WHEN DO PEOPLE STOP NON-BOUND PERFORMANCE TASKS?

CENTURY MARK FEEDBACK AS A STOPPING RULE

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STATEMENT OF ORIGINALITY

This is to certify that to the best of my knowledge, the content of this thesis is my own work. This thesis has not been submitted for any degree or other purposes.

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ABSTRACT

Numeric cumulative feedback is often used in tasks to indicate progress and increase performer persistence. However, this research suggests that this type of feedback may unintentionally cause performers to focus on reaching multiples of 100, known as century marks, which become likely stopping points. The significance of multiples of 100 comes from their association with wholeness, completeness, and perfection in everyday language, as well as its cognitive salience. This thesis proposes that when performers encounter a century mark, they perceive it as a psychological landmark, signaling the closure of a performance set. Consequently, performers feel a greater sense of closure when they reach century marks, leading them to choose these figures as their finishing point. Seven studies and two supplementary experiments were conducted to investigate this phenomenon, and the findings indicate that performers are drawn to stop at century marks. Furthermore, century marks can have divergent effects on task persistence, increasing it for those who would not otherwise reach century marks but decreasing it for those who would do more. These results have implications for task design and feedback mechanisms in various domains.

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1. INTRODUCTION

Imagine that you are participating in an online volunteering program that helps feed the hungry by completing word puzzles. For every puzzle you solve, you receive feedback indicating how much progress you have made in helping the cause. The UN World Food Programme's online program "Freerice", for instance, credits you with 10 symbolic "grains of rice" per puzzle correctly solved. After correctly solving eight puzzles, you would have earned 80 grains of rice. Would accumulating 100 grains instead of 80 grains affect your decision to stop the task? How would this ongoing cumulative feedback affect your engagement with the task?

Although it is commonly assumed that cumulative numeric feedback increases task performers' engagement and persistence, this research suggests a more nuanced perspective. Specifically, numeric feedback indicating cumulative progress may inadvertently lead performers to focus on specific points in the task where the accumulated units are multiples of 100, which we refer to as "century marks." This research proposes that century marks can become likely stopping points, and their effect on persistence can be divergent.

To illustrate, consider again the case described above of volunteers helping to feed the hungry by completing word puzzles. If an arbitrary unit is assigned to indicate each subtask completed (e.g., 10 grains of rice for every puzzle completed correctly), and the units show cumulative progress (e.g., "you've accumulated 100 grains"), volunteers tend to stop once their tally reaches multiples of 100. This inclination to stop at century marks may lead individuals to persist until reaching them, even if it requires additional effort. However, once reached, performers may be less likely to persist beyond these century marks, as they may feel a sufficient sense of closure to stop the task.

Cumulative feedback enables performers to know how much they have achieved, and how close or far they are from a goal they have in mind (Koo & Fishbach, 2008; 2012). Much research on cumulative feedback has focused on discrepancies between the goal and the current progress status, and its effects on performance (e.g., Fishbach, Dhar, & Zhang, 2006). Research finds that performers are more likely to stop performing a task when they are further from the goal, and the likelihood of stopping decreases as the distance to the goal decreases (Hull, 1934; Kivetz, Urminsky, & Zheng, 2006). Cumulative feedback also influences stopping when goals are implicit and performers perceive a "gap" to be filled (Gunasti & Ozcan, 2019). For example, when cumulative feedback is presented visually in a set-like manner, such as a six-pack of beer or a four-slice pie chart, performers perceive incompleteness when they see an unfilled part in a set and endeavor to fill these gaps (Barasz, John, Keenan, & Norton, 2017).

In our daily lives, however, we often face tasks without having a specific goal. In such cases, how does cumulative feedback affect performers' decisions to stop the task? Without a goal, cumulative feedback no longer provides information about the distance to the goal or endpoint (Wallace & Etkin, 2018), but instead becomes a raw indicator showing how much has been achieved. This research suggests that performers ascribe unintended meaning to these figures in their quest to understand how much they have achieved during the task and, ultimately, feel a sense of closure upon reaching certain points. Certain numbers that performers encounter as they receive ongoing cumulative feedback can signal a psychological landmark—drawing performers to reach these salient points and prompting them to stop.

This research suggests that multiples of 100 tend to be the most significant landmark when receiving cumulative numeric feedback on performance. The special status of the number 100 comes from cognitive salience (Dehaene & Mehler, 1992; Sigurd, 1988) and its

association with wholeness, completeness, and perfection in everyday language (Li & Chapman, 2009). In addition, in performance contexts, multiples of 100 indicate different progress levels. For example, freshman university classes are coded by 100, while 400 stands for senior-level classes. As with other round numbers (e.g., zero-ending numbers such as 10 and 100), 100 is associated with completeness (Gunasti & Ozcan, 2016) and serves as a boundary or demarcation point (Isaac & Schindler, 2014; Koo et al., 2020). Consequently, people perceive these numbers as psychological landmarks that bring structure and order (Alter & Hershfield, 2014).

This research proposes that when receiving cumulative feedback, performers inadvertently encounter 100—a *century mark*—at some point, signaling the closure of a performance set. Task performers may judge their subjective progress based on the century mark, with a particular focus on whether they have reached it. When contemplating stopping the task, performers may view arriving at 100 units as *finishing* a set, whereas stopping points short of this could be viewed as *quitting* in the middle—despite the arbitrary nature of the unit assignment. We suggest performers feel a greater sense of closure when they reach century marks, leading them to choose these figures as their finishing point. Due to the gravitational pull of century marks, providing numerical cumulative feedback can have divergent effects: increase task persistence for those who would otherwise not reach century marks but decrease persistence for those who would otherwise do more. We bring our focus to contexts in which performers have not been given a specific goal and can continue the task for an extended period of time. We chose a donation task for our studies, as volunteer efforts often fit these criteria. Note, however, that the effects of century marks could extend to many other contexts with these characteristics, including some tasks for which one obtains personal gain based on task performance.

The present research contributes to performance and feedback research by identifying century marks as a stopping point inherent to cumulative numeric feedback. While much research focused on cumulative feedback in relation to goals (Harkin et al., 2016), this study extends the literature by demonstrating that cumulative feedback influences performers' stopping decisions, even without an explicit endpoint. Our findings indicate that modifying the cumulative feedback scheme through adjustments to the subtasks required to reach a century mark can have a significant impact on performers' persistence, without altering the external rewards associated with feedback or completion.

Furthermore, the present research provides practical implications for promoting prosocial behavior by highlighting the importance of designing cumulative feedback schemes that increase persistence, rather than inadvertently decreasing it. Prosocial marketers, volunteering organizations, and fundraisers often provide cumulative feedback to their donors or volunteers to increase participation, selecting round numbers as a feedback scheme (Lin & Pursiainen, 2021). Receiving cumulative feedback may cause unexpected effects on persistence, such as an increase of rewards per subtask leading to earlier termination. Counter-intuitively, our results show that participants persisted longer when they received fewer units per subtask, as it requires more participation to reach a century mark. Our findings can help prosocial organizations by guiding effective ways to make volunteers exert more time and effort on prosocial tasks.

Finally, this study extends the body of knowledge on round number research by illuminating the unique significance of the century mark (100) compared to other round numbers. Previous research has indicated that not all round numbers have equal cognitive salience (Jasen & Pollmann, 2001; Ozcan & Gunasti, 2019), yet limited empirical evidence has been provided. Our findings provide empirical support for this proposition by showing that even when performers cannot reach the exact 100, they tend to stop based on reaching

100 instead of other zero-ending numbers (e.g., 70 or 90). Our findings suggest that multiples of 100 are the most powerful stopping points influencing persistence, with a strong cognitive salience.

The remainder of the thesis is structured as follows. In the second chapter, an extensive review of the existing literature on cumulative feedback and round numbers is conducted to provide a theoretical foundation to understand why multiples of 100 can become century marks, and how they influence performers' behavior. In the third chapter, the theoretical framework for the effect of century marks on stopping is proposed. Subsequently, from Chapter 4, a series of experimental studies supporting the proposed hypotheses are presented. In the final chapter, both theoretical and practical implications of the findings are discussed, while suggesting avenues for future research.

2. LITERATURE REVIEW

2.1. Cumulative Feedback

2.1.1. Overview

This section establishes a foundation for understanding the influence of cumulative feedback on performers' decisions to stop a task. Given the extensive research on feedback and goals, it is necessary to clarify the scope of this section. Specifically, this section begins with a brief overview of cumulative feedback and progress information. Then reviews the effect of cumulative feedback on performance and stopping decisions in relation to both the presence and absence of goals. Finally, recent research on the impact of cumulative numeric feedback on ongoing performance is presented.

2.1.2. Cumulative Feedback and Progress Information

Cumulative feedback serves to monitor progress by indicating the accumulated performance up to the most recent action (Crone & Van der Molen, 2004), enabling performers to become aware of how much they have accomplished and how close or far they are from the goal (Koo & Fishbach, 2008). Previous research has demonstrated that cumulative feedback enhances performance by motivating performers to narrow the gap between the current state and the goal (Kivetz, Urminsky, & Zheng, 2006; Harkin et al., 2016; Higgins, 1987; Locke & Latham, 2002), as well as helping them judge whether their performance requires adjustment to reach the goal (Carver & Scheier, 2001; Ferguson et al., 2009).

A key finding in this area is the goal-gradient effect, which posits that performers are more motivated to achieve the goal when they perceive a smaller (vs. larger) distance to the

goal (Hull, 1934; Sharief & Woolley, 2020; Schroeder & Fishbach, 2015). For instance, consumers purchase coffee more frequently when they are close to earning a free coffee from a cafe reward program (Kivetz, Urminsky, & Zheng, 2006). Also, funds close to the campaign goal received more donations than funds far from the goal (Cyder, Loewenstein, & Seltman, 2013; Zvilichovsky, Danziger, & Steinhart, 2018).

These two types of progress information, how much has been accomplished and how much is left, can increase motivation in different circumstances. Koo and Fishbach (2008) demonstrate that focusing on what performers have accomplished signals a high level of commitment and enhances motivation when the level of commitment is uncertain (e.g., studying for a relatively unimportant exam). In contrast, highlighting the discrepancy to the goal signals a lack of progress, which increases motivation when commitment is certain (e.g., studying for an important exam). Similarly, focusing on accumulated progress increases persistence at the beginning of goal pursuit, while focusing on how far from the goal increases goal pursuit when close to the goal (Koo & Fishbach, 2012).

2.1.3. Cumulative Feedback in relation to Goals Determines when to Stop

When receiving cumulative feedback, a performer's distance from the explicit goal influences their decision to stop a task. More specifically, people are more likely to terminate the task when they are further from the goal, and the probability of stopping decreases as the distance to the goal decreases (Huang, Zhang, & Broniarczyk, 2012; Kivetz, Urminsky, & Zheng, 2006). One of the studies by Kivetz et al. (2006) shows that when consumers participate in a music-rating program and get a reward for rating 51 songs, they become more likely to persist as they approach the 51 song goal and stop just after reaching the goal. For example, 8.7% of participants stopped the task when they accumulated only one song, while

only 0.2% of participants terminated when 50 songs were accumulated (Kivetz, Urminsky, & Zheng, 2006).

Cumulative feedback influences stopping when goals are implicit as well, as performers can perceive a "gap" to be filled (Barasz et al., 2017; Gunasti & Ozcan, 2019). Barasz and colleagues (2017) examine stopping behaviors when cumulative feedback is provided via a visual form that is divided into an arbitrary number of subunits (e.g., a six-pack of drinks, a four-slice pie chart). Completing these pseudo-sets becomes an implicit goal because performers perceive the pseudo-set as the whole and are motivated to complete the unfilled part in a set. For example, in one of their studies, participants received one of three types of cumulative feedback: a four-slice pie chart, a seven-slice pie chart (one slice of the pie chart filled upon completing each iteration of the task), or the total number of completed tasks (control). Results showed that participants who were given feedback via pseudo-sets were likely to prioritize completing these sets. Participants who received feedback via the four-slice pie chart were more likely to complete multiples of 20 tasks (20%) than the other two conditions (4% and 3%). In contrast, those who received feedback via the seven-slice pie chart were more likely to complete multiples of 35 tasks (12%) than other conditions (both 0%).

2.1.4. The Effect of Cumulative Feedback in the Absence of Specific Goals

Research examining the influence of cumulative feedback on task persistence often has focused on tasks with a specific goal rather than without. However, in everyday life, people often engage in tasks without a specific goal. The most common form of nonspecific goal is the "do your best" task without an end state (Locke & Latham, 1990; Wright & Kacmar, 1994) or self-regulation ongoing tasks (e.g., to be healthy or educated; Gollwitzer,

1999; Locke & Latham, 2002). Wallace and Etkin (2018) demonstrate the prevalence and importance of tasks without an end state by asking US adults to list their personal goals and indicate whether these goals have a specific end state. The study found that half of the listed life goals had no specific end states, yet were perceived as equally important as goals with specific end states.

In the absence of a specific goal, cumulative feedback does not provide information about the distance to the goal or end state and instead becomes a raw indicator of the accumulated progress. The absence of a goal introduces ambiguity in performance evaluation (Naylor & Ilgen, 1984; Wright & Kacmar, 1994), prompting performers to rely on available information to assess their achievement (Wallace & Etkin, 2018). For example, performers spontaneously adopt the starting point as an alternative reference point to compare their progress when no specific endpoint exists. As performers progress away from the starting point, task motivation and feelings of achievement decrease (Huang et al., 2012; Wallace & Etkin, 2018).

If cumulative feedback provides numeric values to indicate progress, certain numbers that performers encounter during the performance can become a reference point. For example, performers use round numbers as their reference point to perceive goal accomplishment (Gunasti & Ozcan, 2019) and adjust their performance (Pope & Simonsohn, 2011). The detailed effects of round numbers will be further discussed in the next section.

2.1.5. Cumulative Numeric Feedback and Performance

This research focuses on cumulative numeric feedback, where numeric values are utilized to indicate behavioral outcomes or accumulated progress that has been achieved. Shen and Hsee (2017) suggest a concept of numerical nudging, in which meaningless

numbers encountered during a task can shape performance, even if the number is not associated with external incentives. The results of studies demonstrate that performers who were presented with a number that increased at an accelerating rate performed better on an ongoing task than those who were presented with a decreasing or constant pace number or those who were not presented with a number.

Recent research on cumulative numeric feedback is related to self-tracking, which refers to generating and accumulating personal information in numeric form. Performers can receive immediate and cumulative numeric feedback about their activities through self-tracking (Etkin, 2016; Whitson, 2013), which has become increasingly common in everyday life facilitated by apps or trackers (Ajana, 2018; 2020). The accumulated outcomes of activities become more salient with cumulative numeric feedback, leading to decreased task enjoyment (Etkin, 2016).

While performance feedback often involves numeric information, research on the effect of performance information has tended to focus less on the numbers themselves (Olsen, 2015). We expect that when receiving cumulative numeric feedback on an ongoing task with no specific goal, performers are likely to attribute specific meanings to certain numbers they encountered, influencing performance. In the next section, we review numbers likely to be perceived as psychological landmarks that serve as a stopping point.

2.2. Round Numbers

2.2.1. Overview

This section builds the theoretical foundation supporting the prediction that when people receive cumulative numeric feedback during a task with no explicit goal, certain numbers they encounter represent psychological landmarks that prompt stopping. By receiving cumulative feedback, people continuously reach different numbers, indicating progress as a result of each action. Among these numbers, we propose that multiples of 100—*century marks*—are perceived as unique. The special status of the number 100 comes from cognitive salience (Dehaene & Mehler, 1992; Sigurd, 1988) and its association with wholeness, completeness, and perfection in everyday life (Fisher & Mormann, 2022; Li & Chapman, 2009). Moreover, as one of the significant *round numbers*, which are non-zero numbers ending in zero (King & Janiszewski, 2011; Schindler & Yalch, 2006), 100 occupies the features of round numbers and their impacts on perceptions and behavior. Such round numbers deliver additional meanings beyond their numerical values (Jerez-Fernandez, Angulo, & Oppenheimer, 2014; Park & Kwon, 2022; Pena-Marin & Bhargave, 2016).

This section begins by providing a summary of the definition and features of round numbers, then reviews their broad impacts on human perception and behavior. Round numbers are perceived as category boundaries dividing consecutive numbers into groups (Alter & Hershfield, 2014; Issac & Schindler, 2014) and are related to various cognitive associations and inferences such as perceived completeness (e.g., Gunasti & Ozean, 2016; 2019; Pena-Marin & Bhargave, 2016). Due to these characteristics, people tend to choose round number amounts in an everyday consumption environment (Lynn, Flynn, & Helion, 2013) and judge their performance with round numbers as implicit goals (Allen, Dechow, Pope, & Wu, 2017; Pope & Simonsohn, 2011). This section will provide the theoretical

foundation for understanding why century marks in cumulative feedback affect decisions to stop, which will be discussed in the following framework chapter.

2.2.2. What is a Round Number

Some numbers are cognitively more salient than others (Dehaene & Mehler, 1992; Rosch, 1975; Sigurd, 1988). These numbers have become salient because of their prominent usage in communications and the 10-based number system we use. For example, as compared to other less prominent numbers, 10, 50 and 100 are more frequently used in communications across different languages and cultures (Dehaene & Mehler, 1992; Jasen & Pollmann, 2001). *Round numbers* can be defined as multiples of 10 (e.g., 10, 20, 30) and halfway of these multiples (e.g., 5, 15, 25; Isaac & Schindler, 2014; Lynn et al., 2013; Schindler & Yalch, 2006). Research has examined the round number effects on human perceptions and behaviors in various contexts, but the definitions of round numbers used in these studies are still broad.

Some researchers define round numbers as multiples and divisors of 10, 100, and 1,000 (Sigurd, 1988) or simply as zero-ending numbers (Lotz, 1955; Mitchell, 2001), while others use a definition of ending with more zeros (Frech, Friese, & Loschelder, 2022; Pena-Marin & Bhargave, 2016; Pena-Marin & Wu, 2019; Shoham & Munichor, 2021; Thomas et al., 2010; Yan, 2016), and yet others include midpoints of multiples of 10 as a round number definition, using zero-ending or five-ending numbers as the definition (Gunasti & Ozcan, 2016, 2019; Isaac et al., 2021). However, not all zero-ending or five-endings are cognitively salient (Jasen & Pollmann, 2001; Ozcan & Gunasti, 2019). Zero-ending numbers, such as 10, 50, or 100, are more frequently used in communications and have cognitive salience; therefore, they can be defined as round numbers. Five-ending numbers, such as 25, are more frequently used in communications and have features of round numbers. However, zero-

ending numbers, such as 110, or five-ending numbers, such as 295, do not have cognitive salience and are not used as frequently as other round numbers (Ozcan & Gunasti, 2019). Despite the ambiguous boundary of the definition, round numbers have been shown to have specific features compared to non-round numbers: prominent frequency in usage and processing fluency.

2.2.3. What Determines Saliency?

Prominent frequency. Round numbers are more frequently used in communications and everyday life than other numbers (Dehaene & Mehler, 1992; Ozcan & Gunasti, 2019). Dehaene and Mehler (1992) examine the frequency of usage of numbers in seven different languages (American English, Catalan, Dutch, French, Japanese, Kannada, and Spanish) and find that some numbers (e.g., 10, 12, 15, 20, 50, or 100) are used more than others. Specifically, people are more likely to use more precise non-round numbers when referencing smaller quantities or figures, but are more likely to use less precise round numbers for bigger ones. This prominent frequency of certain numbers is observed across languages (Jasen & Pollmann, 2001). In a similar vein, Ozcan and Gunasti (2019) analyze the frequency of numbers 10 through 1,000 in Google Books data and find that round numbers are used seven times more than other numbers. For example, in the range from 10 to 20, frequently used numbers were 10, 12, 15, and 20, the same as the results of Dehaene and Mehler (1992). In the numbers range from 50 to 100, the most significant frequency numbers were 50 and 100; other frequently used numbers were 50, 60, 70, 80, and 90. In summary, some round numbers are used more frequently than others numbers, leading them to have cognitive salience.

Processing fluency. Due to cognitive salience and accessibility, round numbers (vs. non-round numbers) are easier to process (King & Janiszewski, 2011; Thomas et al., 2010;

Wadhwa & Zhang, 2015), retrieve (Isaac & Schindler, 2014; Isaac et al., 2021; Schindler & Wiman, 1989), and perform mathematical operations with (Jasen & Pollmann, 2001; King & Janiszewski, 2011). For example, Schindler and Wiman (1989) presented pairs of prices to participants and asked them to recall these prices two days later (e.g., $400.00 vs. $399.99 vs. $399.98). Participants recalled round number prices more accurately than non-round number prices. Due to processing fluency, consumers are more likely to experience "feeling right" when they choose options described in round numbers (King & Janiszewski, 2011; Thomas et al., 2010; Wadhwa & Zhang, 2015), and often prefer round number prices over non-round prices (Guido & Peluso, 2004; Isaac et al., 2021).

2.2.4. Judgments and Inferences Influenced by Round Numbers

Less accurate. Because round numbers are used to express estimates, round numbers represent not only the exact number itself but are also assumed to represent a wide range of numbers (Pena-Marin & Wu, 2019). Therefore, people tend to infer that information expressed in round numbers is less accurate and, thus, less believable than information expressed in precise numbers (Schindler & Yalch, 2006). For example, Schindler and Yalch (2006) show that participants judged the round number claim ("Lasts 50% longer than any other deodorant") less likely to be based on empirical evidence than non-round number claims ("Lasts 47% (or 53%) longer than any other deodorant"). Consequently, using round numbers is seen as less confident than using non-round numbers (Jerez-Fernandez et al., 2014).

