

CONSUMER STREAKS

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ABSTRACT

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Because of technological developments, consumers can record and track their behaviors more easily than ever before. Consequently, consumers are now especially aware of their streaks (i.e., doing something three or more times in a row) and other patterns of behavior. In my dissertation, I explore how patterns of repeated behavior – in particular, streaks – influence actual and predicted behavior. Chapter 1 examines how streaks of consecutive behaviors affect consumers' subsequent decisions to continue those behaviors. Chapter 2 investigates how patterns of past behavior inform people's forecasts about goal-directed behavior and inferences of commitment.

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INTRODUCTION

Technology is making it increasingly easy for consumers to record and track their behaviors over time, including things like food consumption, spending, and physical activity. As a result, streaks and other patterns of behavior are now evident to consumers. How do streaks of consecutive behaviors (i.e., doing something three or more times in a row) affect consumers' subsequent decisions to continue those behaviors in the future? And how might being aware of streaks in working towards a goal, such as by eating healthy several days in a row, affect predictions of future goal success? In my dissertation, I explore how patterns of repeated behavior – in particular, streaks – influence actual and predicted behavior.

The first essay of my dissertation examines how intact and broken streaks affect consumers' motivation. I find that consumers view maintaining their streaks as a goal in and of itself, above and beyond other goals they may have associated with the repeated behavior. Consequently, consumers' behavior is affected by the status of their streak; relative to not having a streak, intact streaks make consumers more likely to continue a behavior, while compared to intact streaks, broken streaks make consumers less likely to continue a behavior, even when the break is caused by external events outside of their control. Consistent with this “streaks as goals” theory, consumers are less likely to continue doing a behavior after a “missed” behavior when that miss breaks a streak compared to when it does not (i.e., they are demotivated by breaking their streak, rather than just experiencing a “miss”). Furthermore, making streaks more salient (e.g., through behavioral tracking or the framing of behavior) encourages people to preserve them even more when they remain intact, but magnifies the negative effects of broken streaks. These

findings provide insight into the trade-offs involved when consumers' streaks are made salient.

Behavioral tracking technology also provides individuals with a record of their past behavior, which can inform their inferences and predictions about whether they might succeed or fail at their long-term goals. In the second essay of my dissertation, I investigate how patterns of past behavior inform people's forecasts about goal-directed behavior. I show that even when holding the overall rate of behavior constant, a successful recent streak of a goal-consistent behavior causes people to predict more goal-consistent behavior in the future. This builds off research on the hot-hand belief (Gilovich, Vallone, and Tversky, 1985), which argues that people infer meaning from a streaky sequence of outcomes even if generated by random chance. In the context of goal pursuit, I posit that people perceive a streak of goal-consistent behavior (e.g., three days in a row of sticking to a diet) to be indicative of the individual's dedication to their goal (e.g., losing weight), and thus infer that a streak signals an individual's high level of commitment. In turn, people are more likely to believe that an individual with a recent streak can reach their long-term goal without the aid of restrictive goal pursuit strategies, like commitment devices. Furthermore, I find that the effect is attenuated in the presence of other diagnostic cues that signal commitment, but is stronger for predictions regarding behaviors that require a high level of a commitment, relative to other activities.

CHAPTER 1. ON AND OFF TRACK: HOW (BROKEN) STREAKS AFFECT
FUTURE BEHAVIOR

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ABSTRACT

Technology has made it incredibly easy for consumers to track their repeated behaviors over time, leading consumers to be more aware of their streaks of consecutive behaviors than ever before. But how do these streaks (and whether they are broken or remain intact) affect consumers' subsequent decisions to continue those behaviors in the future? Across six studies, we show that, compared to intact streaks, broken streaks make consumers less likely to continue a behavior, even when the break is caused by external events outside of their control. This effect occurs because consumers are motivated to maintain their streaks, which provide them with a sense of accomplishment. Consistent with our "streaks as goals" theory, making streaks more salient (e.g., through behavioral tracking or the framing of behavior) encourages people to preserve them even more when they remain intact, but magnifies the negative effects of broken streaks.

Furthermore, consumers are less likely to continue doing a behavior after a "missed" behavior when that miss breaks a streak, compared to when they do not have a streak. Finally, this effect is diminished when consumers have the opportunity to "repair" a broken streak, thus providing a potential solution for firms that wish to highlight streaks

without incurring the costs of salient broken streaks. These findings provide insight into the trade-offs involved in motivating repeated consumption behaviors by increasing the salience of consumers' streaks.

INTRODUCTION

One of the author's friends was recently training for a marathon. To prepare, she decided to track her runs on a work-out app for several weeks leading up to race day, and seeing her daily streak felt motivating. A few weeks into her training, there was a terrible thunderstorm that kept her from going on a run that day. After this break in behavior, she stopped using the work-out app and found herself unmotivated to continue her daily runs. This puzzled her given her favorable opinion of the app and her previous consistency in running every day. The current paper seeks to understand this phenomenon: when and why streaks can both motivate and demotivate subsequent consumer behavior.

New technologies, such as smartphone apps and fitness wristbands, are making it easier for consumers to visualize and track their patterns of behavior in a variety of domains, including their health (Fox 2013) and their finances (Jacobe 2013). Companies encourage consumers' repeated behaviors by highlighting their streaks, or unbroken sequences of three or more repeated behaviors. For example, Snapchat fills users' contact lists with emojis representing how many days in a row they have messaged each person. Language-learning apps like Duolingo highlight the number of consecutive days consumers have used the program with a graphic depicting their streak length, and by sending daily reminders. And game apps, such as Pokémon Go and the New York Times Crossword, emphasize when a user has completed a desired action multiple times in a row (e.g., catching a Pokémon or solving a crossword) through badges and notifications.

Apps in these domains and others presumably focus on streaks to motivate consumers to continue their behavior, as sustained consumer engagement is an important source of value for both app developers and content providers (Egan 2015). Anecdotally,

consumers report that this emphasis on streaks within an app draws them in and keeps them coming back (Lorenz 2017; Kumar 2016).

However, consumers inevitably experience interruptions in their behaviors and streaks, even when they have the best of intentions. For example, a busy travel schedule might result in missing a day of exercise, and bad internet reception might interfere with a variety of tracked online activities. Indeed, dozens of Duolingo users have complained in the app's community forum about broken streaks for reasons outside their control (e.g., observing a religious holiday, extreme weather causing power outages), and gamers are quick to post on social media about app malfunctions that ruin their streaks. Some Snapchat users strike an even more dramatic tone, claiming, "if you lose your streak, it's like the world's over" (Shamsian 2016).

In this article, we investigate the effect of (broken) streaks on consumers' future behavior. Across six studies, we find that relative to having an intact streak, consumers with broken streaks are less likely to continue the behavior, regardless of whether the break is within or outside of their control. Additionally, we examine how the emphasis on streaks can amplify this effect, and thus be a double-edged sword. When consumers have an intact streak, highlighting streaks (e.g., through notifications or images) can be a motivating force, thus increasing their likelihood of continuing the behavior even more. However, when consumers have a broken streak, highlighting streaks can lead to further demotivation and an even lower likelihood of continuing the behavior.

Our paper makes an important theoretical contribution to a number of literatures. First, we build on the large body of work studying consumer goal setting and pursuit (e.g., Locke and Latham 1990; Bagozzi and Dholakia 1999). Prior research has explored

how progress towards a goal, or lack thereof, can affect subsequent goal-consistent behavior (e.g., Kivetz, Urminsky, and Zheng 2006; Cochran and Tesser 1996; Soman and Cheema 2004), as well as how the nature of the goal plays a role in these effects (e.g., specificity: Scott and Nowlis 2013; Wallace and Etkin 2017; feasibility: Bagozzi and Dholakia 1999). Yet, this work has not explicitly examined how specific patterns of goal-consistent behavior within a trajectory towards a goal impact consumer motivation. We show that a streak of past behavior can become a goal in and of itself, with independent effects beyond how much progress one has made toward some end state. More broadly, this work contributes to our understanding of repeated consumer decision making (e.g., Hoyer 1984; Jacoby and Kyner 1973), and particularly how past behaviors can affect future behaviors (e.g., Ouellette and Wood 1998). While prior research has examined how a consumer's behavior in the previous time period can affect their behavior in the next time period, less work has studied the influence of consecutive behaviors or particular patterns such as streaks.

We also build on recent work studying consumer tracking behaviors, which has mostly focused on how tracking affects enjoyment of the experience (Etkin 2016). Beyond the effects on the current experience, we show that tracking can affect future choices. More generally, our work contributes to the growing body of consumer research examining how technology is affecting consumer behavior in various ways (e.g., Deighton, Goldenberg, and Stephen 2017; Barasch, Zauberaman, and Diehl 2017; Roth, Wänke, and Erev 2016; Rosario et al. 2016). As such, our research has important practical implications, both for consumers, who want to maximize their motivation to

perform certain behaviors, and for companies and marketers, who want to optimize consumer engagement with their products.

Repeated Behavior

Research has examined repeated behaviors in a wide variety of contexts (for reviews, see Aarts, Verplanken, and van Knippenberg 1998; Ouellette and Wood 1998). When considering what to do next in light of their recent decisions, consumers sometimes act consistently with their past actions, while other times they act inconsistently.

First, several areas of previous research have shown that people often behave consistently with their former decisions. For example, consumers frequently choose consistency within sets of products that they purchase (Evers et al. 2014), and are more likely to order a healthy entrée for a given meal if they have already ordered a healthy appetizer (Dhar and Simonson 1999). Relatedly, consumers are less likely to act upon an attractive opportunity after having already missed an even more attractive opportunity (Tykocinski, Pittman, and Tuttle 1995; Arkes, Kung, and Hutzel 2002), and are more likely to commit to an effortful behavior when they have already completed an easier related behavior (Freedman and Fraser 1996; Burger 1999). Additionally, prior research on goal-directed behavior demonstrates that past behaviors that enable progress towards a goal encourage continuation of that behavior (Kivetz et al. 2006; Soman and Shi 2003), while lapses in goal-directed behavior can undermine subsequent goal pursuit by focusing consumers on their failures (Cochran and Tesser 1996; Polivy, Herman, and Deo 2010; Soman and Cheema 2004).

Other work has shown that consumers also sometimes act inconsistently with their past actions. For example, within moral decision-making contexts, people often

exhibit licensing or balancing effects, compensating for immoral decisions with subsequent moral ones (or vice versa; Jordan, Mullen, and Murnighan 2011; Khan and Dhar 2006; Merrit et al. 2010). Similarly, for behaviors involving self-control, an occasional indulgence can restore individuals' self-regulatory resources and promote more virtuous behavior in the future (Baumeister et al. 1998). Moreover, a break from a prolonged or repeated behavior can disrupt satiation, thus restoring the utility derived from the behavior in the next time period and increasing consumers' motivation to continue (Kurzban et al. 2013; Nelson, Meyvis, and Galak 2009). People also value variety-seeking in certain contexts, such as when they feel boredom (Fishbach, Ratner, and Zhang 2010).

Streaks

Streaks are a special pattern of repeated behaviors, marked by one original and at least two repeat events occurring in sequence (Carlson and Shu 2007). Although a great deal of research has examined *perceptions* of streaks (e.g., hot hand belief; Gilovich, Vallone and Tversky 1985), no work has looked at the impact of streaks on consumers' future behaviors.

This gap is surprising given the ubiquity of such patterns of behavior in everyday life: pretty much everyone experiences periods of time where they exhibit streaks in their behavior, whether purposefully or inadvertently. And as described earlier, many firms have begun to highlight such streaks of both online and offline behaviors (e.g., consecutive language lessons completed, consecutive days exercised). To assess people's familiarity with apps that reinforce their streaks of behavior, we asked 100 online respondents (M age = 31.86 years, SD = 8.15, 41% female) to tell us about their

experiences in a short survey (see Appendix for full questionnaire). Over 90% of participants could name an app they are currently using that emphasizes streaks in their behavior, and over 90 different apps were listed in an open-ended question asking for examples. Moreover, 79% of participants in our survey reported that these apps have made them more aware of their streaks than they had been in the past, 70% liked having their streaks emphasized, and 66% felt that streak highlighting enhanced their experiences.

Thus, it is clear that apps and tracking technology have increased the salience of streaks for consumers in their daily lives across a wide range of contexts. But how does consumers' awareness of these streaks, whether intact or broken, affect their decisions about whether to continue doing a behavior in the future?

The current research

In this research, we study how a) the status of consumers' streaks (i.e., whether they are intact or broken) and b) the salience of consumers' streaks affect their future likelihood to perform the same behavior. That is, we experimentally manipulate consumers' previous behavior (whether their streaks are intact or broken) and the salience of their streaks (whether their streaks are highlighted to them or not) and examine the causal effects of these dimensions on consumers' subsequent decisions. Our research also investigates the psychological process underlying streaks' influence on consumer behavior.

We propose that when consumers pursue repeated behaviors over time, they find maintaining a streak to be a meaningful goal in and of itself. Streaks can be seen as a natural indicator of consistency, something that people generally value because it

conveys cognitive balance and increases ease of processing (e.g., Cialdini, Trost, and Newsom, 1995; Singer 1966; Evers et al. 2014). Indeed, the importance of consistency appears to have a biological basis, as work in neuroscience has shown that non-human primates react more sensitively to consistent (i.e., low variance) reward environments (e.g., Kobayashi, Pinto de Carvalho, and Schultz, 2010). Moreover, streaks are often viewed as a positive signal of others' future success (e.g., when a basketball player is "hot", Gilovich et al. 1985; when a gambler is lucky, Oskarsson et al 2009). Because of these positive associations with streaks, as well as the reinforcement of consistent behavior, we expect that consumers will want to maintain their streaks of behavior over time, even beyond their desire to achieve particular end states or complete the behavior more generally. If consumers adopt streaks as a goal in and of itself, then the maintenance of a streak should provide consumers with a sense of accomplishment from their past behavior and motivate them to continue that behavior in the future (e.g., Lantham and Locke 2006; Koo and Fishbach 2008). Relatedly, past work has shown that when consumers have failed a goal, they feel demotivated and become less likely to complete behaviors related to that goal moving forward (e.g., Cochran and Tesser 1996; Soman and Cheema 2004). Therefore, to the extent that consumers view maintaining a streak as a goal in and of itself, breaking it may reduce their sense of accomplishment and feel discouraging, even if the 'miss' contributing to the break is outside their control. Consequently, we predict that, relative to a having an intact streak, or no streak at all, having a broken streak may decrease consumers' likelihood to continue the behavior.

That is, consumers' behavior will change as a function of their streak's status:

H1: Relative to intact streaks of behaviors, broken streaks lead consumers to be less likely to continue the behavior.

H2: The effect of streaks on consumer behavior is driven by consumers' goal to maintain their streaks. Relative to consumers with intact streaks, consumers with broken streaks will have a decreased sense of accomplishment and motivation to continue the behavior, which will drive the effect on continued behavior.

Furthermore, we propose that increased salience of a consumer's streak may amplify this effect. Much like visual cues can shift attention to certain aspects of the environment (Schneider and Shiffrin 1977), emphasizing streaks through notifications or graphics should increase how much consumers focus on them, and as such, their influence on consumers' behaviors. Thus, when an intact streak is highlighted, consumers should become even more motivated to continue that behavior moving forward than when the intact streak is not highlighted.¹ Conversely, when a broken streak is highlighted, the failure to maintain their streak goal should demotivate consumers even further. As a result, we expect the salience of streaks to magnify their effects in both directions.

H3a. Highlighting intact streaks will make consumers more likely to continue the behavior, relative to when the same sequence of previous behavior is not highlighted.

¹Consistent with this, in the app experience survey we conducted, 73% of users reported feeling motivated by having their streaks highlighted.

H3b. Highlighting broken streaks will make consumers less likely to continue the behavior, relative to when the same sequence of previous behavior is not highlighted.

In sum, we expect that because consumers have a goal of maintaining their streaks, the status of their streaks will affect future behavior: consumers will be less likely to do a behavior in the future when their streaks are broken, relative to when they are intact. Furthermore, when streaks are highlighted, consumers will be even more likely to continue the behavior when the streaks are intact, and even less likely to continue the behavior when the streaks are broken. We also expect that, because consumers value having an intact streak, the effect of a broken streak is diminished when consumers have the opportunity to “repair” their broken streaks, thus providing a potential solution for firms that wish to highlight streaks without incurring the costs of salient broken streaks.

In addition, our “streaks as goals” theory implies that a consumer’s decision of whether to continue their behavior in these contexts is a deliberate and conscious one. That is, individuals often make an active choice to do a certain behavior or not as a function of whether they are motivated to keep their streak going. This process is distinct from the automaticity of habitual behavior (e.g., Aarts, Verplanken, and van Knippenberg 1998; Ouellette and Wood 1998) and from the momentum of implementation mindsets, in which individuals no longer focus on *whether* to do something but on the concrete steps required to reach a given objective (Dhar, Huber, and Khan 2007; Gollwitzer 1990; Gollwitzer and Bayer 1999). To the extent that a habit has been formed or an implementation mindset has been adopted, there is no reason to expect a one-time interruption or “break” to undermine future behavior (e.g., Jager 2003; Zhen et al. 2011).

Moreover, these theories would not make differential predictions for future behavior based on the salience of past behavior, as we do in our third hypothesis.

Furthermore, this work expands past work on goal progress (e.g., Soman and Cheema 2004) by examining the effect of behavioral lapses (i.e., broken streaks) when there is no inhibitory goal (e.g., dieting) in place. That is, while previous work has studied what happens when consumers try to avoid certain behaviors over sustained periods of time (e.g., refraining from eating unhealthy food; Cochran and Tesser 1996), no prior literature has specifically investigated the motivating role of previous behavior on achieving acquisitional goals. Similarly, while prior work on partitions has shown that physical barriers creating smaller portions can help consumers control their myopic behaviors by considering the long-term consequences (e.g., eating unhealthy food, overspending; Cheema and Soman 2008; Geier, Wansink and Rozin 2012), our paper examines the impact of streaks in adhering to goals that do not involve self-control and preventing impulsive actions. Instead, our work focuses on behaviors that are not necessarily valuable for consumers' long-term well-being (e.g., hedonic behaviors, like playing games in an app).

Study Overview

Six studies test these predictions using a multi-method approach. Importantly, the majority of our studies (studies 1a, 1b, 3, 4, and 5) test the effects of real streaks of repeated behaviors on actual consumer decisions (e.g., whether to play another game). In all studies, we examine how participants' patterns of recent behavior – whether their streaks are intact or broken – affect their decision to continue that behavior in the future (hypothesis 1). Studies 2 and 3 also examine the effect of highlighting previous streaks

on participants' future behavior (hypotheses 3a and 3b). Moreover, we explore how the proposed "streaks as goals" hypothesis plays a role in how streaks affect future behavior (hypothesis 2; studies 1b, 3, 4, and 5) through mediation. Finally, studies 4 and 5 examine factors that are important to the "streaks as goals" theory and the implementation of streak highlighting by companies. Study 4 tests the effects of broken versus intact streaks explicitly, compared to recent behavior without a preceding streak. Lastly, study 5 explores if consumers are willing to change their behavior to restore a broken streak if given the opportunity. By doing so, we examine the effectiveness of a potential strategy for firms wanting to highlight streaks without the negative effects of salient broken streaks.

In addition, we examine the effects of streaks on different types of behaviors, both online and offline. In our app experiences survey, 59% of participants reported that they had gone out of their way to maintain (or avoid breaking) their streaks on an app by doing some actual behavior in real life. For example, a fitness tracker user wrote that one evening, he "didn't want to work out... but did a quick 7-minute workout in the back of a bar to make sure that [his] streak remained intact." Thus, we test whether highlighting streaks has an effect for both offline (e.g., tasting candies) and online (e.g., completing language lessons or playing word games on an app) behaviors.

In all studies, our sample size was determined in advance, and we report all measures assessed. No conditions or participants were dropped from any of the analyses (Simmons, Nelson, and Simonsohn 2011).

STUDIES 1A AND 1B: A BROKEN STREAK DECREASES FUTURE BEHAVIOR

Studies 1a and 1b examine how a broken streak, relative to an intact streak, affects people's real decisions to consume candy (study 1a) and play games in an app (study 1b). Study 1b also provides initial evidence for the "streaks as goals" hypothesis by measuring participants' motivation to continue the behavior and testing whether it mediates the effect of broken streaks on future behavior.

STUDY 1A: CANDY CONSUMPTION

Methods

Two hundred twenty-one participants in a behavioral lab at a northeastern university (M age = 20.75, 75.57% female) were recruited to participate in a "Tasting Study" as part of an hour-long lab session, for which they were paid \$10. Sample size was determined by the number of participants who signed up for the four-day lab session. Of those participants who signed up, 55 participants (24.89%) were unable to participate due to allergies or dietary restrictions.

Participants first learned that they would have the opportunity to try several different types of candy in the lab that day. A cover story indicated that the researchers were interested in how candy appearance and other information affect how people perceive different tastes. Participants were told that they could try as many or as few candies as they wanted. Our primary dependent measure for this study was how many candies participants would decide to try.

For each candy that they tried, participants first saw an advertisement in the survey, and were then instructed to get out of their seats and go to an adjacent room where a research assistant would distribute the candies. This research assistant was blind

to the hypothesis. Participants were instructed to bring their Tasting Study log sheet with them to this room. This sheet had 10 boxes in a line at the top of the sheet, each corresponding to a different candy. When participants entered the room, they handed their log sheet to the research assistant, who was sitting behind a table that had 10 numbered paper bags, each filled with a different type of candy. The research assistant made sure all bags had their openings facing her, so that the participants could not see what was inside. The research assistant looked at the participant's log sheet and instructed the participant which candy to take next. After the participant reached inside the bag and took one candy, they received a blue stamp inside the box corresponding to the candy's number. Thus, participants logged each candy that they tasted, similar to consumer logging behavior in many tracking apps.

Participants were then asked to return to their desks, where they could eat the candy and answer some questions related to the cover story. After answering these questions, participants read that if they wanted to continue with the study, they could press the arrow button to proceed to the next candy. If they decided to try the next candy, they began the full procedure again by viewing the relevant advertisement and then going to the adjacent room to obtain another candy. However, if participants decided *not* to try the next candy, they could simply leave the lab session entirely. Our study was scheduled as the last one in the session, so that participants were free to leave at any time (and would not miss any of the other studies). There was plenty of time in the lab session for participants to try all 10 candies if they wanted to, without having to stay beyond their one-hour time slot, but participants often leave lab sessions early when they have the opportunity since they are paid the same amount regardless of how much time they are

there. Participants were explicitly told that the choice of how many candies to try was completely up to them, and no guidance was provided about how many candies they should try.

Participants were assigned to one of two between-subjects conditions in alternating order. For the first three candies, all participants went through the procedure exactly as described above. In the *intact streak* condition, the procedure for Candy #4 was exactly the same as the previous candies. However, in the *broken streak* condition, when participants reached into the bag for Candy #4, there was no candy left. Upon realizing this, the research assistant apologized and said she hadn't been given enough of just this particular candy. This wording was used to prevent participants from inferring that other candies would also be unavailable. The research assistant told the participant that in order to continue, they needed to return to their desk, type "NA" into the survey questions, and view the advertisement for Candy #5 in the online survey. The research assistant also wrote an "X" in the stamp box for Candy #4, meant to visually reinforce the broken streak manipulation. Forty-three participants (19.46%) started the study but did not try more than three candies, and thus did not experience our manipulation, leaving a final sample of 123 participants (61 *intact streak* condition, 62 *broken streak* condition).

When participants decided to end the study, they were instructed to bring their log sheet to a different research assistant in a separate room, who was not associated with that particular study. This research assistant gave them an "anonymous feedback questionnaire" asking them how satisfied they were with the session on a 9-point Likert scale, and eliciting any additional comments they had about how the session was run. This confidential feedback was intended to capture any general discontent from

participants about the study or experimenter (e.g., for not having enough candy) in an inconspicuous way.

From the log sheet, we were able to record how many candies each participant tried (or attempted to try). Using the participants' lab IDs, we were able to acquire basic demographic information about participants through the behavioral lab's database, as well as their responses to the anonymous feedback questionnaire. For the complete cover story survey and all study materials, see the Appendix.

Results

Future behavior. First, we tested the effect of our manipulation on participants' decision to try Candy #5. A chi-square test revealed that fewer participants tried Candy #5 in the *broken streak* condition (24, 38.71%) than in the *intact streak* condition (48, 78.69%; $\chi^2(1) = 20.25, p < .001$). In addition, fewer participants in the *broken streak* condition actually consumed 5 or more candies (20, 32.36%) compared to the *intact streak* condition (48, 78.69%; $\chi^2(1, N=123) = 26.81, p < .001$), and fewer participants reached the last available candy (Candy #10) in the *broken streak* condition (14, 22.58%) than in the *intact streak* condition (24, 39.34%; $\chi^2(1, N=123) = 4.05, p = .044$). Furthermore, when we compared how many candies each participant tried (or attempted to try) across conditions, a one-way ANOVA revealed a significant difference ($F(1, 121) = 10.79, p = .001$), such that participants in the *broken streak* condition tried (or attempted to try) fewer candies ($M = 5.73, SD = 2.52$) than participants in the *intact streak* condition ($M = 7.21, SD = 2.50$).

Dissatisfaction. It is possible that fewer participants in the *broken streak* condition continued the study after Candy #4 because the missing candy led them to be dissatisfied

with the session or the experimenter. However, based on the results from the anonymous feedback survey, a one-way ANOVA revealed that participants in the *broken streak* condition were just as satisfied with the session ($M = 7.60, SD = 1.97$) as participants in the *intact streak* condition ($M = 7.11, SD = 2.41; F(1, 121) = 1.47, p = .227$). The open-ended responses also did not indicate any frustration with the study or researchers. Comments were generally focused on how enjoyable the study was (e.g., “I love candy! Thank you!”), though one was negative (“Too much candy?”). There were no differences between conditions in the number or types of comments ($ps > .24$). These results suggest that participants in the *broken streak* condition did not make more negative inferences about the experimenter’s competence or the execution of the study.

