm of the season.

Sixty-one percent of participants who were presented the positively framed long version considered the town's residents lucky (it was 68% of those presented the short version), while only 9% who were presented the negatively framed long version considered the residents lucky (it was 4% in the short version). When combining the results from all eight of the long versions of the luck scenarios, we observed an average shift in luckiness of about 55%. That is, positively framed long versions were judged lucky by 55% more of the participants compared to the statistically identical negatively framed long versions.

In the same study, the long versions of the luck scenarios offered us an opportunity to test the influence of another cognitive bias, the serial position effect. The serial position effect is a memory processing bias which states that information presented first (primacy effect) and information presented most recently (recency effect) benefits from better recall (Ebbinghaus 1885; Rundus 1971). For example, when reading a story, a person might better remember the beginning (primacy effect) and end (recency effect) compared to the middle of the story. We reasoned that if the beginning and end of a story benefit from a memory boost, placing the key component of the luck scenario in those positions would lead to the greatest framing effect.

We used the long versions of the luck scenarios but varied the placement of the positively or negatively framed portion of the event. That is, the framed portion of the event occurred at the beginning of the story for some participants, the middle of the story for other participants, and at the end of the story for the remaining. Below are examples of a positively framed event from our study.

Positive Frame at the Beginning:
"I hit half my shots from the free throw line! Not bad for a beginner, huh?" Mark exclaimed with a grin. Even though he was one of the tallest kids in his class, Mark Zabadi had never picked up a basketball before. "I dunno," he said, "Guess I'm more of a gamer—not much of a team sports guy." But when some of his friends found themselves short a player for a pickup game, they convinced Mark to play.

Positive Frame in the Middle:
When some of his friends found themselves short a player for a pickup game, they convinced Mark to play. "I dunno. Guess I'm more of a gamer—not much of a team sports guy. *But I hit half my shots from the free throw line! Not bad for a beginner, huh?" Mark exclaimed with a grin.* Mark Zabadi had never picked up a basketball before even though he was one of the tallest kids in his class.

Positive Frame at the End:
Even though he was one of the tallest kids in his class, Mark Zabadi had never picked up a basketball before. "I dunno," he said, "Guess I'm more of a gamer—not much of a team sports guy." But when some of his friends found themselves short a player for a pickup game, they convinced Mark to play. *"I hit half my shots from the free throw line! Not bad for a beginner, huh?" Mark exclaimed with a grin.*

Interestingly, the location of the positively framed portion of the event did not significantly affect luck attributions; the scenario was considered lucky across all three versions. For example, the percent of respondents who rated Mark as lucky was 92% for the beginning version, 84% for the middle version, and 88% for the end version. When combining the results of all eight scenarios from our study, luck ratings when the event was at the beginning (86% judged lucky), middle (85% judged lucky), and end (88% judged lucky) did not significantly differ. Such consistency could be due to the Pollyanna principle (i.e., positivity bias), which is the tendency for people to generally recall positively valenced events better than negatively valenced events (Matlin & Stang 1978). Positivity bias could mean that the location of the positive event had no influence on recall because positive events are recalled well regardless of their serial position.

On the other hand, the location of the negatively framed portion of the event did significantly affect luck attributions. Below are examples.

Negative Frame at the Beginning:
"Yeah, I missed half my shots from the free throw line. Not great, huh?" Mark said with a frown. Even though he was one of the tallest kids in his class, Mark Zabadi had never picked up a basketball before. But when some of his friends found themselves short a player for a pickup game, they convinced Mark to play. "I dunno," he said, "Guess I'm more of a gamer—not much of a team sports guy."

Negative Frame in the Middle:
When some of his friends found themselves short a player for a pickup game, they convinced Mark to play. "I dunno," he said, "Guess I'm more of a gamer—not much of a team sports guy. *Yeah, I missed half of my shots from the free throw line. Not great, huh?" Mark said with a*

frown. Mark Zabadi had never picked up a basketball before even though he was one of the tallest kids in his class.