The use of round numbers may also have negative consequences in contexts when higher accuracy is appreciated (Park & Kwon, 2022). For instance, Park and Kwon (2022) demonstrate that when a technology product is unfamiliar, performance-related attribute

information expressed in round numbers (vs. precise numbers) is seen as low-calibrated, leading to a decrease in the perceived reliability of the technology and a lower willingness to purchase. However, using round numbers may be beneficial in other contexts (Pena-Marin & Wu, 2019). For example, Pena-Marin and Wu (2019) show that when the estimate is incorrect, round number estimates elicit higher source trustworthiness than estimates in precise numbers, even if the precise estimate is more accurate.

Greater in magnitude. Individuals tend to use more precise non-round numbers for smaller magnitudes and round numbers for greater magnitudes. Because of this relationship between the frequency of number usage and the magnitude of the number, consumers tend to judge round number prices as greater in magnitude than non-round number prices of similar magnitude, even if the round prices are smaller than the precise prices (Thomas et al., 2010). This magnitude judgment influences consumers' willingness to pay. Thomas et al. (2010) analyze real estate transaction data and show that prices ending with more zeros decrease the sale price. In other words, round prices decrease buyers' willingness to pay relative to non-round prices.

Reliance on feelings. As fluently processed targets lead people to rely more on feelings than cognition when making judgments and decisions (Alter et al., 2007), round number prices increase reliance on feelings. Therefore, consumers evaluate products more positively when they have round prices (vs. non-round prices) and are presented in feelings-based contexts (Wadhwa & Zhang, 2015). For instance, Wadhwa and Zhang (2015) demonstrate that participants rated greater anticipated satisfaction with a camera with a round price (vs. non-round price) when the consumption goal was hedonic (in a vacation, feelings-based context). In contrast, when the consumption goal was utilitarian (in a class project, cognitive-based context), participants rated greater anticipated satisfaction with a camera with a non-round price.

2.2.5. Round Numbers as Category Boundaries

Previous research has shown that people use round number categories to interpret figures they encounter in the world, rather than perceiving continuity across numbers (Alter & Hershfield, 2014; Isaac & Schindler, 2014). Numbers slightly above these round number categories (e.g., 1,001) trigger increased arousal, as they fall just beyond the category boundaries (Huang & Gong, 2018). The round number that serves as a landmark signaling a category boundary is context-dependent (Dehaene & Mehler, 1992). For instance, intervals of 10 indicate the numbers most frequently used in the range between 30 and 50 (30, 40, 50), though the interval becomes 100 when the range is 300 and 500 (300, 400, 500; Ozcan & Gunasti, 2019). Similarly, when considering one-unit increments, 10 may be a landmark (e.g., every 10-year birthday is a landmark). But if 10-unit increments are used, 100 is likely to be a landmark (e.g., a 100 score is a landmark when solving a puzzle with a score of 10 at each increment).

Consumers infer a greater difference between numbers when they span round number categories, rather than both being in the same round number category. And this bias influences evaluations of entities tied to these numbers (Alter & Hershfield, 2014; Isaac & Schindler, 2014). For example, Isaac and Schindler (2014) show that consumers perceive a greater distance between ranked numbers 10 and 11 compared to the distance between 9 and 10 or 11 and 12 on a ranked list, as 10 and 11 are perceived as being in different categories, while 9 and 10 or 11 and 12 are perceived as being in the same round number categories (i.e., the top-ten effect).

This inclination to evaluate numbers based on round number categories has behavioral consequences. Alter and Hershfield (2014) demonstrate that people perceive the human life span based on 10-year period categories rather than continuously (e.g., “twenties,”

"thirties") and judge which age group they belong to based on these landmark ages. Therefore, reaching a landmark age is not just adding one more year to chronological age but is perceived as a life transition from one stage to another. For example, turning 30 years old seems special compared to a 27th birthday. The approach of a new decade represents a salient boundary between life stages and functions as a landmark, leading people to behave in ways to search for the meaning of life when they approach a landmark age (e.g., at ages 29, 39, 49, etc.).

2.2.6. Associations with Round Numbers and Consequences in Consumer Behavior

Round numbers evoke various associations beyond their numeric values. Previous research has found that round numbers are associated with completeness (Gunasti & Ozcan, 2016; Yan & Pena-Marin, 2017), stability (Pena-Marin & Bhargave, 2016), and femininity (Yan, 2016). Due to these associations, round numbers affect consumer behaviors differently compared to non-round numbers.

Completeness. Round numbers are often used to indicate the level of completion in our daily communications. For example, a 100 score often refers to a perfect score; 100% refers to the whole. Therefore, round numbers are associated with perceived completeness. Implicit Association Test (IAT) results (categorizing numbers into "complete" or "incomplete") showed that numbers were more likely to be categorized as complete and showed faster response times if they were round rather than non-round numbers (Gunasti & Ozcan, 2016; Yan & Pena-Marin, 2017). Gunasti and Ozcan (2016) provide further empirical evidence for this association. In one of their studies, participants were asked to rate the perceived completeness of consecutive numbers ranging from 10 to 100 ("this number may imply completeness, wholeness, or fullness", p. 311). After the rating task, participants saw

another 30 numbers and were asked to write the first adjective they thought related to the numbers. Results revealed that round numbers—10 basis numbers (10, 20, 30, […], 100) and two five-ending numbers (25 and 75)—showed significantly higher scores in perceived completeness than other numbers. Furthermore, participants used more completeness-related adjectives to describe round numbers than non-round numbers.

The association between round numbers and completeness affects consumer behaviors. For example, when bargainers consider closing a deal, they are more likely to accept round-number offers compared to non-round-number offers because round numbers signal completion (Yan & Pena-Marin, 2017). Brand names that include round numbers (e.g., Centrum 100) are perceived as more complete and are, thus, more preferred than brand names with non-round numbers (e.g., Centrum 97 or Centrum 103; Gunasti & Ozcan, 2016).

Stability. Round numbers are associated with a sense of stability. For example, participants rated a stronger feeling of stability for the number 200 compared to the number 203 ("stable," "durable," and "balanced"). Due to the association with stability, consumers perceive product benefits will last longer when product characteristics are described in round numbers than non-round numbers (Pena-Marin & Bhargave, 2016). For example, in one study, Pena-Marin and Bhargave (2016) show that participants perceived that an energy drink with 100 mg of caffeine would provide longer-lasting consequences than an energy drink with 102 mg of caffeine. Similarly, participants felt that a tablet containing 100 mg of miraculin would have a longer-lasting effect than a tablet containing 103.97 mg of miraculin. Moreover, participants indicated a higher likelihood of future consumption of the tablet with a round number description (100 mg) than the tablet with a non-round number (103.97 mg).

Femininity. People even make associations between numbers and gender-related meanings. Round numbers are seen as more feminine, while more precise non-round numbers

are seen as more masculine (Yan, 2016). Yan (2016) asked participants to imagine a series of numbers as human (20, 40, 60, and 80 for the round number condition; 19.92, 39.94, 59.96, and 79.98 for the precise "under" condition; 20.08, 40.06, 60.04, and 80.02 for the precise "over" condition) and rate how feminine or masculine the number seemed. The results showed that round numbers were rated more feminine than other precise numbers, regardless of whether precise numbers were smaller or larger than round numbers. Results from an IAT task showed that participants have implicit associations between numbers and gendered meanings—round number/female and non-round number/male pairings. Participants responded more quickly when round numbers were paired with female names and non-round numbers were paired with male names compared to the opposite pairing (round numbers/male names vs. non-round numbers/female names).

This round number/gender association affects consumer behavior. Participants evaluate products with round numbers more favorably when the product category or attributes are positioned as feminine (Yan, 2016). In one experiment by Yan (2016), for women's shampoo (white in color with the word "women" in the brand name), participants showed more favorable evaluations when the product information was presented using round numbers ("rated 90 by Consumer Reports," "Performing 10% better than competing brands") than precise numbers ("rated 90.02 by Consumer Reports," "Performing 9.98% better than competing brands"). In contrast, for men's shampoo (blue in color with the word "men" in the brand name), participants rated the product more favorably when the product information was described using precise numbers rather than round numbers.

2.2.7. Round Numbers in Consumer Behavior: Monetary Decisions

Consumers prefer round number prices over non-round prices of similar magnitude and are more likely to select round number prices as their final or total prices (Isaac et al., 2021; Lynn et al., 2013; Yan & Pena-Marin, 2017). For example, Lynn et al. (2013) analyze real-world gasoline purchase data, showing consumers' self-pumped gas prices were more likely to be round number prices (56%, ending in .00) or half of these round number prices (4%, ending in .50), far greater than the chance level. The median was $20.00, and the mode was $10.00. Round number preferences as final prices occur in various monetary decision contexts beyond purchase decisions. For instance, individuals are more likely to pay off round-number debts faster than non-round-number debts (Isaac et al., 2021), and bargainers are more likely to accept a round-number offer than a non-round offer (Yan & Pena-Marin, 2017).

Moreover, consumers are more likely to donate when a round number amount is available to choose for their donation (Hwang et al., 2021; Kelting et al., 2019), even if they must donate more money by choosing a round number option (Reiley & Samek, 2019). Field experiment results from a study conducted by Reiley and Samek (2019) showed that consumers were more likely to donate when a round number amount is available among suggested amounts (e.g., $35, $50, $75, $100, $250, and a write-in option) compared to no round number options (e.g., $35, $50, $75, $95, $250, and a write-in option). Even if there was no round number option among suggested amounts (i.e., no $100 option but having a $95 option), consumers selected $100 to donate through the write-in option.

Recently, a growing number of companies have asked consumers to round up their total bill to the next whole dollar and donate the difference to a charity. These round-up donations explicitly activate the concept of roundedness and introduce a round number for

the overall total. Participants are more likely to donate for a round-up donation request than a flat donation request, as round-up donations decrease the pain of consumers' donations (Hwang et al., 2021; Kelting et al., 2019).

2.2.8. Round Numbers in Performance: Goals, Progress Perception, and Feedback

Round numbers as goals. Individuals prefer to set goals at round numbers, regardless of whether a goal is for the self or others (Gunasti & Ozcan, 2016; Lin & Pursiainen, 2021), explicit or implicit (Pope & Simonsohn, 2011). For example, fundraisers are more likely to select round numbers as their goal amounts. Crowdfunding goal amounts are clustered at round numbers, having $5,000 and $10,000 as the two most frequent goal amounts (Lin & Pursiainen, 2021). In a similar vein, individuals are more likely to expect other people's goals to be a round number. Gunasti and Ozcan (2016) asked participants to answer how many more pounds should be lost to reach the individual's goal when a person had lost 46 pounds; 71% of participants answered 4, 14, 54, etc. pounds, making the goal 50, 60, 100, etc. pounds. In contrast, when participants were told that a person had lost 44 pounds, only 7% of participants wrote these numbers.

Individuals tend to judge their performance in various competitive activities based on whether they reach relevant round numbers, giving these numbers the role of an implicit goal even though they are not tied to external rewards (Allen et al., 2017; Pope & Simonsohn, 2011). For instance, Pope and Simonsohn (2011) show that a performance score just below a round number motivates people to improve their final score to be just above these numbers in various contexts. SAT exam takers are more likely to retake the exam when their score is just below a round number (e.g., 990) than just above (e.g., 1,000). Professional baseball players with .299 averages are more likely to exert effort in the last scheduled plate appearance to

finish their season above .300 averages. In contrast, players with averages just above .300 end their season earlier (Pope & Simonsohn, 2011).

Progress perception. Individuals feel a greater sense of accomplishment when their progress is expressed in a round number than a non-round number, even when the objective progress is greater in non-round numbers. Gunasti and Ozcan (2019) found that people perceive different levels of accomplishment based on the numbers used to express progress. For example, progress expressed with a round number (e.g., 10 kg) leads people to feel more accomplished than the identical progress expressed in a non-round number using a different scale (e.g., 22 lbs) (Gunasti & Ozcan, 2019).

Numeric feedback. Numbers also occur in performance contexts as a form of feedback. Numeric feedback is often provided to people on their performance (Anseel et al., 2007; Ashford & Tsui, 1991), and accumulated numeric feedback is used to indicate the performer's progress (Wilson & Ross, 2001). Round number feedback influences people's subjective evaluation of their performance and progress. For instance, receiving round number feedback (e.g., a score of 60) encourages self-comparison, leading people to use themselves as a reference point. In contrast, receiving precise number feedback (e.g., a score of 61) encourages social comparison, leading people to use others as a reference point (Shoham & Munichor, 2021).

Drawing on prior research, we contend that multiples of 100—the century mark—encountered during cumulative feedback will obtain a distinct meaning beyond their numeric value. The next chapter provides a theoretical framework to elucidate how and why century marks inherent to cumulative feedback influence performers' decisions to stop.

Table 1. Definitions of Round Numbers

Authors (Year, *Journal)*	What is a Round Number
Dehaene & Mehler (1992, *Cognition)* Wadhwa & Zhang (2014, *Journal of Consumer Research)*	Numbers with cognitive salience and more frequently used in communications (e.g., 10, 12, 15, 20, 50, or 100).
Schindler & Yalch (2006, *Advances in Consumer Research*) Lynn, Flynn, & Helion (2013, *Journal of Economic Psychology*) Isaac & Schindler (2014, *Journal of Consumer Research*)	Multiples of 10 (e.g., 10, 20, 30) and halfway points between these multiples (e.g., 5, 15, 25).
Gunasti & Ozcan (2016, *Marketing Letters)* Gunasti & Ozcan (2019, *Marketing Letters*) Isaac, Wang, & Schindler (2021, *Journal of Consumer Psychology*)	Zero-ending or five-ending numbers.
Ozcan & Gunasti (2019, *Journal of Brand Management*)	Not all zero-ending or five-ending numbers are the same (see also Jasen & Pollmann, 2001).
Thomas, Simon, & Kadiyali (2010, *Marketing Science*) Yan (2016, *Journal of Consumer Research*) Pena-Marin & Bhargave (2016, *Journal of Consumer Psychology*) Pena-Marin & Wu (2019, *Journal of Consumer Psychology*) Shoham & Munichor (2021, *Frontiers in Psychology*)	Numbers ending with more zeros.

Table 2. Round Number Research in Consumer Behavior Contexts

Features of round number	Authors (Year, *Journal*)	Key findings
Processing fluency	Schindler & Wiman (1989, *Journal of Business Research*)	Round number prices are more likely to be recalled accurately than non-round number prices.
	Thomas, Simon, & Kadiyali (2010, *Marketing Science*)	Non-round numbers in large prices can lead consumers to feel uncertainty as they are more difficult to process than round numbers.
	Isaac, Wang, & Schindler (2021, *Journal of Consumer Psychology*)	Round number debts are more likely to be paid off faster than non-round number debts of similar magnitude due to processing fluency and retrieval fluency of round numbers.
Judgments (less accurate)	Jerez-Fernandez, Angulo, & Oppenheimer (2014, *Psychological Science*)	The use of round numbers is seen as less confident than non-round numbers.
	Park & Kwon (2022, *Journal of Consumer Psychology*)	When an attribute of a technology product is unfamiliar, attribute information in round numbers decreases willingness to purchase the product compared to non-round number information. This is because of the perceived reliability of the technology.
	Pena-Marin & Wu (2019, *Journal of Consumer Psychology*)	When the estimate is revealed to be incorrect, round number estimates increase source trustworthiness than non-round number estimates, even if the non-round number estimate is objectively more accurate than the round number estimate.

	Schindler & Yalch (2006, *Advances in Consumer Research*)	Round number claims are more likely to be estimates (less factual) and, therefore, less believable than non-round number claims.
Judgments (greater magnitude)	Thomas, Simon, & Kadiyali (2010, *Marketing Science*)	Round number prices are judged to be greater than non-round number prices, leading to a lower willingness to pay for houses using round number prices.
Judgments (feelings-based)	Wadhwa & Zhang (2015, *Journal of Consumer Research*)	Round number prices lead people to experience "feeling right" and increase positive evaluation when the purchase decision is driven by feelings (vs. cognition).
Category boundaries	Alter & Hershfield (2014, *Proceedings of the National Academy of Sciences*)	Round number ages (e.g., 30, 40, 50, etc.) are seen as more special than other ages. Therefore, people are more likely to engage in behaviors that search for existential meaning when they approach a new decade in age (e.g., at ages 29, 39, 49, etc.).
	Huang & Gong (2018, *Journal of Consumer Research*)	Numbers slightly above a round number category boundary (e.g., 1,001, slightly above 1,000) increase arousal. Number-induced arousal can be misattributed to the product, leading consumers to want the product more.
	Isaac & Schindler (2014, *Journal of Consumer Research*)	Consumers subjectively divide ranked lists into round number categories (e.g., top ten) and exaggerate differences between numbers that belong to different round number categories (e.g., the difference between 10 and 11 is perceived as greater than the difference between 9 and 10).

Associations (completeness)	Gunasti & Ozcan (2016, *Marketing Letters*)	Round numbers are associated with perceived completeness. Consumers are likely to evaluate brand names that include round numbers more favorably because they perceive round numbers as thresholds for reaching particular levels of completeness.
	Yan & Pena-Marin (2017, *Journal of Consumer Research*)	Round numbers are associated with completion; therefore, round number offers are more likely to be accepted by bargainers than non-round number offers.
Associations (stability)	Pena-Marin & Bhargave (2016, *Journal of Consumer Psychology*)	Product characteristics described in round numbers are perceived as lasting longer than those described in non-round numbers.
Associations (femininity)	Yan (2016, *Journal of Consumer Research*)	Marketing communications using round numbers lead to more favorable evaluations when the products are positioned as feminine (vs. masculine) than non-round number communications.
Preferred to be selected as a total/final price	Isaac, Wang, & Schindler (2021, *Journal of Consumer Psychology*)	Round number debts are more likely to be paid off faster than non-round number debts of similar magnitude.
	Lynn, Flynn, & Helion (2013, *Journal of Economic Psychology*)	Round number prices are more likely to be selected as total or final prices by consumers than non-round number prices.
	Yan & Pena-Marin (2017, *Journal of Consumer Research*)	Round number offers are more likely to be accepted by bargainers than non-round number offers.

Preferred to be selected as a donation amount	Hwang, Choi, & Mattila (2021, *International Journal of Hospitality Management*)	Round-up donations decrease the pain of donation and increase donation likelihood. This effect occurs in a crowded environment.
	Kelting, Robinson, & Lutz (2019, *Journal of Consumer Psychology*)	Round-up donation requests lead to more favorable responses from consumers than flat donation requests with identical amounts.
	Reiley & Samek (2019, *Economic Inquiry*)	Removal of round number donation options from the suggested amounts decreases donations.
Serve as goals	Lin & Pursiainen (2021, *Journal of Corporate Finance*)	Round number amounts are more likely to be selected as crowdfunding goals than non-round number amounts.
	Pope & Simonsohn (2011, *Psychological Science*)	Round numbers play the role of reference points in performance. People are more likely to perform to finish just above rather than just below these round number scores.
Progress perception/feedback	Gunasti & Ozcan (2019, *Marketing Letters*)	Progress expressed in round numbers leads to a higher sense of accomplishment than identical progress expressed in non-round numbers on a different scale.
	Shoham & Munichor (2021, *Frontiers in Psychology*)	Round number feedback (e.g., a score of 60) leads people to use themselves as a reference point. In contrast, non-round number feedback (e.g., a score of 61) leads people to use others as reference points.

3. THEORETICAL FRAMEWORK

3.1. Preliminary Considerations

This research focuses on an ongoing performance task that consists of multiple independent subtasks in which the performer can stop at any time. By completing more subtasks, the performer accumulates more rewards which are conveyed to them by numerical cumulative feedback, and it is their decision how many subtasks to complete. In this situation, how many subtasks should a performer do, and when is “a good time to stop?”

This research posits that performers use century marks—multiples of 100—encountered in the course of cumulative feedback as a stopping rule. While other round numbers could be encountered, this research focuses on 100 as a psychological landmark due to its heightened cognitive salience than other round numbers. For instance, the frequency of 100 in communications is significantly higher than other round numbers (Dehaene & Mehler, 1992; Ozcan & Gunasti, 2019). Moreover, in language discourse, 100 is used to express wholeness, completeness, and perfection (e.g., "100% sure"; "50/50" also implies that the whole is 100). People view 100% as a saliant landmark, leading them to overweight it (Li & Chapman, 2009) and produce cognitive errors when processing percentage changes greater than 100% (Fisher & Mormann, 2022). Further, in daily life performance contexts, multiples of 100 indicate different progress levels. For example, freshman university classes are coded by 100 (e.g., PSY 101), while 200, 300, and 400 stand for sophomore-, junior-, and senior-level classes, respectively. Individuals perceive 100 as a landmark that induces a discontinuity in perception of time. In one experiment conducted by Koo et al. (2020), participants were more likely to perceive 100 seconds as the beginning of a new section than when it is presented as 1 minute and 40 seconds.