STUDY 1B: WORD GAMES

Methods

Three hundred thirty-two participants (M age = 36.67, $SD = 11.45$, 46.99% female) were recruited from Amazon Mechanical Turk to try out a word game app that we created, and answer questions about their experience. Only 188 participants (56.63%) reached our manipulation (as described below) and thus were included in our study. Our target sample size was 200 participants. Regardless of completion, all participants were paid \$0.60 for participating in the study.

For this study, we designed an interface within Qualtrics resembling a game app. The interface allowed us to customize the background and color scheme of the page to differentiate it from the rest of the survey and to make the games feel unique. In this study, participants played a game called “Word Jumble,” in which they unscrambled a jumble of letters to create a noun in a given category (e.g., “ASLDA” would unscramble

to “SALAD” and in the “food” category). The interface also featured a “hint” button that revealed a clue (e.g., “This is a vegetable dish starting with the letter S”). Participants were encouraged to try their best to get the correct answer, but were able to submit any answer (or none at all) to proceed.

After reading the game instructions, participants they were informed that they would see a “game tracker” of their jumble attempts while playing the game. At multiple points during the game, participants were told that they could attempt as many or as few jumbles as they wanted, and that this tracker would show a checkmark for every jumble that they attempted. Participants also read that they might encounter the following message up to one time during the game: “Unfortunately, we have reached the quota of players for this game.” Participants were told that this “quota” message indicated that enough participants had already played that particular jumble and was not a sign that they had made a mistake or that the app had messed up.

After each jumble, participants were given the correct answer and made an explicit choice of whether to keep playing the game, or to stop playing the game. Our manipulation occurred at Jumble #4.² After all participants had established a three-in-a-row streak, they were randomly assigned to one of two between-subjects conditions, much like in study 1a. In the *intact streak* condition, participants played Jumble #4 without any change in procedure, thus continuing their streak. In the *broken streak* condition, participants saw the “quota” notification instead of playing a jumble. As a result, their game tracker displayed a broken streak (see figure 1), even though it held

²If participants chose to stop before Jumble #4, they answered some additional questions to finish the survey, and were not included in our final sample.

constant the reported number of jumbles attempted (4 for all participants). Importantly, this manipulation and the information within the game tracker had no influence on participants' earnings or any other consequential aspects of this study.



Figure 1. Game trackers displayed in the *intact streak* condition (left) and *broken streak* condition (right) after players reached Jumble #4.

Our key dependent measure was participants' decision to continue playing the game after Jumble #4 (i.e., whether they chose to play Jumble #5 or not). Regardless of their decision, we informed all participants on the next page that they had completed all available jumbles and asked them to answer some questions about their experience.

Participants answered three questions on 1 (not at all) to 11 (a great deal) scales regarding how their streak affected their motivation (“How much did you feel motivated to continue playing?”; “How much did your past behavior push you to continue?”; and “How much did you feel like you were ‘on a roll’?”; $\alpha = 0.79$). Participants also answered six items addressing their emotions (How angry, upset, happy (reverse coded), disappointed, annoyed, and excited (reverse coded) they felt; 1 (not at all), 11 (extremely); $\alpha = 0.72$). Participants also answered five exploratory items regarding the automaticity and perceived momentum they felt during their decision (e.g., “How automatic was your decision about whether to continue playing?”, “How much did you

think about the ‘momentum’ you had in playing?”). In this study, there was no effect of condition on automaticity and perceived momentum ($p = .241$). Additionally, participants answered two exploratory items about how consistent they felt (e.g., “How much did you think about consistency in your playing behavior?”; see Appendix for all measures).

Lastly, participants answered basic demographic questions.

Results

Future behavior. A chi-square analysis revealed that fewer participants continued playing the jumbles when their streak was broken (56, 60.22%) than when their streak was intact (88, 92.63%; χ^2 (df=1) = 27.55, $p < .001$).

Motivation. A one-way ANOVA revealed that participants with a broken streak felt less motivated to continue playing ($M = 7.47$; $SD = 2.33$) than participants with an intact streak ($M = 8.52$, $SD = 1.81$; $F(1, 186) = 12.08$, $p < .001$).

Negative emotions. A one-way ANOVA revealed that participants with a broken streak felt more negatively ($M = 3.84$, $SD = 1.55$) than participants with an intact streak ($M = 3.21$, $SD = 1.37$; $F(1, 186) = 8.49$, $p = .004$).

Mediation analysis. We conducted mediation analyses using a bootstrap procedure with 10,000 samples (Hayes, Preacher, and Myers 2011) to test the process by which a broken versus intact streak of behavior affects future behavior. The mediation model (SAS PROCESS Macro, Model 4) included streak condition (broken = 1; intact = 0) as the independent variable, motivation and negative emotion as simultaneous mediator variables, and likelihood of doing the behavior as the dependent variable. In this model, motivation mediated the effect of a broken streak on future behavior (Indirect effect = $-.23$, $SE = .12$, 95% CI = $[-.54, -.06]$), but negative emotion did not (Indirect

effect = $-.001$, SE = $.09$, 95% CI = $[-.20, .27]$). Mediation models considering each mediator separately found similar results (motivation: Indirect effect = $-.24$, SE = $.12$, 95% CI = $[-.54, -.05]$; negative emotions: Indirect effect = $-.04$, SE = $.08$, 95% CI = $[-.23, .11]$).

Discussion

Studies 1a and 1b demonstrate that participants are less likely to continue a behavior after a broken streak, relative to an intact streak. In addition, these studies suggest that while broken streaks may generate negative emotions, the decreased motivation following a broken streak exerts a stronger influence on future behavior.

To examine the effects of broken streaks in an ecologically valid setting (i.e., without forcing people to experience broken streaks) we ran an additional study in which participants ($N = 135$) played a series of word games like those described in Study 1b (see Appendix for full methods and results). Rather than exogenously manipulating their streaks, whether participants had a broken or intact streak depended on their choice between a math game or word game for game #4. We found that participants who broke their streak were less likely to choose the same behavior which contributed to the original streak (27.59%) compared to participants who chose to keep their streaks intact (97.17%; $\chi^2(1) = 73.23$, $p < .001$). Notably, the endogenous choice to maintain versus break a streak in this study establishes the robustness of our findings to real consumer choices, but does not allow us to make any causal claims about the relationship of (broken) streaks and future behavior. The remaining studies build on this correlational evidence by experimentally manipulating people's streaks directly.

STUDY 2: HIGHLIGHTING STREAKS AMPLIFIES THE EFFECT OF A BROKEN STREAK ON FUTURE BEHAVIOR

Study 2 investigates how highlighting the presence of a consumer's streak, as is common practice among many tracking apps, impacts the effect of a broken streak. We predict that increasing the salience of a recent streak will amplify the effect we found in the previous studies: making consumers even more likely to continue a behavior if a streak is intact, and even less likely to continue that behavior if the streak was recently broken.

Methods

One thousand two hundred and eight participants from Amazon Mechanical Turk (M age = 36.03³, 51.16% female, 0.58% other/did not say) were recruited to participate in a study for \$0.20. Our target sample size was 1,200 participants.

Participants first read some information about an app that helps users learn a new language by providing interactive lessons of progressing difficulty in reading, writing, and speaking a selected language (similar to the Duolingo app). Participants saw sample images of the information provided on the app and read a few sentences about its purposes and features, then were told to imagine that they were frequent users of the app. They read that they had progressed through several levels in the past few months and that they have been using the app every day.

Participants were then randomly assigned to condition in a 2(*streak: intact vs. broken*) by 2(*salience: high vs. low*) between-subjects design. In the *intact streak* condition, participants were told that they used the language app yesterday, while in the

³ We had 1209 responses in our data, but removed one participant who reported that they were 45,177 years old.

broken streak condition, they were told that they did not use language app yesterday. In the *low salience* condition, participants did not receive any additional information about their recent behavior. However, in the *high salience* condition, participants' recent streak on the app was highlighted by reminding them that they had a streak of using the app before yesterday. Participants in this condition were also told that their behavior yesterday either maintained their streak (if they were in the *intact streak* condition) or broke their streak (if they were in the *broken streak* condition).

Participants were then asked "how likely are you to use [the app] today?" on a 1 (extremely unlikely) to 11 (extremely likely) scale. Participants then answered a manipulation check question about if they had used the app yesterday.⁴ Lastly, participants answered a question about their familiarity with apps like the one described in the study and basic demographics questions.

Results

Future behavior. Replicating our previous findings, a two-way ANOVA revealed a main effect of streak ($F(1, 1204) = 58.59, p < .001$); participants were less likely to use the language app after a broken streak ($M = 8.86, SD = 2.09$) than after an intact streak ($M = 9.68, SD = 1.62$). There was no main effect of salience on likelihood of continuing to use the app ($F(1, 1204) = 0.22, p = .64$).

Notably, there was a significant interaction between streak and the salience of recent behavior ($F(1, 1204) = 11.39, p < .001$; see figure 2). In the *low salience* condition, participants with a broken streak were less likely to continue using the app ($M = 9.06, SD = 1.88$) compared to participants with an intact streak ($M = 9.52, SD = 1.64$;

⁴One hundred participants (9.11%) failed this manipulation check.

$t(606) = 3.19, p = .002$). This effect was even larger in the *high salience* condition ($M_{broken} = 8.65, SD = 2.27$ vs. $M_{intact} = 9.83, SD = 1.58; t(598) = 7.42, p < .001$).

Moreover, salience had an effect both when the participant broke their streak and when they maintained it, but in opposite directions. Specifically, participants with a broken streak were *less* likely to continue using the app when their recent streak was highlighted ($t(581) = 2.38, p = .018$), while participants with an intact streak were *more* likely to continue using the app when their recent streak was highlighted ($t(623) = 2.41, p = .016$). Thus, not only is the effect of streak larger when recent behavior is made salient, but this is also driven by effects in both directions.

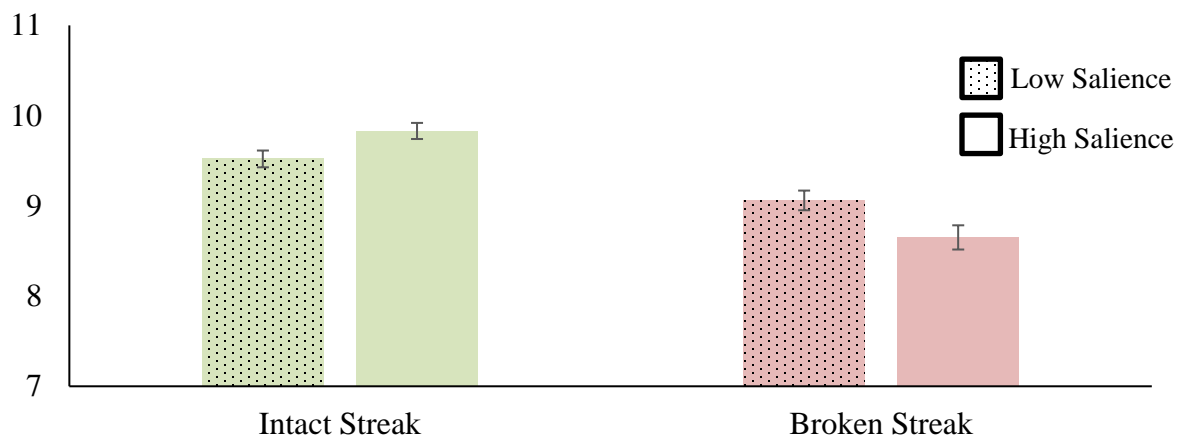


Figure 2. Participants' likelihood of continuing to use a language app, as a function of their streak and the salience of their recent behavior. Error bars are ± 1 standard error.

Discussion

Study 2 replicates our findings from previous studies: compared to an intact streak, participants were less likely to continue a behavior after a broken streak. This study also demonstrates that making the previous streak more salient can strengthen these effects, both promoting and undermining future behavior. That is, highlighting streaks

increased the effects in both directions: highlighting intact streaks leads people to be even more likely to continue the behavior, while highlighting broken streaks leads people to be even less likely to continue the behavior. Additionally, we find these effects hold when the broken streak is not explicitly caused by an external factor, suggesting that these effects likely occur even when consumers feel like the cause of their own broken streaks.

The salience manipulations in these studies were intended to mirror the experience of using many tracking apps nowadays, where consumers are frequently reminded of their recent behavioral streaks. Comparing the effect of a broken streak in this context (i.e., high salience) to the effect of a broken streak with low salience provides a clean examination of how streak highlighting in the real world affects future behavior, controlling for possible inferences consumers may make from a recent miss (e.g., that they do not like the behavior anymore). The fact that the effect of a broken streak is amplified when streak salience is high (i.e., there is a significant interaction) suggests that such inferences do not fully explain the difference between broken and intact streaks. To further rule this out, in the next study, we hold participants' behaviors constant across conditions and just manipulate whether the behavior contributes to a streak or not. We also return to examining real behavior to see whether simply framing the same last behavior as part of a streak can affect individuals' real decisions about what to do in their next behavior.

STUDY 3: FRAMING THE SAME BEHAVIOR AS BREAKING A STREAK DECREASES FUTURE BEHAVIOR

Study 3 further investigates how broken streaks can be demotivating. However, rather than manipulating the status of participants' streaks by changing their most recent

behavior (i.e., whether they did the behavior or not), as in the previous studies, in this study we classify the exact same behavior as either part of a streak or not. This approach allows us to control for the behavior participants did most recently, thus isolating the effect of intact versus broken streaks independent of factors that might arise from differences in the last behavior between conditions.

To do this, we build on work on categorization (Redden 2007; Goldsmith, Khan, and Dhar 2010) and define participants' streaks using either more narrow or more broad categories. Specifically, we frame the same behavior as adding to a broadly categorized streak or breaking a narrowly categorized streak. We predict that this categorization, and subsequent status of the streak, will affect participants' behavior. If participants have the goal of maintaining their streak, then after their streak is broken, they should no longer be motivated to continue the behavior. Thus, participants with a broken streak will be less likely to continue the behavior relative to participants with an intact streak, as shown in previous studies, even though all participants did the same behavior most recently. Consequently, broader categorization of behaviors that count toward a streak should allow more consumers to keep their streaks intact, thus encouraging continued behavior (relative to narrow categorization).

We also build on the results regarding the role of streak highlighting from study 2 by examining the case in which the same sequence of behavior remain untracked, and thus not part of a streak at all. We expect that participants with a broken streak will also be less likely to continue the behavior relative to these participants whose behavior is not explicitly tracked, again because of how highlighting a streak impacts consumers' motivation to continue a behavior.

Moreover, in this study we further test the hypothesized mechanism through a more extensive set of measures of motivation.

Methods

Eight hundred five participants were recruited from Amazon Mechanical Turk to try out a game app and answer questions about their experience. Only 452 participants (M age = 35.65, SD = 10.81, 46.68% female, 0.44% other/did not say) reached our manipulation (as described below) and were included in our study. Regardless of completion level, all participants were paid \$0.50 for participating in the study. Our target sample size was 450 participants. This study was preregistered, and additional details about these exclusion criteria and our planned analyses can be found at:

<http://aspredicted.org/blind.php?x=uk6tg7>.

All participants read about the same game app design as in study 1b, but were able to choose to start by playing one of two games: they could unscramble sets of letters to form words in a word jumble game, like in study 1b, or they could find the two numbers in a matrix which summed to 200 in a number sums game (see Appendix for example). Regardless of their game type choice, participants were told that they could complete as many or as few games as they wanted. However, in this study, there was no mention of a potential quota in the instructions. Participants answered comprehension checks about the game instructions before proceeding to the game (see Appendix for comprehension checks).

Then, participants attempted three of the game type they chose. When participants reached Game #4, we informed them that we had run out of the game from their chosen category (jumbles or sums), and they would instead be playing the other type of game

mentioned in the instructions (e.g., if they chose to play jumbles, they would be forced to play a sum for Game #4).

Participants were randomly assigned to one of three streak-framing conditions (*intact streak*, *broken streak*, *no streak information*). In the *intact streak* condition, participants were informed in the instruction phase that all game types would count in their game tracker. Therefore, even though Game #4 was a different game type (e.g., a sum, not a jumble), it was added to their tracker and thus kept their streak going. In the *broken streak* condition, participants were told that only the game type that they selected at the beginning (jumbles or sums) would count in their game tracker. As a result, Game #4, which was the other game type, was not added to their tracker and thus broke their streak. In the *no streak information* condition, there was no game tracker shown.

As in study 1b, our key dependent measure was participants' decision to stop or continue playing after Game #4 (i.e., whether they chose to play Game #5 or not). Regardless of their decision, we informed all participants on the next page that they had completed all available games and asked them to complete some questions about how they felt right after playing their most recent game. Participants answered five items about their motivation, including two items similar to those asked in previous studies ("How much did you feel motivated to continue playing?" and "How much did your past playing push you to continue?") and three additional items ("How determined were you to play another game?"; "How much did you feel driven to continue playing?"; and "How much did you feel compelled to play more games?"; 1 (not at all) to 11 (extremely); $\alpha = 0.93$). To further examine if people view their streaks as a goal, participants also answered four items about their feelings of achievement ("How successful did you feel?";

“How effective did you feel?”; “How proud did you feel?”; and “How much did you feel like you had achieved something?”; 1 (not at all) to 11 (extremely); $\alpha = 0.91$). While measuring separate goal characteristics, these two sub-scales were closely correlated ($r = .71$) and their items loaded on the same factor in a factor analysis. Thus, we combined them into a single measure of sense of accomplishment ($\alpha = 0.94$) for our analyses, but report the results for each sub-scale separately in the Appendix. Similar to study 1b, participants also answered four questions about the negative emotions that they felt (angry, upset, disappointed, annoyed; 1 (not at all) to 11 (extremely); $\alpha = 0.97$). Participants also answered a free response question about why they made the choice that they did after Game #4.

Finally, participants answered four exploratory measures about participants’ overall attitude towards the games (as described in our preregistration) and one question regarding how often they used any gaming apps. In addition, participants answered a manipulation check question measuring the impact of the presence of the game tracker in the *intact streak* and *broken streak* conditions compared to the absence of the game tracker in the *no streak information* condition (“How much were you aware of your streak of attempting the games?”; 1 (not at all), 11 (extremely)). Participants also answered basic demographic questions.

Results

Manipulation check. A one-way ANOVA revealed a significant effect of condition ($F(2, 449) = 14.13, p < .001$). Independent t-tests showed that participants in the *broken streak* condition ($M = 8.61, SD = 2.19$) and the *intact streak* condition ($M = 8.80, SD = 2.46$) were more aware of their streaks than participants in the *no streak*

information condition ($M = 7.29$, $SD = 3.23$; $t_s > 4.15$, $p_s < .001$). Participants in the *broken streak* and *intact streak* conditions were equally aware of their streaks ($t(306) = 0.71$, $p = .48$).

Future behavior. A binary logit revealed a significant effect of condition (X^2 (df = 2) = 9.22, $p = .010$; see figure 3). Separate chi-square analyses showed that fewer participants in the *broken streak* condition chose to continue playing (67.92%) compared to participants in the *intact streak* condition (82.55%; X^2 (df = 1) = 8.78, $p = .003$) and participants in the *no streak information* condition (77.78%; X^2 (df = 1) = 3.69, $p = .055$). Participants in the *intact streak* condition were directionally more likely to continue playing than participants in the *no information* condition (X^2 (df = 1) = 1.05, $p = .31$).

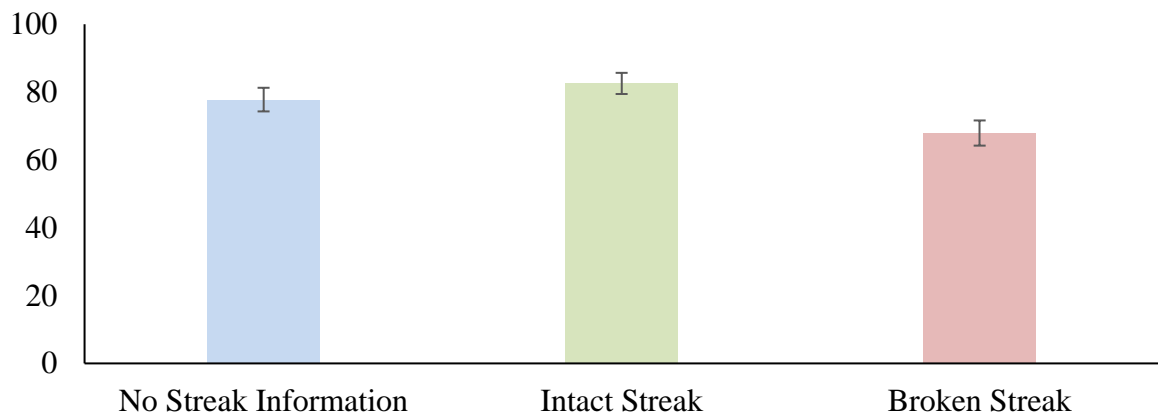


Figure 3. Percent of participants choosing to continue playing a game (versus stop), as a function of streak framing.

Sense of accomplishment. A one-way ANOVA revealed a significant effect of condition ($F(2, 449) = 9.41$, $p < .001$). Independent t-tests revealed that participants in the *broken streak* condition felt a decreased sense of accomplishment ($M = 7.45$, $SD = 2.38$) than participants in the *intact streak* condition ($M = 8.49$, $SD = 1.99$; $t(306) = 4.15$, $p <$

.001) and in the *no streak information* condition ($M = 8.18$, $SD = 2.10$; $t(301) = 2.83$, $p = .005$). Participants in the *intact streak* condition felt directionally more accomplished than participants in the *no streak information* condition ($t(291) = 1.29$, $p = .199$).

Negative emotions. A one-way ANOVA revealed a significant effect of condition ($F(2, 449) = 21.18$, $p < .001$). Participants in the *broken streak* condition felt more negatively ($M = 5.05$, $SD = 3.51$) than participants in the *intact streak* condition ($M = 2.80$, $SD = 2.87$; $t(306) = 6.13$, $p < .001$) and in the *no streak information* condition ($M = 3.25$, $SD = 3.22$; $t(301) = 4.64$, $p < .001$). Participants in the *intact streak* condition felt directionally less negatively than participants in the *no streak information* condition ($t(291) = 1.26$, $p = .210$).

Mediation analysis. We conducted mediation analyses using a bootstrap procedure with 10,000 samples (Hayes et al. 2011) to test the process by which a broken streak affects future behavior. We predicted that people with a broken streak would feel a decreased sense of accomplishment, thus decreasing their likelihood of doing that behavior. The mediation models (SAS PROCESS Macro, Model 4) included sense of accomplishment as the mediator variable and continuation of the behavior as the dependent variable. We ran two models with these variables using different independent variables: one comparing a broken streak (1) to an intact streak (0) and another comparing a broken streak (1) to no streak information (0). We found that sense of accomplishment mediated the negative relationship between breaking a streak and continuing the behavior, relative to both having an intact streak (Indirect effect = -0.49, $SE = .15$, 95% CI = [-.82, -.25]) and having no streak information (Indirect effect = -0.42, $SE = .16$, 95% CI = [-.77, -.13]).

To further examine our proposed mechanism, we ran two additional mediation models which tested the specific relationship between our two subscales: sense of achievement and motivation. Based on past work in goal-setting (e.g., Lantham and Locke 2006), it is possible that the process involved multiple steps, such that goal failure (i.e., a broken streak) decreases the consumer's sense of accomplishment, which in turn decreases their motivation to continue the behavior. Thus, we ran two serial mediation models (SAS PROCESS macro, Model 7) on the effect of a broken streak (compared to an intact streak or no information) on future behavior, with sense of accomplishment as the first mediator and motivation as the second mediator. The indirect effect was significant for the relationship between breaking a streak and future behavior (*vs. intact streak*: Indirect effect = -.45, SE = .13, 95% CI = [-.73, -.24]; *vs. no information*: Indirect effect = -.49, SE = .16, 95% CI = [-.84, -.23]; see Appendix for a similar analysis in study 5).

Lastly, we also conducted four additional models examining how negative emotions mediated the effect of a broken streak (versus an intact streak and versus no streak information) on continuing the behavior. Negative emotions failed to mediate either relationship, as both 95% confidence intervals for the indirect effects contained zero (*broken streak vs. intact streak*: Indirect effect = -0.11, SE = .10, 95% CI = [-.31, .08]; *broken streak vs. no streak information*: Indirect effect = 0.00, SE = .07, 95% CI = [-.14, .14]). Furthermore, competing mediation models found that sense of accomplishment the effects of a broken streak on future behavior even when including negative emotions as a competing mediator (*vs. intact streak*: Indirect effect = -.58, SE =

.17, 95% CI = [-.95, -.29]; vs. *no streak information*: Indirect effect = -.45, SE = .17, 95% CI = [-.82, -.13]).

Discussion

In this study, we found additional evidence that broken streaks decrease real repeated behavior. Participants with a broken streak are less likely to continue a behavior relative to participants with an intact streak, and relative to participants for whom their behavior is not tracked (i.e., their streaks are not highlighted). Notably, these effects exist in a controlled scenario, where we merely framed the same behavior as contributing to a streak or not. Thus, the effect of a broken streak on future behavior cannot be fully explained by inferences consumers make from not engaging in the behavior (e.g., no longer liking the behavior). Together, these results provide evidence that streaks themselves can influence consumer behavior even in the absence of other factors often present when consumers break or maintain their streaks (i.e., doing or not doing a behavior). We also found supporting evidence of the proposed “streaks as goals” hypothesis through our measure of motivation and sense of achievement, which mediates the effect of streak on future behavior.⁵

Interestingly, we found that highlighting participants’ intact streaks only directionally increased their likelihood of continuing the behavior, relative to having no information about their streak. This finding differs from the results in study 2, where increasing the salience of an intact streak increased future behavior. Post hoc, we believe this effect may be reduced in this study because we may have encountered a ceiling effect (i.e., the percent of participants continuing in the *no information* condition was around

⁵In an additional study (N = 459), we replicate these effects using a slightly different game paradigm (see Appendix for full methods and results).