Negative Frame at the End:
Even though he was one of the tallest kids in his class, Mark Zabadi had never picked up a basketball before. "I dunno," he said, "Guess I'm more of a gamer—not much of a team sports guy." But when some of his friends found themselves short a player for a pickup game, they convinced Mark to play. *"Yeah, I missed half of my shots from the free throw line. Not great, huh?" Mark said with a frown.*

We found that the closer the negatively framed portion of the event was to the end of the story, the less luck was attributed by the participants. For example, the percent of respondents who rated Mark as lucky was 52% for the beginning version, 32% for the middle version, and 24% for the end version. When combining the results of all eight scenarios, the pattern remained. In particular luck ratings were similar when the negatively framed portion was at the beginning (35% judged lucky) and in the middle (30% judged lucky), but decreased when it was at the end (21% judged lucky). The effect was significant and suggested that the recency effect might have influenced respondents' luck attributions.

Overall, regardless of the length of the luck scenario or the order in which the scenario was presented, we found that framing caused robust and consistent changes in people's judgments of good and bad luck. This demonstrated that luck attributions, like many other human judgments, are affected by cognitive biases.

In more recent work we sought to determine if dispositional optimism plays a role in people's luck attributions (Hales & Johnson 2018). We presented participants with scenarios that involved luck but it was unclear whether the scenarios were instances of good or bad luck (i.e., the scenarios were ambiguous in regard to luck). For example, take the following true story that was presented to participants in our study.

Channing Moss was a US soldier serving in Afghanistan. His unit was attacked by Taliban insurgents, who fired a rocket propelled grenade (RPG) into Moss's abdomen. The unexploded but live warhead stuck out of his left side and the rocket fins stuck out of his right. After a very risky operation, the RPG was removed. Several surgeries later, Moss is home with his family.

Overall, should Channing Moss be considered unlucky because he was hit with an RPG, or should he be considered lucky because he survived? We reasoned that optimistic people would be drawn more to the bright side of the situation and thereby judge Channing Moss as more lucky than pessimistic people who would be swayed more by the negative part of the scenario. Optimism is commonly—and properly—considered a personality trait. It is relatively stable over time, differs across humans, and is at least in part heritable (Carver et al. 2010). But more specifically, optimism is a trait that reveals one's cognitive expectation for future events. That is, an optimist has the expectation that good things will happen in one's future, while a pessimist has the expectation that bad things will happen in one's future. Given the fact that optimism is inherently cognitive in nature made it of particular interest to us as we continued our journey to discover how cognitive biases and expectations influence the interpretation of luck events as good or bad luck.

In our first study, we presented participants with five ambiguous luck vignettes that were all based on true stories. They included the story of Channing Moss surviving the RPG, Tsutomu Yamaguchi surviving the atomic bombings of Hiroshima and Nagasaki, Bill Morgan surviving a near-fatal car accident, Eduardo Leite surviving a head-first 5th story fall, and Roy Sullivan surviving seven lightning strikes. Participants were asked to judge the luckiness of the person in each story (i.e., was the person *unlucky*, *somewhat unlucky*, *somewhat lucky*, *lucky*?). Then participants completed the 10-item Life Orientation Test (LOT-R), the most common measure of dispositional optimism (Scheier et al. 1994). The LOT-R requires participants to state their agreement with statements such as "I am always optimistic about my future" and "Overall, I expect more good things to happen to me than bad."

Scores on the LOT-R provide a continuum of optimism with no criterion for what score constitutes the cut-off between an optimist and a pessimist. Therefore, to test our hypothesis we examined the correlation between luck judgments of the ambiguous vignettes and scores on the LOT-R. We found a significant positive correlation between one's level of optimism and one's luckiness ratings of the vignettes. That is, the more optimistic a person, the more likely they were to judge people in the vignettes as lucky. Likewise, the more pessimistic a person, the more likely they were to judge the people in the vignettes as unlucky. The findings seemed to suggest that a person's cognitive expectation that good or bad events should happen to *them* (i.e., their level of optimism) influenced their judgments about the luckiness of *others* (i.e., the people in the vignettes).

One concern with these findings is the possibility that the subjects were effectively ignoring half of the information they received. Perhaps the optimists were just setting aside the negative component of the case and focusing solely on the good aspect, and the pessimists were doing the same by focusing on the bad portion and ignoring the positive features of the vignette. If that was going on, then the optimists and pessimists were essentially talking past each other; they were not really assessing the *total* situation for luck. To obviate this concern we designed a follow-up study.