3.2. Century Mark Feedback Evokes a Sense of Closure

This research proposes that when there is no specific goal, performers are attentive to cumulative feedback information, and century marks are imbued with unintended meaning. Performers may view ongoing performance as a series of performance sets, with century marks serving as psychological landmarks that signify the completion of one set and the start of another. Therefore, reaching a century mark is interpreted as "closing" the current performance set and evokes a sense of closure, while continuing beyond the century mark may be perceived as "starting" a new performance set. This assertion is grounded on the theoretical perspectives discussed in the previous chapter. First, people incline to divide consecutive numbers into subjective categories, with round numbers as category boundaries (Alter & Hershfield, 2014; Huang & Gong, 2018; Isaac & Schindler, 2014, Koo et al., 2020). Second, round numbers are associated with completeness, and people perceive greater completeness for a subject includes a round number rather than a non-round one (Gunasti & Ozcan, 2016; Yan & Pena-Main, 2017). Third, people prefer to set round numbers as goals, regardless of whether a goal is for themselves or others (Gunasti & Ozcan, 2016; Lin & Pursiainen, 2021), or is explicit or implicit (Pope & Simonsohn, 2011).

This research proposes that performers subjectively judge their progress based on whether a century mark has been reached. Specifically, when contemplating whether to stop, performers may view arriving at 100 units as *finishing* a set, whereas stopping short of 100 could be viewed as *quitting* in the middle. Therefore, performers should feel a greater sense of closure when they reach century marks, which they interpret it as finishing a set. While an individual's need for closure varies across different contexts (Webster & Kruglanski, 1994) and is determined by the perceived benefits and costs of possessing versus lacking closure, people tend to seek closure when it seems feasible. This tendency can be influenced by contextual features that make benefits and costs more salient (Hiel & Mervielde, 2003;

Kruglanski, Pierro, Mannetti, & De Grada, 2006). For example, individuals may be more motivated to seek closure when they are nearing the end of a goal (Roberts & Fishbach, 2020). Performers may not consider stopping at a century mark to obtain a sense of closure when they commence a task, but it may arise when performers approach a century mark. Critically, the cost of obtaining closure become smaller as performers approach century marks, leading them to conduct a few more actions to reach a century mark and obtain closure rather than quitting a few steps before and not obtaining closure.

To conclude, this research proposes that performers are more likely to choose a finishing point that provides them with a sense of closure and will adjust performance to stop at this point. Therefore, performers are more likely to choose to stop at a century mark rather than quitting a few steps before.

H1: Performers are more likely to stop at century marks than at other possible stopping points.

H2: Performers who stop at century marks feel a greater sense of closure than those who do not stop at century marks.

H3: Performers sense of closure mediates the effect of century marks on decisions to stop.

3.3. The Effect of Century Marks on Task Persistence

We propose that the drive to feel a strong sense of closure when stopping leads performers to persist until they reach century marks, regardless of the total number of subtasks they must complete. In particular, performers persist in the task for longer or shorter in order to finish at century marks.

The present research proposes that the more subtasks it takes to arrive at a century mark, the more subtasks performers will complete. In contrast to the intuition that providing performers more rewards per subtask will increase task persistence, this research suggests that less rewards per subtask will increase performer persistence because it will require them to complete more subtasks to reach a century mark. For example, imagine that three performers receive cumulative feedback providing 5, 10, and 20 points per successfully completed subtask, respectively. The performer that receives 20 points per subtask will reach 100 points after completing five subtasks, the performer receiving 10 points per subtask must complete 10 subtasks to reach 100 points, and the performer receiving 5 points per subtask must complete 20 subtasks to reach 100 points. In each case, we predict performers will complete the number of subtasks necessary to reach a century mark. As a result, performers will persist longer when they receive fewer points per subtask completed and therefore must complete more subtasks to reach a century mark.

> **H4:** Performers are more likely to engage in more subtasks when the number of subtasks required to complete for reaching a century mark increases. The less units performers receive for completing a subtask, the more subtasks they will perform.

Intuitively, it may seem that cumulative numeric feedback would enhance performers' persistence as they would be motivated to reach a sequence of century marks (e.g., 100, 200, 300, 400, etc.). However, the same process that draws performers towards century marks can also hinder them from persisting beyond century marks. While cumulative numeric feedback leads performers to do more to reach century marks, it also prompts performers to stop at these points, thereby impeding overall task persistence.

This research proposes that cumulative numeric feedback can have divergent effects on task persistence: Performers often increase persistence prior to reaching the century mark.

But also, we expect that once reached, century marks hinder performers who may otherwise have done more work, particularly those with high motivation. In the absence of cumulative feedback and century marks, the proportion of participants who persist over the century mark increases with their level of task motivation. However, when receiving cumulative feedback, performers are likely to stop at century marks regardless of their level of task motivation, which in turn decreases the proportion of performers who continue beyond the century mark.

> **H5a:** Among performers with strong task motivation, the proportion of performers who continue after the century mark is lower for those who receive cumulative feedback than those who receive non-cumulative feedback.

> **H5b:** Among performers who have weak task motivation, the proportion of performers who persist after the century mark is similar whether they receive cumulative feedback or non-cumulative feedback.

In sum, this chapter hypothesizes the gravitational pull of century marks on subtask persistence. When receiving cumulative numeric feedback, performers encounter century marks at some point. Reaching century marks increases a sense of closure, urging performers who are a few steps below the century mark to persist. Once reached, however, these century marks hold back performers who would do more without interference, leading them to stop. Since reaching a century mark is more crucial for feelings of closure than the objective amount of participation, individuals' overall persistence is influenced by the feedback scheme and by how many subtasks are required to encounter a century mark. Seven experiments were conducted to test the proposed hypotheses, and two supplementary studies were conducted to provide a clearer explanation. The next chapter will present an overview of these studies.

4. STUDY OVERVIEW

This research conducts a comprehensive examination of whether, how and why century marks affect task persistence and stopping when performers are given cumulative numeric feedback. We hypothesize that the occurrence of century marks with cumulative numeric feedback would cause an unintended termination of task progress. To test this idea, we focus on the donation task, but the implications of our findings could be relevant to other contexts where individuals continue performing a task without a specific goal or with personal gain tied to task performance.

To fully understand the effect of century marks on task persistence, seven studies and two supplementary experiments were conducted. They include both behavioral tasks (Studies 1, 4A – 7) and scenario-based prediction tasks (Studies 2 and 3). More specifically, the first three studies (Studies 1 – 3) establish the relationship between century marks and decisions to stop the task, and demonstrate the underlying mechanism behind the effect. Study 1 employs behavioral measures to reveal that performers are significantly more likely to stop at century marks when receiving cumulative feedback (H1). Studies 2 and 3 expand on this finding by employing scenario-based prediction tasks. In Study 2, we find that participants predict a higher likelihood of stopping at century marks and willingness to complete more subtasks until arriving at century marks. In Study 3, we confirm that the effect of century marks on stopping is mediated by the sense of closure (H2 and H3).

Studies 4A – 5B demonstrate that century marks can either increase or decrease task persistence, depending on the particular situation. On the one hand, century marks could improve task persistence by manipulating the units per subtask which cumulate to achieve century marks (Studies 4A and 4B). When performers received fewer units per subtask (e.g., 9 units per subtask vs. 10 units per subtask), they performed more subtasks due to the

increased effort required to reach the century mark (H4). On the other hand, cumulative numeric feedback also can hurt task persistence among highly motivated performers, as they adjust their stopping point at the century mark even if they could continue and complete more subtasks (Studies 5A and 5B, H5a and H5b). The proportion of performers who continue beyond the century mark does not increase with their level of motivation when receiving cumulative feedback, as performers are more likely to stop once the century mark is reached. Study 6 provides additional support for these findings by showing that performers who have stopped before the century mark are willing to continue until reaching the century mark, despite the additional behavioral costs. Finally, Study 7 confirms that even in the presence of an explicit endpoint, the role of century marks as a local stopping point persists. By comparing cumulative feedback with various schemes in which century marks are encountered after completing different numbers of subtasks (Studies 4A, 4B, and 6), and comparing cumulative feedback to non-cumulative feedback (Studies 5A – 7), the present research provides a comprehensive examination of the impact of century marks on stopping.

In Studies 2 and 3, scenario-based prediction experiments, a manipulation check question was included to assess participants' understanding of the cumulative numeric feedback system. Participants who failed to choose the correct answer for this manipulation check question were excluded from the analyses in Studies 2 and 3. In the remaining studies (Study 1, 4A – 7), which involved actual behavior tasks, the question evaluating the understanding of the feedback system was not included. Instead, participants' English proficiency level was asked due to the nature of the behavioral task, which involved an English word puzzle. Participants who self-reported their English proficiency level lower than the average (rated 3 out of 5 on a Likert scale) were excluded from the analyses. Detailed exclusion criteria for each experiment are provided within their respective sections.

5. STUDY 1

5.1. Background

Study 1 aimed to examine our hypothesis that performers provided with cumulative feedback are more likely to stop at century marks than at other feedback values. First, participants read a cover story and answered filler questions as part of a paid experiment. Then, they could voluntarily perform a donation task modeled after *Freerice* (Freerice, n.d.). *Freerice* is a non-profit website and mobile application that donates 10 grains of rice to the United Nations World Food Programme for each word puzzle that people complete. Consistent with this real-world donation program, our participants earned 10 grains of rice for people in need for each subtask (word puzzle) they correctly completed. After each subtask, they received cumulative feedback that informed how many grains they had donated so far.

5.2. Method

5.2.1. Design and Participants

Study 1 was conducted online with US adult participants on Prolific for a flat rate cash payment. Two hundred and thirteen participants completed the paid portion of the experiment (54.5% females; M_{age} = 35.80 years, SD = 13.37). The 135 participants who initiated the voluntary prosocial task after the paid part of the experiment were included in the analysis (60.0% females; M_{age} = 36.83 years, SD = 13.72). The number of trials completed on the donation task was our dependent measure.

5.2.2. Procedure

A cover story informed participants the experiment aimed to understand how people evaluate products and how they think about themselves and others. Participants completed

several filler tasks evaluating products and answered individual difference measures. After providing their demographic information, all participants were presented with the prosocial task: correctly choosing a target word's synonym from four words. Participants could complete a maximum of 40 subtasks, but they were not informed of this endpoint unless they reached it.

In this and all other studies we introduced the donation task to participants as unrelated to the paid part of the survey: "Thank you for your participation in this study! You have completed all questions required for payment. Before leaving the survey, we want to introduce you to an easy and good way to help people in need." The instructions highlighted the voluntary nature of participation in the donation task by stating, "If you are interested, please click the button below to generate a donation! Your survey completion rewards will be paid REGARDLESS of whether you do the Freerice task. Participation in Freerice is voluntary." Participants who chose not to participate were thanked and dismissed.

Participants who proceeded to the Freerice task were told they could terminate the task at any time and were then presented with the task. After solving each subtask, participants were given feedback about the correct answer, newly earned grains (i.e., 10 grains), and the number of total grains they had accumulated (e.g., "You have donated 100 grains" for participants who completed 10 trials correctly). After each subtask, participants chose whether to continue. The proportion of participants who stopped at each grain total notification was the dependent measure.

5.3. Results

As predicted, participants were more likely to stop at the century marks than other points. As shown in Figure 1, 28.9% of participants stopped when they had accumulated 100

grains, while no participants stopped at 90, and only 3.7% stopped at 110. Furthermore, 200, 300, and 400 grains served as the most likely stopping points for participants who continued after obtaining 100 grains, exerting a weaker gravitational effect. Since participants could complete 40 trials, the likelihood of stopping at each number equals 2.5%. As Figure 1 shows, the proportion of participants stopping at century marks was far greater than this value, and far greater than the proportion stopping at immediately adjacent numbers.

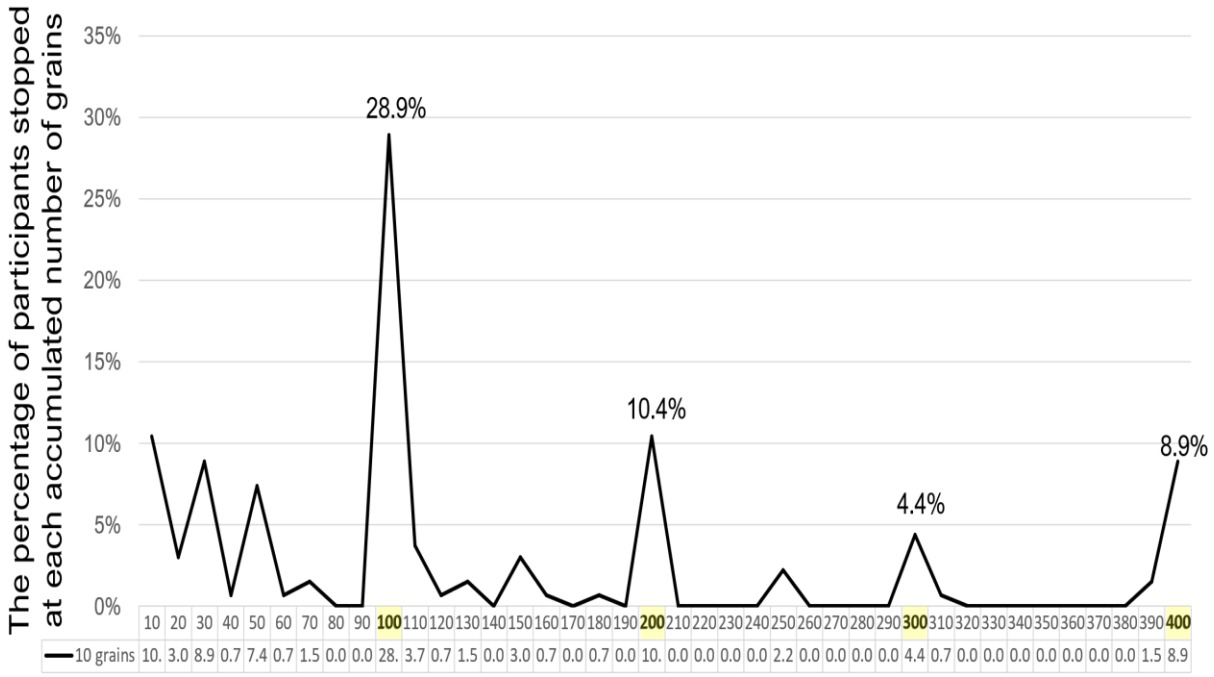

Figure 1. The % of participants who stopped at each accumulated number of grains (Study 1). Stopping rates show significant increases at multiples of 100 (century marks).

We tested whether participants stopped at century marks at a level greater than chance by comparing the proportion of values they encountered while receiving cumulative feedback (possible stopping points) and the proportion of participants who stopped at these values (actual stopping points). To achieve this, the 40 values that participants could encounter while receiving cumulative feedback (from 10 to 400 grains in increments of 10) were coded into three categories as follows: (a) century marks (100, 200, and 300), (b) the final trial

amount (400), and (c) all 36 remaining values. The 400 value was categorized independently because it is impossible to determine whether participants who stopped at 400 grains intended to cease at 400 or stopped because they could not perform any more subtasks.

A Chi-square t-test was conducted to compare the absolute proportion of the number categories and the number of participants who stopped at these categories. The results showed significant differences ($\chi^2 = 285.181$, $p < .00$), with participants being far more likely to stop at century marks than their proportion of values from the overall, and far less likely to stop at all other values (see Figure 2). Century marks represented only 7.5% of the overall values, yet 43.7% of participants stopped at century marks. By contrast, the remaining values represented 90% of the overall values, yet only 47.4% of participants stopped at them. These findings show that participants were most likely to stop at century marks, supporting hypothesis 1.

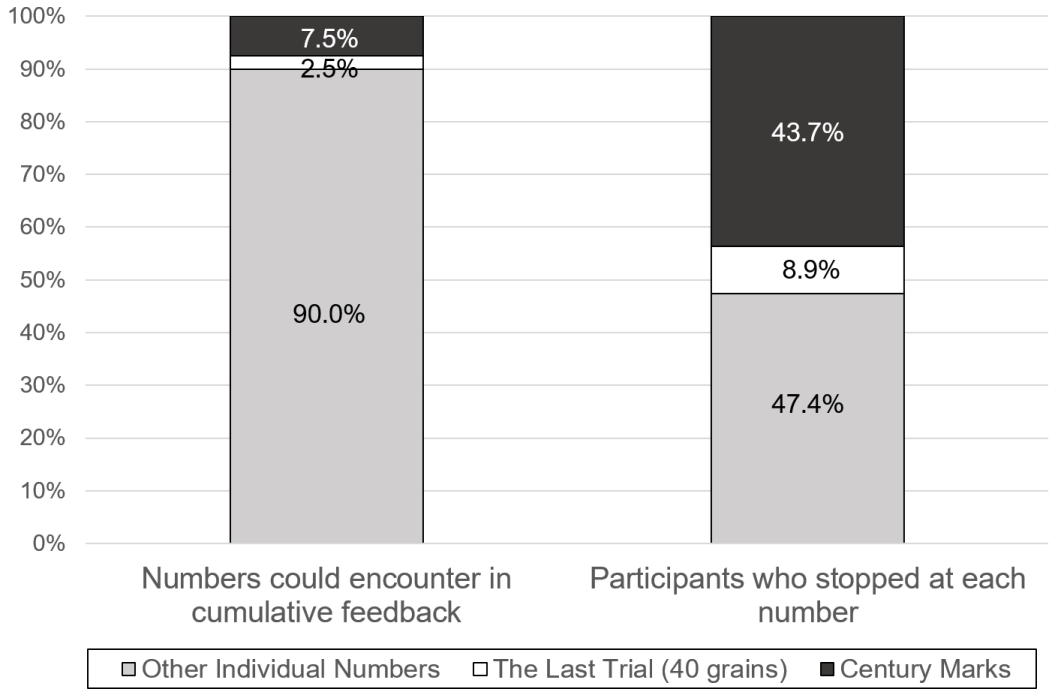

*Figure 2. T*he proportion of numbers (left) and the proportion of participants stopping at each number (right; Study 1). Although the proportion of century mark numbers was only 7.5% of all numbers, 43.7% of participants stopped at century marks (100, 200, 300).

5.4. Discussion

The results of Study 1 offer preliminary insights into the relationship between century marks and stopping behavior such that performers exhibit a greater tendency at stop at century marks when receiving cumulative numeric feedback. However, it remains unclear whether performers are merely more likely to stop at century marks when they encounter it, or whether they consciously exert extra effort to reach the century marks. Study 2 aimed to address this gap and explore the robustness of the effect by using a scenario-based prediction task. Through this task, we can examine whether performers who have stopped before century marks are willing to complete more subtasks to reach century marks. Additionally, the predictive task allows us to observe whether performers who have surpassed a century mark have a similar drive to stop as those who are at a century mark.

6. STUDY 2

6.1. Background

Study 1 shows people are far more likely to stop at century marks than non-century mark values when they receive cumulative numeric feedback. Study 2 used a prediction task to further examine the century mark effect's robustness. Participants read a scenario indicating that they had accumulated a certain number of points, then they predicted how many more subtasks they would complete before stopping. If century marks act like magnets with a gravitational pull, performers should predict continuing exactly until the next century mark, or if they were told the person was at the century landmark will stop at that point.

6.2. Method

6.2.1. Design and Participants

Study 2 used a 4 level (stopping point: 80 coins vs. 90 coins vs. 100 coins vs. 110 coins) between-subjects design. Four hundred and one Amazon Mechanical Turk workers (all US participants at least 18 years old) participated online and were paid a flat rate (45.1% of female; M_{age} = 40.08 years, SD = 11.51). Excluding three straight-liners, 11 participants who rated their English level as below average on a five-point scale (two participants rated "Below average" and nine participants rated "Average"), and 19 participants who incorrectly answered the manipulation check question, we were left with 370 participants whom we included in the analyses (45.7% of female; M_{age} = 40.12 years, SD = 11.78). Participants were randomly and evenly assigned to one of the four conditions. There were no differences in gender (p =.620) or age (p =.676) between the conditions.

6.2.2. Procedure

A cover story informed participants that the purpose of the survey was to gather the thoughts and feelings of potential volunteers for developing an online volunteering program. Participants read the instructions for Givingcoins, a similar online volunteering program to that used in Study 1, and completed one practice subtask of Givingcoins to gain a better understanding of it. Next, participants were informed of the cumulative feedback structure (i.e., receiving 10 giving coins for each correctly answered trial). To determine whether participants understood the structure, we asked them how many giving coins they would receive after correctly solving seven puzzles. Participants who chose an incorrect answer were excluded from the analyses.

Participants then read a scenario in which a volunteer was playing the Givingcoins game and had stopped at a certain point ("Now imagine that the volunteer correctly solved eight (nine vs. ten vs. eleven) puzzles, meaning that they accumulated 80 (vs. 90 vs. 100 vs. 110) coins. They decided to stop at this point"). Participants were then asked how likely they would be to stop at the same stopping point indicated by the scenario if they were to play the Givingcoins game in the future ("Now, imagine that you play the Givingcoins task in the future. How likely is it that you will stop at 80 (vs. 90 vs. 100 vs. 110) coins—the same stopping point mentioned in the scenario?" 1 = I will stop at a much earlier point, 5 = I will stop at the same point, 9 = I will stop at a much later point). Then, participants were asked what they would do if they reached the number of coins mentioned in the scenario ("If you play the Givingcoins task in the future, what will do when you reach 80 (vs. 90 vs. 100 vs. 110) coins?"). Participants were given 10 options, ranging from solving no more puzzles (ending the game at the same point as in the scenario) to solving nine or more puzzles. For example, for the 80-coin condition, participants could select "I will stop playing the game and donate a total of 80 coins," "I will solve 1 more puzzle and donate a total of 90 coins," "I will

solve 2 more puzzles and donate a total of 100 coins", … "I will solve 9 or more puzzles and donate a total of 170 coins or more." Finally, the participants provided demographic information.