80%, so there may not have been much room to see a positive effect of highlighting an intact streak above this baseline). In an additional study featuring a similar design as study 3 (N = 601), we found that the *no streak information* condition was significantly less likely to continue a given behavior (62.94%) relative to the *intact streak* condition (77.27%; $\chi^2(1) = 9.68, p = .002$) but not different from the *broken streak* condition (63.11%; $\chi^2(1) < .01, p = .97$; see full methods and results in Appendix). Together, these results suggest that while the negative effect of a broken streak (compared to an intact streak) is quite robust, the motivating or demotivating forces of highlighting streaks depends somewhat on the specific context.

STUDY 4: THE EFFECT IS DRIVEN BY BREAKING A STREAK, NOT EXPERIENCING A MISS

In study 4, we seek to establish that the observed effects are due to people creating, then subsequently breaking, their streaks, rather than other alternative explanations. Specifically, the effect of a broken streak could be due to the presence of a recent “miss” in general, rather than a miss after a streak. People may be demotivated from continuing a behavior after a recent miss because they have received negative feedback (and thus are upset or discouraged) or wish to be consistent with what they have done most recently (leading them to stop the behavior after a miss). While our mediation analyses in studies 1b and 3 provide evidence for the streaks-as-goals mechanism, we rule out these alternatives explicitly via manipulation in study 4. To do so, we introduce a new factor of having a miss or not earlier in a game-playing sequence, before participants can establish a streak, or after participants have established a streak. This allows us to

investigate the importance of the presence of a streak in the observed effects.⁶ If the effect of a broken streak is simply due to having a recent miss, then participants will be less likely to continue the behavior after a recent miss, no matter whether a streak preceded that miss. However, if the effect is driven specifically by the decreased motivation and sense of achievement from a broken streak, we expect that participants will only be less likely to continue the behavior after a recent miss that was preceded by a streak (i.e., three games in a row), but not after a recent miss preceded by fewer than three games in a row.

Methods

Six hundred three participants were recruited from Amazon Mechanical Turk to try out a game app and answer questions about their experience. Only 487 participants (M age = 35.04, SE = 11.90, 44.97% female) reached our manipulation (as described below) and were included in our study. Regardless of completion level, all participants were paid \$0.50 for participating in the study. Our target sample size was 300 participants. This study was preregistered, and additional details about these exclusion criteria and our planned analyses can be found at: <http://aspredicted.org/blind.php?x=tp6y7u>.

Participants first read about the same game app as in study 1b, where they could play as many word jumble games as they wanted. Like in study 1b, all participants were warned that they might see a “quota” message instead of being able to play one of the word jumble games. Participants answered comprehension checks about the game

⁶Past work has demonstrated that people perceive streakiness once something occurs three times in a row (Carlson and Shu 2007). We also ran a pre-test ($N = 167$) asking participants to report the perceived streakiness of 25 different patterns of app use to replicate past findings in a consumer behavior context, as well as to better understand the bounds of perceived streakiness (see Appendix for full methods and results). Importantly, we found that people view previous behavior as streaky (i.e., significantly higher than the midpoint of the scale) whenever there are at least three behaviors in a row without a recent miss ($ps < .001$), and that three behaviors in a row is significantly more streaky than two behaviors in a row ($p < .001$).

instructions before proceeding to the game (see Appendix for comprehension checks). Then, participants started playing the games.

Participants were randomized into a 2(*prior game: recent miss vs. no miss*) x 2(*streak vs. no streak*) between-subjects design. For participants in the *no miss* condition, they never encountered the “quota” message and all games they attempted were available (much like the *intact streak* condition in study 1b). Participants in the *recent miss* condition encountered the “quota” message in place of one of their games (much like the *broken streak* condition in study 1b). We also manipulated how many games participants played before the *prior game* manipulation; in the *no streak* condition, participants experienced the *prior game* manipulation after just one game, such that those in the *no miss* condition played two games in a row and participants in the *recent miss* condition played one game and then saw the “quota” message. In the *streak* condition, participants played three games before the *prior game* manipulation. Thus, for participants in the *streak* condition, those in the *recent miss* condition had a broken streak, while those in the *no miss* condition had an intact streak.

Our key dependent variable was participants’ decision to stop or continue paying after the *prior game* manipulation (i.e., after either two or four games, depending on *streak* condition). Regardless of their decision, we informed all participants on the next page that they had completed all available games and asked them to complete some questions about how they felt right after playing their most recent game. Participants answered the same process questions as in study 3 regarding their motivation to continue (5 items; $\alpha = .92$) and their sense of achievement in past playing (4 items; $\alpha = .92$). As previously, these two sub-scales were closely correlated ($r = .79$) and their items loaded

on the same factor in a factor analysis. Thus, we combined them into a single measure of sense of accomplishment ($\alpha = 0.94$) for our analyses, but report the results for each subscale separately in the Appendix.

Like in study 3, participants also answered a free-response question about their decision to continue or stop playing the games, four questions regarding how negatively they felt ($\alpha = 0.94$), four exploratory measures about participants' overall attitude towards the games, and one question regarding how often they used any gaming apps. Lastly, participants answered a manipulation check question regarding how much they felt that they had a streak of playing games in general (1 – “Not at all” to 11 – “Very much”) and basic demographic questions.

Results

Manipulation check. A one-way ANOVA revealed that participants in the *no streak* condition felt less like they had a streak ($M = 5.74, SD = 3.65$) than participants in the *streak* condition ($M = 9.02, SD = 2.22; F(1, 485) = 135.65, p < .001$).

Future behavior. A binary logit model with prior game, streak presence, and their interaction as factors revealed a marginal effect of prior game ($\chi^2 (df = 1) = 3.63, p = .057$), such that participants in the *recent miss* condition were less likely to continue the behavior (79.08%) than participants in the *no miss* condition (87.10%). There was also a main effect of streak presence condition ($\chi^2 (df = 1) = 7.25, p = .007$), such that participants in the *streak* condition were more likely to continue (88.10%) than participants in the *no streak* condition (77.06%).

Importantly, this main effect was qualified by an interaction ($\chi^2 (df = 1) = 6.67, p = .010$; see figure 4). Separate chi-square analyses revealed that within the *streak*

condition, participants in the *recent miss* condition were less likely to continue the behavior (67.57%) than participants in the *no miss* condition (86.93%; X^2 (df = 1) = 11.54, $p < .001$). However, within the *no streak* condition, there was no effect of prior game on future behavior (*recent miss*: 89.06% vs. *no miss*: 87.23%; X^2 (df = 1) = 0.21, $p = .64$). Furthermore, participants with a recent miss in the *streak* condition (i.e., those who had a broken streak) were less likely to continue than participants in either *no streak* condition (X^2 s > 14.25, $ps < .001$).⁷

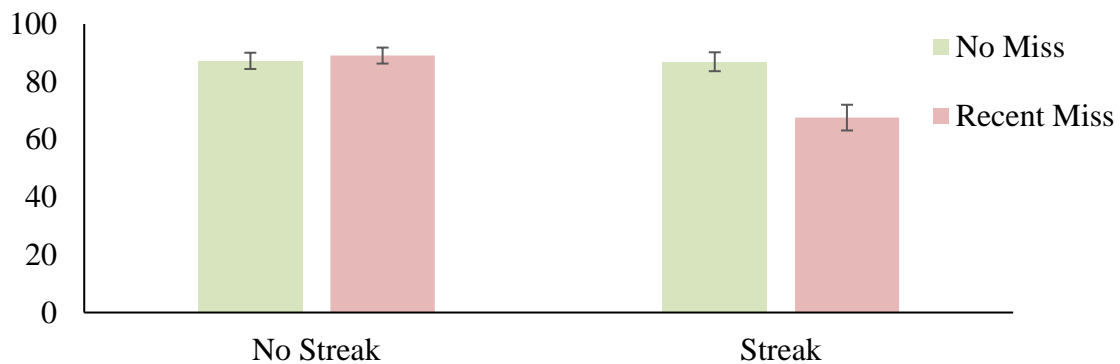


Figure 4. Percent of participants choosing to continue playing a game (versus stop), as a function of prior game and presence of a streak.

Sense of accomplishment. A two-way ANOVA with prior game, presence of a streak, and their interaction as predictors revealed no effect of streak presence on sense of accomplishment ($F(1, 483) = 0.48, p = .49$). There was a marginal effect of prior game

⁷ There were different rates of participants reaching the dependent variable based on the streak manipulation (*no streak*: 88.49% vs. *streak*: 72.91%; X^2 (df = 1) = 23.54, $p < .001$). To conservatively control for this endogenous effect, we added 41 hypothetical participants who would have chosen to continue the games (i.e., were coded as “1” in our DV) to the *streak* conditions to create equal cell sizes across all conditions. With this data alteration, we still found that participants with a recent miss in the *streak* condition were less likely to keep playing than participants in all other conditions ($ps < .06$).

($F(1, 483) = 3.25, p = .072$), such that participants in the *recent miss* condition felt less of a sense of accomplishment ($M = 8.06, SD = 2.07$) than participants in the *no miss* condition ($M = 8.36, SD = 2.14$).

This effect was qualified by an interaction ($F(1, 483) = 4.70, p = .031$).

Independent t-tests revealed that within the *streak* condition, participants with a recent miss felt less of a sense of accomplishment ($M = 7.91, SD = 1.98$) than participants with no miss ($M = 8.67, SD = 1.88; t(216) = 2.90, p = .004$). However, no difference existed for participants in the *no streak* condition ($M_{recent\ miss} = 8.19, SD = 2.15$ vs. $M_{no\ miss} = 8.12, SD = 2.29; t(267) = 0.26, p = .80$). Interestingly, participants with an intact streak (i.e., in the *no miss* and *streak* conditions) felt a marginally greater sense of accomplishment than participants in the *no streak* conditions ($ts > 1.75, ps < .07$), which indicates that having an intact streak can boost motivation to continue and sense of achievement, relative to before a streak has been established. Participants with a broken streak (i.e., in the *recent miss* and *streak* conditions) felt a directionally lower sense of accomplishment than participants in the *no streak* condition ($ts > 0.75, ps < .45$).

Negative emotions. A two-way ANOVA with presence of streak, prior game, and their interaction as predictors revealed no effect of streak presence ($F(1, 483) = 0.34, p = .56$). There was a significant effect of prior game ($F(1, 483) = 7.23, p = .007$), such that participants in the *recent miss* condition felt more negatively ($M = 2.94, SD = 2.51$) than participants in the *no miss* condition ($M = 2.32, SD = 2.40$). There was no significant interaction ($F(1, 483) = 0.22, p = .64$).

Mediation analysis. Although this analysis was not pre-registered, we conducted a mediation analysis using a bootstrap procedure with 10,000 samples (Hayes et al. 2011)

to examine the role that sense of accomplishment played in the observed effects of the presence of a streak and recent miss on future behavior. The mediation model (SAS PROCESS Macro, Model 7) included prior game (*recent miss* condition = 1, *no miss* condition = 0) as the independent variable, sense of accomplishment as the mediator variable, presence of a streak (*streak* condition = 1, *no streak* condition = 0) as the moderator, and continuation of the behavior as the dependent variable. Consistent with our hypotheses, we found that sense of accomplishment mediated the negative relationship between a recent miss and continuing the behavior only when the person had a streak (i.e., in the *streak* condition: Indirect effect = -.29, SE = .15, 95% CI = [-.70, -.13] vs. *no streak* condition: Indirect effect = .04, SE = .14, 95% CI = [-.24, .32]).

Discussion

Study 4 replicates the effect of a broken (versus intact) streak on future behavior and, consistent with our ‘streaks as goals’ theory, on people’s sense of achievement and motivation. Furthermore, this study demonstrates that this effect only happens after a streak is broken, rather than after a missed behavior in general. This finding rules out several alternative explanations for the observed effects, such as people wishing to be consistent with their most recent action or reacting to negative information about their performance or the experimenter.

STUDY 5: THE EFFECT OF A BROKEN STREAK IS ATTENUATED BY THE ABILITY TO MAKE UP THE MISS

Thus far, we have demonstrated that consumers are less likely to continue a behavior after a broken streak, relative to an intact streak, because they are less motivated by the goal of streak maintenance. In study 5, we examine how appealing people find an

intact streak; will they change their behavior, when given the opportunity, to repair their broken streak into an intact streak? We also explore the effect of broken streaks on a new real decision: whether to continue playing the same game or to switch to a new type of game.

Methods

Six hundred one participants (M age = 35.80, SD = 11.84, 45.59% female, 0.33% other/did not say) were recruited through Amazon Mechanical Turk to test a game app and answer questions about their experience for \$0.50. Our target sample size was 600 participants. The preregistration of this study detailing the recruitment, dependent variables, and planned analyses can be found at:

<http://aspredicted.org/blind.php?x=uc3q92>.

As in studies 1b, 3, and 4, participants in this study played a sequence of games on an interface which simulated a real gaming app. Like in study 3, participants read about how to play two available games – “World Jumbles” or “Number Sums” – then chose which game type they wanted to start playing. They also read that only the game type they chose – either jumbles or sums – would count towards their game tracker. Similar to the previous studies, participants could view hints to help them find the answers to the games, and it was possible to enter incorrect or blank answers. All participants were told that they had to play five games in the study.

As in studies 1b and 4, participants read that they might encounter a “quota” message up to one time during their game experience indicating that enough participants had already played that particular game, but that this was not a sign that they or the app had messed up. As in studies 3 and 4, participants answered comprehension checks about

the nature of this quota message and other aspects of the game instructions before proceeding to the game (see Appendix for comprehension checks).

Participants were randomly assigned to one of three between-subjects conditions (*intact streak*, *repairable streak*, *broken streak*). The manipulation occurred at Game #4. In the *intact streak* condition, participants played the same type of game as they had chosen and had already been playing, thus continuing their streak at Game #4. In the other two conditions, participants saw the “quota” notification instead of playing a game, and thus broke their streak at Game #4.

After this part of the manipulation, participants were informed that they could choose what type of game they wanted to play for their last game in the study (Game #5): a jumble or a sum. Participants in the *repairable streak* condition were told that they could restore their streak if they chose the same game type that they had selected before (e.g., they chose to play a word jumble for Game #5 after choosing to play word jumbles at the start of the study), while participants in the *broken streak* condition were told that they not be able to repair their streak from this choice.

The primary dependent measure was which type of game they selected to play for their last game in the study. Participants then answered a series of questions about their game experience. These included the same motivation ($\alpha = 0.92$), sense of achievement ($\alpha = 0.93$), and negative emotion questions ($\alpha = 0.97$) as in study 4.⁸ The motivation and sense of achievement sub-scales were closely correlated ($r = .56$) and the items loaded on the same factor in a factor analysis, so we combined them into a single measure of sense of accomplishment ($\alpha = 0.92$) in our analyses (see Appendix for results of each sub-scale

⁸One of the five motivation items (“How much did you feel motivated to continue playing?”) was inadvertently left out in the programming of this study, thus leaving four items in this sub-scale.

separately). Participants also answered a free response question about why they made the choice that they did after Game #4, a question about how aware they were of their streak, and the same five exploratory measures as in study 4. Lastly, participants played the final game they had chosen, and answered basic demographic questions.

Results

Future behavior. A binary logit revealed a significant effect of condition on future behavior (X^2 (df = 2) = 43.64, $p < .001$; see figure 5). Separate chi-square analyses shows that participants in the *broken streak* condition were less likely to continue playing the same type of game (68.66%) than participants in the *intact streak* condition (93.14%; X^2 (df = 1) = 33.33, $p < .001$) or the *repairable streak* condition (85.20%; X^2 (df = 1) = 14.69, $p < .001$). Participants in the *repairable streak* condition were more likely to switch to the other type of game than participants in the *intact streak* condition ($b = 0.86$, $SE = 0.34$, X^2 (df = 1) = 6.27, $p = .012$).

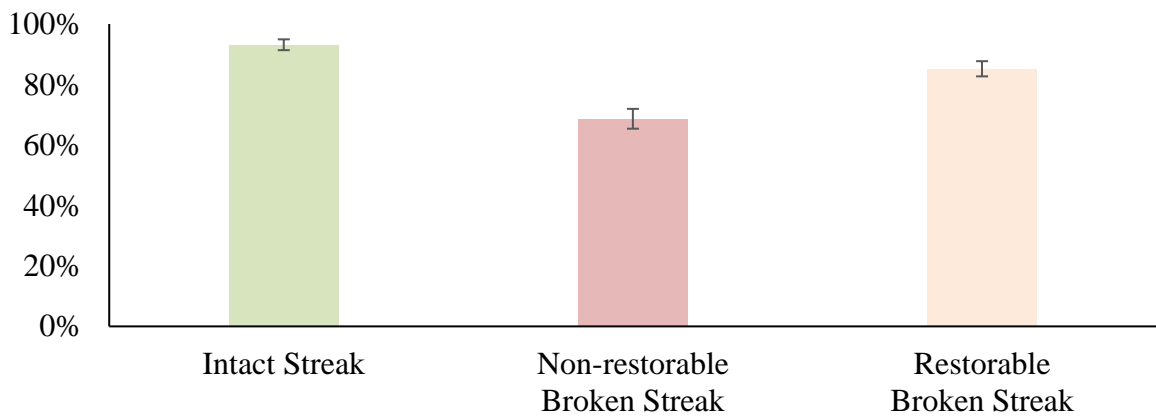


Figure 5. Percent of participants choosing to continue the same game (versus switch games) as a function of their streak.

Sense of accomplishment. A one-way ANOVA revealed a significant effect of condition ($F(2, 598) = 16.82, p < .001$). Independent t-tests showed that participants in the *broken streak* condition felt a decreased sense of accomplishment ($M = 7.37, SD = 2.31$) than participants in the *intact streak* condition ($M = 8.56, SD = 1.90; t(403) = 5.63, p < .001$) and in the *repairable streak* condition ($M = 8.10, SD = 1.97; t(395) = 3.35, p < .001$). Participants in the *repairable streak* condition also felt a lower sense of accomplishment than participants in the *intact streak* condition ($t(398) = 2.38, p = .018$).

Negative emotions. A one-way ANOVA revealed a significant effect of condition ($F(2, 598) = 12.62, p < .001$). Independent t-tests showed that participants in the *broken streak* condition felt more negatively ($M = 3.16, SD = 2.77$) than participants in the *intact streak* condition ($M = 2.11, SD = 2.33; t(403) = 4.15, p < .001$). However, participants in the *broken streak* condition felt just as negatively as participants in the *repairable streak* condition ($M = 3.33, SD = 2.82; t(395) = 0.59, p = .56$). Participants in the *repairable streak* condition also felt more negatively than participants in the *intact streak* condition ($t(398) = 4.72, p < .001$).

Mediation analysis. We conducted mediation analyses using a bootstrap procedure with 10,000 samples (Hayes et al. 2011) to test the process by which a broken streak versus an intact streak affects future behavior. The mediation model (SAS PROCESS Macro, Model 4) included streak condition (broken streak = 1; intact streak = 0) as the independent variable, sense of accomplishment as the mediator variable, and choosing to continue the behavior as the dependent variable. As predicted, we found that sense of accomplishment mediated the negative relationship between breaking a streak

and continuing the same behavior (Indirect effect = -0.28, SE = .09, 95% CI = [-.48, -.13]).

We also conducted an additional model examining how negative emotions mediated the effect of a broken streak versus intact streak on future behavior. When examining negative emotions as a sole mediator in this relationship, we found that negative emotions did not mediate the effect (Indirect effect = -.08, SE = .06, 95% CI = [-.20, .02]). In a competing mediation model with sense of accomplishment and negative emotions as the mediators, we found that the former process mediated the effect (Indirect effect = -0.30, SE = .09, 95% CI = [-.51, -0.15]) while the latter did not (Indirect effect = -0.11, SE = .06, 95% CI = [-.25, .00]).

Discussion

Study 5 shows that broken streaks increase switching behavior (or increase continuing a behavior), relative to intact streaks. Furthermore, when given the opportunity, people with broken streaks are willing to change their behavior in order to restore their streak. Thus, this study also provides firms with a potential strategy that could be used to partially alleviate the issue: allowing consumers to repair or restore their streaks attenuates, but does not eliminate completely, the negative effect of broken streaks. We find that participants with broken streaks are more likely to continue the same type of behavior when doing so allows them to restore their streaks, relative to when it does not, but not to the same extent as having intact streaks. The same pattern also holds for participants' sense of accomplishment.

Interestingly, people experience the same level of negative emotion after broken streaks regardless of their ability to restore their streaks. This could explain why the

ability to restore streaks does not fully eliminate the effect of broken streaks on switching behavior. Or, the effect may not be fully attenuated because people feel that their repaired records are still less accurate or authentic than if they had maintained their streaks in the first place. Regardless, the fact that the ability to restore broken streaks significantly increases the number of people choosing to continue the same type of behavior suggests that providing this option may be a viable strategy for alleviating the negative effects of broken streaks.

GENERAL DISCUSSION

Technology has made it increasingly easy for consumers to track their repeated behaviors over time. For example, apps frequently highlight streaks in consumers' usage of their products, such as when they log in for several days in a row. However, these practices may also end up alerting consumers to recent or imminent breaks in their streaks of usage. Consequently, consumers are becoming more and more aware of both consistency and lapses in their recent behavior. Our research is the first investigation of how people's own streaks of behavior influence their decisions to continue that behavior in the future.

Across six studies using multiple methodologies, we find that compared to an intact streak, a broken streak decreases a consumer's likelihood to continue a behavior in the future, even when the cause of the break is outside their control (hypothesis 1). We demonstrate this effect across a variety of contexts, including tasting candies (study 1a), playing games (studies 1b, 4, and 5), learning a new language (study 3a), and rating beers (studies 2 and 3b). Moreover, we show that this effect applies to both real behavior (studies 1a, 1b, 4, and 5) and behavioral intentions (studies 2 – 3b), and not only

influences decisions about whether to continue a behavior (studies 1a-4), but also the decision about whether to switch to a different type of behavior (study 5). Additionally, these effects persist even when the consumer cannot attribute the broken streak to their own diminished desire to continue the behavior (studies 1a, 1b, 2, 3b, 4, and 5).

Furthermore, we show that this effect is due to consumers' having a goal of streak maintenance (hypothesis 2). Consequently, consumers feel less motivated to continue the behavior and more negatively overall after breaking a streak (studies 1b, 2, 3b, 4, and 5). Building on this "streaks as goals" hypothesis, we find that highlighting consumers' recent behavior has positive and negative effects (hypotheses 3a and 3b). Highlighting intact streaks leads consumers to be more likely to continue the behavior, while highlighting broken streaks (or even framing their past sequences of behavior as broken streaks) leads them to be less likely to do so (studies 3a, 3b, and 4).

Additionally, the length of the streak does not influence the effect of a broken streak on future behavior, which suggests that consumers are motivated by the goal of maintaining their streak as soon as they feel that one exists (study 2). Lastly, we find that having the opportunity to repair a broken streak attenuates the effect (study 5), which provides a potential remedy that firms can implement in cases where consumers inevitably do break their streaks.

Theoretical Contributions

The present research offers several novel insights for consumer research. This work contributes to our understanding of consumer goal setting and pursuit (e.g., Locke

and Latham 1990; Bagozzi and Dholakia 1999). Though past work has examined goal progress (Kivetz et al. 2006) and the potential for failures to undermine subsequent effort (Polivy and Herman 1985; Soman and Cheema 2004; Cochran and Tesser 1996), it has focused almost exclusively on behaviors and goals related to an ultimate “end state” (e.g., completing a loyalty punch card, sticking to a diet to lose weight). Our work builds on this previous research by broadening beyond actions that require goal orientation or self-control and examining the effect of streaks on continued behavior in general.

Additionally, our findings establish new links to prior work on the value of consistency in consumer behavior across contexts (e.g., products sets, Evers et al. 2014; components of an experience, Dhar and Simonson 1999), which has never examined the impact of streaks in particular. This work also provides an explanation as to why consumers engage in repeated behaviors beyond habit formation and automaticity (e.g., Aarts et al. 1998; Ouellette and Wood 1998). Specifically, we find that consumers have a goal of keeping their streaks intact, which implies that their decision to continue a behavior after a broken or intact streak is deliberate (rather than automatic). In fact, previous research on habits and automaticity suggest that insofar as a habit has been formed, a miss should not undermine future behavior (e.g., Jager 2003; Zhen et al. 2001), which is contrary to the effects we observe when a consumer experiences a broken streak. In addition, our examination builds on previous work that has looked at observers’ perceptions of streaks in other people’s behaviors (e.g., Gilovich et al. 1985) by providing an initial understanding of how the salience of one’s own streaks can impact future decisions.

Furthermore, these findings also add to the growing literature on consumer tracking behaviors by examining the role of streaks in this context. Existing research has started to explore the experiential consequences of consumer logging, such as decreased enjoyment of logged activities (Etkin 2016) or enhanced feelings of autonomy over time (Karapanos et al. 2016). Other approaches have focused on identifying the types of people most likely to log their behaviors, finding that these people also tend to be more willing to disclose personal data (Maltseva and Lutz 2017). Our work is the first to examine how the salience of streaks in logging and other contexts affects future behavior.

Practical Implications

Our work also provides substantive insights to guide firms in effectively motivating consumers through streaks. With advances in technology (e.g., smartphones, fitness trackers), consumers are increasingly tracking their behavior across a wide range of contexts. Thus, the ability to emphasize consumers' streaks to motivate continued behavior seems to be a relatively easy way to increase revenue while also improving the consumer experience (see the app experience survey reported in the introduction and Appendix). Though highlighting consumer streaks can help companies take advantage of consumers' desire to maintain their streaks, our results suggest that doing so may have unintended costs if they draw attention to broken streaks.

