



Should you always have a backup? One vs. two goals in games



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ABSTRACT

Goal setting theory has been studied and adopted in a wide variety of domains including game design. While goals can help people regulate and change behavior, they are less motivating when people no longer believe they can meet their goals. Previous literature suggests that having two goals—a primary goal and a backup goal—might help people continue striving even when the primary goal becomes unattainable. We evaluated this hypothesis and found no direct relationship between two goals and performance. However, people having two goals had higher self-appraisals of their performance than those with one goal. People in the two-goal condition also played more rounds or spent more time in games. However, a high percentage of people stopped playing after achieving their backup goal. These results have the potential to enhance game experiences and may extend to other domains, such as health behavior change.

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1. Introduction

Goal setting theory (Locke and Latham, 1994) has been widely adopted in various domains such as organizational performance (Meyer et al., 2004; Piccolo and Colquitt, 2006), education sciences (Schunk, 1996), and health behavior change (Eakin et al., 2007; Strecher et al., 1995). Difficult but achievable goals motivate people to work harder and achieve higher performance than easy goals (Locke and Latham, 1990). Specific goals generally lead to better task performance than abstract, do-your-best goals (Latham and Locke, 1991) or long-term goals (Nothwehr and Yang, 2007).

Many games include goals. Games that provide appropriate goals, offer ways to achieve these goals, and that communicate goal attainment provide better player experiences and increase the amount of time people play (Andersen et al., 2011). In a first-person-shooter game, for example, players found game experiences that facilitated goal attainment more engaging (Clarke and Duimering, 2006). In health education games, goals that are personal and close to real-world goals are easier to understand and to achieve (Thompson et al., 2008).

Researchers have suggested that setting and pursuing two goals, rather than one, may lead to a more engaging or satisfying experience, which in turn could lead to higher performance or longer-term engagement (Consolvo et al., 2008; Munson and Consolvo, 2012). Much like how many games allow users to select a difficulty level, users of these mobile applications to promote physical activity could set, and later select between, two goals with varying difficulty levels. Participants in these studies reported that having two goals helped their motivation.

While the prior results are encouraging, they do not measure the actual effects of having two goals on goal setting behavior or goal attainment. While it is possible that setting two goals helps people perform better overall, it is also possible that it just helps them feel better about the same level of performance, or even allows some people to be satisfied with achieving only the backup goal, and consequently actually perform less well.

To understand how two goal levels—a primary goal and a backup goal—affect people's behavior, we conducted two online experiments using casual games. We focus on short-term goals (e.g., points scored) for these primary and secondary goals, but people may pursue them alongside other goals, such as improving their mental health or having a positive social experience (Kultima, 2009). This resembles Munson and Consolvo's (2012) use of primary and secondary goals for short-term exercise plans, which people may also pursue alongside longer-term goals such as losing weight or being able to be more active with their kids.

We found that participants in the two-goal condition did not perform better, but perceived their performance as better. Depending on the game, they played more rounds or spent more time playing. However, a high percentage of people stopped playing after meeting their secondary (backup) goals rather than continuing to strive toward their primary goal. In at least these games, having two goals can increase player self-efficacy and motivate them to work harder, but some players are satisfied with achieving only their backup goal and quit earlier.

In the remainder of this paper, we review motivating background research on goal setting theory and the use of multiple goals in physical activity applications and game design. We then present two studies and

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results, followed by a discussion of their implications for design and future research.

2. Background

In this section, we review determinants for goal setting behavior and prior research concerning setting multiple goals, including the use of two goals in physical activity applications and current goal setting strategies used in game design.