6.3. Results

6.3.1. Likelihood of Stopping

We coded participants' responses into three categories based on the likelihood to stop at the same point mentioned in the scenario, which was measured on a nine-point scale: will stop at an earlier point (scale 1 to 4), at the same point (5), and at a later point (6 to 9). A chi-squared analysis revealed a significant difference between conditions ($\chi^2 = 52.45$, $p < .001$; see Figure 3). Specifically, participants in the 100-coin condition (44.6%) were significantly more likely than those in the 80-coin (12.2%), in the 90-coin (16.8%), and in the 110-coin condition (8.6%) to stop at the respective same point. Furthermore, participants in the 110-coin condition (34.4%) were significantly more likely to stop at an earlier point than those in the other conditions (18.9% In the 80-coin condition vs. 26.3% in the 90-coin condition vs. 12.0% in the 100-coin condition).

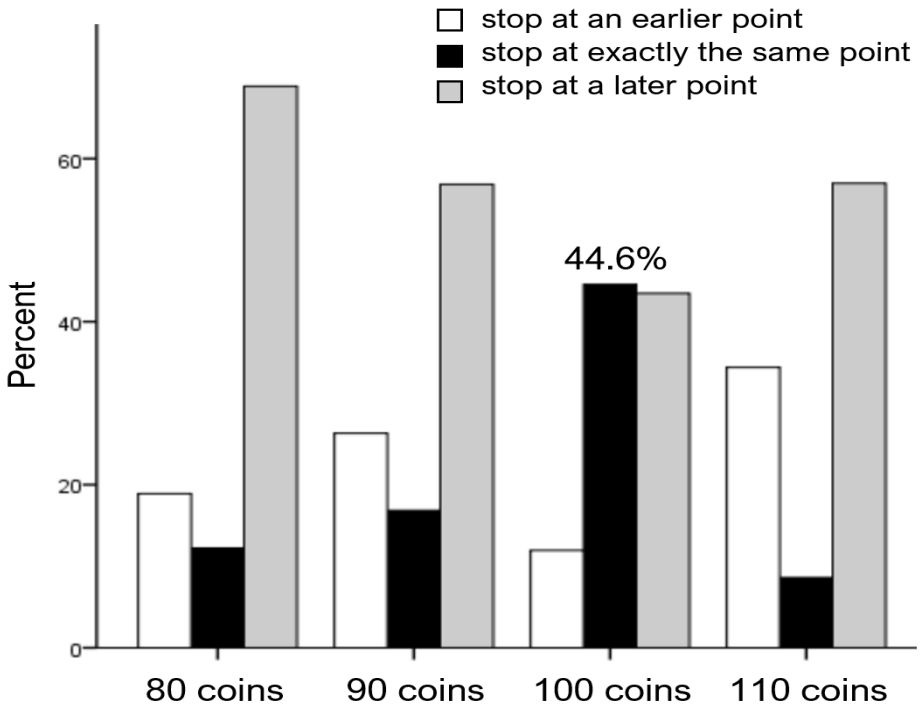

Figure 3. The likelihood of stopping at the stopping point mentioned in the scenario (Study 2). The likelihood was significantly higher in the 100-coin condition compared to each of the three other conditions.

6.3.2. Number of Additional Puzzles

As predicted, a chi-squared test revealed participants were more likely to report they would solve the number of subtasks required to reach a century mark—either 100 coins or 200 coins ($\chi^2 = 227.529$, $p < .001$; see Figure 4). Further, a century mark was the modal total score at which participants predicted they would stop, excluding those who chose not to solve any more puzzles (Figure 5). As Figure 4 shows, 28.9% of participants in the 80-coin condition said they would complete two more subtasks and reach 100 coins, 32.6% of participants in the 90-coin condition answered they would complete one more subtask and reach a total of 100 coins, 60.9% of participants in the 100-coin condition answered they would solve no more subtasks and donate 100 coins, and 26.9% of participants in the 110-coin condition said they would complete nine or more subtasks and reach 200 coins.

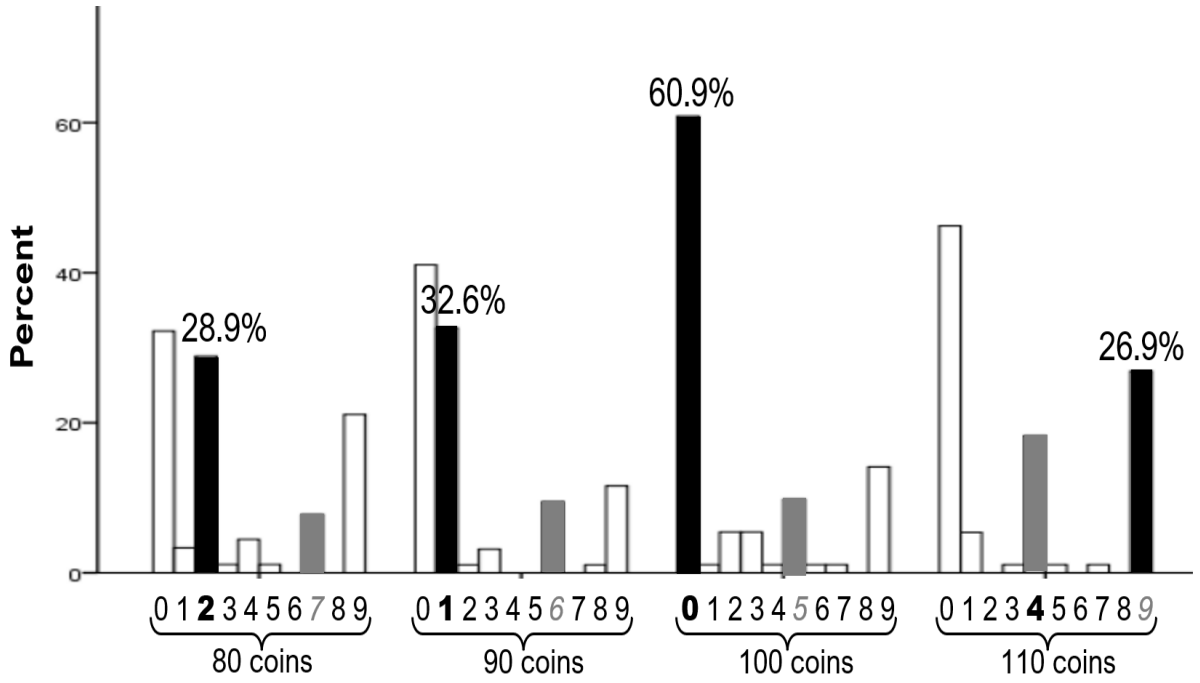

Figure 4. Predictions regarding the number of additional puzzles participants would complete (Study 2). The number of subtasks marked in bold represents the number of subtasks needed in each condition to reach a century mark (either 100 or 200 coins); the number of subtasks marked in italic gray represents the number of subtasks needed to reach 150 coins in each condition.

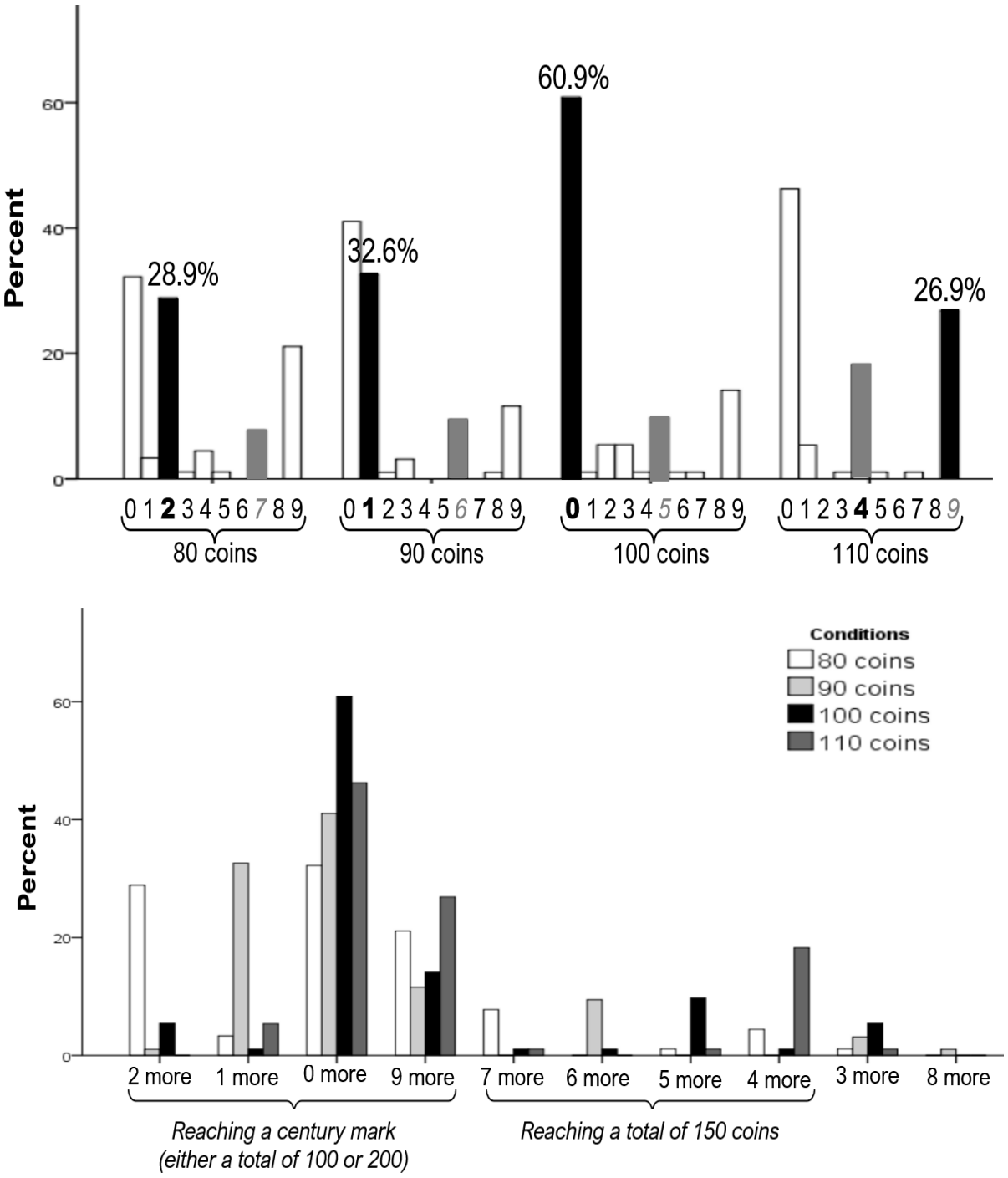

Figure 5. Predictions regarding the number of additional puzzles participants would complete (Study 2).

6.4. Discussion

Study 2 extends the findings of Study 1 by demonstrating in a prediction scenario that performers are aware that century marks as preferred stopping points and readily adjust to

stop at them. Participants who were told to imagine they were at 100 coins were more likely to stop at 100 coins. In contrast, participants in all other "imagine" conditions predicted they would do continue to do more subtasks, until they reached a century mark (total 100 coins for those in the 80- and 90-coin conditions, and total 200 coins for those in the 110-coin condition). So that they could reach a century mark, performers in the 110-coin condition predicted they would complete 4.5 times more subtasks than those in the 80-coin condition. This finding is notable because it confirms that performers are not satisfied having surpassed the century mark, but instead wish to land on this critical point before stopping. These findings support our prediction that performers are more likely to stop at century marks than at other stopping points. Having established in studies 1 and 2 the robust tendency of performers to seek century marks for concluding tasks, study 3 examines the underlying mechanism of this phenomenon.

7. STUDY 3: MEDIATING EFFECT OF SENSE OF CLOSURE

7.1. Background

What makes century marks unique in possessing a gravity-like feature that causes performers to stop at them? We propose people feel a greater sense of closure when they reach century marks compared to all other values, triggering a stopping behavior. Study 3 tests this possibility by using a scenario-based prediction task in which participants were asked to evaluate the task performer's sense of closure and willingness to complete more subtasks as a function of an accumulated progress (80 vs. 90 vs. 100 vs. 110 coins). It should be noted that the prediction task allows us to measure the sense of closure specifically evoked by reaching the century mark. This approach enables us to differentiate the closure experiences at the century mark from that elicited by completing the task in general. In contrast, if a behavioral task in which participants are asked to evaluate one's own sense of the closure were used, we could measure the sense of closure after performers have decided to stop. Some performers may report a higher sense of closure simply due to completion of the experiment, regardless of the stopping point.

7.2. Method

7.2.1. Design and Participants

Study 3 used a single factor between-subject design (accumulated progress: 80 vs. 90 vs. 100 vs. 110 coins). Four hundred participants completed an online experiment via Amazon Mechanical Turk for a flat rate cash payment (45.3% female; M_{age} = 41.2 years, *SD* = 13.5). Excluding nineteen participants who incorrectly answered the manipulation check question, 381 participants were included in the analyses (44.9% female; M_{age} = 41.0 years, *SD* = 13.4).

7.2.2. Procedure

The experimental procedure followed that used in Study 2. Participants were informed the survey aimed to understand how volunteers felt when participating in an online volunteering program. Participants learned about the Givingcoins game and answered the manipulation check question to determine their understanding of cumulative coin feedback. Then, participants read a scenario in which a volunteer played the donation game.

Participants were randomly assigned to one of four conditions: the volunteer had solved eight (vs. nine vs. ten vs. eleven) puzzles and had accumulated 80 (vs. 90 vs. 100 vs. 110) coins. Then, we asked participants to predict the volunteer's sense of closure at that point on 7-point scale (measured by three items: a sense of closure, a sense of completeness, and a sense of wholeness; Cronbach's $\alpha = .924$; presented in random order). Next, participants predicted how likely that volunteer would be to stop at 80 (vs. 90 vs. 100 vs. 110) coins (1 = not at all likely, 7 = very likely), and how many more puzzles the volunteer would solve ("What do you think the volunteer will do when they reach 80 (vs. 90 vs. 100 vs. 110) coins?" with options ranging from solving 0 to 9 or more puzzles). Finally, we measured individual differences and demographics.

7.3. Results

7.3.1. Sense of Closure

In line with hypothesis 2, the results of one-way ANOVA showed significant differences across conditions (F (3, 377) = 4.27, $p < .01$), with a higher sense of closure at the 100-coin condition than at all other conditions (see Figure 6). Participants in the 100-coin condition predicted the volunteer would feel a significantly higher sense of closure than those in the 80-coin condition ($M_{100\ coins}$ = 5.39 vs. $M_{80\ coins}$ = 4.97, t(185) = - 2.17, $p < .05$), the 90-

coin condition (vs. $M_{90\ coins}$ = 4.72, t(187) = - 3.45, p < .001), and the 110-coin condition (vs. $M_{110\ coins}$ = 5.01, t(193)= - 1.99, p < .05). There was no difference among the other three conditions ($M_{80\ coins}$ = 4.97 vs. $M_{90\ coins}$ = 4.72 vs. $M_{110\ coins}$ = 5.01, F (2, 283) = 1.50, p = .224).

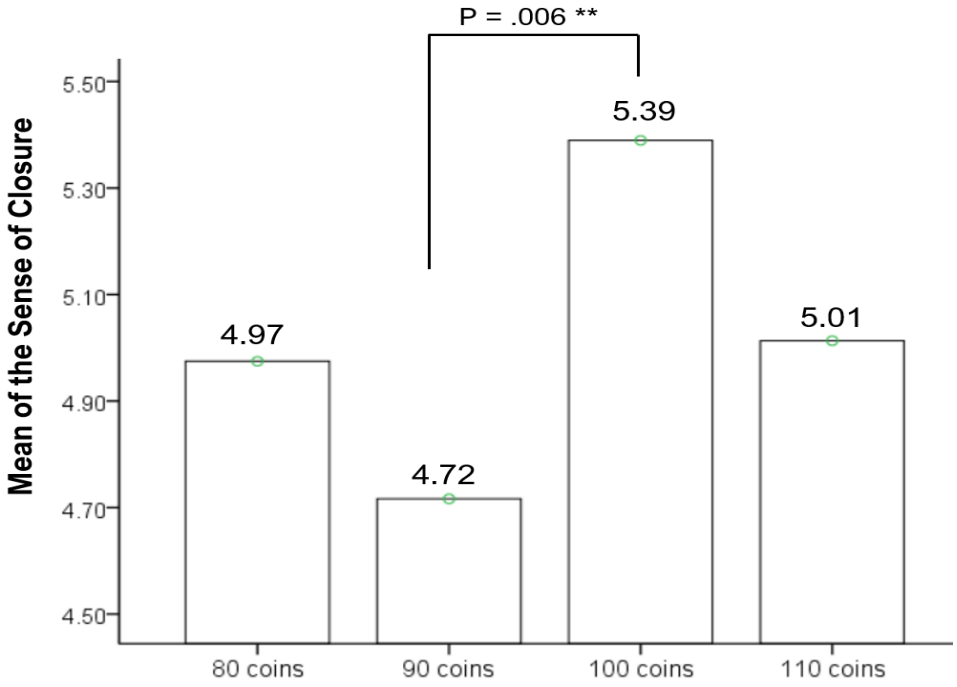

Figure 6. Means of individuals' sense of closure at each point value (Study 3).

7.3.2. Predicted Likelihood of Stopping

A one-way ANOVA revealed participants in the 100-coin condition predicted the volunteer would be more likely to stop at their assigned point value than participants in the other three conditions (F (3, 377) = 8.112, p < .00; Figure 7). Particularly, participants in the 100-coin condition predicted the volunteer would be more likely to stop at their assigned point value than those in the 80-coin condition ($M_{100\ coins}$ = 4.74 vs. $M_{80\ coins}$ = 3.95, t(185) = -3.34, p < .001), the 90-coin condition (vs. $M_{90\ coins}$ = 3.62, t(187) = -4.83, p < .00), while the difference with the 110-coin condition did not reach the significance level (vs. $M_{110\ coins}$ = 4.35, t (193) = -1.63, p = .105). Furthermore, participants predicted the volunteer would be

more likely to stop at 110 coins that at 90 coins ($M_{110\ coins}$ = 4.35 vs. $M_{90\ coins}$ = 3.62, t(192) = -3.0, p < .01).

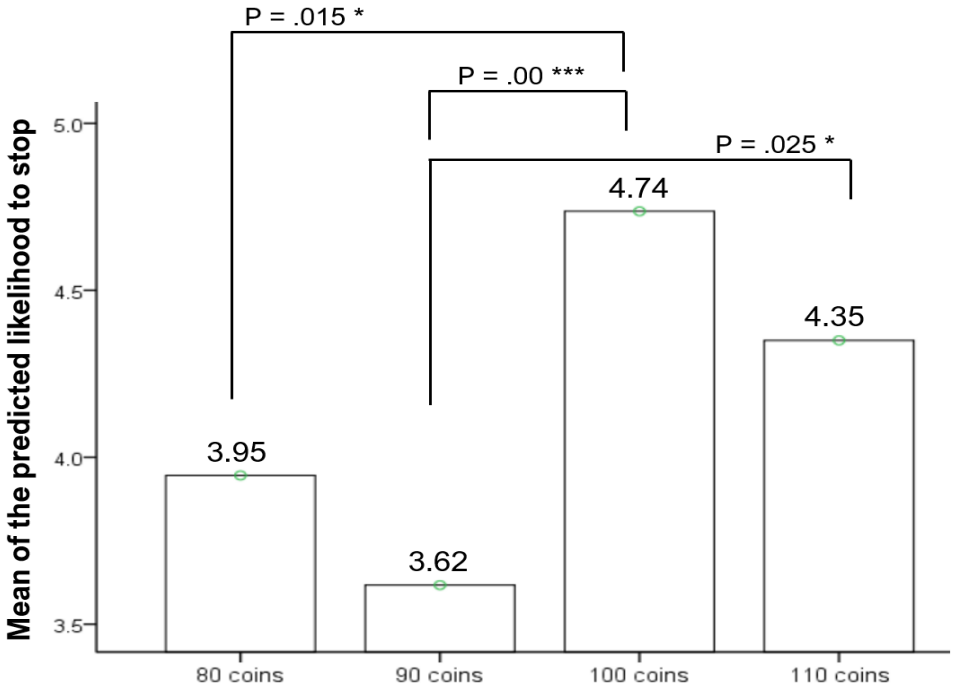

Figure 7. Means of the volunteer's predicted likelihood of stopping at each point value (Study 3).

7.3.3. Sense of Closure as a Mediator

A mediation analysis using PROCESS Macro Model 4 (Hayes, 2012) was performed to determine whether the higher sense of closure associated with reaching a century mark influences people's stopping decisions. Four conditions were dummy coded to run mediation analysis, with the 100-coin condition serving as the baseline group. Supporting H3, the results showed a mediating effect of the sense of closure on the likelihood of stopping for group comparisons between the 100-coin vs. the 80-coin conditions (indirect = -.17, *SE* = .09, 95% CI [-0.35, -0.01]), the 100-coin vs. the 90-coin conditions (indirect = -.27, *SE* = .09, 95% CI [-0.47, -0.11]), and the 100-coin vs. the 110-coin conditions (indirect = -.16, *SE* = .08, 95% CI [-0.33, -0.01]).