Accordingly, companies may need to adjust their practices to benefit from consumer streaks while minimizing the negative impact of breaks. As studies 3a, 3b, and 4 illustrate, one simple means of doing so might be to use visuals and specific information to highlight intact streaks but reduce the salience of broken streaks. Moreover, the results of study 2 indicate that the positive effects of having a streak accrue

quickly but do not necessarily increase continuously as the streak lengthens. This suggests that there are potentially more benefits to firms from highlighting initial behaviors and early milestones to encourage the formation of new streaks, rather than rewarding consumers solely for achieving longer streaks. As companies become more sophisticated in using rich consumer data to predict behavior, they may be able to determine the types of consumers and situations that increase the likelihood of broken streaks (e.g., locations, days of the week), enabling them to develop and target appropriate communication tactics.

Furthermore, as more companies move beyond app-based behaviors and towards digital tracking of real-world behaviors (e.g., visiting the same restaurant, shopping at the same retail chain or website), the salience of streakiness of consumer behaviors will only increase. Hence, besides keeping consumers engaged on apps themselves, calling attention to existing streaks (and away from broken streaks) may carry over and encourage consistent usage of company products and services outside of the digital environment. As such, our findings may also have applications in a broader set of domains, such as regular grocery shopping, hotel bookings, or crowdsharing rides.

Moreover, since many consumers use apps as a way to track and motivate goals that are difficult or require self-control, such as exercising (Goode 2015), eating healthy (Henry 2013), and budgeting (Malcolm 2015), encouraging consistency may often represent a win-win situation that enables firms to benefit from helping consumers achieve better control of their consumption behavior. Apps could consider building in more flexibility as to what counts towards or against a streak. For example, the results of study 4 suggest that companies could motivate consumers by allowing them to define

their streaks more broadly (e.g., completing a language lesson today), rather than restricting them to subcategories (e.g., doing a French, German, or Mandarin lesson today). Additionally, as study 5 demonstrates, allowing consumers to repair their broken streaks can help attenuate the negative effects of broken streaks on consumers' motivation and future behavior. In fact, several companies have implemented creative ways for consumers to keep their streaks alive after a miss. For example, Timehop, an app that organizes users' photos and shows them photo memories each day, allows users to watch an advertisement in order to fill in a day that broke their streak. Similarly, providing consumers with streak "cheat days" (e.g., as with gym attendance, Sharif and Shu 2017) could eliminate the need for streak restoration. One instance of a firm using this strategy is Duolingo's "streak freeze," which allows users to spend money to keep their streak intact if they ever miss a day. Monetizing these strategies may be a smart way for firms to appeal to consumers' desire to maintain their streaks while also increasing revenue.

Future Directions

While this article is the first to investigate the impact of streaks on future behavior, and focus on the consequences of making streaks salient, many aspects of streaks merit further investigation. For instance, our studies examine the effects of streaks in the short run, both in terms of how long consumers' behaviors are tracked (e.g., a few instances of playing games, a few weeks of logging beers) and when we measure the effect (e.g., the next opportunity to do the behavior). Future work should examine the effect of prolonged behavioral tracking (i.e., across months or years), and how the results might change in the long run. On the one hand, long-term behavioral tracking may desensitize consumers to

the impact of streaks, thus attenuating their effects over time. On the other hand, repeat exposure to streaks could make them more valuable to consumers (e.g., a source of pride, especially when they become particularly long), in turn amplifying their effects. By the same token, "restored" streaks that increase behavior in the short term (as in study 5) could backfire in the long term if individuals start to feel "inauthentic" because the streak does not reflect their true sequence of behaviors.

In addition, most of our studies explore the effects of streaks that are relatively short, and though the results of study 2 suggest that the effects of broken streaks are unaffected by length, they are based on one specific operationalization. Focusing on streak length more specifically might yield interesting insights. For example, what is the minimum threshold for positive effects on future behavior, and what do people infer when streak length is unspecified? At the other extreme, people may view streaks themselves as accomplishments only after they surpass certain length thresholds or salient milestones (e.g., 365 days in a row), thus increasing the discouraging effects of breaking a streak.

Similarly, the time intervals separating repeated behaviors (i.e., daily vs. weekly vs. monthly) might influence the effect of streaks. For instance, more time between behaviors might reduce the motivation to continue them, thus decreasing both the benefits of intact streaks and harm from broken streaks. Additionally, applying different time intervals might enable apps to frame streaks more strategically. Just as categorizing behaviors broadly can help consumers maintain their streaks (study 4), using larger units of time might allow them to portray irregular or inconsistent behavior as an intact streak instead of a broken one. For example, gyms that frame a customer's attendance as "every

week for the last two months” instead of drawing attention to all the days they missed might encourage continued attendance more effectively. In fact, different units of time might be more appropriate for different consumer segments (e.g., portray streaks in days for heavy users and in weeks for light users).

Many tracking apps not only allow individuals to log their behavior, but also encourage them to interact with other online community members and share their activities and streaks. For example, Untappd users can view and comment on each other’s beer logs, Pokémon Go users can interact within the game and meet up in real life to play together, and Snapchat user dyads are jointly responsible for using the app daily to keep their messaging streaks alive. Future work might also examine how streaks affect interpersonal outcomes. For example, how will seeing others’ recent patterns of behavior impact interactions within a community, shape social networks, and affect bonds between users? While sharing logging information may increase closeness (Reis et al. 2010), it might also contribute to self-presentational concerns (Barasch et al. 2017). In general, the effects of sharing streaks on user engagement are unclear: seeing others’ progress might be motivating or demotivating depending on one’s own progress (e.g., Wheeler and Miyake 1992; Collins 1996).

The study of how behavioral tracking and streaks affect consumer behavior is still in its infancy, and many potentially fruitful open questions remain. Given the growing prevalence of apps that track consumers’ behaviors and highlight their streaks, as well as the interesting psychological mechanism evidence uncovered in this research, the current and future work in this domain may have important implications for practitioners and academics alike.

CHAPTER 2. HOT STREAK! CONSUMER INFERENCES AND PREDICTIONS
ABOUT STICKING TO LONG-TERM GOALS

Jackie Silverman

Alixandra Barasch

Deborah Small

ABSTRACT

When do people make optimistic forecasts about goal-directed behavior? In five studies, we examine how predictions regarding an individual's likelihood of sticking to their goal are affected by that individual's recent pattern of behavior. Specifically, we show that even when the overall rate of behavior is identical, a recent streak of goal-consistent behavior increases the predicted likelihood that the individual will persist, compared to a variety of other patterns. This effect is due to a perceived higher level of commitment following a recent streak. In turn, people are less likely to recommend the use of a restrictive goal pursuit strategy, like a commitment device, after a streak because they believe that it is unnecessary. The effect is attenuated in the presence of other diagnostic cues of commitment (i.e., the individual has a high base rate of goal-consistent behavior) and for predictions regarding behaviors that do not require commitment to a goal. Together, these results demonstrate the significance of streaky behavior for judgment and prediction.

INTRODUCTION

Consumers' long-term goals often require a great deal of commitment in the face of frequent temptation (e.g., Loewenstein 1996; Hoch and Loewenstein 1991; Bitterly et al. 2015). For example, the goal to lead a healthy lifestyle requires avoiding tasty food in favor of less appealing, but healthier, alternatives. Likewise, the goal of finishing writing a paper requires effort and persistence over relaxation and fun. Critically, consumers must maintain commitment to goal-consistent behavior over time while avoiding the frequent temptation to pursue immediate pleasure to reach their goals.

Whereas much research has examined the factors that influence when consumers are more likely to stay committed to their goals and when they give in to temptation, less research has examined consumers' beliefs about what signals commitment and their predictions about whether a person will stick to their long-term goals. The research that does exist in this domain largely focuses on consumers' inaccuracy in predicting their own behavior, and more specifically, their failure to anticipate the allure of immediate temptation (e.g., Loewenstein and Schkade 1999). Notably, past research has not examined the birds-eye view of how patterns of past behavior inform beliefs and predictions regarding future commitment and goal adherence.

In this paper, we examine how consumers' patterns of past behavior influence predictions of future behavior. For example, consider two consumers who have a goal of becoming healthier through regular exercise. Imagine that each of them exercised four days in the past week. Consumer A exercised on Days 1, 2, 5, and 7, whereas Consumer B exercised on Days 1, 5, 6, and 7. Despite both consumers exercising the same amount, only Consumer B exhibits a "recent streak:" a pattern of past behavior in which they

acted in a specific way for three or more consecutive opportunities (Carlson and Shu 2007). Our key prediction is that, compared to other patterns of past behavior, a recent streak is seen as a signal of goal commitment, which leads to more optimistic predictions for future behavior.

In the advent of behavioral tracking technology, data on patterns of behavior are increasingly accessible to consumers. Rather than needing to actively monitor goal pursuit or rely on their memory, consumers now count on a host of applications to measure and display how they eat, exercise, and spend their time and money. This technology highlights sequences of behavior over time and sometimes even explicitly highlights when consumers are “on a roll” both to themselves and to others in their network (Loh 2017). This data may inform self-assessments of commitment, as well as the assessments of others.

These assessments are important because they affect the strategic actions an individual may take for themselves or others to support goal pursuit. Specifically, the more optimistic someone is about their own or others’ future goal success, the more they might be inclined to a laissez-faire approach—favoring consumer freedom with little fear of failure. However, the more pessimistic someone is, they may prefer a more restrictive, paternalistic approach at the expense of consumer freedom.

Using the Past to Forecast the Future

Much behavioral research supports the old adage “past behavior is the best predictor of future behavior” (e.g., Ajzen 1991; Ouellette and Wood 1998). There is some evidence that consumers abide by this rule when making a variety of predictions, including about their social interactions, consumption choices, and financial decisions

(Osberg and Shrauger 1986). Specifically, people use their recent experiences, such as whether they have fought with a friend, changed their hairstyle, or been unable to pay a bill, to inform their predictions of whether they will engage in the same behavior in the near future.

While little work has examined how specific patterns of past behavior inform predictions of future behavior, research has examined how patterns of outcomes of events inform predictions of future outcomes (Gilovich, Vallone, and Tversky 1985; for review see Bar-Eli, Avugos, and Raab 2006). Specifically, when people observe a streak of successes in an event (e.g., making shots in basketball), they sometimes infer that the individual is “hot” and will continue succeeding in the near future (Gilovich et al. 1985). This bias stems from seeing patterns in random noise and thus assuming that what appears “streaky” reflects something other than chance. Other times, streaks of success can lead people to believe that success is due to end, such as after repeated coin flips result in consecutive heads or tails (i.e., gambler’s fallacy; Tunc 1964). This too is due to misunderstanding chance, and specifically the intuition that a random process cannot generate a streak of heads or tails. These cases are sometimes related to goals, but the outcomes are determined by other factors beyond a consumer’s explicit actions (e.g., random chance, their competitors’ behaviors).

In contrast, the present work investigates how people make predictions about autonomous behaviors, rather than outcomes of events, following streaks versus other patterns of past behavior. Specifically, we look at predictions of future behavior when people have a higher-order goal but face countervailing temptations each time they act.

Such contexts involve the fundamental tradeoff between what individuals want in the short-run and what they need to do repeatedly to reach their long-term goal.

In these contexts, people may also imbue meaning in streaks. Whereas streaks of random events can be attributed to any non-independent process (e.g., a basketball player with a “hot hand,” a biased coin), we propose that a streak of goal-consistent behavior will be attributed to the consumer’s underlying commitment to their goal.

Lay theories of commitment to goal pursuit

An abundance of research has examined what people actually choose when faced with a self-control dilemma (e.g., Loewenstein 1996; Hoch and Loewenstein 199; Baumeister, Vohs, and Tice 2007). Relatively less research has examined people’s beliefs about their own self-control, and especially when they infer commitment to their goals. Understanding these beliefs is important because they can guide people’s strategic behavior with respect to their goals. When people believe they lack self-control, they employ commitment devices to support their goal progress (Brocas, Carrillo, and Dewatripont 2006; Bryan, Karlan, and Nelson 2010). For example, smokers sometimes buy packs of cigarettes instead of cartons, thus self-imposing time and monetary costs to prevent themselves from over-consuming (Wertenbroch 1998).

People also employ strategic goal pursuit based on how they believe self-control works. For instance, consumers set fewer goals for themselves when they believe that self-control is a limited and malleable resource (Mukhopadhyay and Johar 2005). Additionally, beliefs about self-control affect decisions concerning others. For example, parents who believe that self-control is a limited resource are more likely to choose virtuous products, like educational TV shows, and restrict the consumption of vices, like

fast food, for their children (Mukhopadhyay and Yeung 2010). Finally, people's beliefs about the consistency and stability of their identities over time affect goal pursuit. The more people believe that their future self will be similar to their current self, the more likely they are to choose goal-consistent options in the present (Bartels and Urminsky 2011).

In sum, people choose tactics for managing behavior in accordance with their beliefs about their own and others' self-control, and about the nature of self-control more generally. We build on this research by exploring the role of perceived commitment as a critical aspect of lay theories of self-control.

The current research

In this work, we examine how patterns of past behavior affect beliefs about goal success. In particular, we focus on how a recent streak of engaging in goal-consistent behavior influences predictions of future success, relative to other patterns with the same base rate of engaging in such behavior. As such, we connect research on streaks of random events (i.e., the hot hand belief; Gilovich et al. 1985) with work on lay theories of self-control.

As seen in the previous research, people attribute streaks to non-random processes. How might people make sense of a recent streak in this context? We propose that streaks will take on a special meaning when observing them in the context of goal-driven behavior: people will see a recent streak as particularly diagnostic of future goal success. As a result, people will infer (new or renewed) commitment to an individual's goal from seeing them engage in a recent streak, and predict that such an individual is more likely to continue to do the goal-driven behavior in the future.

H1: People predict an individual with a recent streak is more likely stick to their goal in the near future, compared to other patterns of past behavior, even when holding base rates of past goal success constant.

H2: The effect of a recent streak on predictions of future behavior is driven by beliefs about the individual's increased commitment to their goal.

Because of these lay beliefs about commitment and predictions of future behavior, we further propose that patterns of past behavior will affect consumers' preferences for restrictive tools, such as commitment devices, that benefit consumers by helping them achieve their long-term goals (e.g., Thaler and Benartzi 2004; Milkman, Minson, and Volpp 2013). Such tools involve a trade-off between choice freedom and long-term consumer welfare. We expect that when consumers believe that the chances of goal success are high, they will lean towards preferring choice freedom and fewer restrictions. However, when they believe that the chances of goal success are low, they will be more willing to sacrifice that freedom for restrictive commitment devices that will help consumers achieve their goals. Therefore, we expect that following a recent streak, people will believe that a commitment device is less necessary and thus will be more prone to favor choice freedom.

H3: People will be less likely to recommend a restrictive commitment device following a recent streak, compared to other patterns of past behavior.

Further stemming from the lay belief regarding commitment, we propose several boundary conditions for when streaks will affect predictions of behavior. First, we predict that this effect will be strongest when other diagnostic cues about commitment are absent. One such diagnostic cue might be the overall rate of sticking to the goal; for example, an observer gains little extra insight about a consumer from learning of their recent streak of gym attendance when they know that individual has worked out almost every day for the last six months. We predict that the effect of a recent streak will be weaker when the individual has a higher base rate of goal-consistent behavior.

H4: People predict an individual with a recent streak is less likely to continue with that behavior when their base rate of goal-consistent behavior is high, compared to when the base rate is low.

The lay belief regarding commitment further suggests that the effect of a recent streak on predictions of future behavior will be stronger when commitment is important for the type of behavior at hand. This will be the case for behaviors involving self-control, where commitment is fundamental. For instance, when choosing between a healthy food (like fruit) and an indulgent food (like ice cream), commitment to a diet goal is relevant, so a recent streak of choosing fruit may imply something about the individual's future behavior. However, in the case of choosing between ice cream flavors, self-control is less important, so a recent streak of choosing chocolate over vanilla is less likely to imply anything about commitment to a particular goal and therefore the likelihood to choose chocolate in the future.

H5: People predict an individual with a recent streak is more likely to continue with that behavior when that behavior requires commitment, compared to other activities.

In sum, we expect that a recent streak is viewed as diagnostic of commitment to a goal and thus has a positive effect on predictions of future goal success and preferences for consumer freedom over interventions for goal pursuit. Consistent with this, a recent streak has a greater effect on predictions of future behavior in the absence of other diagnostic cues and when the behavior pertains to a goal.

Study Overview

Across five studies, we contrast a recent streak with several alternate choice patterns. Study 1 examines hypotheses 1 and 2: people will perceive that an individual with a recent streak of goal-consistent behavior, compared to other patterns of past behavior, is more committed to their goal and more likely to continue with goal-consistent behavior in the near future. Study 2 replicates Study 1 using different stimuli and also examines people's preferences between choice freedom and a more restrictive commitment device tool (hypothesis 3).

The remaining studies explore the extent to which a recent streak conveys a higher level of commitment to the related goal, and how that higher perceived commitment in turn affects predictions of future choices. Study 3 examines whether the presence of another diagnostic cue of commitment (a high base rate of goal-consistent behavior) moderates the effect (hypothesis 4). Finally, studies 4a and 4b examine whether

predictions about future behavior following a recent streak depend on whether the behavior is in pursuit of a goal (hypothesis 5).

STUDY 1: PREDICTIONS AND INFERENCES AFTER A RECENT STREAK OF GOAL-CONSISTENT BEHAVIOR

In Study 1, participants learned about another individual's pattern of past behavior and then reported their predictions and inferences about the individual. We predict that an individual with a recent streak of goal-directed behavior will be perceived as more committed to their goal, compared to other patterns and holding constant the base rate of goal-consistent behavior. Because of this inference, we expect that a recent streak will also increase the predicted likelihood that the individual will stick to their goal in the near future.

Methods

Three hundred one participants from Amazon Mechanical Turk (M age = 34.20, 45.85% female, 1.00% other/did not say) were recruited to participate in a study for \$0.25. In this and all other studies, all participants were U.S. residents and at least 18 years old, and were screened so that they had not completed a similar study in at least the past two months.

Participants read about an individual who had been trying to eat healthy in order to lose weight for several weeks. Each day, this individual chose whether to eat healthy a dessert, like fruit, or an unhealthy dessert, like ice cream. All participants were told that the individual had done the goal-consistent behavior (eaten fruit) on three of the last six days, and had done the goal-inconsistent behavior (eaten ice cream) on the other three days.

Then, participants learned the individual’s pattern of behavior from the last six days. Participants were randomly assigned to see one of three pattern conditions in a three-group between subjects design (see figure 1). In the *recent streak* condition, the individual had eaten fruit on the three most recent days. There were two distinct control conditions. In the *old streak* condition, the individual had eaten fruit on the third, fourth, and fifth days. In the *scattered* condition, the individual had eaten fruit on the first, fourth, and sixth days. The two control conditions enable us to test whether any effects are driven by the presence of a streak (which is true for both the recent streak and old streak control) or by recently behaving consistently with the goal (which is true for both the recent streak and scattered control).

Recent Streak	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6
	Ice Cream	Ice Cream	Ice Cream	Fruit	Fruit	Fruit
Old Streak Control	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6
	Ice Cream	Ice Cream	Fruit	Fruit	Fruit	Ice Cream
Scattered Control	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6
	Fruit	Ice Cream	Ice Cream	Fruit	Ice Cream	Fruit

Figure 1. Representations of recent patterns of behavior shown to participants in each condition in Study 1.

After viewing the individual’s pattern of recent behavior, participants were asked how likely the individual was to eat fruit the next day, and how likely the individual was to eat ice cream the next day (1 = extremely unlikely to 7 = extremely likely; $r = -.87$). The latter question was reverse coded and these responses were averaged together to

create our primary dependent variable in this and all other studies. Then, participants were asked about the perceived commitment the individual had to eating healthy with four items: how committed they are to eating healthy, how much they care about eating healthy, how important eating healthy is to the individual, and how motivated this individual is to eat healthy (1 = not at all, 7 = extremely; $\alpha = .89$). These four measures were averaged together to create a measure of perceived commitment.

Participants then answered an attention check question in which they had to identify the pattern of recent behavior for the individual about whom they read. 98.01% of participants passed this attention check. In this and all other studies, we report results for our full sample. Lastly, participants answered demographic questions. Participants were also asked four exploratory measures about the individual's long-term ability to eat healthily and four other exploratory process questions; see the Appendix for all measures.

Results

Our key prediction is that an individual with the recent streak will be perceived as more likely to stick to their goal in the future, compared to other patterns. Therefore, we compare the *recent streak* condition to the two control conditions combined (i.e., collapsing across the *old streak* and *scattered* conditions). For completeness, we also report analyses comparing each control condition to the *recent streak* condition and show the separate means for each control condition in our figures. We follow a similar procedure for all studies with more than one control condition (i.e., Studies 2, 4a and 4b).

Predictions about sticking to the goal. A one-way ANOVA revealed that participants predicted an individual would be more likely to eat fruit following a recent streak ($M = 3.88$, $SD = 1.52$) than following the other patterns ($M = 3.30$, $SD = 1.41$; $F(1,$

299) = 10.33, $p = .002$; see figure 2). Considering each control group separately, a one-way ANOVA revealed a main effect of pattern condition ($F(2, 298) = 5.33, p = .005$). Independent t-tests showed that participants predicted an individual with a recent streak was more likely to eat fruit than an individual with an old streak ($M = 3.24, SD = 1.53; t(198) = 2.91, p = .004$) and an individual with a scattered pattern ($M = 3.36, SD = 1.28; t(198) = 2.55, p = .012$).

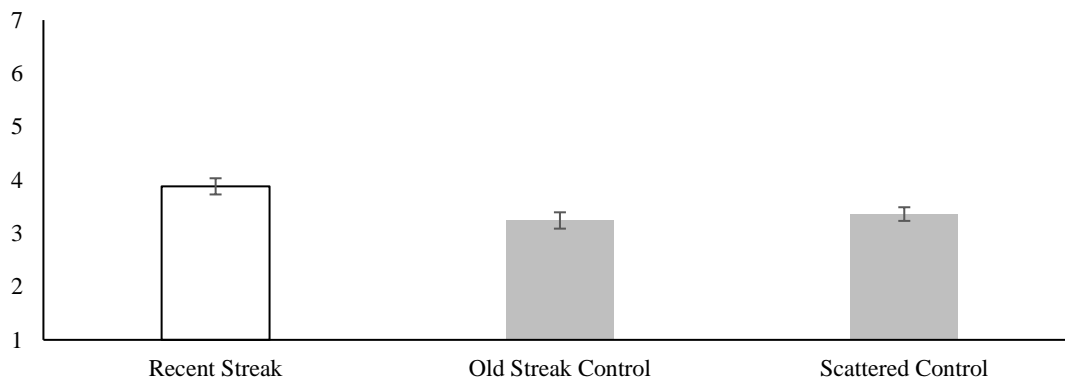


Figure 2. Predicted likelihood that an individual will stick to their goal as a function of their recent pattern of behavior. Error bars are ± 1 standard error.

Perceived commitment. A one-way ANOVA revealed that participants perceived an individual with a recent streak to be more committed to eating healthy ($M = 3.81, SD = 1.01$) than an individual without a recent streak ($M = 3.42, SD = 1.02; F(1, 299) = 9.78, p = .002$). Considering each control group separately, a one-way ANOVA revealed a main effect of pattern condition ($F(2, 298) = 5.51, p = .005$). More specifically, independent t-tests showed that an individual with a recent streak was perceived as more committed to eating healthy than an individual with an old streak ($M = 3.50, SD = 0.92;$

$t(198) = 2.28, p = .024$) or with a scattered pattern of past behavior ($M = 3.34, SD = 1.11$; $t(198) = 3.12, p = .002$).

Mediation analysis. We conducted a mediation analysis using a bootstrap procedure with 10,000 samples to test the process by which an individual's pattern of behavior affects the predicted likelihood of behaving consistently with their goal (Hayes, Preacher, and Myers, 2011). We predicted that an individual with a recent streak would be viewed as more committed to their goal (in this case, eating healthy), which would increase the predicted likelihood of goal-consistent behavior in the near future. Our mediation model (SAS PROCESS Macro, Model 4) included pattern of behavior as the independent variable (comparing the *recent streak* condition, coded as 1, to the collapsed control conditions, both coded as 0), perceived commitment as the mediator variable, and predicted likelihood of eating healthy as the dependent variable. Consistent with our hypothesis, perceived commitment mediated the effect of pattern of behavior on predicted likelihood to do goal-consistent behavior (Indirect effect = .17, SE = .06, 95% CI = [.06, .32]).

Discussion

Study 1 demonstrates that people believe that a recent streak of goal-consistent behavior is predictive of future goal-consistent behavior. By contrasting a recent streak to an old streak, we demonstrate that the recency of streak, not merely its existence, is important to this effect. By comparing a recent streak to a scattered pattern, which included goal-consistent behavior at the most recent opportunity, we demonstrate that the effect is not simply about the individual's most recent single behavior; rather, it necessitates more than one instance. In addition, inferences about the individual's

commitment to the virtuous behavior drive the effect. In the next study, we further demonstrate this effect and its consequences.

STUDY 2: RECOMMENDATIONS FOR COMMITMENT DEVICES AS A FUNCTION OF RECENT PATTERNS OF BEHAVIOR

In Study 2, we build on the findings of Study 1 by examining a potential downstream consequence of these inferences: recommendations for commitment devices to help individuals reach their goals. Because a recent streak of goal-consistent behavior signals higher commitment to the goal, we expect that consumers will also think an individual with a recent streak is sufficiently motivated and “on track” to reach their goal without external assistance. Therefore, consumers will prefer to offer other individuals the freedom to choose their future behaviors rather than imposing restrictive tools, like commitment devices, that could help in goal success. We also examine the robustness of the effect in a new context and when using a within-subjects design. This study’s preregistration can be found at: <https://aspredicted.org/blind.php?x=jd5s4c>.