2.1. Goal setting theory

The social cognitive theory of self-regulation (Bandura, 1991) and goal setting theory (Locke and Latham, 1990) describe determinants for both performance and appraisal of performance. Self-efficacy, the belief that one can attain his or her goal, enhances goal commitment. Higher goal commitment corresponds to greater goal striving, that is, effort toward the goal (Bandura and Cervone, 1983). Strategies that enhance self-efficacy can increase how motivated people are to commit to their goal and the performance toward their goal, while people with low self-efficacy for a task may abandon it (Bandura, 1997). Goal attainment is also positively related to satisfaction (Mento et al., 1992). People who achieve or exceed their goals are more satisfied than those who do not. Also, people who set higher goals often have higher expectations about satisfaction with achieving the goals and thus are more motivated to achieve higher goal.

While researchers have studied the effects of setting and attaining a single goal across a variety of domains, researchers have only recently started to explore the effect of having two goals rather than one.

2.2. Two goals in physical activity applications

Having two goal levels may enhance motivation. Users of *Ubi-Fit* (Consolvo et al., 2008), a mobile app supporting physical activity with goal setting and self-monitoring features, could select each week whether they would pursue a primary or backup goal, depending on their constraints. Participants reported that being able to choose the backup goal helped them stay motivated even in weeks when they would have been too busy to achieve the primary goal. Users of *Goal-Post* (Munson and Consolvo, 2012), a follow-on mobile app that also supported goal-setting and self-monitoring for physical activity, could simultaneously pursue both a primary goal and a secondary goal. Participants reported that having a primary and secondary goal encouraged them to set higher goals, pushed them to try harder, and helped them to stay motivated in challenging weeks.

2.3. Multiple goals in game design

Previous research has explored offering multiple types of goals in game design, with the different goals intended to appeal to different player motivations. Yee categorized three major motivation components in massively-multiplayer online role-playing games: achievement, social, and immersion (Yee, 2006). Different players resonate with each of these motivations to varying degrees, and player engagement with a game will correspond to how well the game satisfies their motivations (Hoffman and Nadelson, 2010). Thus, a game may offer a portfolio of goals, with the intent of appealing to multiple player types (Yee, 2006). Similarly, educational games may offer both mastery-focused goals, which emphasize the ability to learn a task, and performance-focused goals, which encourage better performance outcomes (Elliot and Harackiewicz, 1994).

Some games also include secondary, optional challenges, intended to increase engagement with or the replayability of a game. Although providing secondary goals gives flexibility and extra challenges to players, it can distract a player from pursuing the primary goal. If a secondary goal does not support or reinforce the game's primary goal, players played

significantly fewer levels, spent less time, and were less likely to return to the game later (Andersen et al., 2011).

In contrast to previous research on multiple types of goals in games, we examine the effects of setting two simultaneous goal levels, similar to those used *UbiFit* and *GoalPost*, on game performance and perception. In this study, we defined primary and secondary goals as different levels—a main goal and a backup goal—for a performance goal.

3. Theory and hypotheses

Based on goal setting theory, we believed that having both a primary and backup goal could enhance player performance appraisal and self-efficacy, leading to spending more time or effort on the game and thus greater performance. Specifically, achieving a backup goal could increase a player's perception that he or she is making progress. This should increase self-efficacy, which is predicted to lead to greater effort perseverance with the game and higher final performance.

Finally, we wanted to compare effort, performance, and perceptions of performance in the goal-setting conditions to not having a goal, which we predicted would result in less effort and lower performance than conditions with goals.

Specifically, we hypothesized that:

H1. People with two goals will perform better than those having (a) one goal (b) no goal.

H2. People with two goals will spend more effort than those having (a) one goal (b) no goal.

An alternative hypothesis, however, is that meeting the lower backup goal is sufficiently satisfying for many players. Once satisfied, they may stop playing, and thus actually perform worse than participants who had just one goal.

4. Study I

To test our hypotheses about primary and backup goals, we developed versions of two casual online games, *Snake* and *Whack-A-mole*, to assess how goal-setting conditions affect performance and effort. We chose these two games because they were relatively simple to learn and they could be played in short rounds typically lasting less than two minutes each. These are common casual games; people play these and similar online, casual games in short breaks or waiting time. Prior research shows that people often approach casual games with a focus on fun rather than performance (Kultima, 2009). They represent a challenging context for performance goals: we expect that finding an effect of performance-based goals in a context in which people are likely to discount them should encourage future researchers to test the effects in a variety of games and other contexts.