7.3.4. Number of Additional Puzzles the Volunteer Would Complete

We conducted a Chi-square analysis to examine whether the number of additional puzzles participants predicted the volunteer would do varied by conditions. Consistent with the findings of Study 2, participants predicted the volunteer would solve the number of subtasks required to reach either 100 (80-coin and 90-coin condition) or 200 coins (110-coin condition) in all conditions ($\chi^2 = 399.85$, $p < .00$; see Figure 8). As Figure 8 shows, 59.8% of participants in the 80-coins condition predicted the volunteer would solve two more puzzles and stop; 62.8% of participants in the 90-coin condition predicted the volunteer would solve one more puzzle and stop; 54.7% of participants in the 100-coin condition predicted the volunteer would solve no more puzzles; and 35% of participants in the 110-coin condition predicted the volunteer would solve nine or more puzzles and stop (to presumably reach total 200 of coins). These findings indicate that century marks affect people's persistence, showing that people persist until they reach a century mark.

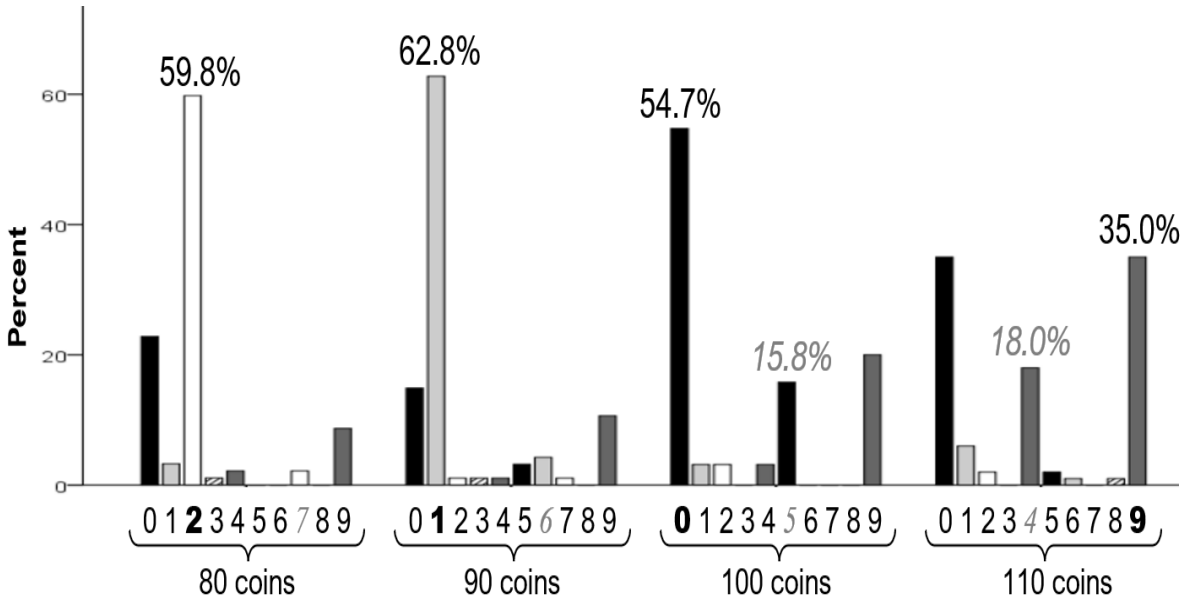

Figure 8. Predictions regarding the number of additional puzzles the volunteer would complete (Study 3). The number of subtasks marked in **bold** is the number of subtasks needed to reach the century mark in each condition (either 100 or 200 coins); the number of subtasks marked in *italic* gray is the number of subtasks needed to reach 150 coins in each condition.

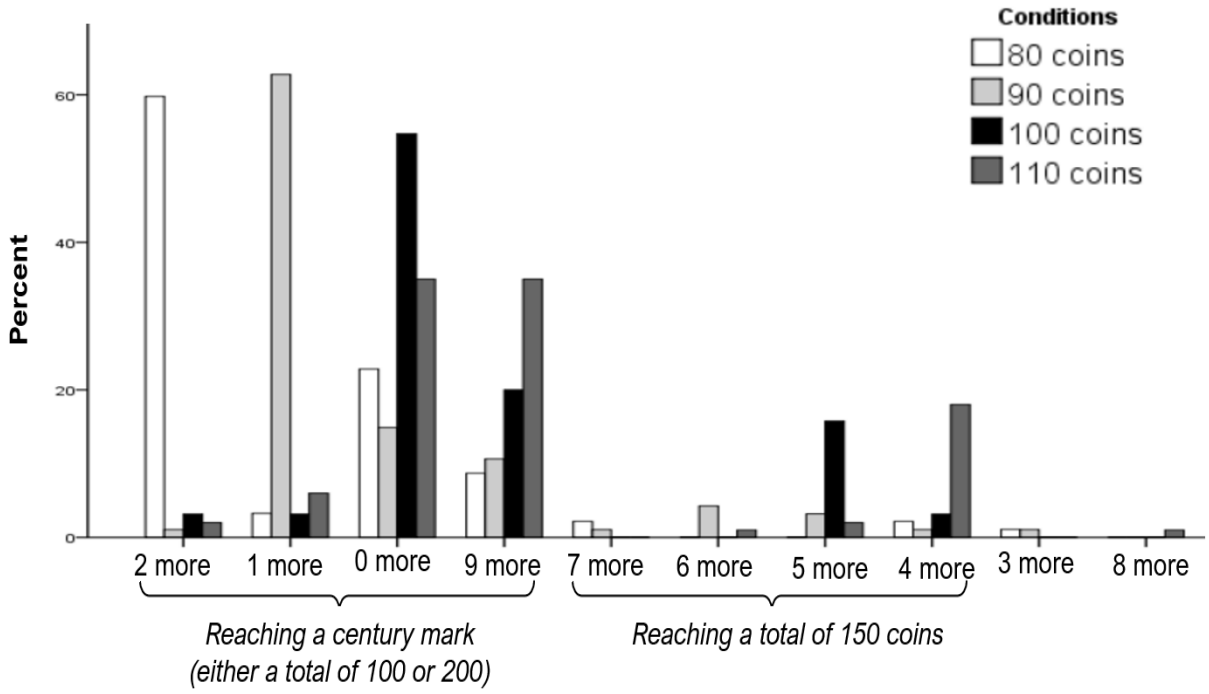

Figure 9. Predictions regarding the number of additional puzzles the volunteer would complete (Study 3)

7.4. Discussion

The results of Study 3 provide empirical evidence for the predictions that performers who stop at century marks have a greater sense of closure than those who stop at other points (H2), and that sense of closure mediates the effect of century marks on the stopping decision (H3). The fact that participants perceive volunteers will experience a greater sense of closure at 100 coins than at 110 coins implies that once a century mark is reached, progress beyond that point is perceived as starting a new performance set rather than continuing a performance set.

Studies 1- 3 demonstrate people use century marks as a stopping point and identify sense of closure as the underlying mechanism. Study 1 assessed participants' actual stopping performance, while Studies 2 and 3 used scenarios to examine the century mark effect. Participants may have answered they (and the volunteer) would continue to perform until

they reach a century mark because responding that way does not entail actual cost. It is easier to state one would complete nine more puzzles and donate a total of 200 coins than do so. In the following studies we examine actual behavior measures to provide converging evidence for the effects of century marks on stopping.

8. STUDY 4

8.1. Background

Studies 4A and 4B tested whether participants would complete more subtasks to reach the century mark when a subtask was associated with accumulating fewer points (10 vs. 9 points per subtask in Study 4A; 10 vs. 7 points per subtask in Study 4B). For example, when participants receive 10 points per subtask, they need to complete 10 subtasks to reach 100 points, but when they receive 7 points per subtask, they need to complete 15 subtasks to reach 100 points (accumulating 105 points). We predicted participants would complete more subtasks in the 9 and 7 points per subtask conditions than in the 10 points per subtask condition.

8.2. Study 4A

8.2.1. Method

Design and participants. Study 4A employed a 2 level (cumulated feedback: 10 grains per subtask vs. 9 grains per subtask) between-subject design. Three hundred ninety-two participants completed an online survey via Amazon's Mechanical Turk for a flat-rate cash payment (42.1% of females; M_{age} = 38.7 years, SD = 12.3). Of the 392 respondents, 153 participants who voluntarily initiated a donation task after completing their paid part of the survey—our dependent variable—were included in the analyses (49.7% females; M_{age} = 41.3 years, SD = 13.0; initiation rate = 39.0%).

Procedure. We used the same donation task (Freerice) as in Study 1. A cover story told participants the study aim was to understand how individuals rate technology-related products. Participants were asked to read a description of a Bluetooth earphone and indicate

their preferences. Next, we asked demographic questions. After participants clicked the "next" button to finish the survey, we introduced an online volunteering program as an activity unrelated to the previous part of the survey. Participants were informed that evaluating the technology-related products was for pay and that the donation task was voluntary.

Participants were randomly assigned to one of two conditions: Receiving 10 grains versus 9 grains per subtask. Depending on condition participants read that “for each correct answer, the cash equivalent of (9) 10 grains of rice will be sent to the World Food Programme.” Participants saw one of two volunteering program descriptions. One description told participants the donation would be saved in the fund and would help those affected by future natural disasters, presented with organization logos. The second description told participants the donation is needed now to help support the victims of the wildfires in the Western USA, from immediate assistance to long-term recovery, presented with pictures of the wildfire and organization logos. Because initiation rates were similar in the two volunteering program descriptions, we combined them in the analyses.

Then, participants were asked if they would like to do the donation task voluntarily. Those who chose not to take part were thanked, paid, and dismissed. Those who started the donation task were given cumulative feedback after each subtask and were asked whether they would like to continue. After each subtask, participants were presented with their accumulated number of grains for donation and were asked whether they would like to continue. The number of subtasks completed is the dependent variable. Participants could complete a maximum of 100 subtasks, but we did not inform them of this endpoint unless they reached it.

8.2.2. Results

Performers in the 10-grain condition were most likely to stop after completing 10 subtasks, having reached 100 grains (30%). Critically, performers persisted longer when they received fewer grains per subtask. When performers received 9 grains per subtask, 23% stopped at 12 subtasks, reaching 108 grains (Figure 10). An independent-sample median test showed a significant difference in the number of completed subtasks: 10 was the median number of subtasks completed in the 10-grain condition, and 12 was the median number of subtasks completed in the 9-grain condition ($Median_{\ 10\ grains}$ = 10.0 vs. $Median_{\ 9\ grains}$ = 12.0; χ^2 = 8.072, p = .004). Departing from the intuition that greater incentives will increase persistence, performers in the 9-grain condition completed 20% more subtasks than those in the 10-grain condition. These results support the prediction that to reach the century mark, performers receiving fewer units for completing a subtask will perform more subtasks (H4).

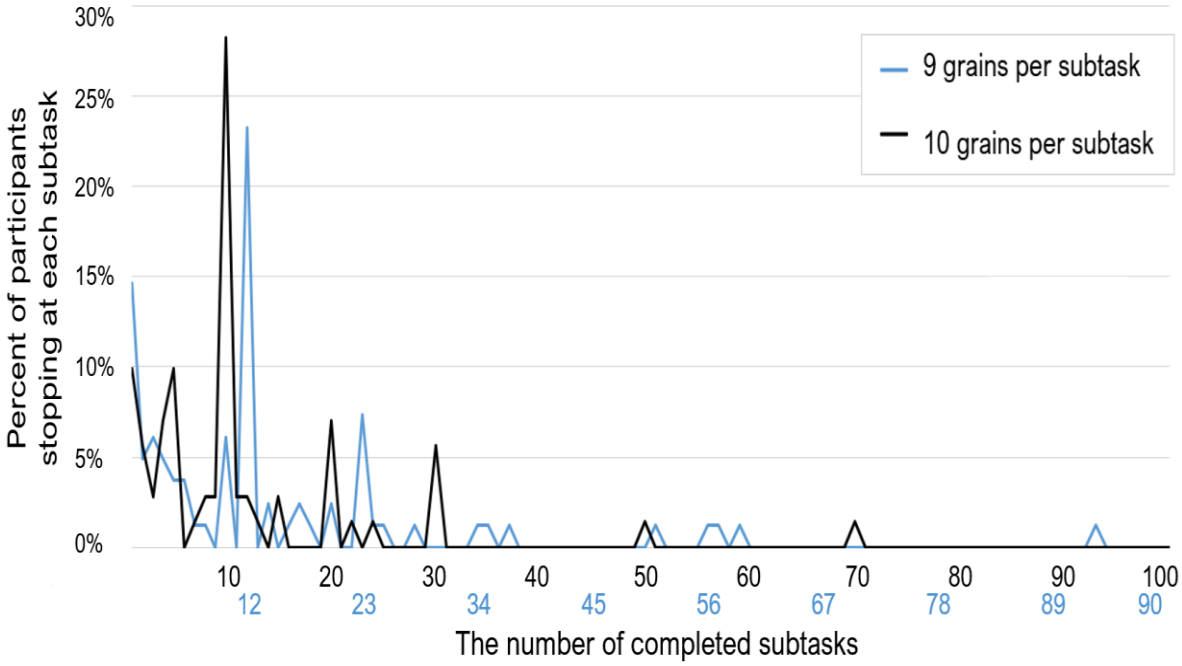

Figure 10. The modal stopping point for participants receiving 10 grains versus 9 grains per subtask (Study 4A). The modal stopping point for participants receiving 10 grains per subtask was 10 subtasks, while the modal stopping point for those receiving 9 grains per subtask was 12 subtasks.

To observe the century mark effect differently, we coded participants' stopping points into three case types: (a) cases in which the 10-grain condition reached the century marks (i.e., multiples of 10 subtasks. Participants who received 10 grains per subtask reached 100 grains while those receiving 9 grains per subtask reached 90 grains), (b) cases in which participants in the 9-grain condition reached the century mark (e.g., 12 subtasks—participants with 9 grains per subtask reached 108 grains, while participants in the 10 grains per subtask condition reached 120 grains), and (c) other cases. A Chi-square test showed that participants were more likely to stop in cases where they reached the century mark (overall: $\chi^2 = 35.172$, $p < .00$; Figure 11). Participants in the 10 grains per subtask condition were more likely to stop when they reached century marks (43.7%; e.g., when they reached 100, 200, and 300) than those in the 9-grain condition (8.5%). Participants in the 9 grains per subtask condition were also more likely to stop at subtasks in which the 9-grain condition reached the century marks (32.9%; e.g., when they reached 108, 207, 306 grains after completing 12, 23, 34 subtasks) than those in the 10-grain condition (4.2%).

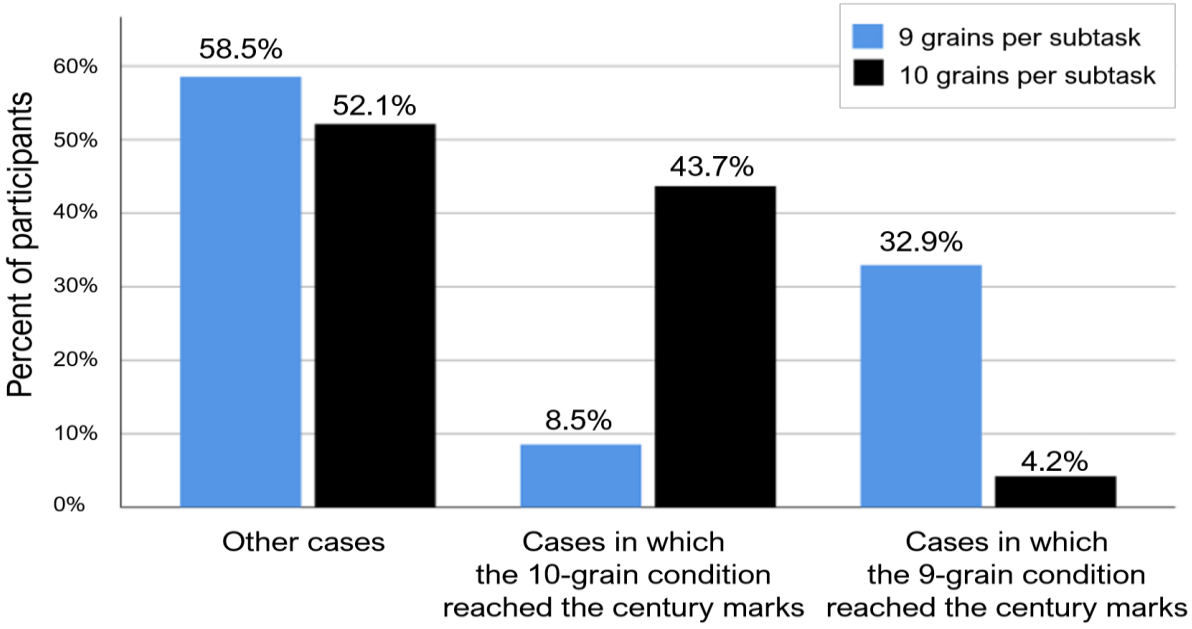

Figure 11. The proportion of participants stopped at three case types (Study 4A). Participants receiving 10 grains per subtask were more likely to stop at subtasks when the 10-grain condition reached century marks, while participants receiving 9 grains per subtask were more likely to stop at subtasks when the 9-grain condition reached century marks.

8.3. Study 4B

8.3.1. Method

Design and participants. Study 4B employed a 2 level (cumulated feedback: 10 grains per subtask vs. 7 grains per subtask) between-subject design. Two hundred eighty-seven Amazon Mechanical Turk workers participated in an online experiment for a cash payment (42.2% female; M_{age} = 37.9 years, SD = 11.7). Of the 287 respondents, 128 participants who voluntarily initiated a donation task after completing their paid part of the survey—our dependent variable—were included in the analyses (47.7% female; M_{age} = 40.6 years, SD = 12.4; initiation rate = 44.6%).

Procedure. Study 4B was the same as Study 4A, except that we compared the 10 grain per subtask condition to a 7 grain per subtask condition. Also, when participants decided whether to initiate the volunteering task, we asked them their motivation to engage in the donation task.

A cover story informed all participants that the survey's purpose was to understand the social and economic impact of COVID-19, and we proceeded to ask them questions about consumption patterns during the outbreak. Then, participants learned about a word puzzle game that people played at home during the outbreak and were asked to complete three puzzles. This was the word puzzle we later introduced as a voluntary donation task. We introduced the word puzzle task to familiarize participants with it ahead of time. After collecting demographic information, participants were informed the paid survey had ended and were invited to participate in a voluntary donation task.

We again used Freerice as the donation task. Participants were introduced to an online volunteering program through a grammar game that they had played in an earlier part of the survey. The donation task description informed participants that the earned donation grains

would be sent to support families affected by the wildfires. Participants were randomly presented with one of two stimuli. Half of the participants were presented with descriptions of the impact of the wildfires with relevant visual images, while the other half received descriptions with no pictures. After reading the description of the donation task, the participants were asked to indicate their motivation to engage in the Freerice game on a 7-point scale ("We would like to understand how you feel about Freerice. How motivated are you to participate in this task?" 1 = not at all motivated, 7 = very motivated), and if they would like to participate in this donation task voluntarily. Because self-reported motivation (4.29 vs. 4.27, $p = .95$) and initiation rates (43.6% vs. 52.0%, $p = .23$) were similar in the two versions of descriptions, these were combined in the analyses. Those who did not want to initiate the donation task were thanked, paid and dismissed.

For participants who initiated the donation task, they were randomly assigned to one of two cumulative feedback conditions. Depending on condition participants received 10 grains (the 10-grain condition) or 7 grains for each correct subtask (the 7-grain condition). Participants received cumulative feedback on their total earnings after each subtask and were asked whether they wanted to continue. The number of completed subtasks was used as the dependent variable. Participants could complete a maximum of 100 subtasks, however, participants were not informed of this endpoint unless they reached it.

8.3.2. Results

In accordance with Study 4A, performers completed more subtasks when they received fewer grains per subtask. Participants in the 10-grain condition were most likely to stop after completing 10 subtasks as they reached 100 grains (25%), whereas 20% of performers in the 7-grain condition stopped at 15 subtasks, reaching 105 grains (Figure 12).

Participants in the 7-grain condition completed 50% more subtasks than those in the 10-grain condition (*Median* $_{10\ grains}$ = 10.0 vs. *Median* $_{7\ grains}$ = 15.0), though this difference did not reach significance (χ^2 = 2.384, p = .123).