Methods

Two hundred twenty-six participants from Amazon Mechanical Turk (M age = 34.75, SD = 10.56, 44.69% female, 0.44% other/did not say) were recruited to participate in a study for \$0.35.

All participants read about an individual who had been trying to cut back on how much time they spent online. Every evening, the individual could either stick to their goal by staying offline or not stick to their goal by going online. Participants read that the individual was able to stay offline 50% of their evenings for the past several weeks. As in Study 1, participants across conditions were told that the individual had stayed offline on

three of the last six days and went online on the other three days. Participants also saw the same pattern conditions as in Study 1 (*recent streak*, *old streak*, and *scattered*). However, in this study, participants saw all three conditions in random order in a within-subjects design.

After viewing an individual's pattern of recent behavior, participants were asked how likely they would be to recommend that the individual use a website blocker as a commitment device to help them reach their goal (1 = extremely unlikely to 7 = extremely likely). Then, participants reported their predictions about the individual's future behavior ($r = -0.62$) and perceived commitment to the goal ($\alpha = .92$) using the same items as in Study 1. Lastly, participants reported their age and gender.

Results

Recommendation of a commitment device. Collapsing across both control conditions, a repeated generalized linear model revealed that participants were less likely to recommend a commitment device to an individual with a recent streak than an individual without a recent streak ($b = -0.37$, $SE = .07$, $t(451) = 5.31$, $p < .001$; see figure 3). A model considering each control group separately also found a significant main effect of pattern condition ($F(2, 450) = 14.83$, $p < .001$). Fixed effects for each condition in this model showed that participants were less likely to recommend a commitment device to an individual with a recent streak ($M = 4.04$, $SD = 1.73$) compared to an individual with an old streak ($M = 4.36$, $SD = 1.76$; $t(450) = 4.00$, $p < .001$) or a scattered pattern ($M = 4.46$, $SD = 1.78$; $t(450) = 5.20$, $p < .001$).

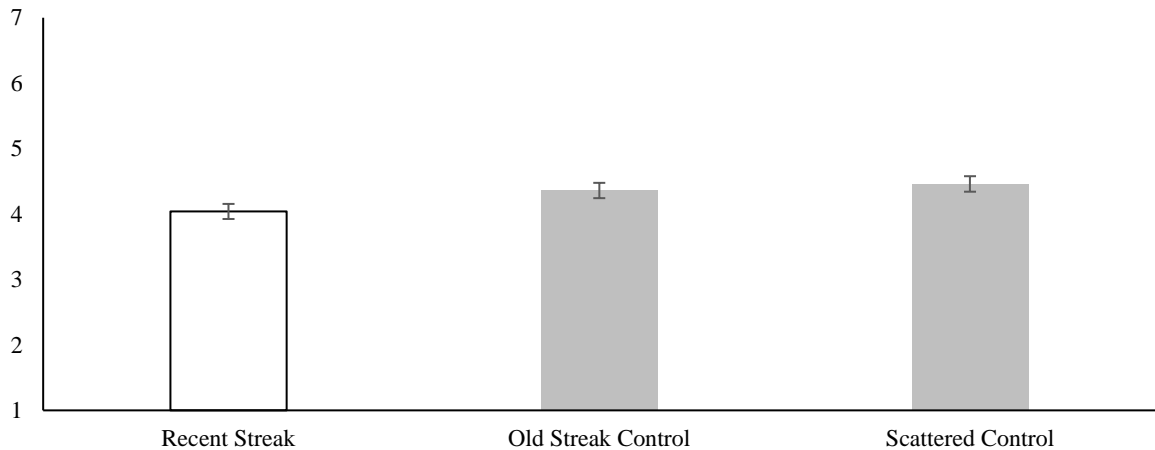


Figure 3. Recommendations for a commitment device as a function of an individual's recent pattern of behavior. Error bars are ± 1 standard error.

Predictions about sticking to the goal. A random intercept regression model revealed that participants predicted the individual would be more likely to stick to their goal following a recent streak compared to the control conditions ($b = 0.73$, $SE = .10$, $t(451) = 7.40$, $p < .001$). A model considering each control group separately also found a significant main effect of pattern condition ($F(2, 450) = 27.74$, $p < .001$). Fixed effects for each condition in this model showed that participants predicted an individual with a recent streak would be more likely to stick to their goal ($M = 4.35$, $SD = 1.37$) than an individual with an old streak ($M = 3.68$, $SD = 1.17$; $t(450) = 5.98$, $p < .001$) or a scattered pattern ($M = 3.58$, $SD = 1.22$; $t(450) = 6.84$, $p < .001$).

Perceived commitment. A random intercept regression model revealed that participants perceived an individual with a recent streak to be more committed to their goal compared to the other two conditions ($b = 0.57$, $SE = .06$, $t(451) = 9.27$, $p < .001$). A model considering each control group separately also found a significant main effect of

pattern condition ($F(2, 450) = 45.85, p < .001$). Fixed effects for each condition in this model showed that participants perceived an individual with a recent streak to be more committed ($M = 4.79, SD = 1.05$) than an individual with an old streak ($M = 4.30, SD = 1.03; t(450) = 6.96, p < .001$) or a scattered pattern ($M = 4.14, SD = 1.08; t(450) = 9.18, p < .001$).

Mediation analysis. We conducted repeated measures mediation analyses using a bootstrap procedure with 10,000 samples to test the process by which an individual's recent pattern of behavior affects preferences for a commitment device (Montoya and Hayes 2017). We predicted that an individual with a recent streak would be perceived as more committed to and more likely to do a goal-consistent behavior, which would in turn decrease recommendations for a commitment device. Indeed, perceived commitment mediated the relationship between a recent streak and recommendations for a commitment device, relative to an old streak (Indirect effect = $-.23, SE = .06, 95\% CI = [-.36, -.12]$) and a scattered pattern (Indirect effect = $-.19, SE = .06, 95\% CI = [-.31, -.10]$). Predicted likelihood of doing the goal-consistent behavior in the near future also mediated this relationship (versus *old streak*: Indirect effect = $-.21, SE = .06, 95\% CI = [0.34, -.11]$; versus *scattered pattern*: Indirect effect = $-.18, SE = .04, 95\% CI = [-.27, -.10]$). Replicating the results from Study 1, perceived commitment mediated the relationship between a recent streak and the predicted likelihood of doing the goal-consistent behavior relative to an old streak (Indirect effect = $.52, SE = .08, 95\% CI = [.36, .69]$) and a scattered pattern (Indirect effect = $.55, SE = .10, 95\% CI [.36, .74]$).⁹

Discussion

⁹ We report the mediation analyses that we preregistered. We obtain qualitatively similar results if we instead perform a serial mediation (see Appendix).

Study 2 demonstrates the robustness of the effect in a new context and using a within-subjects design. Additionally, we show that a recent streak of goal-consistent behavior has important consequences, in that it decreases the likelihood of recommending a commitment device to help the individual attain the related goal. Thus, when an individual is perceived as committed, the perceived need to restrict their freedom to choose is attenuated. In the next study, we further examine this proposed mechanism.

STUDY 3: THE BASE RATE OF GOAL-CONSISTENT BEHAVIOR MODERATES PERCEPTIONS FOLLOWING STREAKS

Studies 1 and 2 demonstrate the effect of a recent streak on predicted likelihood of goal-consistent behavior and provide initial evidence of the proposed mechanism. Study 3 further examines this mechanism by investigating a potential boundary condition: when another diagnostic cue about commitment is present. Specifically, we examine the effect when varying the base rate, or how often the individual has behaved consistently with their goal historically. We expect that in the presence of another diagnostic cue (i.e., when the individual has a high base rate of goal-consistent behavior), the effect of a recent streak on predicted future behavior and perceived commitment will be diminished. In addition, Study 2 tests the robustness of the effect through a different operationalization of the pattern of behavior.

Methods

Six hundred two participants from Amazon Mechanical Turk (M age = 34.43, 45.51% female, 0.66% other/did not say) were recruited to participate in a study for \$0.25.

As in Study 1, participants read about an individual choosing between eating healthy desserts, like fruit, and unhealthy desserts, like ice cream. Participants were randomly assigned to one of six conditions in a 2(pattern: *recent streak* or *no streak*) by 3(base rate: *low*, *moderate*, or *high*) between-subjects design. Participants saw either that the individual ate fruit for dessert for three of the last three days (*recent streak* condition) or that they ate fruit for dessert yesterday (*no streak* condition). Participants also read that this individual had chosen fruit for dessert either 20% (*low base rate* condition), 50% (*moderate base rate* condition), or 80% (*high base rate* condition) of the time over the past several weeks.

After reading this information, participants answered how likely it was that the individual would eat fruit and ice cream today, as in Study 1 ($r = -.85$). Participants then answered one item to measure perceived commitment to the goal (“how committed is this individual to eating healthy overall?”; 1 = not at all committed, 7 = extremely committed). Then, participants answered two attention check questions in which they had to identify the individual’s pattern of recent behavior and past base rate of eating fruit. 95.02% of participants passed the pattern attention check question and 94.19% passed the base rate attention check question. Lastly, participants answered demographic questions. We also asked three additional exploratory questions about the individual’s long-term ability to eat healthy; see Appendix for all measures.

Results

Predictions about sticking to the goal. A two-way ANOVA revealed a main effect of pattern ($F(1, 596) = 12.16, p = .001$), such that participants predicted an individual with a recent streak ($M = 4.23, SD = 1.53$) was more likely to eat fruit than an individual

who ate fruit yesterday ($M = 3.62, SD = 1.72$). There was also a significant effect of base rate ($F(2, 596) = 159.11, p < .001$), such that people thought an individual with a higher base rate was more likely to eat fruit.

Most importantly, we found the expected significant interaction between pattern and base rate ($F(2, 596) = 27.24, p < .001$; see figure 4). In the *low base rate* condition, we replicate the effect from Studies 1 and 2; participants thought an individual with a recent streak was more likely to eat fruit ($M = 3.72, SD = 1.55$) than an individual without a recent streak ($M = 2.47, SD = 1.16; t(200) = 6.51, p < .001$). This effect persists in the *moderate base rate* condition ($M_{recent\ streak} = 3.82, SD = 1.47$ vs. $M_{no\ streak} = 3.29, SD = 1.29; t(200) = 2.74, p = .007$). However, this effect goes away, and surprisingly reversed, in the *high base rate* condition ($M_{recent\ streak} = 4.97, SD = 1.27$ vs. $M_{no\ streak} = 5.64, SD = .89; t(196) = 4.09, p < .001$).

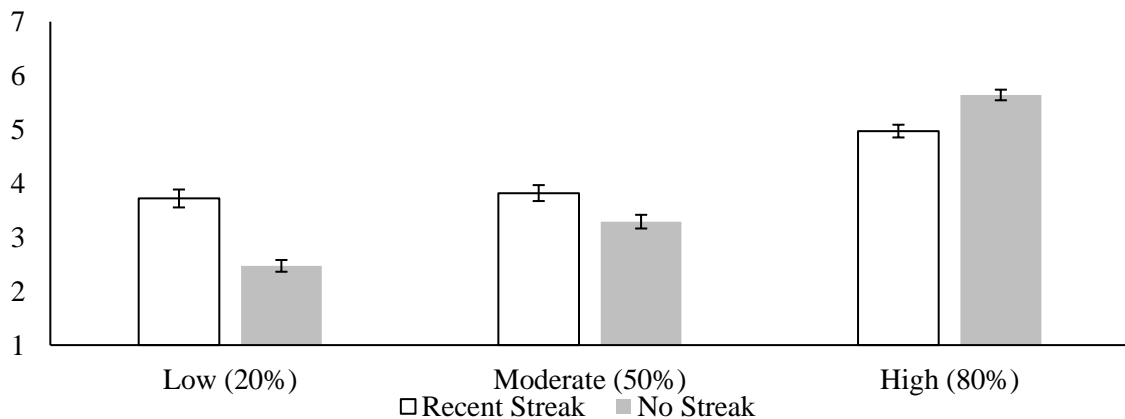


Figure 4. Predicted likelihood that an individual will stick to their goal based on their recent pattern of behavior and base rate of goal-consistent behavior. Error bars are ± 1 standard error.

Perceived commitment. A two-way ANOVA revealed a significant main effect of pattern ($F(1, 596) = 8.25, p = .004$), such that participants thought that an individual with a recent streak was more committed to eating healthy ($M = 4.29, SD = 1.50$) than an individual who ate fruit yesterday ($M = 3.74, SD = 1.67$). There was also a significant effect of base rate ($F(2, 596) = 225.01, p < .001$), such that individuals with higher base rates were perceived as more committed to eating healthily.

Importantly, we found a significant interaction between pattern and base rate ($F(2, 596) = 10.36, p < .001$). In the *low base rate* condition, participants thought an individual with a recent streak was more committed to eating healthy ($M = 3.21, SD = 1.43$) than an individual without a recent streak ($M = 2.50, SD = 1.11; t(200) = 3.93, p < .001$). This effect also holds in the *moderate base rate* condition ($M_{recent\ streak} = 4.15, SD = 1.15$ vs. $M_{no\ streak} = 3.67, SD = 1.32; t(200) = 2.76, p = .006$). However, this effect did not hold, and in fact reversed, in the *high base rate* condition ($M_{recent\ streak} = 5.23, SD = 1.18$ vs. $M_{no\ streak} = 5.57, SD = .86; t(196) = 2.22, p = .027$).

Mediation analysis. We conducted a moderated mediation analysis using a bootstrap procedure with 10,000 samples to test the process by which an individual's recent pattern of sticking to their goal affects the predicted likelihood of goal-consistent behavior (Hayes, Preacher, and Myers, 2011).

We predicted that perceived commitment would mediate the effect of a recent streak on predicted likelihood goal-consistent behavior, but not when the individual has a high base rate of behaving consistently with their goal in the past. Our mediation model (SAS PROCESS Macro, Model 7) included pattern of behavior as the independent variable (where 1 = *recent streak* condition and 0 = *no streak* condition), base rate of

doing the goal-consistent behavior as the moderator variable (where -0.5 = low base rate, 0 = moderate base rate, and 0.5 = high base rate), perceived commitment as the mediator variable, and predicted likelihood of goal-consistent behavior as the dependent variable. Consistent with our hypothesis, we found that perceived commitment mediated the interaction in the predicted direction. Specifically, we found a significant indirect effect for the *low base rate* condition (Indirect effect = $.47$, $SE = .10$, $95\% CI = [.27, .68]$) and a smaller significant indirect effect for the *moderate base rate* condition (Indirect effect = $.20$, $SE = .07$, $95\% CI = [.07, .33]$). Importantly, we found a nonsignificant effect for the *high base rate* condition (Indirect effect = $-.08$, $SE = .08$, $95\% CI = [-.24, .09]$).

Discussion

Study 3 replicates the effect that people infer from a recent streak of goal-consistent behavior that the individual is more likely to continue to do that behavior in the near future. Also, Study 3 shows that this effect is robust to a different operationalization of the individual's recent pattern of behavior (i.e., comparing a streak of three days in a row of goal-consistent behavior to just one day of goal-consistent behavior). In addition, we uncovered an important moderator of this effect: past base rate. The effect holds when the individual has a low or moderate base rate of behaving consistently with their goal, but the effect does not hold (and actually reverses) when the individual has a high base rate. This moderation of the effect demonstrates that a recent streak is a strong cue of commitment in cases where other cues (i.e., a high base rate) are absent. As in previous studies, we also find that perceived commitment mediates the relationship between a recent streak and an increase in the predicted likelihood of behaving consistently with the goal.

We predicted an attenuation, not the observed reversal of the effect of a recent streak on predicted likelihood in the *high base rate* condition. We posit post hoc that this reversal could be due to one of two unanticipated effects. We believe the most likely cause is that participants were attempting to have the individual's recent pattern of behavior match their base rate; an individual with three days in a row of eating healthy (i.e., the *recent streak* condition) should eat unhealthily on the fourth day to bring their recent pattern of behavior close to their base rate of 80%. However, it is also possible that participants reasoned that the individual with a recent streak feels like they “deserve a break” occasionally.

STUDIES 4A AND 4B: PERCEPTIONS FOLLOWING A RECENT STREAK OF GOAL-DIRECTED VERSUS NEUTRAL BEHAVIORS

STUDY 4A

Study 4a examines an additional moderator of the effect of a recent streak on predictions of future behavior: whether the behavior requires commitment or not. Because perceived commitment plays a critical role in this effect, we expect the effect of a recent streak to be diminished when predicting behaviors for which commitment to a goal is less relevant. In addition, we employ a third way of presenting recent pattern of behavior in Study 4a to test the robustness of the effect.

Methods

Four hundred two participants on Amazon Mechanical Turk (M age = 36.92, 52.37% female, 0.25% other/did not say) were recruited to participate in a study for \$0.45.

Participants were randomly assigned to condition in a 2 (behavior: *goal-directed* or *neutral*) by 4 (pattern: *0 of 3 days*, *1 of 3 days*, *2 of 3 days*, or *3 of 3 days*) mixed design. Participants read about two individuals' recent choices in a randomized order. As in Studies 1 and 3, one of these individuals chose between eating a healthy dessert (fruit) and an unhealthy dessert (ice cream) in order to lose weight (*goal-directed behavior* condition). The other individual chose between watching TV and playing video games as a daily leisure activity (*neutral behavior* condition).

Participants then read that over the past several weeks, the individual ate fruit 50% of the time (*goal-directed behavior* condition) or watched TV 50% of the time (*neutral behavior* condition), thus controlling for the base rate. Then, participants read that the individual had eaten fruit/watched TV on 0, 1, 2, or 3 out of the last 3 days. The *3 of 3 days* condition represents a recent streak. In contrast, the other patterns (0, 1, and 2 out of 3 days) represent control pattern conditions. Participants read about and evaluated an individual in the *goal-directed behavior* and the *neutral behavior* conditions, but each participant viewed the same pattern of past behavior for both individuals.

Next, as in Studies 1-3, participants predicted how likely the individual was to do the behaviors ($r_{\text{goal-directed behavior}} = -.74$; $r_{\text{neutral behavior}} = -.53$). We also asked participants the same four questions to measure perceived commitment as in Studies 1 and 2 ($\alpha_{\text{goal-directed behavior}} = 0.94$; $\alpha_{\text{neutral behavior}} = 0.91$). Then, participants were asked two attention check questions in which they had to identify the base rate of eating fruit/watching TV for each individual, and two attention check questions in which they had to identify on how many of the last three days each individual had eaten fruit/watched TV. 87.56% of participants passed both pattern attention check questions and 88.81% passed both base

rate attention check questions. Lastly, participants reported demographic information. We also asked one exploratory question concerning inferences about the individual's behaviors more generally and two exploratory questions concerning negative emotions about not eating fruit/watching TV; see Appendix for all measures.

Results

Predictions about sticking to the goal. A mixed ANOVA revealed that participants thought the individual in the *goal-directed behavior* condition was more likely to eat fruit ($M = 4.10, SD = 1.55$), than the individual in the *neutral behavior* condition was to watch TV ($M = 3.90, SD = 1.33; F(1, 400) = 21.78, p < .001$). There was also a significant effect of pattern ($F(1, 400) = 5.94, p = .015$), such that participants thought an individual with a recent streak (i.e., 3 of 3 days) was more likely to eat fruit/watch TV ($M = 4.28, SD = 1.07$) than individuals without a recent streak ($M = 3.92, SD = 1.27$).

Importantly, this effect was qualified by an interaction ($F(1, 400) = 19.30, p < .001$; see figure 5). The findings from previous studies were replicated within the *goal-directed behavior* condition; participants thought the individual with a recent streak was significantly more likely to eat fruit ($M = 4.68, SD = 1.55$) than individuals who did not have a recent streak ($M = 3.93, SD = 1.59; t(400) = 4.10, p < .001$). As predicted, within the *neutral behavior* condition, participants' predictions of watching TV did not differ depending on if the individual had a recent streak of watching TV ($M = 3.88, SD = 1.27$) or not ($M = 3.91, SD = 1.35; t(400) = 0.19, p = .85$).

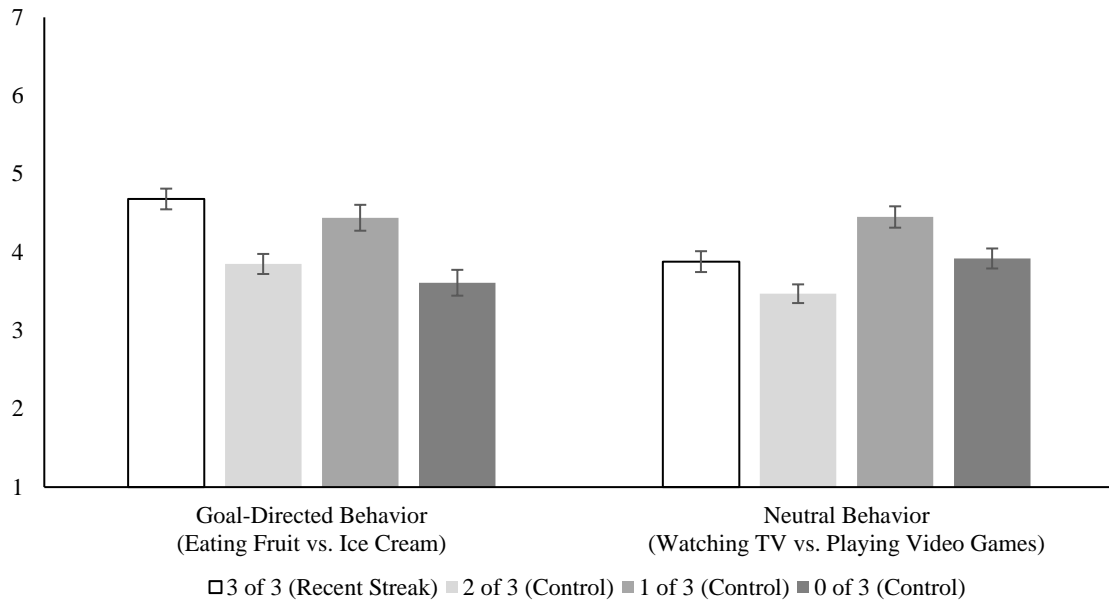


Figure 5. Predicted likelihood that the individual would eat fruit/watching TV as a function of their recent pattern of behavior and if their behavior was goal-directed or not. Error bars are ± 1 standard error.

When we considered each control condition separately, we found some unexpected effects. A 2(behavior) by 4(pattern) mixed ANOVA found a significant interaction between the two factors ($F(3, 398) = 10.85, p < .001$). In the *goal-directed behavior* condition, participants predicted the individual with a recent streak was more likely to do eat fruit than an individual who had eaten fruit on 0 of 3 days ($M = 3.61, SD = 1.73; t(199) = 4.89, p < .001$) or on 2 of 3 days ($M = 3.66, SD = 1.17; t(202) = 4.43, p < .001$), but only directionally more likely than an individual who had eaten fruit on 1 of 3 days ($M = 4.44, SD = 1.36; t(177) = 1.10, p = .27$). As expected, in the *neutral behavior* condition, participants thought an individual with a recent streak was not different in their likelihood of watching TV ($M = 3.88, SD = 1.27$) than an individual who had watched

TV 0 of 3 days ($M = 3.92$, $SD = 1.34$; $t(199) = 0.24$, $p = .81$). But, the *recent streak* condition was seen as more likely to watch TV than the *2 of 3* condition ($M = 3.47$, $SD = 1.27$; $t(202) = 2.27$, $p = .025$) and less likely than the *1 of 3* condition ($M = 4.45$, $SD = 1.28$; $t(177) = 3.02$, $p = .003$). Post hoc, we believe a similar unexpected effect surfaced as we posited for the results in the *high base rate* condition in Study 3; it is possible that for both behavior conditions, participants predicted the individual in the *1 of 3* condition was more likely to eat fruit/watch TV than we anticipated because participants tried to match the individual's recent behavior with their overall base rate. In other words, participants may have thought the person would eat fruit/watch TV on the next day in the *1 of 3* condition so that they had done the behavior on 2 of 4 days, thus matching the person's overall base rate of doing the behavior (50%). This desire to match the recent behavior with the base rate could also explain why the prediction of future behavior in the *2 of 3* condition was lower than anticipated in the *neutral behavior* condition.

Perceived commitment. In a mixed ANOVA, there was no effect of behavior condition on perceived commitment to eating fruit/watching TV ($F(1, 400) = 0.71$, $p = .40$). There was a significant effect of pattern ($F(1, 400) = 43.35$, $p < .001$), such that participants thought an individual with a recent streak was more committed to eating healthy/watching TV ($M = 5.08$, $SD = 0.78$) than individuals without a recent streak ($M = 4.28$, $SD = 1.08$).

Importantly, this effect was qualified by an interaction ($F(1, 400) = 15.30$, $p < .001$). In the *goal-directed behavior* condition, the individual with a recent streak was perceived as more committed to eating healthy ($M = 5.27$, $SD = 1.03$) than individuals who did not have a recent streak ($M = 4.16$, $SD = 1.29$; $t(400) = 7.53$, $p < .001$). In the

neutral behavior condition, the individual with a recent streak was more committed to watching TV ($M = 4.90$, $SD = 0.92$) than individuals who did not have a recent streak ($M = 4.40$, $SD = 1.26$; $t(400) = 3.32$, $p < .001$), but to a lesser degree.

A mixed ANOVA considering each control condition separately also revealed a significant interaction between behavior and pattern ($F(3, 398) = 7.77$, $p < .001$).

Independent t-tests showed that within the *goal-directed behavior* condition, participants perceived an individual with a recent streak as more committed to eating healthy relative to each of the control conditions ($ts > 2.75$, $ps < .007$). Within the *neutral behavior* condition, participants perceived an individual with a recent streak as more committed to watching TV than the *0 of 3* and the *1 of 3* conditions ($ts > 2.35$, $ps < .020$), but not different from the *2 of 3* condition ($t(202) = 0.70$, $p = .49$).