In the second study, a new group of participants was presented the same vignettes that we used in our first study, but the "good" and "bad" parts of the vignettes were presented separately to ensure that optimists could not just ignore the negative component of the case and pessimists could not ignore the positive component. Below is an example of how we presented Tsutomu Yamaguchi's case as two parts.

- In 1945, Tsutomu Yamaguchi was on business in Hiroshima when the first atomic bomb hit and in his hometown of Nagasaki in the second-ever nuclear attack. Tsutomu Yamaguchi was: (circle one): *unlucky*, *somewhat unlucky*, *somewhat lucky*, *lucky*
- Tsutomu Yamaguchi survived both nuclear attacks and lived until he was 93. Tsutomu Yamaguchi was: (circle one): *unlucky*, *somewhat unlucky*, *somewhat lucky*, *lucky*.

Overall, optimistic and pessimistic participants were largely in agreement regarding the luckiness of the "good" and "bad" events. Ninety-seven percent of participants rated the good events as *lucky* or *somewhat lucky*, and all participants rated the bad events as *unlucky* or *somewhat unlucky*. Optimists and pessimists can clearly agree upon what constitutes good versus bad luck. However, optimists and pessimists varied in their judgments of the severity of the bad luck components. The more pessimistic the person, the more unlucky she considered the bad luck component. The more optimistic the person, the less unlucky she considered the bad luck component. This was not the case for the good luck component; level of optimism did not significantly predict attributions of luckiness to the good luck component.

We think the results of our second study help explain the findings of our first study. We posit that when people judged the ambiguous luck scenarios in their entirety in our first study, optimists were seeing the bad luck component of the event as unlucky but not as unlucky as pessimists deemed it to be. This could explain why optimists judged the scenario in its entirety as more lucky than pessimists.

What are the philosophical implications of these psychological findings? The apposite solution to other cases of cognitive biases is to disregard the error-prone System 1 intuitions in favor of the reflective theorizing of System 2. For example, if you know that you are subject to the Gambler's Fallacy, then a careful application of probability theory when gambling is the cure. If you know that you keep falling for the Availability Error (considering only recent or psychologically salient events) when calculating future risk, then the right response is a close examination of risk statistics. Given the fact that optimists view events as luckier than pessimists do, or the result that luck attributions are strongly determined by framing and salience effects, perhaps the correct thing to do is revert to a theory of luck that will tell us how to accurately decide whether someone is lucky or not. Then we will be able to avoid the erroneous biases or personality traits that distort our perceptions of luck.

There are three major theories of luck: the probability, modal, and control theories. According to the probability theory, an occurrence is lucky (or unlucky) only if it was improbable that it would occur. The modal theory of luck maintains that an event is lucky only if it is fragile—had the world been very slightly different it would not have occurred. The third theory of luck is the control view, which states that if a fact was lucky or unlucky for a person, then that person had no control over whether it was a fact. To these necessary conditions for luck, nearly everyone (Pritchard (2014) being the lone exception) adds a significance condition: for someone to be lucky (or unlucky) that an event has occurred, that event must in some way be of significance to that person. All other more sophisticated versions are variants or elaborations on these ideas.[4]

Unfortunately, the hope of a bailout by theory is in vain. The available theories of luck are incapable of solving the problems raised in our studies. To settle the framing cases here is what we want: a defensible theory of luck to tell us whether Tara Cooper really is lucky or whether she really is unlucky. Then we could dismiss one frame as misleading and accept that the other frame is better at leading us to the truth. Consider first the probability theory of luck. According to it, something's luckiness is a function of its importance and probability of occurrence. Under the probability theory, Tara is lucky to hit five out of six numbers in the Megabuck$ lottery if and only if (1) hitting five numbers mattered to her in a positive way and (2) it was improbable that she would hit five of six numbers. Let us suppose that those conditions were satisfied. Thus Tara *was* lucky to hit five numbers in the lottery. Also according to the probability theory, she was *un*lucky to miss one of six numbers in the Megabuck$ lottery if and only if (1) missing one of the numbers mattered to her in a negative way, and (2) it was improbable that she would hit all six numbers. Assuming those conditions were satisfied, it follows that she was unlucky to miss one of the six numbers.