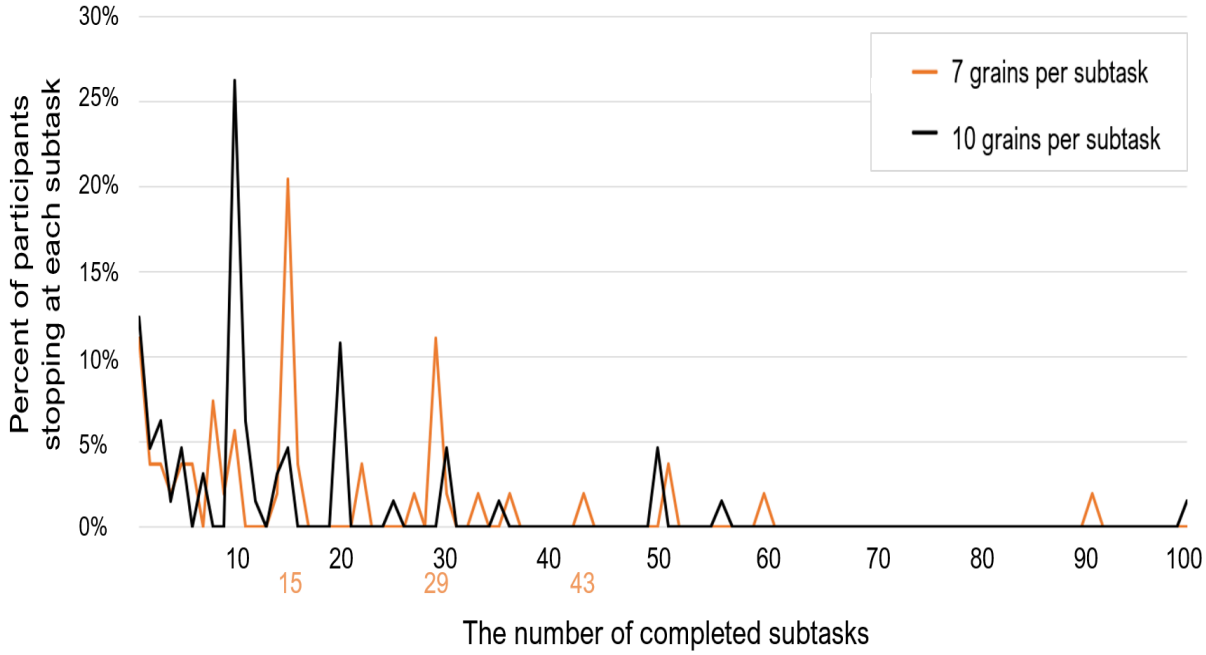

Figure 12. The modal stopping point for participants receiving 10 grains vesrus 7 grains per subtask (Study 4B). The modal stopping point for participants receiving 10 grains per subtask was 10 subtasks, while the modal stopping point for those receiving 7 grains per subtask was 15 subtasks.

Again, the participants' stopping points were coded into three case types. In line with the results of Study 4A, participants were more likely to complete as many subtasks as they could reach their century marks. Participants in the 10-grain condition were more likely to stop when they reached century marks (46.5%; 100, 200, and 300 grains) than those in the 7-grain condition (8.8%). Participants in the 7-grain condition were more likely to stop at subtasks in which the 7-grain condition reached the century marks (31.6%, e.g., when they reached 105, 203, and 301 grains after completing 15, 29, and 43 trials) than those in the 10-grain condition (4.2%; p < .00; see Figure 13).

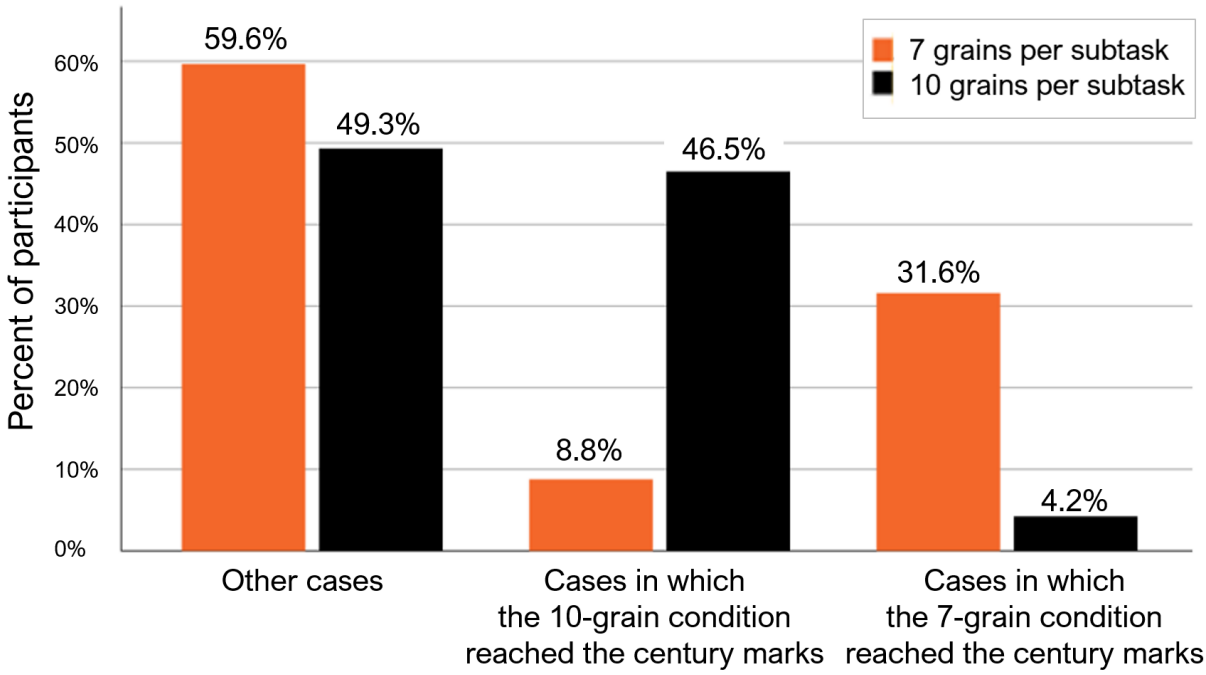

Figure 13. The proportion of participants stopped at three case types (Study 4B). Participants receiving 10 grains per subtask were more likely to stop at subtasks when the 10-grain condition reached century marks, while participants receiving 7 grains per subtask were more likely to stop at subtasks when the 7-grain condition reached century marks (Study 4B).

8.4. Discussion

Studies 4A and 4B provide further evidence of the gravitation-like feature of century marks, pulling performers to reach the century mark. Participants adjusted their performance to reach century marks and were willing to exert more effort when reaching the century mark required to complete more subtasks. In line with the hypothesis 4, participants performed more subtasks when fewer units were received for completing a subtask.

Moreover, the results of Studies 4A and 4B suggest that the criteria for determining stopping points was not based on how close performers were to reaching a century mark, but on whether they actually reached it. For instance, in Study 4A, participants in the 9-grain condition were more likely to stop at 108 (after completing 12 subtasks), which is just past 100, rather than at 99 (after completing 11 subtasks), which is closer to 100 but didn't reach

it. Similarly, in Study 4B, participants in the 7-grain condition were more likely to stop immediately after reaching 100 (at 105 after completing 15 subtasks) instead of closer to 100 but before reaching it (at 98 after completing 14 subtasks). These results imply that the century mark works as a crossline that signals the closure of one performance set. Regardless of how close we are to the century mark, stopping before reaching it would not increase a sense of closure.

Additionally, the fact that participants perceived passing 100 grains (e.g., 108 or 105) as a century mark, rather than other round numbers like 70 grains or 90 grains, implies that 100 is has a special significance in performance contexts.

Overall, Studies 1, 2, 3, 4A, and 4B provide consistent evidence that numerical century marks have a powerful impact on human behavior, acting like "gravitational forces" that pull people to get there when they approach these century marks. However, it is important to note that "gravity" also has a feature that holds people not to leave—so do century marks. Studies 5A and 5B aim to examine whether cumulative numeric feedback hinders performers from continuing to perform beyond the century mark, making it not only easy to get to but also hard to leave.

9. STUDY 5: WHEN CUMULATIVE NUMERIC FEEDBACK HINDERS THE TASK PERSISTENCE?

9.1. Background

This research proposes that the tendency to stop after reaching the century mark could have directionally different effects on task persistence: Feedback should increase task persistence for those who would otherwise not reach accumulated 100 units but decreases persistence for those who would otherwise do more. Studies 5A and 5B tested whether receiving cumulative feedback decreased the proportion of highly motivated participants continuing past 100—the first and most significant century mark—by measuring (Study 5A, $N = 293$) and manipulating (Study 5B, $N = 281$) the participants' task motivation. We expect that numeric century marks would hinder highly motivated participants from persisting beyond 100 at non-chance levels. When there was no cumulative feedback, participants would complete more subtasks as their motivation increased, and thus more proportion of highly motivated performers would persist over 100 than those with low motivation. However, when receiving cumulative feedback, the proportion of highly motivated performers who continue over the century mark would decrease, due to the influence of the century mark.

9.2. Study 5A: Measured Task Motivation

9.2.1. Method

Design and participants. Study 5A was conducted with a 2(feedback: cumulative vs. non-cumulative) between-subject design, while measuring participants' self-reported motivation. Six hundred ninety-three participants completed an online experiment via Amazon Mechanical Turk for cash payment (50.3% of females; $M_{age} = 40.9$ years, $SD =$

13.4). The 293 participants who initiated a donation task voluntarily after completing the paid part were included in the analyses (57.3% of females; M_{age} = 42.3 years, *SD* = 13.7; overall initiation rate = 42.3%).

Procedure. A cover story informed all participants that the current study aimed to understand the social and economic impacts of the COVID-19 outbreak, and asked them filler questions about their consumption patterns during COVID-19. Participants' donation experiences during and before the covid outbreak were asked, which were used as covariates in the analyses. Then, participants learned about a word puzzle and asked to play three puzzles, as in Study 4B. After answering demographic questions, all participants were introduced an online volunteering program called *Givingcoins*, a similar donation task used in Studies 2 and 3.

Participants read an instruction of the Givingcoins game and a detailed description of the charity where accumulated donation coins will be sent. Then, participants were asked to indicate their motivation to play the donation task on a 7-point scale which was used as a measured motivation in the analysis ("We would like to understand how you feel about Givingcoins. How motivated are you to play the game and donate to the charity?" 1 = not at all motivated, 7 = very motivated). Then, participants were asked if they would like to initiate the Givingcoins game voluntarily. Those who decided not to participate in the donation task were thanked, paid, and dismissed.

Those who initiated the donation task were randomly assigned to one of two feedback conditions: cumulative or non-cumulative. In the cumulative feedback condition, participants were informed of their accumulated progress after every subtask. In the non-cumulative feedback condition, participants only knew whether their answer was correct or not, without knowing the total number of coins earned. All participants received 10 coins per subtask, and

could choose whether to continue after each subtask. The proportion of performers who continued beyond 100 coins was the dependent measure.

9.2.2. Results

The effect of cumulative feedback on stopping at century marks. As in previous studies, participants in the cumulative feedback condition (vs. non-cumulative feedback) were more likely to stop at multiples of 100 coins, which were century marks ($\beta = 1.74$, Wald = 31.23, $p < .00$). Specifically, 42% of participants who received cumulative feedback stopped at century marks, while only 9.4% of participants in the non-cumulative feedback condition did so.

The effect of cumulative feedback and motivation on the proportion of performers persisting over the century mark. As predicted, a binary logistic regression results indicated that cumulative feedback decreased the proportion of highly motivated participants who continued past 100 coins (see Figure 14). In the non-cumulative feedback condition, participants were more likely to persist beyond 100 coins as their self-reported motivation increased (-1 *SD* = 31.4% vs. *Mean* = 40.5% vs. +1 *SD* = 50.2%; $\beta = -.26$, $p < .01$). However, in the cumulative feedback condition, this relationship became marginal (-1 *SD* = 27.2% vs. *Mean* = 33.2% vs. +1 *SD* = 39.8%; $\beta = -.19$, $p = .064$) and reduced the proportion of highly motivated participants continued over the century mark. Half of the highly motivated participants (+1 SD of self-reported motivation) persisted over 100 when they received non-cumulative feedback (50.2%), while only 39.8% did so when they received cumulative feedback.

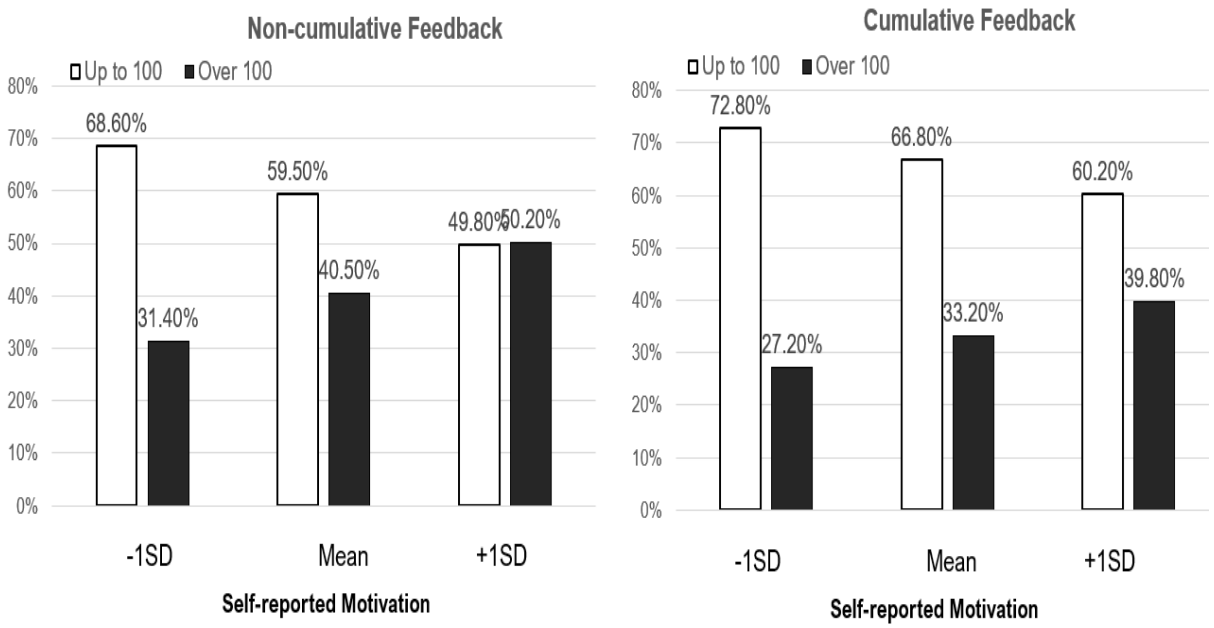

Figure 14. The proportion of participants who persisted in the donation task up to 100 versus more than 100 (Study 5A).

9.3. STUDY 5B: Manipulated Task Motivation

9.3.1. Method

Design and participants. Study 5B was conducted to replicate the results in Study 5A with manipulated motivation, by employing a 2(feedback: cumulative vs. non-cumulative) x 2(task motivation: low vs. high) between-subject design. Five hundred eighty-five participants (all US participants who are at least 18 years old) completed an online experiment via Amazon Mechanical Turk for a cash payment (47.9% of females; M_{age} = 40.197 years, *SD* = 12.4). The 281 participants who initiated a donation task voluntarily after completing the paid part were included in the analyses (53.7% of females; M_{age} = 42.3 years, *SD* = 12.1; the overall initiation rate = 48.0%).

Procedure. In Study 5B, the same experimental procedure as in Study 5A was replicated, while manipulating the participant's level of motivation. The procedures were identical to Study 5A, with the except of the motivation manipulation.

Participants were randomly assigned to one of two conditions: high versus low motivation. In both conditions, participants were informed that they will accumulate "giving coins" that could be donated to the charity. In the high motivation condition, participants were asked to choose a charity they wanted to donate to among four options of four-star rating organizations. The high motivation condition also emphasized that charity participation rates have plummeted significantly due to the COVID-19 outbreak and that these organizations were in need of support. In the low motivation condition, a two-star rating charity was presented to participants, and they had no other option to choose. To control the effect of the stimuli, the same four organizations were used in both conditions, with the same names and descriptions but varying in the star rating. In the low motivation condition, participants were randomly presented to one of four charities. Following the introduction of the Givingcoins game, participants were asked to indicate how motivated they were to play Givingcoins on a 7-point scale (1 = not at all motivated, 7 = very motivated) and whether they would like to initiate. If participants chose not to continue, the experiment was ended immediately.

Participants who initiated the donation task were assigned to one of two feedback conditions: cumulative feedback versus non-cumulative feedback. In both conditions, participants received 10 giving coins for every correct solved subtask, and were asked to choose whether to continue after each subtask.

9.3.2. Results

Manipulation check. To check whether the motivation manipulation worked as intended, an independent sample t-test was conducted. There was a significant difference in self-reported task motivation across motivation conditions ($t = -7.975$, $p < .00$), with

participants in the high motivation conditions (M = 4.77) reporting a higher level of motivation to engage in the donation task than those in the low motivation conditions (M = 3.42). The motivation manipulation was successful.

The effect of cumulative feedback on stopping at century marks. Consistent with previous results, participants in the cumulative feedback condition (44.1%) were more likely to stop when they reached century marks—100, 200, or 300 coins—than those in the non-cumulative feedback condition (11.3%; $\beta = 1.74$, Wald = 31.23, $p < .00$). This effect was observed regardless of motivation levels, indicating that the century mark effect on stopping is not due to lack of motivation.

The effect of cumulative feedback and motivation on the proportion of performers persisting over the century mark. As predicted, a Chi-square result showed that cumulative numeric feedback decreased the proportion of highly motivated participants persisting over the most significant century mark—100 coins (Figure 15). In the non-cumulative condition, the proportion of participants who continued beyond 100 coins increased as their motivation level increased, consistent with our intuitions: 37.1% of participants in the low motivation condition persisted over 100 coins though 53.2% of participants in the high motivation condition did so ($\chi^2 = 3.840$, $p < .05$). However, when receiving cumulative feedback, there was no significant difference in persistence between the high-and low-motivation conditions: 23.9% of low motivation participants and 29.2% of high motivation participants continued after reaching 100 ($\chi^2 = .485$, $p = .486$).

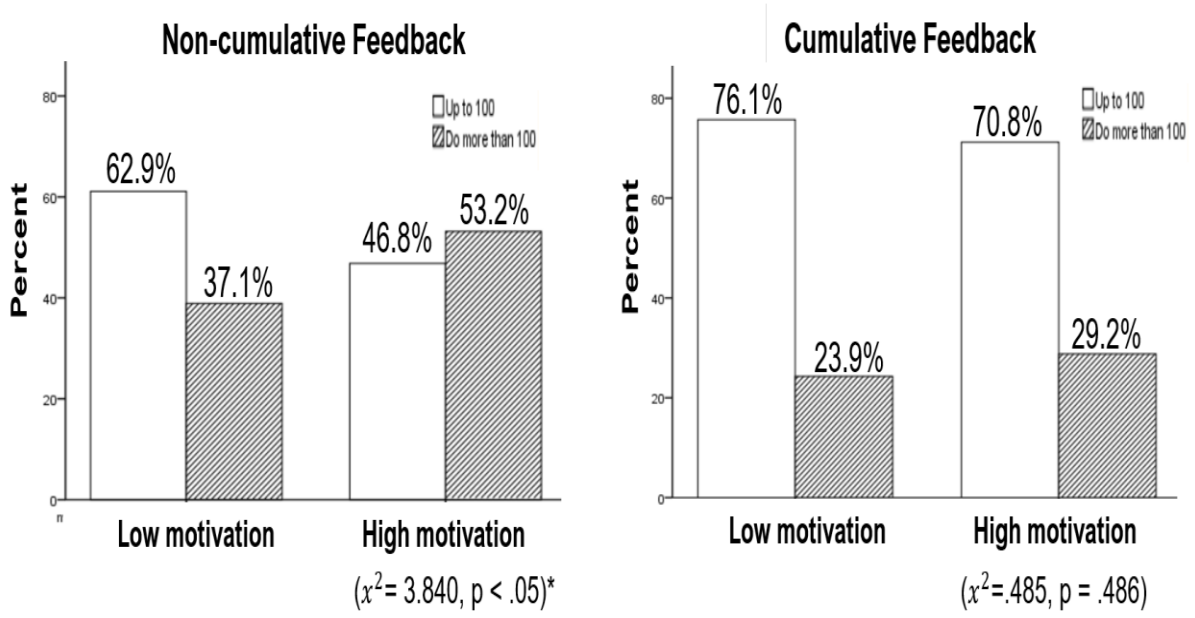

Figure 15. The proportion of participants who persisted in the donation task up to 100 versus more than 100 (Study 5B).

9.4. Discussion

Studies 5A and 5B provide further evidence for century mark effects: receiving cumulative feedback and thus encountering century marks not only increase the likelihood of reaching them but also hinders persistence, particularly for highly motivated participants. The proportion of highly motivated participants who continue beyond the century mark is lower when they receive cumulative feedback compared to receiving non-cumulative feedback (supporting H5a). These findings indicate that once performers reach a century mark, they are less likely to persist beyond this modal stopping point.

Moreover, the results of Studies 5A and 5B indicate that the effect of cumulative feedback on stopping at century marks occurs regardless of the participants' motivation levels. This finding eliminates an alternative explanation that numeric information may shape behavior due to a lack of motivation—performers who lacked motivation were sensitive to the cues providing an excuse to quit, which is the numeric century mark.

10. SUPPLEMENTARY STUDIES

10.1. Study 6

In Study 2, performers predict they would do additional subtasks to stop at century marks. Performers may, however, not behave this way when they must invest actual time and effort. Thus, Study 6 aims to replicate the results of Study 2 with actual behavioral measures. In the first phase of the study, participants learned about the donation task and were asked to complete ten subtasks. During the first-phase task, participants received either cumulative or non-cumulative feedback, and the number of coins awarded per subtask was different across conditions, with ten coins per subtask awarded in one condition and seven coins per subtask awarded in the other. Next, they were asked whether they would like to continue. For those who chose to do so, their feedback and award coins for each subtask completion remained the same for both the initial (mandatory) and second (voluntary) phases of the study. We predicted that among performers who chose to complete more subtasks in the voluntary phase, those who received cumulative feedback would continue until they reached the next century mark. More specifically, performers in the ten-coin condition, who were awarded 100 coins for completing the initial phase, were expected to complete ten more subtasks to reach 200 coins. Whereas those in the seven-coin condition, who had accumulated 70 coins when they decided voluntary participation, were expected to complete five more subtasks to reach 105 coins—stopping immediately after surpassing 100 coins.