Mediation analysis. We conducted a moderated mediation analysis using a bootstrap procedure with 10,000 samples to test the process by which an individual's recent pattern of eating fruit/watching TV affects the predicted likelihood of doing that behavior in the future (Hayes, Preacher, and Myers, 2011).

We predicted that perceived commitment would mediate the effect of a recent streak on predicted likelihood of eating fruit in the *goal-directed behavior* condition, but the predicted likelihood of watching TV in the *neutral behavior* condition. Our mediation model (SAS PROCESS Macro, Model 7) included pattern of behavior as the independent variable (where 1 = *recent streak* condition and 0 = the three *control* conditions combined), behavior as the moderator variable (where 1 = *goal-directed behavior* and 0 = *neutral behavior*), perceived commitment as the mediator variable, and predicted likelihood of eating fruit/watching TV as the dependent variable. We found that

perceived commitment mediates the interaction in the predicted direction. Specifically, we found a significant indirect effect for the *goal-directed behavior* condition (Indirect effect = .35, SE = .07, 95% CI = [.23, .49]). We also found a significant indirect effect for the *neutral behavior* condition, but to a lesser degree (Indirect effect = .16, SE = .04, 95% CI = [.08, .26]).

STUDY 4B

Study 4b conceptually replicates Study 4a through the use of different behaviors as stimuli and a different operationalization of the pattern of behavior.

Methods

Three hundred two participants on Amazon Mechanical Turk (M age = 35.92, 48.34% female, 0.66% other/did not say) were recruited to participate in a study for \$0.25.

Participants were randomly assigned to condition in a 2(behavior: *goal-directed* or *neutral*) by 3(pattern: *recent streak*, *old streak*, or *scattered*) mixed design. As in Study 4a, participants read about two individuals' recent choices – one who chose between sticking to their goal or not (*goal-directed behavior*) and another who chose between two actions which did not require commitment to a goal (*neutral behavior*) – in a randomized order. Half of participants in the *goal-directed behavior* condition read about an individual with a goal of eating healthy who chose between eating fruit or ice cream for dessert (as in previous studies), while the other half read about an individual with a goal of getting in shape who chose between exercising or watching TV. In the *neutral behavior* condition, half of participants read about an individual choosing between watching TV or playing video games (as in previous studies) and the other half read

about an individual choosing between eating oatmeal or eggs for breakfast. To simplify the description, we will refer to main behavior asked about in each condition (eating fruit or exercising in the *goal-directed behavior* condition; watching TV or eating oatmeal in the *neutral behavior* condition) as the “focal behavior” when explaining our dependent variables and analyses.

As in Studies 1 and 2, participants read that each individual had done the focal behavior for three of the last six days and saw in a graphic representation that each person had a recent streak, old streak, or scattered pattern of doing the focal behavior in the past six days. Participants saw the same pattern for both the *goal-directed* and *neutral* behavior conditions.

Next, participants answered the same two questions used in previous studies about the likelihood that the individual would do either behavior next ($r_{\text{goal-directed behavior}} = -.72$; $\alpha_{\text{neutral behavior}} = -.65$). We also asked three of the four questions used in Studies 1, 2, and 4a to create a measure of perceived commitment (commitment to, importance of, and care about doing the focal behavior; $\alpha_{\text{goal-directed behavior}} = .87$; $\alpha_{\text{neutral behavior}} = .88$ ¹⁰). Then, participants answered three attention check questions about what they had read regarding the behaviors in the *goal-directed behavior* condition, the behaviors in the *neutral behavior* condition, and the pattern of behavior both individuals had. 95.36%, 86.42%, and 97.02% of participants passed each of these attention check questions, respectively. Lastly, participants reported their demographics. In addition, we asked two exploratory questions concerning inferences about the focal behavior more generally and two

¹⁰ This was the second study we conducted and we did not include a measure of motivation.

exploratory questions concerning negative emotions about not doing the focal behavior, see Appendix for all measures.

Results

First, we conducted 2(operationalization of behavior) by 3(pattern) mixed design ANOVAs for our key dependent variables. There were no significant interactions between operationalization of behavior and pattern conditions for the *goal-directed behavior* conditions ($F_s < 1.10$, $p_s > .36$) or the *neutral behavior* conditions ($F_s < 1.50$, $p_s > .22$). Therefore, we collapse across these operationalizations in our analyses.

Predictions about sticking to the goal. A mixed ANOVA revealed that participants predicted the individual in the *goal-directed behavior* condition was more likely to do the focal behavior ($M = 3.57$, $SD = 1.55$) than the individual in the *neutral behavior* condition ($M = 3.36$, $SD = 1.31$; $F(1, 300) = 8.12$, $p = .005$). There was also a significant effect of pattern ($F(1, 300) = 14.34$, $p < .001$), such that participants thought an individual with a recent streak was more likely to do the focal behavior ($M = 3.82$, $SD = 1.22$) than an individual without a recent streak ($M = 3.29$, $SD = 1.10$).

Importantly, this effect was qualified by an interaction ($F(1, 300) = 4.71$, $p = .031$; see figure 6). The effects within the *goal-directed behavior* condition replicate those found in the previous studies; participants thought the individual with the recent streak was more likely to do the focal behavior ($M = 4.08$, $SD = 1.60$) than individuals without a recent streak ($M = 3.32$, $SD = 1.47$; $t(300) = 4.05$, $p < .001$). Within the *neutral behavior* condition, the individual in the *recent streak* condition ($M = 3.57$, $SD = 1.40$) was perceived as marginally more likely to do the focal behavior than individuals in the *control* conditions ($M = 3.25$, $SD = 1.26$; $t(300) = 1.95$, $p = .052$).

A mixed ANOVA considering each control condition separately also found a significant interaction between pattern and behavior type ($F(2, 299) = 3.82, p = .023$). Independent t-tests revealed that within the *goal-directed behavior* condition, participants thought the individual with the recent streak was more likely to do the focal behavior than an individual with an old streak ($M = 3.48, SD = 1.50; t(198) = 2.71, p = .007$) or an individual with a scattered pattern ($M = 3.17, SD = 1.43; t(199) = 4.24, p < .001$). Within the *neutral behavior* condition, participants thought the likelihood of doing the focal behavior was marginally higher in the *recent streak* condition than the *old streak* condition ($M = 3.21, SD = 1.17; t(198) = 1.94, p = .054$) but was not different from the *scattered* condition ($M = 3.29, SD = 1.39; t(199) = 1.47, p = .163$).

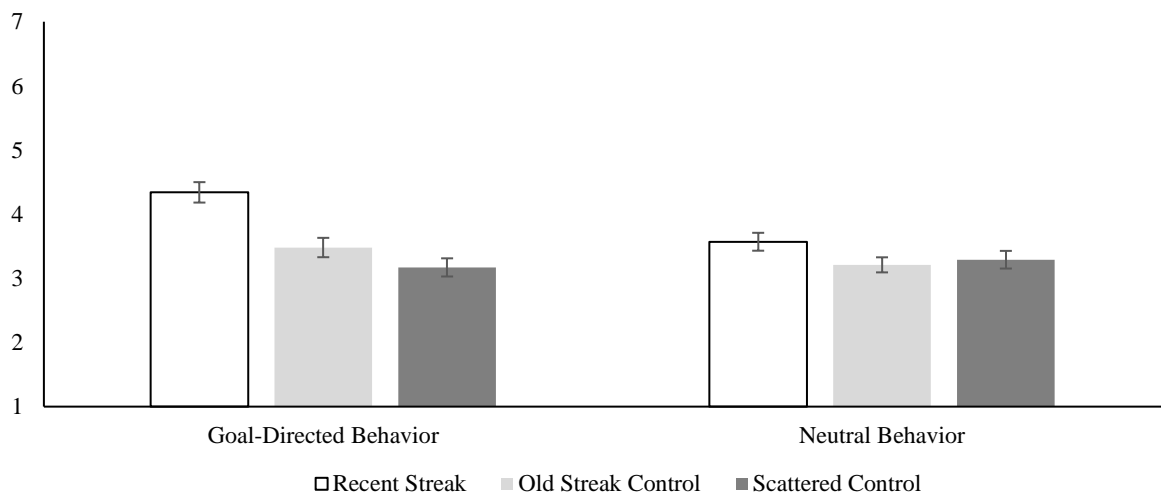


Figure 6. Predicted likelihood that an individual would do the focal behavior based on their recent pattern and type of behavior. Error bars are ± 1 standard error.

Perceived commitment. In a mixed ANOVA, there was neither a significant effect of behavior ($F(1, 300) = 0.11, p = .74$), nor a significant effect of pattern on commitment to the focal behavior ($F(1, 300) = 2.98, p = .085$).

While the interaction between pattern of behavior and type of decision was not significant ($F(1, 300) = 0.22, p = .64$), contrasts revealed the predicted pattern directionally. In the *goal-directed behavior* condition, participants perceived higher commitment for the individual with a recent streak of the focal behavior ($M = 4.62, SD = 1.16$) than individuals who did not have a recent streak ($M = 4.40, SD = 1.06; t(300) = 1.66, p = .097$). In the *neutral behavior* condition, there was no difference in perceived commitment to the focal behavior between the *recent streak* ($M = 4.61, SD = 1.06$) and *control* conditions ($M = 4.46, SD = 1.09; t(300) = 1.14, p = .25$).

The interaction between pattern and behavior type remained non-significant when considering the control conditions separately ($F(2, 299) = 0.11, p = .89$). Independent t-tests revealed that in the *goal-directed behavior* condition, participants thought an individual with a recent streak was directionally more committed to the focal behavior than an individual with an old streak ($M = 4.41, SD = 0.94; t(198) = 1.43, p = .154$) or an individual with a scattered pattern ($M = 4.39, SD = 1.18; t(199) = 1.41, p = .159$). In the *neutral behavior* condition, there were no differences between any of the pattern conditions ($M_{old\ streak} = 4.48, SD = 1.02; M_{scattered} = 4.44, SD = 1.17; ts < 1.10, ps > .28$).

Mediation analysis. We conducted a moderated mediation analysis using a bootstrap procedure with 10,000 samples to test the process by which an individual's recent pattern of behavior affects the predicted likelihood to do that behavior (Hayes, Preacher, and Myers, 2011). We predicted that perceived commitment would mediate the effect of a recent streak on predicted likelihood of doing the focal behavior for behaviors which involve commitment (i.e., the *goal-directed behavior* condition), but to a lesser extent for behaviors which do not (i.e., the *neutral behavior* condition). Our mediation

model (SAS PROCESS Macro, Model 7) included pattern of behavior as the independent variable (where 1 = *recent streak* condition and 0 = the *control* conditions), behavior as the moderator variable (where 1 = *goal-directed behavior* condition and 0 = *neutral behavior* condition), perceived commitment as the mediator variable, and predicted likelihood of doing the focal behavior as the dependent variable. We found that perceived commitment to the focal behavior mediates the interaction in the predicted direction. Specifically, we found a significant indirect effect for the *goal-directed behavior* condition (Indirect effect = .03, SE = .02, 95% CI = [.001, .09]). However, the indirect effect was not significant for the *neutral behavior* condition (Indirect effect = .02, SE = .02, 95% CI = [-.01, .08]).

Discussion

Studies 4a and 4b replicate the key predicted effect: people predict that an individual is more likely to stick to their goal after seeing that they have a recent streak of goal-consistent behavior. These studies demonstrate the robustness of the effect to a different way of conveying recent patterns of behavior (Study 4a) and across different behaviors (Study 4b).

Furthermore, these studies show that people do not make such inferences, or at least do so to a lesser extent, after a recent streak of behavior that does not involve commitment to a goal (e.g., leisure activities). Importantly, this moderation demonstrates the mechanism behind this effect; because commitment is not an important factor when making decisions that do not require self-control, a recent streak of choosing one of the options does not signal commitment. This mechanism is further supported in mediation analyses, where perceived commitment mediates the relationship between a recent streak

and predicted likelihood of doing a goal-consistent behavior, but does not mediate (Study 4b) or mediates to a lesser extent (Study 4a) for a neutral behavior.

GENERAL DISCUSSION

Consumers face a fundamental conflict between choosing short-term temptation and attaining their long-term goals. In this article, we examined how people make predictions about future goal-directed behavior based on recent patterns of behavior. We find that an individual with a recent streak of goal-consistent behavior is seen as more committed to their goal, compared to an individual with the same overall rate of past behavior but of a different pattern. These beliefs not only affect predictions of future behavior but also people's preferences for restrictive tools for goal pursuit. We also demonstrate the boundary conditions for these effects. Specifically, these effects are attenuated in the presence of another diagnostic cue about goal commitment and when the behavior does not pertain to a goal.

Implications

These findings may be especially relevant given the rise of behavioral tracking tools, wherein streaks (or lack thereof) can be easily evaluated. For example, consumers can track their steps and calories on smart devices and phone apps. Likewise, managers and teachers can track attendance and performance of their employees and students, respectively. Our results suggest that observed patterns of behavior in these different contexts can affect beliefs about commitment, predictions about future behavior, and the perceived necessity of stringent interventions.

Future Directions

In the studies herein, we focus on predictions about others' behavior. Doing so provides a cleaner manipulation of recent behavior without participants bringing to bear other self-knowledge. In other words, a consumer might use information about the causes of their behavioral pattern when forming judgments about which an outside observer would not be aware. Yet we expect that the same effects would hold for self-inference, albeit controlling for confounding knowledge about the self.

In addition, we focus on inferences and predictions but do not examine actual behavior following different patterns of goal-oriented behavior. Thus, we do not know how well people's inferences and predictions following recent streaks map on to actual behavior. The accuracy of the hot hand belief has been hotly debated (Bar-Eli, Avugos, and Raab 2006; Miller and Sanjurjo 2016). Therefore, it would be interesting to learn whether people's inferences about recent streaks of goal-consistent behavior are indeed accurate or whether people are over-interpreting randomness.

Lastly, the studies examined relatively short streaks (i.e., three in a row). How might our effects change as an individual's streak increases? On the one hand, a longer streak may serve as an even stronger signal of commitment; resisting temptation many times in a row requires much more effort than resisting temptation a few times. If that is the case, our studies represent a conservative test of how streaks affect inferences and predictions of goal pursuit. On the other hand, a longer streak could at some point lead to a licensing effect, whereby people believe a consumer is due for a reward or reprieve. Therefore, future work can explore the possible interaction of streak length on beliefs and predictions.

In sum, we demonstrate that people make inferences and predictions about goal commitment and behavior based on patterns of past behavior. These inferences, in turn, affect whether people favor consumer freedom versus restrictive commitment devices to aid in long-term goal success. In particular, they believe that a recent streak is diagnostic of commitment to the goal. This sheds light on the specific meaning attributed to streaks in the context of goal pursuit.

APPENDIX A

ON OR OFF TRACK: HOW (BROKEN) STREAKS AFFECT FUTURE BEHAVIOR

Contents

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7. Study 3 Results: Sense of Achievement and Motivation Sub-scales
8. Supplemental Study 3: Additional Framing Streaks Study Replication
9. Supplemental Study 4: Framing Streaks Study Replication with a Choice Between Games
10. Supplemental Study 5: Perceived Streakiness Study
11. Study 4 Instruction Comprehension Questions
12. Study 4 Results: Sense of Achievement and Motivation Sub-scales
13. Study 5 Instruction Comprehension Questions
14. Study 5 Results: Sense of Achievement and Motivation Sub-scales and Serial Mediation

1. Supplemental Study 1: App Experience Study Questionnaire

In this study, you will answer some questions about your personal experiences with apps. Our goal is to understand how consumers interact with technology.

[page break]

Many different types of apps emphasize the streaks that people have in using them.

For example:

- A messaging app can show when users have a streak in sending photos to friends multiple days in a row
- A gaming app can highlight when users have won multiple consecutive games
- A fitness-tracking app can notify users when they have reached their step or exercise goal for several days in a row

Take a moment to think about the apps that you use, and list which of those apps emphasize streaks. [Free response]

[page break]

Think about a time that an app notified you about a streak you had. Please mark how strongly you agree/disagree with the following statements.

I felt overwhelmed by the amount of information. [1 = Strongly disagree, 7 = Strongly agree]

I felt that the streak **took away** from my experience using the app. [1 = Strongly disagree, 7 = Strongly agree]

I felt that the streak **enhanced** my experience using the app. [1 = Strongly disagree, 7 = Strongly agree]

I was **distracted** by seeing my streak. [1 = Strongly disagree, 7 = Strongly agree]

Please explain your responses to the above scale questions (i.e., why you gave the response you did for each question): [Free response]

[page break]

Again, think about a time that an app notified you about a streak you had. Please mark how strongly you agree/disagree with the following statements.

I felt **motivated** to keep using the app. [1 = Strongly disagree, 7 = Strongly agree]

I felt **bothered** that the app was tracking my information. [1 = Strongly disagree, 7 = Strongly agree]

I felt **aware** of my streak. [1 = Strongly disagree, 7 = Strongly agree]

I **liked** that the app emphasized my streak. [1 = Strongly disagree, 7 = Strongly agree]

Please explain your responses to the above scale questions (i.e., why you gave the response you did for each question): [Free response]

[page break]

Think about apps that you use that emphasize streaks. Have you ever gone out of your way to maintain your streak (or avoid breaking your streak) on one or more of these apps? [Yes/No]

[page break]

Please explain [how you have / why you have NOT] gone out of your way to maintain your streak (or avoid breaking your streak) on an app before: [Free response]

[page break]

Many of these apps help users track behaviors **outside of the app** itself.

For example, a fitness-tracking app can tell you that you have a streak in reaching your daily step goal. Steps are an activity that you do outside of the app, but the app can track and report your number of daily steps to you.

Have you ever **gone out of your way** to do an activity **outside of an app** (e.g., walked

extra steps) in order to maintain your streak (or avoid breaking your streak) within an app? [Yes/No]

[page break]

Please explain [what activity you did/ why you have never gone out of your way to do an activity] outside of an app in order to maintain your streak (or avoid breaking your streak) within the app? [Free response]

[page break]

Some apps emphasize streaks, while others do not.

Do you think you are more aware of your streaks (or broken streaks) on apps that emphasize streaks or on apps that do not emphasize streaks? [1 = Definitely more aware on apps that do NOT emphasize streaks, 4 = Equally aware on both apps, 7 = Definitely more aware on apps that emphasize streaks]

[page break]

Imagine that you have a relatively **long streak** on an app (e.g., at least twenty in a row).

How much do you care about **avoiding breaking**, or ruining, your existing streak? [1 = Not at all, 6 = A great deal]

How much do you care about **adding to your streak**, or making it longer? [1 = Not at all, 6 = A great deal]

[page break]

Imagine that you have a relatively **short streak** on an app (e.g., no more than three in a row).

How much do you care about **avoiding breaking**, or ruining, your existing streak? [1 = Not at all, 6 = A great deal]

How much do you care about **adding to your streak**, or making it longer? [1 = Not at all, 6 = A great deal]

[page break]

Reported gender, age, and any comments.

2. Study 1a Materials

Actual “Logging Sheets” from participants in the *intact streak* (top) and *broken streak* (bottom) conditions.

WBL ID Number: [REDACTED]

Tasting Survey Stamp Sheet

Each time you go to the focus room, bring this sheet with you so we can stamp all of the candies that you try! After you try the candy, rate its taste, texture, and appearance from 1 to 7 on the lines underneath.

	1	2	3	4	5	6	7	8	9	10
Taste:	3	4	3	7	3	6	4	7	3	6
Texture:	5	2	5	5	4	6	1	6	6	4
Appearance:	5	7	2	7	7	6	3	7	3	6

WBL ID Number: [REDACTED]

Tasting Survey Stamp Sheet

Each time you go to the focus room, bring this sheet with you so we can stamp all of the candies that you try! After you try the candy, rate its taste, texture, and appearance from 1 to 7 on the lines underneath.

	1	2	3	4	5	6	7	8	9	10
Taste:	4	5	2	4	6	6	4	3	3	5
Texture:	4	2	2	4	6	4	1	3	3	4
Appearance:	4	3	4	4	6	5	7	4	2	4

Cover story survey

Tasting Study: Instructions

In this study, you get to taste several different types of candy! The purpose of this study is to see how appearance and information affects how people perceive different tastes. Press the arrow button below to see the detailed instructions for this study. It is very important that you read everything very carefully and make sure you understand the procedure before you begin.

[page break]

All of the candies that you will try are in the focus room. You will go get each candy one at a time so that you can eat and evaluate each one separately.

Participants will be allowed to enter the focus room to get each candy one at a time.

On your desk, there is a paper called "Tasting Study Stamp Sheet." You will need to bring this Stamp Sheet with you each time you go get a new candy. This helps us keep track of the candies you have tried already. Please put your lab ID number at the top of the page.

[page break]

Before you get each candy from the focus room, you will need to look at an advertisement about the candy you are about to go get. You must do this before you go get the candy.

After you get each candy and return to your seat, you can eat it at your desk. Then you will answer a few questions about the candy, both on your "Tasting Study Stamp Sheet" and on the computer:

On your Stamp Sheet, please rate the candy on its taste, texture, and appearance from 1 to 7 in the spaces below the stamp area, where 1 is "very bad" and 7 is "very good."

On the computer, please respond to a few questions about the candy in this web survey.

[page break]

For this study, we have several candies available for you to try. Trying more candies would be helpful to us, and it means you get to have more candy. Please try as many as you would like!

When you decide that you are finished with this study and do not want to try any more candies, please close this window and bring your Stamp Sheet to the RA who signs you out. Then you will be free to leave.

[page break]

On the next page, you will begin the procedure with Candy #1. Press the arrow button when you are ready to start the study.

Participants saw the following instructions and questions for each of the 10 candies:

Below is some information about Candy #1.

After you have read this information, please press the arrow button to proceed.



[page break]

You are now ready to go get Candy #1 from the focus room.

Please bring only your Stamp Sheet with you.

Once you return to your seat, press the arrow button below to continue. Please do not eat the candy until you are on the next page.

[page break]

Now, please go ahead and eat Candy #1.

Once you have finished eating Candy #1, answer the following questions.

Please describe the taste, texture, and/or appearance of this candy:

(free response)

Have you ever eaten this candy before? (Yes, No, I don't know)

[page break]

Please make sure you have also completed the ratings on your Stamp Sheet for Candy #1.

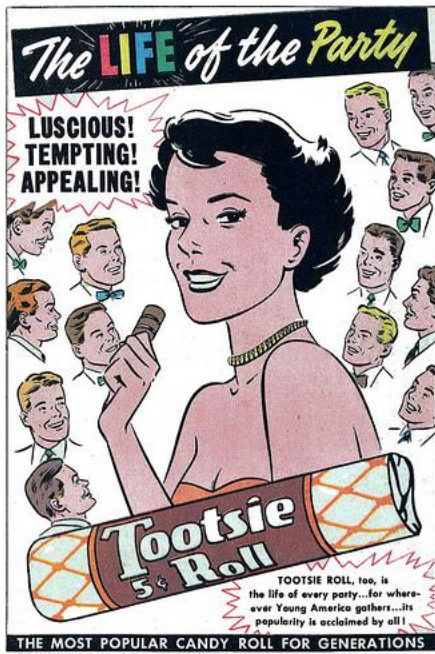
If you would like to continue, press the arrow button to move on to Candy #2.

Below are the images for the corresponding candies.

Candy #2



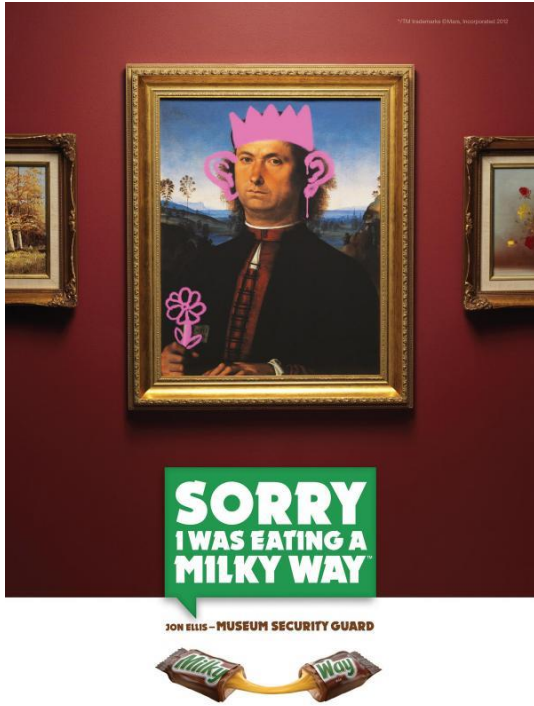
Candy #3



Candy #4



Candy #5



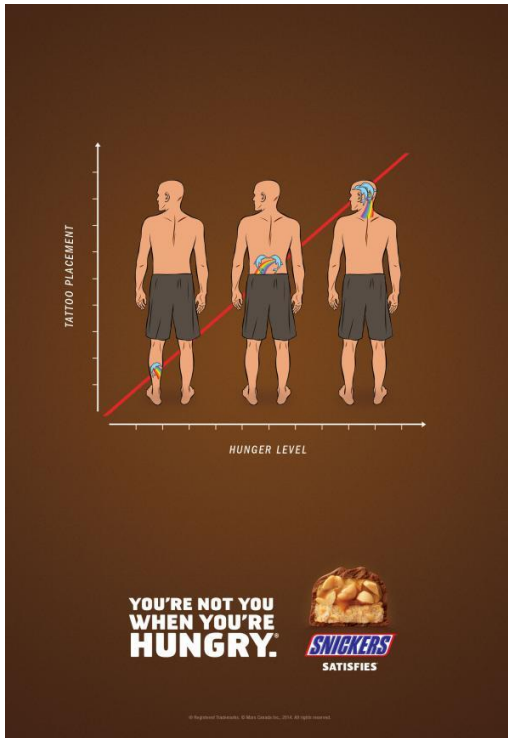
Candy #6



Candy #7



Candy #8

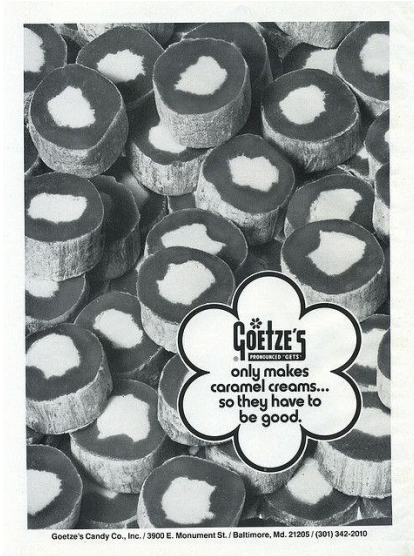


Candy #9.