We get the same result under the modal theory. According to the modal theory, a very small change in the world, such as one ball in the Megabuck$ lottery hopper rotating an extra 20 degrees, would have meant that Tara Cooper did not hit five of six numbers in the lottery, and so her hitting those numbers was modally fragile. Thus her success in getting five out of six was lucky. It is also the case that a very small change in the world would have meant that she got all six numbers right in the lottery, and she was unlucky not to find herself in this very close possible world instead. Again, Tara Cooper is both lucky and unlucky for the same thing.

The control theory lines up with the others. The fact that Cooper got five of six lottery numbers correct was wholly outside her control. Coupled with the fact that getting those numbers mattered to her, under the control theory she was lucky to get five of six numbers in the lottery. However, it was also not within her control to hit all six numbers, although she would have surely loved to. Thus the fact that she missed one number was a case of bad luck. While Tara Cooper was lucky to have hit five out of six numbers in the lottery, she was unlucky to have missed one number.

Tara Cooper was not simultaneously lucky and unlucky for the exact same event. In the snowstorm example, the town's residents were not both lucky and unlucky; those are contrary properties in the same way that *being red all over* and *being blue all over* are contraries, or *skydiving* and *swimming* are contraries. No one can skydive and swim simultaneously, and no one can be both lucky and unlucky for the same thing in the same way. An adequate theory of luck should tell us, in any given case, whether the subject of luck is objectively lucky or objectively unlucky, just as probability theory tells a gambler whether he is objectively likely to be dealt good cards after a run of bad ones, or not. If probability theory could not do that, we would still be stuck with the Gambler's Fallacy. If a theory of luck cannot render a consistent, univocal, and objective decision about a putative case of luck, then we have no solution to cognitive bias. In fact, it suggests that there might be no more to luck than cognitive bias.

Luck defenders might rejoin that it is not the probability, modal, or control elements of a theory of luck that are meant to parse good luck from bad. Rather, it is the significance condition that does that work. It is not enough to know that an event is chancy, or that a chancy event affects someone; we need to know whether it affects them in a good or bad way. The way that we do that is to consider

for whom the event is significant, and the manner in which it matters. For example, if Bertrand and Dora are playing blackjack against each other, and Dora is dealt Jack-Ace, that is very improbable (about 0.5%) and certainly matters for Dora. Obviously it matters just as much for Bertrand too, just inversely. Without establishing that not only is the low chance of Jack-Ace significant for both Dora and Bertrand, but that it affects her in a good way and him in a bad way, it cannot be sorted out who is lucky and who is unlucky.

Coffman has recently argued that an event is a stroke of good (or bad) luck for an agent only if it is in some respect good (or bad) for that agent (Coffman 2015: 34). Ballantyne has similarly argued that an individual is lucky with respect to some event only if the putatively lucky event has an objectively positive or negative effect on an interest of that agent (Ballantyne 2012: 331). Whittington maintains that "significance … is … objective, in the sense that it does not depend entirely on the desires of perceptions of the agent in order to count as significant for that agent. Furthermore, the value of the significance may well be the opposite of what the agent perceives" (Whittington 2016: 1616–1617).

For Coffman, Ballantyne, and Whittington, an event can be simultaneously lucky and unlucky for the same person, as when a lottery win makes one luckily rich but unluckily a prime target for swindlers. In this sense a lottery win is a double-edged sword. Their idea is consonant with the cases we presented in the first optimism/pessimism study which contained a compound event composed of both lucky and unlucky parts. As in those cases, presumably there is also an *overall* assessment about whether an event is lucky or unlucky. For example, a lottery winner could plausibly judge that despite some downsides, taken all in, winning was a lucky event. Ballantyne and Whittington also concur that the subject of luck could be mistaken about whether an event is lucky or unlucky. Ballantyne offers an example of a person with anorexia who vows to drink only water in order to shed pounds, but nonetheless maintains a healthy weight because the water supply is unknowingly connected to a nutritional supplement. Ballantyne argues that the person with anorexia is objectively lucky, even though she might not see it that way (Ballantyne 2012: 322).