10.1.1. Method

Design and participants. Study 6 used a 2 (feedback: cumulative vs. non-cumulative) x 2 (subtask earning: 10 coins vs. 7 coins) between-subject design. Three hundred and seventeen participants (57.4% of female; M_{age} = 41.0 years, *SD* = 12.86)

completed an online survey via Amazon Mechanical Turk (US participants, primary language as English, at least 18 years old) and were paid a flat rate cash payment. The 99 participants who continued the donation task after completing the mandatory 10 subtasks were included in the analyses (52.5% of female; M_{age} = 45.4 years, *SD* = 12.99).

Procedure. Study 6 used a similar experimental procedure to that of Study 5A, except all participants had to complete 10 subtasks before choosing whether to do the voluntary donation task. After participants answered the cover story survey questions and demographic questions, they were introduced to an online donation task (Givingcoins). Participants were randomly assigned to one of two conditions: 10 versus 7 coins per subtask. Depending on condition, participants were told they would earn 10 (vs. 7) donation coins per subtask.

Next, participations were randomly assigned to one of two feedback conditions: cumulative versus non-cumulative feedback. All participants were asked to complete ten subtasks of the donation task and then choose whether to continue. Participants in the cumulative feedback conditions made their decisions either at 100 coins or 70 coins. In the non-cumulative feedback condition, participants were not told how many coins they had accumulated. Those who chose not to continue were thanked, paid and dismissed.

Participants who continued to the voluntary donation task could stop after completing each subtask, and the number of additional subtasks they completed in this voluntary phase was the dependent variable. They could complete a maximum of 90 additional subtasks (a total of hundred subtasks including ten mandatory subtasks), but were not told the endpoint.

10.1.2. Results

Likelihood to voluntarily do the donation task. Unexpectedly, the likelihood participants began the voluntary phase of the study did not differ by condition, based on a

Chi-square test (Figure 16). For participants who received cumulative feedback, 35.40% of those in the 10-coin condition and 27.60% of those in the 7-coin condition chose to do continue the donation task (x^2 =.981, p = .364). For participants who received non-cumulative feedback, 31.70% of those in the 10-coin condition and 31.00% of those in the 7-coin condition chose to continue the donation task (x^2 =.009, p = 1.00). This insignificant difference will be discussed later.

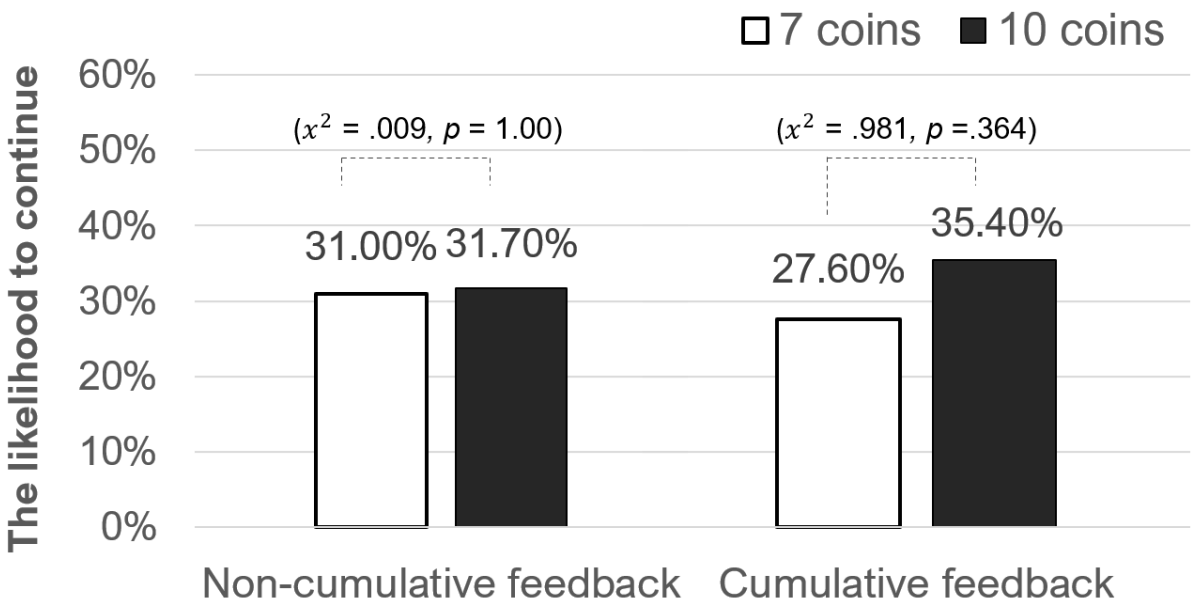

Figure 16. The likelihood to continue the voluntary donation task (Study 6).

Additional subtasks completed. As expected, when receiving cumulative feedback, performers who continue to the voluntary donation task were most likely to persist until reaching the century mark. As shown in Figure 17, 39.1% of performers in the 10-coin condition completed 10 more subtasks and stopped at 200 coins. When performers received 7 coins per subtask, 38.1% completed five more subtasks and stopped at 105 coins. In contrast, for performers receiving non-cumulative feedback, there were no such stopping points across conditions.

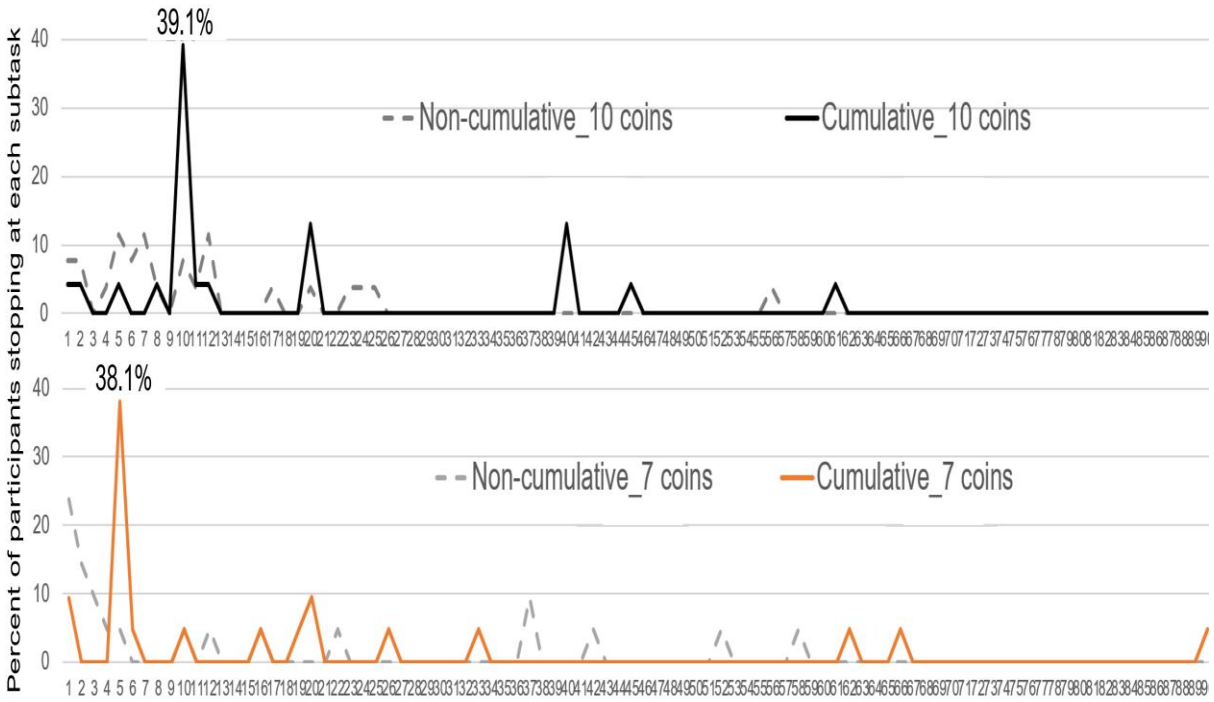

Figure 17. The % of performers who stopped at each subtask (Study 6). Performers receiving cumulative feedback were most likely to stop at the next century mark: the modal stopping point for performers receiving 10 coins per subtask was 10 subtasks (total 200 coins), while the modal stopping point for those receiving 7 coins per subtask was 5 subtasks (total 105 coins).

Performers' stopping points were coded into two cases: stopped at century marks versus non-century marks. For performers who received cumulative feedback, 65.2% of those who received 10 coins per subtask stopped at century marks (e.g., completing 10, 20, 30 more subtasks and stopping at a total of 200, 300, 400 coins, respectively), whereas only 11.5% of performers in the non-cumulative feedback condition who received 10 coins per subtask stopped at these points ($x^2 = 15.13$, $p < .00$). Similarly, for performers who received cumulative feedback, 57.1% of those who received 7 coins per subtask stopped immediately after surpassing century marks (e.g., a total of 105, 203, 301 coins), whereas only 4.8% of performers in the non-cumulative condition who received 7 coins per subtask stopped at these points ($x^2 = 13.48$, $p < .00$; Figure 18).

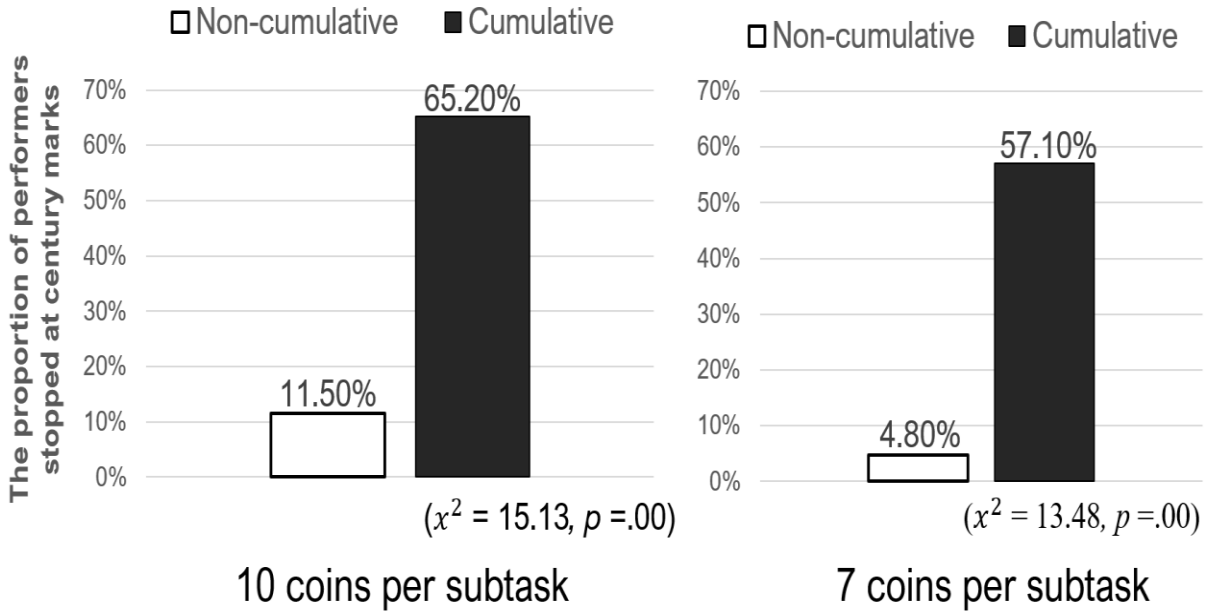

Figure 18. The proportion of performers stopped at century marks across conditions (Study 6).

10.1.3. Discussion

In Study 2 in which participants were provided with a scenario that they had reached at a different point of the progress (80 vs. 90 vs. 100 vs. 110 coins), we found that participants in the 100-coin condition were less likely than those in the other conditions to predict that they would complete more subtasks. Study 6 partially replicated the findings from Study 2 while employing an actual behavioral measure. We found that performers who had voluntarily agreed to complete more subtasks stopped the extra task when reaching the next century mark, and the performers in the 10-coin condition (Median = 10) completed significantly more extra subtasks than did those in the 7-coin condition (Median = 5), confirming a strong tendency to reach century marks, even when actual behavioral costs exist.

Although we expected performers in the 7-coin cumulative feedback condition (accumulated 70 coins when they made their decision) would be more likely than those in the

10-coin cumulative feedback condition (accumulated 100 coins when they made their decision) to agree to complete voluntary extra tasks, Study 6 did not show significant differences in the decision to complete more subtasks. One potential explanation for the nonsignificant difference is that many performers in Study 6 felt enough sense of closure after having completed the 10 mandatory donation subtasks, leading them to stop. The experience of finishing a whole assigned task and reaching the endpoint may have led participants to feel a sense of closure, and thus, the motivation to continue additional subtasks to reach century marks may have decreased. Furthermore, the decision to continue in Study 6 entailed tangible behavioral costs, which may have made participants more cautious and less willing to continue. This finding is consistent with previous research on the sense of closure, which posit that individuals make closure-seeking decisions based on a cost-benefit comparison of possessing versus lacking closure (Kruglanski et al., 2006).

10.2. Study 7

Studies 1-6 examined the effect of cumulative feedback on stopping in the absence of a specific endpoint. Study 7 examined this same effect when performers are given an explicit endpoint. We predicted that if stopping at a century mark provides a sense of closure, a significant proportion of performers will still stop at century marks even when made aware of an explicit endpoint. Participants read a description of the donation task with or without the total number of subtasks they could complete (the explicit endpoint). Once they initiated the task, performers received cumulative or non-cumulative feedback. We expected that having an explicit endpoint would increase the proportion of performers that complete all subtasks, decreasing the proportion stopping at century marks. Nevertheless, we predicted that

performers receiving cumulative feedback would be more likely to stop at century marks than at other points even when made aware of the endpoint.

10.2.1. Method

Design and participants. Study 7 used a 2 (endpoint: absent vs. present) x 2 (feedback: cumulative vs. non-cumulative) between-subject design. Five hundred and ninety-four Amazon Mechanical Turk workers participated online for a flat rate cash payment (56.4% of females; M_{age} = 38.12 years, SD = 12.23). Of the 594 participants, the 339 participants who voluntarily initiated the donation task after completing the paid part of the survey were included in the analyses (62.5% of females; M_{age} = 40.40 years, SD = 12.72; the overall initiation rate = 57.07%).

Procedure. Study 7 used the same experimental procedure as in Study 5B, except that participant received an endpoint manipulation and there was no manipulation of motivation. Participants were randomly assigned to one of two endpoint conditions. Those in the endpoint condition read the description of the Givingcoins task with endpoint information ("There are 40 questions in total," "The more coins you earn, the more we give to the charity. You can earn a maximum of 400 coins" bold and colored in blue), whereas those in the no-endpoint condition read the same description without information about the endpoint ("The more coins you earn, the more we give to the charity"), as in the previous studies. Then, participants were asked to choose a charity to which they wish to donate from among four organizations, and to rate their motivation to donate to the charity by playing the Givingcoins game (1 = not at all motivated, 7 = very motivated). Next, participants could choose to initiate the voluntary donation task. Performers in the endpoint condition were reminded that the maximum number of subtasks was 40 and the total donation amount was 400 coins.

Participants who did not initiate the volunteering task were thanked and dismissed. Participants who initiated the Givingcoins task were randomly assigned to conditions in which they either did or did not receive cumulative feedback. All participants received 10 giving coins for a correctly answered subtask.

10.2.2. Results

Preliminary analyses. There were no differences in self-reported motivation to initiate the donation task ($M_{endpoint} = 4.67$ vs. $M_{no\text{-}endpoint} = 4.78$; $t(592) = .727$, $p = .468$) or in initiation rates between the two endpoint conditions (endpoint = 57.0% vs. no-endpoint = 57.1%; $x^2 = .00$, $p = .991$). Thus, knowing the total length of the task and its endpoint did not influence individuals' choice to engage in the voluntary donation task.

Main analyses. Results from a Chi-square analysis showed that providing performers with an explicit endpoint significantly increased their likelihood of completing all of the subtasks, regardless of feedback types ($x^2 = 34.61$, $p < .00$). Among performers in the endpoint condition, 37.1% completed all 40 subtasks (38.0% of those receiving cumulative feedback, and 36.4% of those not receiving cumulative feedback); while 10.1% of performers in the no-endpoint condition did so (10.5% of those receiving cumulative feedback, and 9.5% of those not receiving cumulative feedback).

More importantly, when given cumulative feedback, performers were more likely to stop at the century mark regardless of the explicit endpoint (see Figure 19). When performers were not given endpoint information, as in the previous experiments, 26.3% of performers receiving cumulative feedback stopped at 100 coins, while only 2.1% of performers receiving non-cumulative feedback stopped at 100 coins. When there was an explicit endpoint, 14.1% of performers receiving cumulative feedback stopped at 100 coins, whereas 1.3% of non-

cumulative feedback performers stopped at the same point. Since there was a total of 40 subtasks, the likelihood of stopping after each subtask equals 2.5%. The proportion of performers stopping at century marks was still much greater than this value, even when performers were made aware of the endpoint.

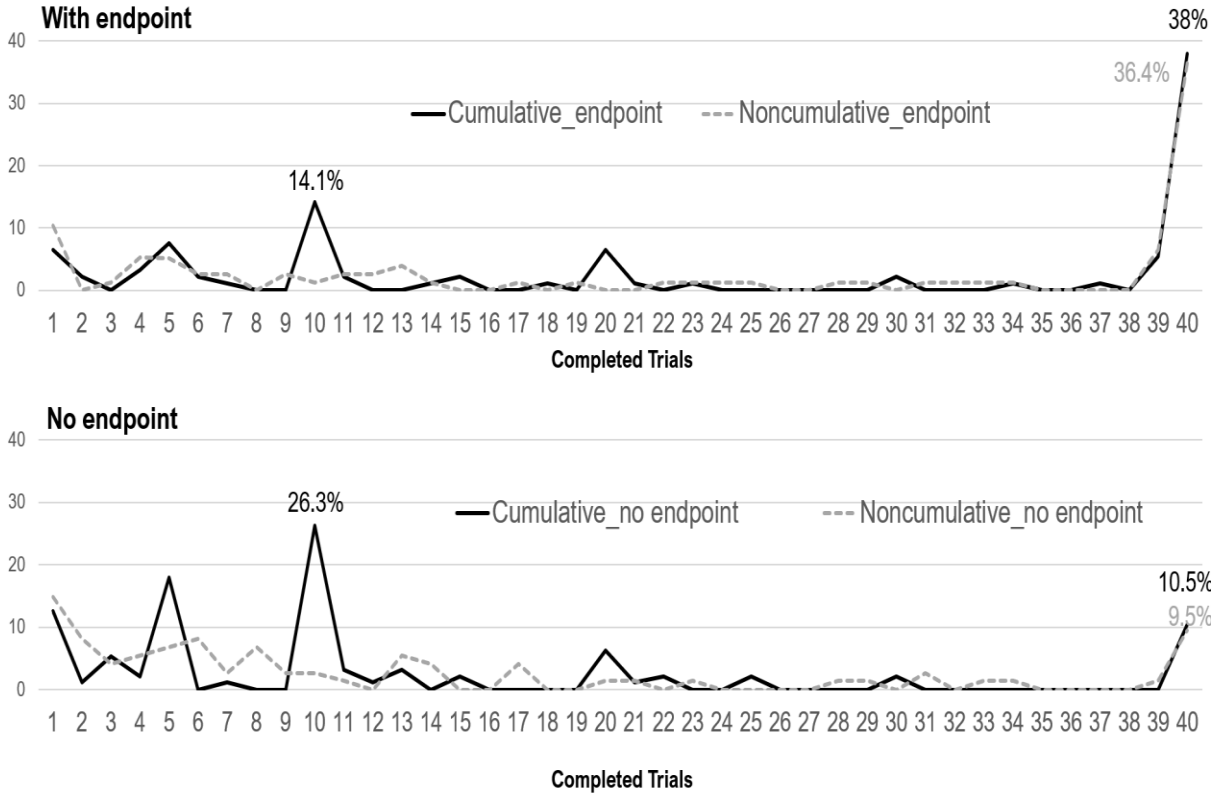

Figure 19. The % of performers who stopped at each subtask, with or without endpoint (Study 7). Performers receiving cumulative feedback were more likely to stop at century marks regardless of the presence of the explicit endpoint.

We coded performers' stopping points into three cases: (a) stopped at century marks (a total of 100, 200, and 300 coins), (b) stopped at non-century marks (stopping points other than 100, 200, 300, and 400 coins), and (c) completed all subtasks (a total of 400 coins). When performers were not told of an endpoint, as in the previous experiments, participants in the cumulative feedback condition were more likely to stop at century marks (34.7%) than those in the non-cumulative feedback condition (4.1%; $x^2 = 24.54$, $p < .00$). This pattern replicates the century mark effect from the previous experiments. The proportion of

performers completing all subtasks increased in the endpoint condition across both feedback conditions (38.0% of performers in the cumulative feedback condition and 35.9% of performers in the non-cumulative feedback condition). More importantly, even when performers were given an explicit endpoint, 22.8% of those in the cumulative feedback condition stopped at century marks whereas only 1.3% of those in the non-cumulative feedback condition stopped at century marks ($x^2 = 19.93$, $p < .00$). Thus, performers use century marks as a stopping point even when they are aware of an explicit endpoint (see Figure 20).