Sweet
gluten-free finds
at CVS/pharmacy



Candy #10



[page break]

Thank you so much for trying all of the candies in this study!
Please close this window and bring your Stamp Sheet to the RA who signs you out of the session.

Research assistant instructions

Prepping materials before the session starts

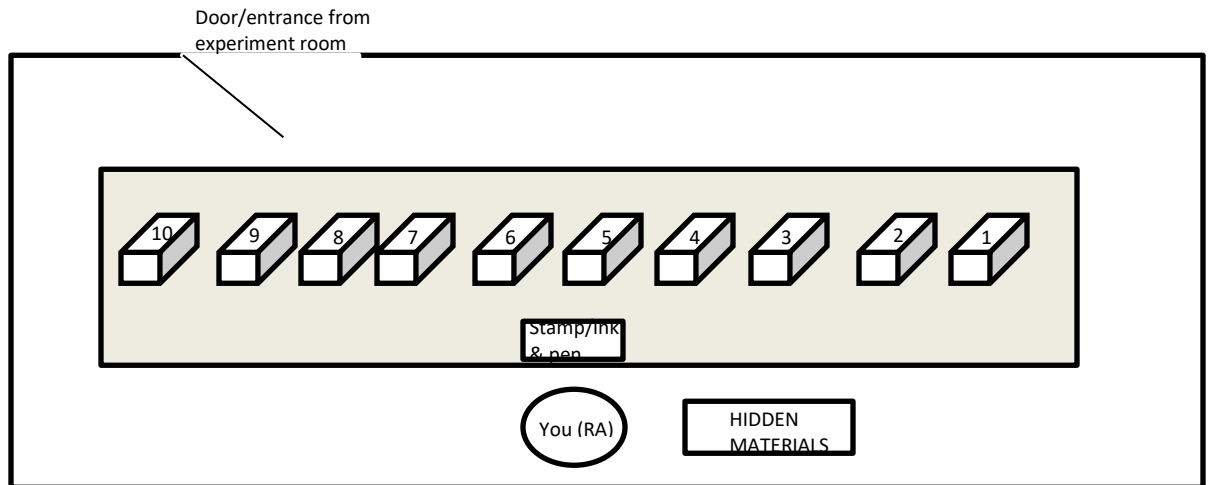
You will be given these materials the week before:

- 10 bags of 10 different types of candies (they will be labeled 1 to 10)
- 10 paper bags labeled 1-10
- 1 extra paper bag labeled 4
- A rubber stamper and inkpad
- A red marker
- 200 pre-printed stamp sheets
- Extra pens/pencils

Before the first session of the day, please set the focus room up as follows:

1. Put a few handfuls of each type of candy (1-10) in its correspondingly numbered paper bag.
2. Put these paper bags in numerical order from right to left on a table.
3. Sit behind these bags, facing the door to the focus room
4. Make sure the contents of the bags are NOT VISIBLE from the opposite side of the table (so participants who enter the room and come up to you cannot see what is in the bags) – the opening of the bag should face you.
5. Have the additional materials – extra candy, the extra #4 bag, the stamper and ink, and the red pen – next to you. The stamper/ink and red pen can be on the table, but the other items should be HIDDEN FROM VIEW.

Set up diagram for focus room:



Experiment room:

- Put 1 “stamp sheet” on computer station with a pen/pencil

Before each new hour of the session:

- Put 1 new stamp sheet on each computer station with a pen/pencil
- Make sure bags the 10 bags of candy have a few handfuls of candy in them.

- Make sure extra supplies and the extra #4 bag are not visible.

During the study

Participants will think that your job is to sit in the focus room to stamp their sheets and watch them take 1 candy out of each bag. You will also be switching between the two different #4 bags, unbeknownst to the participants – for half of the participants, there will be an empty #4 bag, and for the other half, it will have candy in it.

These are the basic steps you will follow:

1. A participant will come into the room with a single piece of paper (their stamp sheet).
2. Tell the participant to show you the paper. It will have numbered areas to stamp.
 - a. Check that it has their WBL ID on the top. If it does not, ask them to write their ID number down.
3. Tell the participant to take a candy out of bag number 1. You can turn the bag towards them at this time so they can easily reach in and take the candy.
 - a. Be sure to turn the bag back towards you after so new participants cannot see inside.
4. Stamp the “1” spot on their paper. Tell them they can go back to their seats and to please close the door behind them.
5. A new participant will come in.
6. Tell the participant to show you their paper.
 - a. If it has no stamps (they are a new participant in the room), then repeat steps 3a – 4.
 - b. If it has 1+ stamps, continue.
7. If the participant has 1+ stamps, tell them to take a candy out of the next number bag. For example, if they have 1 – 5 stamped, they should take a candy out of bag #6.
8. Stamp the corresponding number spot (e.g., “6”) on their paper. Tell them they can go back to their seats and to please close the door behind them.

There is one additional piece to this set up that participants should not observe: switching between the two #4 bags (one that is empty and one that has candy).

- You will switch the bags every other participant who reaches in to #4. So, start with the bag full of candy. Once one participant reaches in to bag #4, switch to the empty bag after they leave. Switch back after someone experiences the empty bag.
- Don't worry about keeping track of participants' IDs – the forms and stamp sheet will help us with that.

When participants get to candy bag #4, one of two things will happen:

1. They are in the “full” condition, meaning they have candy. In this condition, bag #4 will be like all of the other bags.

2. They are in the “empty” condition, meaning they have an empty bag. In this condition, follow the following steps:
 - a. Turn the bag around to them, like you did with bags 1-3. Let them reach in to see it is empty.
 - b. Say exactly what is written on the script: we ran out of that one because we had the least of that candy, but we have everything else. If they want they can quit the study or if they want to continue, they need to return to their desk and do the survey for #4 by writing NA and then they can move on to candy #5.
 - c. Take their stamp sheet and instead of stamping #4, use the red marker to write a big X through the stamp area and the writing area underneath.

Potential questions from participants:

Empty condition: What should I write for the empty candy #4?

Just put N/A – we will tell the experimenters that we were out of this candy.

How many candies can I try?

You can try as many or as few as you want.

Anything that is asking about the procedure: Why must I eat them in order/eat only one/eat them before I fill out the form/eat them at my desk/etc? Why do I have to close the door/why are the bag openings hidden?

I don’t really know – I am an RA.

When can I leave / what do I do to stop?

They are free to leave the study whenever they wish. Since it is last, they can leave the whole session. They should close the survey window and bring the stamp sheet with them to the RA who signs them out and pays them. That RA (not you!) will collect the stamp sheet.

At the end of each hour:

- Check the candy levels for all bags and refill as needed.
- Keep #4 where it is so that we can resume alternating in the new hour.

3. Study 1b Measures

All measures are on 1 (not at all) to 11 (extremely) scales.

Motivation

How much did you feel motivated to continue playing?

How much did your past behavior push you to continue?

How much did you feel like you were 'on a roll'?

Negative Emotions

How angry did you feel?

How upset did you feel?

How happy did you feel? (Reverse coded)

How disappointed did you feel?

How annoyed did you feel?

How excited did you feel? (Reverse coded)

Automaticity and Perceived Momentum

How much did you think about the "**momentum**" you had in playing?

How automatic was your decision about whether to continue playing?

How much did you carefully consider your decision about whether to continue playing?
(Reverse coded)

How much did your decision to continue feel effortless?

How much did you feel that your playing was self-sustaining?

Consistency

How much did you think about consistency in your playing behavior?

How much did you think about **streaks** you may have on your game tracker?

4. Supplemental Study 2: Endogenous Streaks Study

This study examines if the effects of broken streaks generalize to when consumers elect to break their own streaks.

Methods

One hundred thirty-five participants (M age = 20.44, SD = 4.51, 68.89% female) were recruited to participate in this study as part of a fifty-minute session for \$10. This session was held in a behavioral lab at a private northeastern university; most participants were undergraduates, but the lab is open to the public.

As in study 1b, participants were told that they would be testing a gaming app. They read detailed instructions and answered comprehension checks about the games they might play and the game tracker they would see on their screen, which would track the number of games they attempted. Participants in this study could choose whether they wanted to begin with word jumble games (in which they had to unscramble a series of letters into a word) or math games (in which they had to find the two numbers in a matrix which summed to 200).

Then, all participants played three games in a row of their chosen type, thus establishing a streak. Participants were then able to choose what type of game to play for game #4: a math game or a word game. This choice led participants to either maintain their streak or break their streak of their chosen game type, which is analogous to the manipulated *intact streak* and *broken streak* conditions in study 1b, but without exogenously forcing participants to experience a broken streak. One hundred six participants (78.53%) chose the same type of game, thus maintaining their streak, while 29 participants (21.47%) chose the other type of game, thus breaking their streak.

After playing game #4, participants chose what type of game (word or math) they wanted to play for game #5. This choice – whether participants chose the same type of game in which they had a streak, or a different type of game – was our main dependent variable.

Regardless of their choice, participants then answered a series of questions about their experience. Because of the endogenous nature of participants' streaks in this study, these questions were largely exploratory. The questions included five items about their motivation ($\alpha = 0.95$), five items about their sense of achievement ($\alpha = 0.97$), and four items about the negative emotions that they felt ($\alpha = 0.96$). Participants also answered a 9-item scale regarding their preference for consistency (as developed by Cialdini, Trost, and Newsom 1995; $\alpha = 0.88$) and a free response question about why they made the choice that they did after game #4. Lastly, participants answered basic demographic questions. The pre-registration for these methods can be found at:

<http://aspredicted.org/blind.php?x=qk27gq>.

Results

Future behavior. A chi-square analysis revealed that significantly fewer participants with a broken streak (27.59%) chose the same type of game that they started with, compared to participants who had an intact streak (97.17%; $X^2 (df = 1) = 75.43, p < .001$).

Discussion

This study finds that broken streaks lead consumers to be less likely to continue with the same behavior, even when the cause of the broken streak is endogenous. While allowing participants to choose their own behaviors prevents us from making causal

claims from the results of this study, it does allow us to generalize our replicated findings in other controlled studies to real-world contexts in which consumers often do break their own streaks.

5. Study 3 Number Sum Game Example

Sums attempted: 2

✓ ✓

Find the two numbers in the boxes below that sum to 200:

18	80	135
10	99	140
128	72	191

Solution

go

Show Hint

(Answer: 128 and 72)

6. Study 3 Instruction Comprehension Questions

To check your understanding of how the game app works, please answer if the statements are true or false.

Below is an example game tracker:

Jumbles attempted: 1

[*Intact streak* condition]

Games attempted: 1



[*Broken streak* condition]

Sums attempted: 1 Jumbles attempted: 1



or



[*No streak information* condition – N/A]

Broken and Intact Streak conditions only:

- Only JUMBLES [SUMS] (and not SUMS [JUMBLES]) count towards your game tracker.
- If you answer a jumble [sum] incorrectly, it still is added to your game tracker.

All conditions:

- You can play as many games as you would like.
- If we run out of jumbles [sums], you may play a sum [jumble].

7. Study 3 Results: Motivation and Sense of Achievement Sub-scales

Motivation. A one-way ANOVA revealed a significant effect of condition ($F(2, 449) = 4.42, p = .013$), such that participants in the *broken streak* condition felt less motivated ($M = 7.41, SD = 2.68$) than participants in the *intact streak* condition ($M = 8.24, SD = 2.34; t(306) = 2.89, p = .004$) and in the *no streak information* condition ($M = 7.94, SD = 2.43; t(301) = 1.82, p = .070$). Participants in the *intact streak* condition felt directionally more motivated than participants in the *no streak information* condition ($t(291) = 1.06, p = .29$).

Sense of achievement. A one-way ANOVA revealed a significant effect of condition ($F(2, 449) = 15.39, p < .001$), such that participants in the *broken streak* condition felt a lower sense of achievement ($M = 7.50, SD = 2.50$) than participants in the *intact streak* condition ($M = 8.80, SD = 1.89; t(306) = 5.14, p < .001$) and in the *no streak information* condition ($M = 8.48, SD = 1.99; t(301) = 3.75, p < .001$). Participants in the *intact streak* condition felt a directionally greater sense of achievement than participants in the *no streak information* condition ($t(291) = 1.43, p = .153$).

Mediation analysis. We conducted mediation analyses using a bootstrap procedure with 10,000 samples (Hayes et al. 2011) to test the process by which a broken streak affects future behavior. We predicted that people with a broken streak would feel less motivated to continue the behavior, thus decreasing their likelihood of doing that behavior. We found that motivation mediated the negative relationship between breaking a streak and continuing the behavior, relative to having an intact streak (Indirect effect = -0.36, SE = .14, 95% CI = [-.66, -.10]), but not relative to having no streak information (Indirect effect = -0.30, SE = .17, 95% CI = [-.64, .02]).

We also examined the role that sense of achievement plays in the effect of a broken streak on future behavior. We found that sense of achievement mediated the effect (*broken streak vs. intact streak*: Indirect effect = $-.40$, SE = $.12$, 95% CI = $[-.67, -.21]$; *broken streak vs. no streak information*: Indirect effect = $-.35$, SE = $.11$, 95% CI = $[-.59, -.16]$).

8. Supplemental Study 3: Additional Framing Streaks Study Replication

This study replicates the findings of study 3 using a slightly different methodology. All participants played the same sequence of word games, but they were categorized differently within the game tracker to manipulate the presence of a streak. Participants in the *intact streak* condition have a four-game streak of playing four word games while participants in the *broken streak* condition have a three-game streak of playing one sub-category of word games (either ‘animals’ or ‘food’), which was broken by playing a different category of word games (‘flowers’).

Methods

Eight hundred participants were recruited from Amazon Mechanical Turk to try out a word game app and answer questions about their experience. Only 459 participants (M age = 38.40, SD = 12.39, 55.56% female, 0.44% other/did not say) reached our manipulation (as described below) and were included in our study. Regardless of completion level, all participants were paid \$0.50 for participating in the study. Our target sample size was 450 participants. This study was preregistered, and additional details about these exclusion criteria and our planned analyses can be found at:

<http://aspredicted.org/blind.php?x=ua7wu9>.

All participants read about the same word game app as in study 1b: they were instructed to unscramble sets of letters to form words in an app-like interface, and were told that they could complete as many or as few jumbles as they wanted. However, like in study 3, there was no mention of a potential quota in the instructions. In addition, participants were asked to choose which category of jumbles they wanted to play: food or

animals. Participants answered comprehension checks about these categories and other aspects of the game instructions before proceeding to the game.

Then, participants attempted to unscramble three different jumbles within the category they chose. When participants reached Jumble #4, we informed them that we had run out of jumbles for their chosen category (food or animals), and they would instead be unscrambling a jumble from a brand new category (flowers).

As in Study 3, participants were randomly assigned to one of three streak-framing conditions (*intact streak*, *broken streak*, *no streak information*). In the *intact streak* condition, participants were informed in the instruction phase that all game categories would count in their game tracker. Therefore, even though Jumble #4 was from a different category, it was added to their tracker and thus kept their streak going. In the *broken streak* condition, participants were told that only the game category that they selected at the beginning (food or animals) would count in their game tracker. As a result, Jumble #4, which was in a different category, was not added to their tracker and thus broke their streak. In the *no streak information* condition, there was no game tracker, but participants were simply told how many jumbles they had attempted thus far throughout the game experience at the top of the interface. The inclusion of this “game counter” thus controlled for information about the number of jumbles they had seen across conditions.

As in studies 1b and 3, our key dependent measure was participants’ decision to stop or continue playing after Jumble #4 (i.e., whether they chose to play Jumble #5 or not). Regardless of their decision, we informed all participants on the next page that they had completed all available jumbles and asked them to complete some questions about how they felt right after playing their most recent jumble. Participants answered five

items about their motivation, including two items similar to those asked in previous studies (“How much did you feel motivated to continue playing?” and “How much did your past playing push you to continue?”) and three additional items (“How determined were you to play another jumble?”; “How much did you feel driven to continue playing?”; and “How much did you feel compelled to play more jumbles?”; 1 (not at all) to 11 (extremely); $\alpha = 0.94$). Participants also answered five items about their feelings of self-efficacy (“How successful did you feel?”; “How effective did you feel?”; “How proud did you feel?”; “How much did you feel that you accomplished something?”; and “How much did you feel like you had achieved something?”; 1 (not at all) to 11 (extremely); $\alpha = 0.94$). While measuring separate goal characteristics, these two subscales were closely correlated ($r = .62$) and their items loaded on the same factor in a factor analysis. Thus, we combined them into a single measure of motivation ($\alpha = 0.94$) for our analyses, but report the results for each sub-scale separately in the Appendix. Similar to studies 1b and 3, participants also answered four questions about the negative emotions that they felt (angry, upset, disappointed, annoyed; 1 (not at all) to 11 (extremely); $\alpha = 0.95$). Participants also answered a free response question about why they made the choice that they did after Jumble #4.

Finally, participants answered four exploratory measures about participants’ overall attitude towards the games (as described in our preregistration) and one question regarding how often they used any gaming apps. In addition, participants answered a manipulation check question measuring the impact of the presence of the game tracker in the *intact streak* and *broken streak* conditions compared to the absence of the game tracker in the *no streak information* condition (“How much were you aware of your

streak of attempting the jumbles?"; 1 (not at all), 11 (extremely)). Participants also answered basic demographic questions.

Results

Manipulation check. A one-way ANOVA revealed a significant effect of condition ($F(2, 456) = 9.55, p < .001$). Independent t-tests showed that participants in the *broken streak* condition ($M = 8.66, SD = 2.26$) and the *intact streak* condition ($M = 9.16, SD = 2.05$) were more aware of their streaks than participants in the *no streak information* condition ($M = 7.87, SD = 3.18; ts > 2.45, ps < .020$). Participants in the *broken streak* condition were marginally less aware of their streaks than participants in the *intact streak* condition ($t(310) = 1.95, p = .052$).

Future behavior. A binary logit revealed a significant effect of condition ($X^2 (df = 2) = 28.48, p < .001$; see figure S1). Fewer participants in the *broken streak* condition chose to continue playing (61.59%) compared to participants in the *intact streak* condition (83.85%; $b = 1.18, SE = .27, X^2 (df = 1) = 18.69, p < .001$) and participants in the *no streak information* condition (85.03%; $b = 1.27, SE = .29, X^2 (df = 1) = 19.65, p < .001$). There was no difference in frequency of participants choosing to continue between the *intact streak* and *no streak information* conditions ($b = 0.09, SE = .32, X^2 (df = 1) = 0.08, p = .78$).

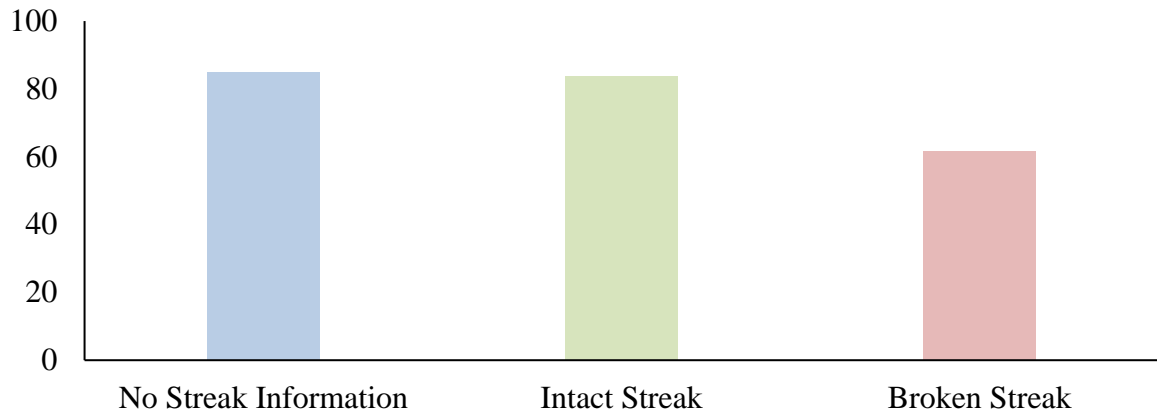


Figure S1. Percent of participants choosing to continue playing a game (versus stop), as a function of streak framing.

Motivation. A one-way ANOVA revealed a significant effect of condition ($F(2, 456) = 9.56, p < .001$), such that participants in the *broken streak* condition felt less motivated to continue the behavior ($M = 7.48, SD = 2.24$) than participants in the *intact streak* condition ($M = 8.46, SD = 1.84; t(310) = 4.25, p < .001$) and in the *no streak information* condition ($M = 8.10, SD = 1.92; t(296) = 2.56, p = .011$). Participants in the *intact streak* condition felt marginally more motivated than participants in the *no streak information* condition ($t(306) = 1.70, p = .090$).

Negative emotions. A one-way ANOVA revealed a significant effect of condition ($F(2, 456) = 40.33, p < .001$). Participants in the *broken streak* condition felt more negatively ($M = 3.51, SD = 2.75$) than participants in the *intact streak* condition ($M = 1.49, SD = 1.36; t(310) = 8.30, p < .001$) and in the *no streak information* condition ($M = 1.98, SD = 1.84; t(296) = 5.60, p < .001$). Participants in the *intact streak* condition felt less negatively than participants in the *no streak information* condition ($t(306) = 2.70, p = .007$).

Mediation analysis. We conducted mediation analyses using a bootstrap procedure with 10,000 samples (Hayes et al. 2011) to test the process by which a broken streak affects future behavior. We predicted that people with a broken streak would feel less motivated to continue the behavior, thus decreasing their likelihood of doing that behavior. The mediation models (SAS PROCESS Macro, Model 4) included motivation as the mediator variable and continuation of the behavior as the dependent variable. We ran two models with these variables using different independent variables: one comparing a broken streak (1) to an intact streak (0) and another comparing a broken streak (1) to no streak information (0). As predicted, we found that motivation mediated the negative relationship between breaking a streak and continuing the behavior, relative to both having an intact streak (Indirect effect = -0.26, SE = .09, 95% CI = [-.47, -.12]) and having no streak information (Indirect effect = -0.19, SE = .08, 95% CI = [-.39, -.05]).

We also conducted four additional models examining how negative emotions mediated the effect of a broken streak (versus an intact streak and versus no streak information) on continuing the behavior. Negative emotions failed to mediate either relationship, as both 95% confidence intervals for the indirect effects contained zero (*broken streak vs. intact streak*: Indirect effect = -0.20, SE = .12, 95% CI = [-.44, .03]; *broken streak vs. no streak information*: Indirect effect = -0.10, SE = .09, 95% CI = [-.27, .07]). In competing mediation models with motivation and negative emotions as the mediators, we found that motivation mediated the effects of a broken streak on future behavior (vs. *intact streak*: Indirect effect = -.46, SE = .09, 95% CI = [-.46, -.12]; vs. *no streak information*: Indirect effect = -.19, SE = .08, 95% CI = [-.38, -.05]). However, negative emotions did not mediate the effect (vs. *intact streak*: Indirect effect = -.16, SE

= .12, 95% CI = [-.41, .08]; vs. *no streak information*: Indirect effect = -.06, SE = .10, 95% CI = [-.25, .13]).

Discussion

In this study, we replicated the effect that broken streaks decrease real repeated behavior. As in study 3, simply categorizing the same sequence of behavior as an intact or broken streak can have profound effect on consumers' decisions. Additionally, we replicated supporting evidence of the proposed "streaks as goals" hypothesis through our measure of motivation, which mediated the effect of streak on future behavior.

9. Supplemental Study 4: Framing Streaks Study Replication with a Choice Between Games

Much like study 3 and supplemental study 3, this study examines the effect of categorizing the same sequence of behavior as intact or broken streaks (or without emphasizing streaks at all) on future behavior. However, we explore these effects on a different dependent variable: the choice between two behaviors.

Methods

Six hundred one participants were recruited from Amazon Mechanical Turk (M age = 37.61, SE = 11.80, 51.08% female, 0.50% other/did not say) to try out a word game app and answer questions about their experience. All participants were paid \$0.60 for participating in the study. Our target sample size was 600 participants, and we did not exclude any participants. This study was preregistered, and additional details about these exclusion criteria and our planned analyses can be found at:

<http://aspredicted.org/blind.php?x=56nq7j>.

All participants read about the same game app as in study 3, where they would be able to play a series of word games or number games. In addition to reading about the word jumble game, as in studies 1b and 3, participants also read that they could play a different type of word game: a word search, where they would have to find a type of animal within a matrix of letters. All participants were told that they would start by playing word games and answered comprehension checks about these game types, their game tracker (if applicable), and other aspects of the game instructions before proceeding to the game.

Then, participants attempted to unscramble three different jumbles. When participants reached game #4, we informed them that we had run out of word jumbles, and they would instead be playing a word search.

As in study 3, participants were randomly assigned to one of three streak-framing conditions (*intact streak*, *broken streak*, *no streak information*). In the *intact streak* condition, participants were informed in the instruction phase that all word games (i.e., both jumbles and word searches) would count in their game tracker. Therefore, even though game #4 a word search, it was added to their tracker and thus kept their streak going. In the *broken streak* condition, participants were told that only jumbles would count in their game tracker. As a result, game #4, which was a word search, was not added to their tracker and thus broke their streak. In the *no streak information* condition, participants played the same sequence of games (i.e., three jumbles and then a word search), but there was no game tracker.