Grant for the sake of argument that an event is lucky or unlucky for an agent only if it is positively or negatively significant for them. Also grant that no one is infallible about the manner in which an event is significant and, like the person with anorexia, could be mistaken. Even these strong assumptions about a significance condition do not ameliorate or help with interpreting the results of our studies.

In our second optimism/pessimism study, participants recognized that getting impaled with an RPG was an event significant to Channing Moss and it was bad luck. Study participants also saw that receiving successful surgeries and surviving the RPG attack was a significant event and an instance of good luck. Optimists and pessimists agreed on these points, and they are surely reasonable views, not at all like Ballantyne's reasoning-impaired person with anorexia. The key finding in the second study was that the more optimistic participants rated the bad luck events as being *more* positive than the more pessimistic participants did. Even optimists acknowledge the bad luck events are unlucky, they just do not see them *as* unlucky as the more pessimistic people do. In our view, it is this difference that serves to explain participants' assessments of the compound events of the first optimism/pessimism study. When Channing Moss had an RPG embedded in his abdomen, that was unlucky (the significance condition gets this right). When he survived the whole ordeal, that was lucky (the significance condition gets this right too). However, for optimists, getting impaled with an RPG was not all *that* bad so it made the getting-impaled-and-surviving event a luckier one than the pessimists believed. For pessimists, his getting skewered with an RPG was so unlucky that it diminished the good fortune of his survival. Here the significance condition cannot sort out who is correct.

Overall, Channing Moss was either lucky or unlucky. Optimists think he was luckier than the pessimists do, because they disagree with the pessimists about just how bad Moss's bad luck really was. Barring relativism about luck, the pessimists and the optimists cannot both be right. The significance condition on luck was supposed to determine just who is lucky or unlucky, and to what extent. As

we have seen, though, it fails to provide a principled way to adjudicate between the varying luck judgments of persons at different locations on the optimism/pessimism scale.

The framing and recency effects are cognitive biases in the perception of luck, and lead to inconsistent judgments as to whether a person or an event is lucky or unlucky. Luck attributions also vary by the personality traits of optimism and pessimism. No doubt there are other cognitive peculiarities or psychological qualities that affect our observations and assignments of luck as well. Why does this matter? A kayak paddle half in the water looks bent, and out of the water it does not. Parallel train tracks disappearing into the distance appear to converge. It is when we have perplexing, inconsistent perceptions like these that we turn to a theoretical explanation to sort things out. A decent theory should (1) tell us that in fact the paddle is not really bent and the tracks do not truly converge and (2) explain away the competing perceptions. A theory of optics that could not do those things would be rejected as inadequate for that very reason. No theory of luck is able to tell us that Tara Cooper or Channing Moss really is lucky (or unlucky), much less offer an explanation as to why the alternative interpretation is mistaken. The popular ideas of probability, modality, lack of control, and significance not only fall short, but there is no clear way to see how they might be improved. When theories of luck fail to do their job, a plausible stance is that—like bent paddles and converging tracks—luck is a cognitive illusion. At the very least, "luck" is not a harmless and anodyne concept to which philosophers should blithely help themselves in thinking about morality, epistemology, or free will.

Notes

1 Petronius (1960) ch. 60.
2 "Let us study such a collection, worn in the form of little silver pendants: the four-leaf clover, a pig, a mushroom, a horseshoe, a ladder, and chimney-sweep. The four-leaved clover has taken the place of the three-leaved one which is really suited to be a symbol. The pig is an ancient fertility symbol. The mushroom is an obvious penis-symbol: there are mushrooms which owe their systematic name (*Phallus impudicus*) to their unmistakable resemblance to the male organ. The horseshoe copies the outline of the female genital orifice, and the chimney-sweep, who carries the ladder, appears in this company on account of his activities, with which sexual intercourse is vulgarly compared" (Freud 1917: 64).
3 Although mathematicians tend not to have noticed. See Bewersdorff (2005), Mazur (2010), and Smith (2016).
4 For example, Coffman (2015) and Levy (2011).

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