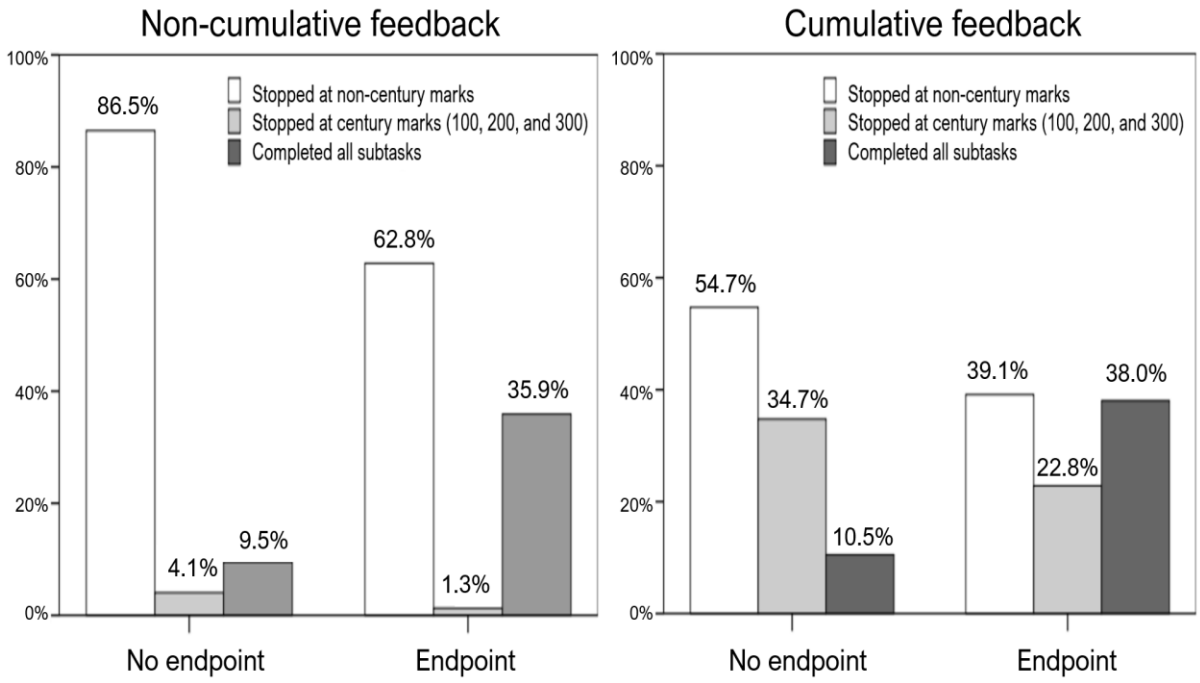

Figure 20. The proportion of participants who stopped at three case types (Study 7).

Last, the modal and median stopping points across conditions showed interesting patterns, though this difference did not reach significance levels (see Figure 21). For performers who were not given the endpoint, the modal stopping point in the cumulative feedback condition was 100 coins, and 10 coins for the non-cumulative feedback condition. In contrast, for performers who were given the endpoint, the modal stopping points for both

feedback conditions were 400 coins. There was also an interesting difference in the median values. Performers median stopping point was greater in the cumulative feedback condition than in the non-cumulative feedback condition when there was no endpoint information (Median $_{\text{cumulative}}$ = 100 coins vs. Median $_{\text{non-cumulative}}$ = 75 coins), but this result flipped when there was endpoint information, with performers median stopping point being greater in the non-cumulative feedback condition than in the cumulative feedback condition (Median $_{\text{cumulative}}$ = 200 coins vs. Median $_{\text{non-cumulative}}$ = 280 coins). These findings indicate that performers were less likely to reach the endpoint when they receive cumulative feedback (vs. non-cumulative feedback), because they stopped at century marks.

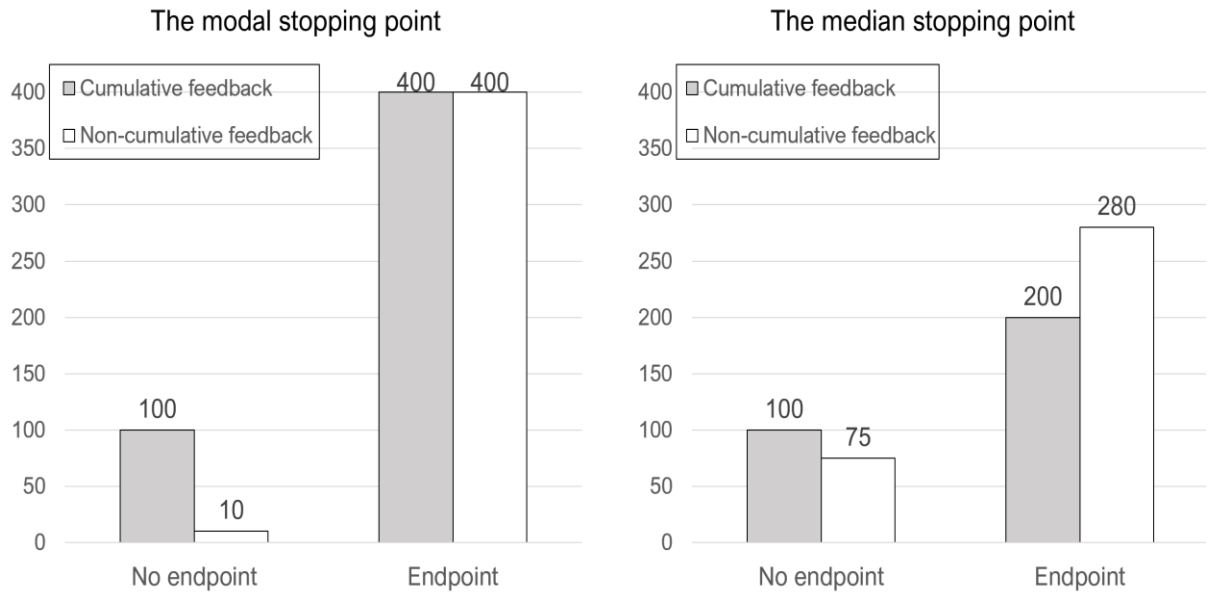

Figure 21. The modal and median stopping point for cumulative versus non-cumulative feedback when there was an endpoint versus no endpoint (Study 7).

10.2.3. Discussion

Study 7 shows that performers given cumulative feedback stop at century marks even when they are made aware of an explicit endpoint. Consistent with the previous findings, the results imply that reaching a century mark leads people to feel a sense of closure that may

cause them to stop instead of to reach the endpoint. If century marks do not lead to a strong sense of closure, and therefore are not a compelling stopping point, performers will tend to continue to an explicit endpoint.

11. GENERAL DISCUSSION

This research examines how and why receiving cumulative numeric feedback affects performance when people complete uncompensated, non-bound tasks. We suggest that when performers receive such feedback, they tend to assess their progress based on whether they have reached century marks. Reaching a century mark fosters a sense of closure, which prompts performers to adjust their performance to stop at century marks. Seven studies and two additional experiments were conducted to confirm this prediction and explore the underlying process. Our studies confirmed participants were drawn to century marks as their stopping point. When completing a donation task field study, 100 accumulated rice grains was the modal stopping point (Study 1). Similarly, participants predicted that they and other performers would continue the task until they reached century marks—even if they had already surpassed a century mark (Studies 2 and 3). These results highlight the importance of a sense of closure in performers' stopping decisions (Study 3). Performers often adjust their performance to stop at century marks, completing more subtasks with no external benefits to do so (Studies 4A and 4B), despite the associated behavioral costs (Study 6); or completing fewer subtasks when capable of doing more (Studies 5A and 5B). The effect of century marks on stopping behavior remained, even when an explicit endpoint was provided (Study 7). Cumulative numeric feedback is widely used in various contexts and understanding century marks' unconscious effects is practically and theoretically important.

11.1. Contributions and Implications

First, the present research contributes to our understanding of task persistence and feedback. The findings demonstrate that century marks, which are often inherent to cumulative numeric feedback, can serve as powerful signals that trigger stopping a task.

Previous research has focused on how perceived discrepancies between individuals' goals and current progress levels influence motivation and behavior (Harkin et al., 2016). However, in everyday tasks, specific goals or end states are often lacking (e.g., Wallace & Etkin, 2018). Our study highlights how cumulative numeric feedback influences performers' stopping decisions, even in the absence of explicit goals, and provides insights into the psychological processes underlying this effect. Our results reveal that simply being positioned after rather than before a century mark is associated with stronger motivation to persist at the task. For instance, in Study 2 participants in the 110-coin condition chose on average to complete nine additional subtasks, though those in the 90-coin condition chose on average to complete one additional subtask. Additionally, in Study 4B our manipulation of the feedback structure (seven vs. ten grains) led participants complete up to 50% more subtasks with no external rewards except for a sense of internal closure from reaching century marks. People often try to improve participants' performance by changing the external rewards associated with feedback, such as providing more incentives per subtask and offering extra rewards for completion. Our research suggests that designers of feedback schemes should take into account the potential impact of cumulative numeric feedback on performers' internal states, such as a sense of closure, rather than merely focusing on external incentives. While performance information often includes numeric values, the unconscious effects of these numbers have received less attention (Olsen, 2015). Our study highlights the potential of numeric nudging, in which using numbers to alter behaviors, as suggested by Shen and Hsee (2017).

Second, the present research provides theoretical and practical implications for the field of prosocial behavior. We emphasize the importance of designing feedback schemes that increase persistence rather than inadvertently decreasing it. Prosocial marketers, volunteering organizations, and fundraisers often provide cumulative numeric feedback to

their donors or volunteers, with the expectation that they will engage for longer. As those who decide feedback schemes are also human, they are more likely to choose round numbers when designing the provision (Lin & Pursiainen, 2021). This means that performers encounter century marks and display the stopping patterns illustrated in this research. Moreover, it may lead to an unconscious and unexpected cycle. For example, when volunteering organizers choose 10 coins per subtask as a cumulative feedback scheme, volunteers are more likely to stop when they have accumulated 100 coins after completing 10 subtasks. In an attempt to increase volunteers' participation, organizers may decide to double the incentive from 10 to 20 coins per subtask. However, counterintuitively, volunteers may be more likely to stop after completing five subtasks when they reach 100 coins. To avoid being inadvertently decreasing participant motivation, decision-makers should be aware of the unexpected effects of century marks and design cumulative feedback schemes accordingly.

Lastly, our study could offer insights helpful for increasing our understanding of the relative salience and influence on human behaviors of different round numbers. The present findings could indicate that in certain contexts (e.g., performance tasks), 100 has a unique role compared to other zero-ending or five-ending numbers (e.g., 90 or 70). Though previous research suggests that not all round numbers have equal cognitive salience (Jasen & Pollmann, 2001; Ozcan & Gunasti, 2019), there is limited empirical evidence to support this proposition. The present research may suggest that 100 is the most critical landmark influencing performance compared to other round numbers. Even when performers could not reach exactly 100, performers tended to stop based on whether they reached 100 rather stopping at other available round numbers, such as 90 or 70 (Studies 4A and 4B).

11.2. Limitations and Directions for Future Research

There are several limitations of the present research that suggest opportunities for future exploration. First, while this research provides converging evidence that performers adjust their performance to reach century marks, further evidence using other methods may strengthen support for this assertion. For instance, we examined responses of 132 participants who voluntarily completed a donation task receiving cumulative feedback with 10 coins per subtask. When performers decided to stop the task, they were asked to provide their reasons for stopping in an open-ended question. As predicted, a substantial proportion of performers (29.55%) chose to stop at the 100-coin mark, despite the likelihood of stopping at each number equals 1% (total 100 subtasks). Furthermore, a significant proportion of performers who stopped at 100 coins (23.08%) explicitly cited "100 coins" as their reason to stop, compared to very few who stopped at other points (1.08%) mentioned numeric values. Performers who stopped at other points were more likely to report reasons outside of the donation task, such as having other work to do or their personal status (e.g., bored, tired). These findings suggest that performers may indeed be aiming to reach century marks, and future research could use more sophisticated design to examine this possibility.

Second, while this thesis provides strong evidence that the century mark significantly increases stopping behavior, several intriguing questions remain regarding the specificity and robustness of this effect. Do stopping effects extend beyond the specific century mark 100? Investigating the influence of other larger century marks, such as 1000, on stopping behavior could clarify whether the century mark holds unique psychological salience or represents a more general marker of roundness and completeness. This question remains untested and requires further exploration for a comprehensive answer. One possibility is that the stopping behavior will be observed significantly more for the 100 mark but not for the larger century marks, such as 1000. Ozcan and Gunasti (2019) conducted a frequency analysis of numbers

from 10 to 1000, revealing that while both 100 and 1000 were used more often than their neighboring numbers, the frequency of 100 (1.2%) was approximately 7.5 times higher than that of 1000 (0.16%). The results of the study suggest the specialness of 100 among other century-based numbers, reinforcing the findings of this thesis. Another possibility is that, while not as strong as 100, larger-scale century marks (e.g., 1000) or other meaningful numbers work as a pseudo-century mark. If this is the case, it would be possible to use a relatively salient number in a given context to evoke century mark effects.

Furthermore, would performers still prioritize reaching the century mark when the per-subtask rewards are smaller (e.g., 2 or 3) and require more completions (e.g., 50) to achieve? Additional insight into this question can be gleaned from an experiment manipulating task difficulty, not included in the main body of this thesis. Task difficulty was manipulated to examine whether performers are willing to persist to reach a century mark even when the task is challenging. A total of 291 participants were randomly assigned to one of four conditions: 2 (feedback: non-cumulative vs. cumulative) x 2 (task difficulty: easy vs. difficult). Of these, 167 participants who voluntarily initiated the donation task were included in the analyses. The results revealed that participants in the difficult conditions were more likely to leave after completing the first few subtasks compared to those in the easy conditions, aligning with our intuition. Notably, in the difficult conditions, a significant proportion of participants in the cumulative feedback condition stopped at 50 coins (22.9%) and 100 coins (14.3%), with no participants stopping between 50 and 100 coins. This trend contrasted with the gradual decline in the non-cumulative feedback condition. It is worth note that there were no participants persisted over 150 coins in the difficult-cumulative feedback condition, whereas the highest scores in the other conditions were 250, 260, and 490 coins. These results suggest that individuals may try to persist to reach a century mark; however, if

the task is difficult or the century mark seems unattainable, performers adjust their behavior, opting to stop at the midpoint of 100 instead.

Third, while the present study included scenario-based experiments (Studies 2 and 3) to examine the psychological processes underlying the century mark effect, future research could complement this approach with behavioral measures to provide additional evidence for the increased sense of closure that performance experience upon reaching century marks. Specifically, future research could measure performers' sense of closure and explore its mediation effects using behavior-based tasks.

Finally, while this research focused on the specific context of a donation task, the results suggest that this effect may extend to other performance contexts when cumulative numeric feedback is utilized. However, the exact magnitude and direction of the effect may depend on the specific context and the individuals involved. Future research could explore century mark effects in various performance contexts, such as academic or work-related tasks, health or exercise goals, and saving goals. Such studies could illuminate the extent to which the century mark effect on stopping is domain-specific or generalizable across different contexts. For instance, future studies could examine whether students are more likely to stop their studying once they reach a certain number of pages or problems completed. Similarly, it could examine whether employees are prone to stop working after accomplishing a certain number of tasks. Additionally, examining the effects of century marks in health-related or exercise contexts would be valuable. Health-related goals often require continuous effort despite the absence of immediate visible changes or tangible external rewards. These days, individuals receive cumulative numeric feedback on their performance in various contexts, through self-tacking apps or wearable devices (Etkin, 2016; Whitson, 2013; Ajana, 2018). For example, Apple watch provides daily activity feedback in cumulative numbers and graphical symbols. Investigating whether performers are more likely

to stop at century marks when engaging in various contexts for themselves could be pivotal. Performers may choose not to stop at century marks but may instead complete as many subtasks as possible, particularly when the benefits increase concerning their performance. Alternatively, performers may still prefer to stop at century marks, suggesting that the gravitational pull of these marks overshadows the potential rewards. Future research could examine how the century mark effect differs between performing for oneself and performing for others, providing a more comprehensive understanding of the effect in diverse contexts.

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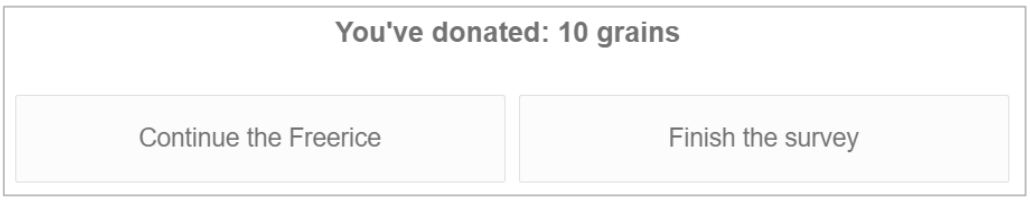
APPENDIX A

The Behavioral Donation Task (Freerice and Givingcoins)

Example of cumulative feedback, receiving 10 grains per subtask



APPENDIX B

The Scenario-based Prediction Task used in Study 3

Example of the 80-coin condition

Next, you will see a description of an experience a volunteer had playing the game. **We want you to predict how that volunteer thought and felt at that point in the game.**

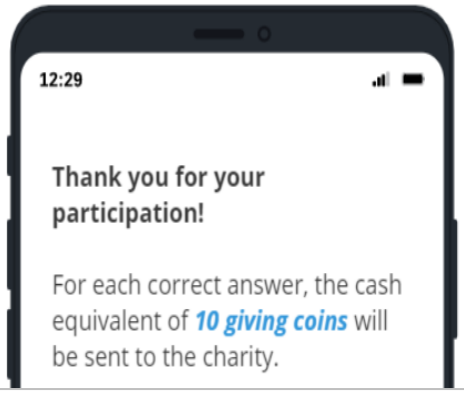
Please imagine the scenario as vividly as possible. Then answer the questions that follow, thinking about **how you predict that volunteer would feel at that point in the game.**

→

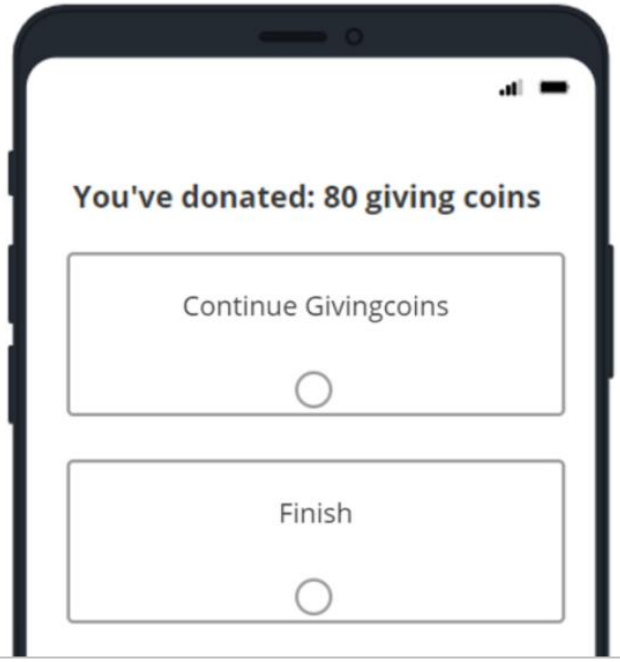
When the volunteer was online, they ran across a website for a volunteering program called "Givingcoins," through which they can play a game, and based on their performance, help charities. They learn that by playing "Givingcoins", they can donate money to worthy organizations that aim to fight hunger.

They decided to play the game. The instructions indicated that for each puzzle they solve they earn **10 giving coins** that will then be turned into money that goes to charity.

Though they are not told the exact dollar equivalent of each Givingcoin they earn, the volunteer knows that the more puzzles they solve the more money they donate to the charity.



Now imagine that the volunteer correctly solved eight puzzles, meaning that they accumulated **80 coins.**



APPENDIX C

Motivation Manipulation Used in Study 5B

The low motivation condition

Givingcoins: We need your help NOW!

'Givingcoins' uses the English skills game **that you completed on the previous pages**, in which you identified a synonym for a target word. When you play this game, you will accumulate "giving coins" that are worth cash. We translate the giving coins you earn for the charity into cash that we send the charity. The more coins you earn, the more we give to the charity.

For each correct answer, you will earn "giving coins" that will be sent to a charity called Futures Without Violence. Details regarding the charity are described below.

Futures Without Violence has a 2-star rating from Charity Navigator, an organization that evaluates charities in the United States. Four (4) is the best rating.

Your donation is needed to help support the charity!

Futures Without Violence

Our name is our vision.

RATING: ★★☆☆
CAUSE: Human and Civil Rights

For more than 30 years, FUTURES has been providing groundbreaking programs, policies, and campaigns that empower individuals and organizations working to end violence against women and children around the world.

FUTURES WITHOUT VIOLENCE

The high motivation condition

Givingcoins: We need your help NOW!

'Givingcoins' uses the English skills game **that you completed on the previous pages**, in which you identified a synonym for a target word. When you play this game, you will accumulate "giving coins" that are worth cash. We translate the giving coins you earn for the charity into cash that we send the charity. The more coins you earn, the more we give to the charity.

For each correct answer, you will earn "giving coins" that will be sent to a charity of your choice. You can choose a charity you want to donate to from four different cause categories: human rights, education, patient support, and animal rights. Details regarding the charities are described below.

The four charities all have a 4-star rating from Charity Navigator, an organization that evaluates charities in the United States. Four (4) is the best rating.

Your donation is needed to help support charities!

Please choose the charity to which you want to donate. Earned giving coins will go to your chosen charity.