Unlike in studies 1b and 3, our key dependent measure was participants' decision to switch to playing math games or continue playing word games after game #4. Regardless of their decision, we asked all participants to complete some questions their experience. Participants answered the same items about their motivation to continue ($\alpha = 0.95$) and sense of achievement ($\alpha = 0.95$) as in study 3. These sub-scales were highly correlated ($r = .84$) and the items loaded on the same factor, and so we combined them into a single measure of motivation. Similar to studies 1b and 3, participants also answered four questions about the negative emotions that they felt ($\alpha = 0.96$). Participants also answered a free response question about why they made the choice that they did after game #4.

Finally, participants answered four exploratory measures about participants' overall attitude towards the games, a six-item maximizer scale (Nenkov et al. 2008), and one question about their preference for word versus math games (as described in our preregistration). In addition, participants answered a manipulation check question measuring the impact of the presence of the game tracker in the *intact streak* and *broken streak* conditions compared to the absence of the game tracker in the *no streak information* condition ("How much were you aware of your streak of attempting the games?"; 1 (not at all), 11 (extremely)). Participants also answered basic demographic questions.

Results

Manipulation check. A one-way ANOVA revealed a significant effect of condition ($F(2, 598) = 38.98, p < .001$). Independent t-tests showed that participants in the *broken streak* condition ($M = 8.48, SD = 2.69$) and the *intact streak* condition ($M = 9.11, SD = 2.21$) were more aware of their streaks than participants in the *no streak information* condition ($M = 7.87, SD = 3.18; ts > 5.80, ps < .001$). Participants in the *broken streak* condition were less aware of their streaks than participants in the *intact streak* condition ($t(402) = 2.57, p = .011$).

Future behavior. A chi-square analysis revealed a significant effect of condition ($X^2(df = 2) = 12.33, p = .002$; see figure S2). Separate chi-square analyses revealed that fewer participants in the *broken streak* condition chose to continue playing word games (63.11%) compared to participants in the *intact streak* condition (77.27%; $X^2(df = 1) = 9.66, p = .002$). Participants in the *intact streak* condition were also more likely to continue playing word games than participants in the *no streak information* condition

(62.94%; X^2 (df = 1) = 9.68, $p = .002$). There was no difference in frequency of participants choosing to continue word games between the *broken streak* and *no streak information* conditions (X^2 (df = 1) < .01, $p = .97$).

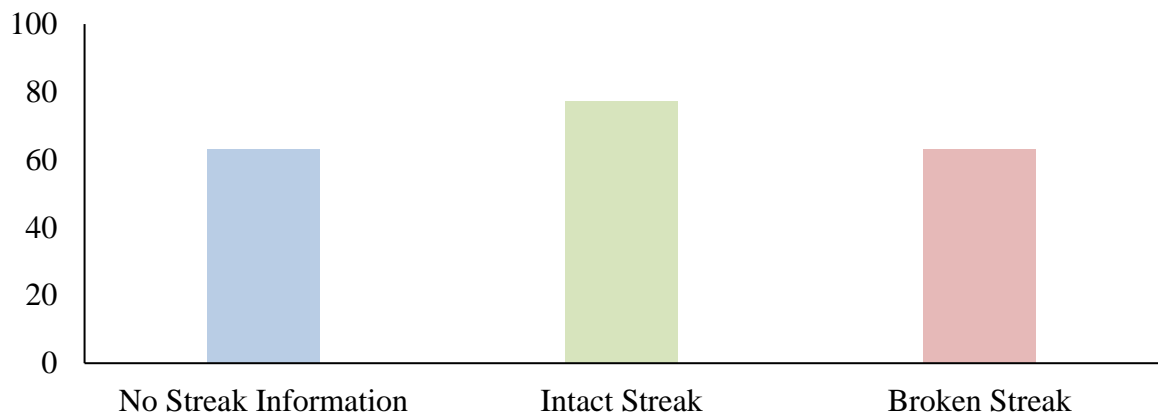


Figure S2. Percent of participants choosing to continue playing word games (versus switch to math games), as a function of streak framing.

Motivation. A one-way ANOVA revealed a significant effect of condition ($F(2, 598) = 22.31, p < .001$), such that participants in the *broken streak* condition felt less motivated to continue the behavior ($M = 6.88, SD = 2.38$) than participants in the *intact streak* condition ($M = 8.34, SD = 2.07; t(402) = 6.54, p < .001$) and in the *no streak information* condition ($M = 7.95, SD = 2.34; t(401) = 4.52, p < .001$). Participants in the *intact streak* condition felt marginally more motivated than participants in the *no streak information* condition ($t(393) = 1.75, p = .080$).

Negative emotions. A one-way ANOVA revealed a significant effect of condition ($F(2, 598) = 78.95, p < .001$). Participants in the *broken streak* condition felt more negatively ($M = 4.28, SD = 3.07$) than participants in the *intact streak* condition ($M =$

1.88, $SD = 1.88$; $t(402) = 9.42$, $p < .001$) and in the *no streak information* condition ($M = 1.71$, $SD = 1.66$; $t(401) = 10.38$, $p < .001$). There was no difference between the *intact streak* and *no streak information* conditions ($t(393) = 0.96$, $p = .34$).

Mediation analysis. We conducted mediation analyses using a bootstrap procedure with 10,000 samples (Hayes et al. 2011) to test the process by which a broken streak (versus an intact streak) affects future behavior. The mediation model (SAS PROCESS Macro, Model 4) included streak condition (broken streak = 1, intact streak = 0) as the independent variable, motivation as the mediator variable, and continuation of the behavior as the dependent variable. We found that motivation mediated the negative relationship between a broken vs. intact streak and continuing the behavior (Indirect effect = -0.22 , $SE = .08$, 95% $CI = [-.41, -.08]$). An additional mediation model found that the mediating effect of motivation on the relationship between a broken streak and future behavior remained significant (Indirect effect = $-.21$, $SE = .08$, 95% $CI = [-.39, -.07]$) when including negative emotions as a competing mediator (Indirect effect: $.08$, $SE = .11$, 95% $CI = [-.28, .15]$). Lastly, a serial mediation model examining the same independent and dependent variables, with sense of achievement as the first mediator and motivation to continue as the second mediator, found a significant indirect effect along the serial mediation path (Indirect effect: $-.28$, $SE = .07$, 95% $CI = [-.45, -.16]$).

Discussion

In this study, we again replicated the effect that broken streaks decrease real repeated behavior relative to intact streaks. We find this effect extends to when consumers are choosing between two behaviors (i.e., continuing with word games or switching to math games) rather than just when consumers decide between continuing or

stopping one behavior (as in study 1b and 3). Unlike in study 3, we find that the baseline *no streak information* condition falls closer to the *broken streak* condition in this study, rather than close to the *intact streak* condition. This suggests that a specific context can affect how consumers may intuit their own streakiness, or lack thereof, thus shifting the direction of the effect of highlighting past behavior. Lastly, this study replicates mediational evidence of the proposed “streaks as goals” hypothesis.

10. Supplemental Study 5: Perceived Streakiness Study

Thus far, we have demonstrated that breaking a streak leads people to stop doing a behavior. But what patterns of behavior do consumers count as a streak? Past work has shown that consumers perceive a streak to exist once there are at least three occurrences in a row, and that streaks of four, five, and six are perceived as just as streaky as a streak of three (Carlson and Shu 2007). In this study, we explore consumers’ perceptions of streakiness for a wide variety of patterns of behavior to 1) replicate the prior findings on sequences of event outcomes for sequences of behaviors, 2) better understand how perceptions of streakiness change with length, and 3) ascertain what specific patterns count as streaks.

Methods

One hundred sixty-seven participants (M age = 19.98, SD = 1.61, 61.08% female) were recruited to participate in this study as part of a fifty-minute session for \$10. This session was held in a behavioral lab at a private northeastern university; most participants were undergraduates, but the lab is open to the public.

Participants first read some information about an app that helps users learn a new language by providing interactive lessons of progressing difficulty in reading, writing,

and speaking a selected language (similar to the Duolingo app). Participants saw sample images of the information provided on the app and read a few sentences about its purposes and features. In particular, participants were told that the app tracks and shows them which days they log on and complete lessons.

Then, participants were told to imagine that they had been using the app regularly for the past few months and had advanced through multiple lessons in the language they wanted to learn. Consequently, they saw many different patterns of use through the tracking feature of the app. Participants were told they would see several of these patterns, and to imagine that the last day of each one was yesterday.

Participants then saw ten randomly-selected patterns out of twenty-five patterns and rated how much they felt like they had a streak on a 1 (not at all) to 7 (very much) scale. These patterns included a wide variety of streak lengths (one, two, three, four, five, ten, and twenty in a row). They also featured different types of patterns: non-streaks (e.g., one day), intact streaks (i.e., with no misses), recently broken streaks, intact streaks with a miss on Day 1, and broken streaks with a miss on Day 1. All 25 patterns are outlined in Table S1. Lastly, participants answered basic demographic questions.

Results

Length of pattern. Paired t-tests reveal that, consistent with previous work (Carlson and Shu 2007), participants view three days in a row as more streaky ($M = 5.40$, $SD = .20$) than one day ($M = 2.60$, $SD = .21$; $t(131) = 9.67$, $p < .001$) or two days in a row ($M = 4.01$, $SD = .22$; $t(133) = 4.63$). Four days in a row was perceived as more streaky ($M = 5.99$, $SD = .16$) than three days in a row ($t(133) = 2.31$, $p = .022$), but after four days in a row, perceived streakiness plateaus to some extent. Specifically, there was no

significant difference between four and five days in a row ($M_{five} = 6.21$, $SD = .14$; $t(132) = 1.06$, $p = .29$), or ten ($M = 6.78$, $SD = .07$) and twenty days in a row ($M = 6.93$, $SD = .05$; $t(135) = 1.72$, $p = .088$). However, ten days in a row was significantly more streaky than five in a row ($t(134) = 3.71$, $p < .001$). Figure S3 shows the perceived streakiness of all patterns in the study.

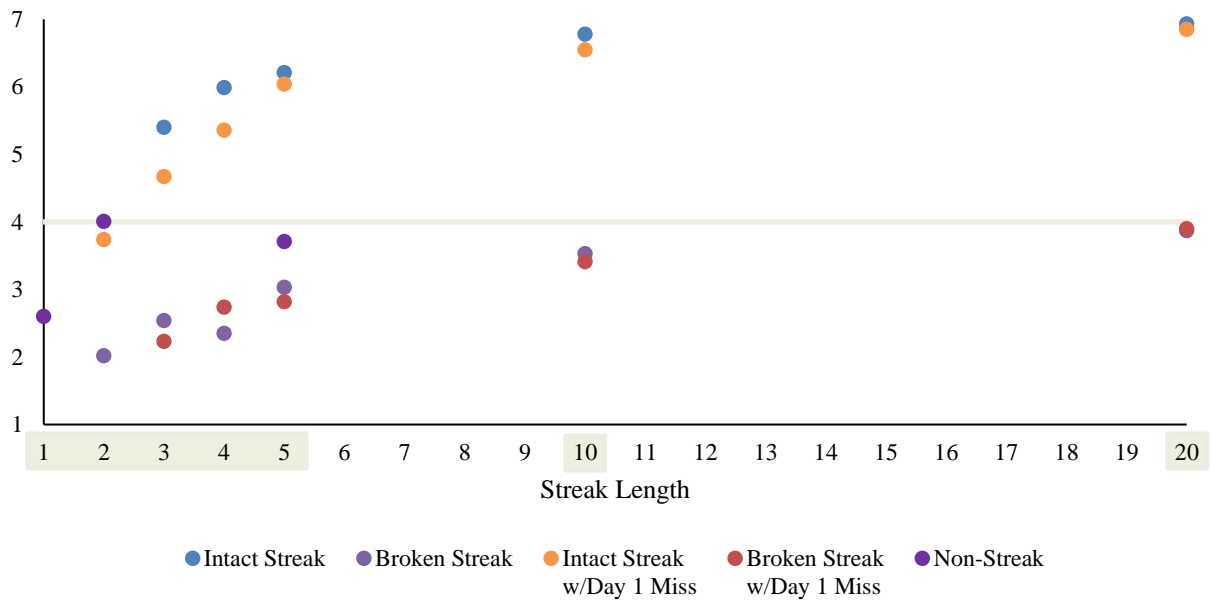


Figure S3. Perceived streakiness of patterns of behavior, as a function of streak length and type of pattern. Participants only judged streaks for the highlighted lengths (1, 2, 3, 4, 5, 10, and 20). The grey line indicates the midpoint of the scale (4).

Types of pattern. Independent t-tests revealed that all intact streaks (either with a Day 1 Miss or no misses) of three or more in a row were significantly higher than the midpoint of the scale (4), suggesting they all were perceived as streaky ($t_s > 3.40$, $p_s < .001$). All other patterns (i.e., non-streaks, broken streaks, and broken streaks with a Day

1 Miss) were not significantly different from or were significantly lower than the midpoint of the scale, suggesting that they were not perceived as streaky.

Discussion

Consistent with prior work, people perceive a sequence of behaviors to be streaky once there are at least three occurrences in a row. This is true for intact streaks without the presence of a miss and when the pattern starts with a miss. Notably, all intact streaks of at least three in a row are described as streaky. Further, while perceived streakiness directionally increases with an increase in streak length, it generally levels off after five behaviors in a row.

		Number of Checkmarks (i.e. streak length)						
		One	Two	Three	Four	Five	Ten	Twenty
Type of pattern	Non-streak	✓	✓✓		✓✓X✓✓			
	Intact Streak			✓✓✓	✓✓✓✓	✓✓✓✓✓	✓✓✓✓✓✓✓✓✓✓	✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓
	Broken Streak		✓✓X	✓✓✓X	✓✓✓✓X	✓✓✓✓✓X	✓✓✓✓✓✓✓✓✓✓X	✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓X
	Streak w/ Day 1 Miss		X✓✓	X✓✓✓✓	X✓✓✓✓	X✓✓✓✓✓	X✓✓✓✓✓✓✓✓✓✓	X✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓
	Broken Streak w/ Day 1 Miss			X✓✓✓X	X✓✓✓✓X	X✓✓✓✓✓X	X✓✓✓✓✓✓✓✓✓✓X	X✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓✓X

Table S1. Patterns of past behavior presented to participants in study S3.

11. Study 4 Instruction Comprehension Questions

The following questions are to make sure you understand how the game app works. Please answer if the statements are true or false.

Below is an example game tracker:

Games attempted: 1



- If you answer a jumble incorrectly, it still is added to your game tracker.
- If you see a message about reaching a quota of players for a given game, it means you or the app have messed up in some way.
- You can play as many games as you would like.

12. Study 4 Results: Motivation and Sense of Achievement Sub-scales

Motivation. A two-way ANOVA with number of games played, prior game, and their interaction as predictors revealed neither a main effect of *prior game* condition ($F(1, 483) = 1.89, p = .170$) nor a main effect of *number of games* condition ($F(1, 483) = 0.03, p = .86$). However, there was a significant interaction between these two factors ($F(1, 483) = 7.23, p = .007$). Independent t-tests revealed that within the *three game* condition, participants with a recent miss were less motivated ($M = 7.88, SD = 2.21$) than participants with no miss ($M = 8.54, SD = 2.02; t(216) = 2.27, p = .024$). However, no difference existed for participants in the *one game* condition ($M_{recent\ miss} = 8.39, SD = 2.13$ vs. $M_{no\ miss} = 7.99, SD = 2.52; t(267) = 1.42, p = .158$).

Sense of achievement. A two-way ANOVA with number of games played, prior game, and their interaction as predictors revealed a significant effect of *prior game* condition ($F(1, 483) = 8.55, p = .004$), such that participants with a recent miss felt a lower sense of achievement ($M = 7.94, SD = 2.41$) than participants with no miss ($M = 8.52, SD = 2.26$). There was no main effect of number of games ($F(1, 483) = 1.67, p = .197$). Despite the interaction between the two factors being not significant ($F(1, 483) = 1.65, p = .199$), independent t-tests revealed effects in the expected directions. Within the *three game* condition, participants with a recent miss felt less of a sense of achievement ($M = 7.94, SD = 2.26$) than participants with no miss ($M = 8.83, SD = 2.05; t(216) = 3.06, p = .003$). However, no difference existed for participants in the *one game* condition ($M_{recent\ miss} = 7.94, SD = 2.54$ vs. $M_{no\ miss} = 8.28, SD = 2.39; t(267) = 1.16, p = .248$).

Mediation analysis. We conducted mediation analyses using a bootstrap procedure with 10,000 samples (Hayes et al. 2011) to examine the role motivation played in the observed



effects of the presence of a streak and recent miss on future behavior. The mediation model (SAS PROCESS Macro, Model 7) included prior game (*recent miss* condition = 1, *no miss* condition = 0) as the independent variable, motivation as the mediator variable, number of games played (*three game* condition = 1, *one game* condition = 0) as the moderator, and continuation of the behavior as the dependent variable. Consistent with our hypotheses, we found that motivation mediated the negative relationship between a recent miss and continuing the behavior only when the person had a streak (i.e., in the *three game* condition: Indirect effect = $-.34$, SE = $.16$, 95% CI = $[-.70, -.05]$ vs. *one game* condition: Indirect effect = $.21$, SE = $.16$, 95% CI = $[-.07, .56]$).

We also examined the role that sense of achievement plays in the effect of a broken streak on future behavior. We found that sense of achievement mediated the effect in the *three game* condition (Indirect effect = $-.26$, SE = $.10$, 95% CI = $[-.49, -.10]$) but not the *one game* condition (Indirect effect = $-.10$, SE = $.09$, 95% CI = $[-.29, .08]$).

11. Study 5 Instruction Comprehension Questions

The following questions are to make sure you understand how the game works. Please answer if the statements are true or false.

Below is an example game tracker:

Sums attempted: 1		Jumbles attempted: 1
	OR	

- If you answer a [sum/jumble] incorrectly, it still is added to your game tracker.
- If you answer a [jumble from the word jumble/sum from the number sums] game, it will be added to your tracker.
- If you see a message about reaching a quota of players for a given game, it means you or the app have messed up in some way.
- Your first games will be from the [numbers sums/word jumble] game, but you may also play games from the [word jumble/number sums] game.
- You will play five games in this study.

12. Study 5 Results: Motivation and Sense of Achievement Sub-scales

Motivation. A one-way ANOVA revealed a significant effect of condition ($F(2, 598) = 19.47, p < .001$), such that that participants in the *broken streak* condition felt less motivated ($M = 6.94, SD = 3.04$) than participants in the *intact streak* condition ($M = 8.40, SD = 2.20; t(403) = 5.53, p < .001$) and in the *repairable streak* condition ($M = 8.25, SD = 2.43; t(395) = 4.75, p < .001$). Participants in the *repairable streak* condition and the *intact streak* condition felt similarly motivated ($t(398) = 0.62, p = .54$).

Sense of achievement. A one-way ANOVA revealed a significant effect of condition ($F(2, 598) = 10.92, p < .001$), such that that participants in the *broken streak* condition felt a lower sense of achievement ($M = 7.72, SD = 2.22$) than participants in the *intact streak* condition ($M = 8.68, SD = 2.01; t(403) = 4.57, p < .001$). However, participants in the *broken streak* condition felt a directionally lower sense of achievement than participants in the *repairable streak* conditions ($M = 7.97, SD = 2.22; t(395) = 1.11, p = .267$). Participants in the *repairable streak* condition also felt lower sense of achievement than participants in the *intact streak* condition ($t(398) = 3.38, p < .001$).

Mediation Analyses. We conducted mediation analyses using a bootstrap procedure with 10,000 samples (Hayes et al. 2011) to test the process by which a broken streak (without the ability to make up the miss) versus an intact streak affects future behavior. We found that motivation mediated the negative relationship between breaking a streak and switching behavior (*Indirect effect* = .42, SE = .11, 95% CI = [.25, .67]), but sense of achievement did not (*Indirect effect* = .04, SE = .06, 95% CI = [-.08, .17]). We also ran a serial mediation model, which tested the effect of a broken streak compared to an intact streak (i.e., excluding the *repairable streak* condition) on future

behavior, with sense of achievement as the first mediator and motivation as the second.

We found that this multi-mediator path did mediate the relationship between breaking a streak and future behavior (Indirect effect: $-.33$, $SE = .09$, $95\% CI = [-.52, -.17]$).

APPENDIX B

HOT STREAK! CONSUMER INFERENCES AND PREDICTIONS ABOUT STICKING TO LONG-TERM GOALS

Contents

1. Study 1 Measures
2. Study 2 Additional Mediation Analyses
3. Study 3 Measures
4. Study 4a Measures
5. Study 4b Measures

1. Study 1 Measures

Predicted Likelihood [1: Extremely unlikely, 7: Extremely likely]

- How likely is it that this person will eat fruit today (on Day 7)?
- How likely is it that this person will eat ice cream today (on Day 7)?

Perceived Commitment [1: Not at all/Very little, 7: Extremely/A great deal]

- How committed is this person to eating healthy overall?
- How much does this person care about eating healthy?
- How important do you think eating healthy is to this person?
- How motivated is this person to eat healthy?

Exploratory Measures

Long-term ability to eat healthily

- Imagine that this person has a specific goal of losing 10 pounds by eating healthy.
How likely is it that this person will reach this specific goal? [1: Extremely unlikely, 7: Extremely likely]
- Imagine that this person has a specific goal of losing 10 pounds by eating healthy.
When will this person reach this specific goal? [1: In an extremely long time, 7: In an extremely short time]
- What percent of the time did this person eat healthy two months ago? [slider scale from 0% to 100%]

- What percent of the time will this person eat healthy two months from now?

[slider scale from 0% to 100%]

Process: automaticity of the decision [1: Not at all, 7: A great deal/Extremely]

- How much momentum does this person have in eating fruit?
- How 'on a roll' is this person in eating fruit?
- How automatic was this person's decision to eat fruit?
- How much did this person carefully consider the decision to eat fruit? (Reverse coded)

2. Study 2 Additional Mediation Analysis

We conducted a serial repeated measures mediation analysis using a bootstrap procedure with 10,000 samples to test the process by which an individual's recent pattern of behavior affects recommendations of a commitment device (Montoya and Hayes 2017). We predicted that an individual with a recent streak would be perceived as more committed to and thus more likely to do a goal-consistent behavior, which would in turn would decrease recommendations for a commitment device. Indeed, we found that an increase in perceived commitment (M_1) leading to a higher predicted likelihood of future goal-consistent behavior (M_2) mediated the effect of an individual's recent behavior on preferences for a commitment device (recent streak versus old streak: Indirect effect = -0.12, SE = .04, 95% CI = [-.21, -.06]; recent streak versus scattered: Indirect effect = -.10, SE = .04, 95% CI = [-.17, -.03]).

3. Study 3 Measures

Predicted Likelihood [1: Extremely unlikely, 7: Extremely likely]

- How likely is it that this person will eat fruit today?
- How likely is it that this person will eat ice cream today?

Perceived Commitment

- How committed is this person to eating healthy overall? [1: Not at all committed, 7: Extremely committed]

Exploratory Measures

- How often do you think that this person will eat fruit in the future? [1: Rarely, 7: Every day]
- Imagine that this person has a specific goal of losing 10 pounds by eating healthy. How likely is it that this person will reach this specific goal? [1: Extremely unlikely, 7: Extremely likely]
- Imagine that this person has a specific goal of losing 10 pounds by eating healthy. When will this person reach this specific goal? [1: In an extremely long time, 7: In an extremely short time]

4. Study 4a Measures

Predicted Likelihood [1: Extremely unlikely, 7: Extremely likely]

- How likely is it that this person will eat fruit/watch TV today?
- How likely is it that this person will eat ice cream/play video games today?

Perceived Commitment [1: Not at all/Very little, 7: Extremely/A great deal]

- How committed is this person to eating healthy/watching TV overall?
- How much does this person care about eating healthy/watching TV?
- How important do you think eating healthy/watching TV is to this person?
- How motivated is this person to eat healthy/watch TV?

Exploratory Measures

General Behaviors

- How often do you think that this person will eat healthy/watch TV in the future?

[1: Rarely, 7: Every day]

Negative Emotions [1: Not at all, 7: Extremely]

- How upset would this person be if they did not eat healthy/watch TV?
- How guilty would this person feel if they did not eat healthy/watch TV?

5. Study 4b Measures

Predicted Likelihood [1: Extremely unlikely, 7: Extremely likely]

- How likely is it that this person will eat fruit/work out/eat oatmeal/watch TV today (on Day 7)?
- How likely is it that this person will eat ice cream/watch TV/eat eggs/play video games today (on Day 7)?

Perceived Commitment [1: Not at all/Very little, 7: Extremely/A great deal]

- How committed is this person to eating healthy/working out/eating oatmeal/watching TV overall?
- How much does this person care about eating healthy/working out/eating oatmeal/watching TV?
- How important do you think eating healthy/staying in shape/eating oatmeal/watching TV is to this person?

Exploratory Measures

General Behaviors

- *Goal-Directed Behavior Condition:* When do you think this person started having the goal to eat healthy/work out regularly? [Before Day 1 / Day 1 / Day 2 / Day 3 / Day 4 / Day 5 / Day 6]

- *Neutral Condition:* When do you think this person starting considering eating oatmeal for breakfast/watching TV as an evening activity? [Before Day 1 / Day 1 / Day 2 / Day 3 / Day 4 / Day 5 / Day 6]
- How often do you think that this person will eat healthy/work out/eat oatmeal/watch TV in the future? [1: Rarely, 7: Every day]

Negative Emotions [1: Not at all, 7: Extremely]

- How upset would this person be if they did not eat healthy/go to the gym/eat oatmeal/watch TV?
- How guilty would this person feel if they did not eat healthy/go to the gym/eat oatmeal/watch TV?

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