We used two different games to be more confident in the results; i.e., they are not just a consequence of some quirk in the game design. Through iterative design and piloting, we adjusted the games so that their complexity and difficulty were comparable. As we describe in later sections, our results show no significant differences between the two games. We implemented our own games because we could instrument them and integrate them into our study flow, but we based them on popular games so they would be engaging and fun for study participants. We also wanted the goals to be the most salient performance indicator, rather than confounded with additional forms of feedback. We iteratively piloted the games over three months. Participants found them engaging: 80% of participants played more than five rounds beyond what study participation required.

Snake (Fig. 1a) consists of a small “snake” that can be moved around the screen using the arrow keys on a keyboard. The objective is to collect “apples” randomly placed around the screen. There are 10 apples in each level and each level has walls as obstacles, increasing the game's difficulty. The snake grows longer with each apple collected. The door

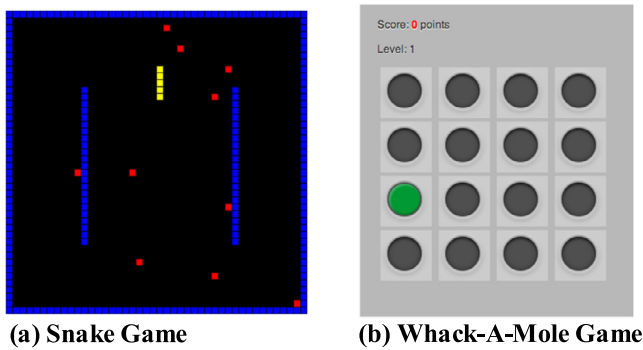


Fig. 1. Study I game interfaces.

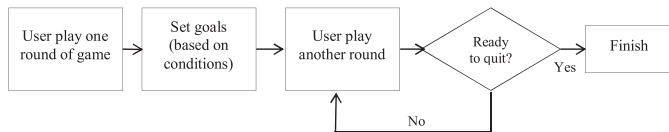


Fig. 2. Study flow.

to the next level opens after all 10 apples have been collected. The game ends when the snake runs into a wall or itself.

Whack-a-Mole¹ (Fig. 1b) is a simpler version of the popular arcade game, where a mole pops up and the player hits the mole on the head. Our version presents a four by four grid of circles. The green circle represents the mole. Players used their mouse or trackpad to click on the green circle. The game starts with a mole appearing every 1.1 s. After ten successful mole clicks, the game levels up and interval between moles decreases by 0.1 s. The game ends when the player clicks outside of the circle or when the player does not click the mole before time runs out.

4.1. Methods

Participants completed the study online. This allowed people to complete the study where they would normally play games and with their everyday activities competing for their attention. This was particularly important, as we wanted to see for how long people played amongst the other things they could be doing, rather than as part of a lab appointment with a pre-determined time. We recruited participants online through Facebook groups and mailing lists associated with University of Washington, researchers' social network feeds, and word-of-mouth referrals. We chose this recruitment approach because many people find out about short casual games from posts on social network sites or quick emails. Scores were recorded anonymously and participants were told their performance would not be linked to their compensation.

Each participant was randomly assigned to one of the two games and one of the three goal-setting conditions. They were asked to play one round to determine his or her baseline performance. After the first round, the participant was assigned or asked to set one, two, or no goals. In two-goal conditions, one goal served as the primary goal and the other was secondary (backup) goal. Participants were prompted to set either one or two goals with the following prompts: "My goal is to play until I reach X points." (1-goal); "My goal is to play until I reach X points. But, if that is too hard, then at least Y points." (2-goals). While participants played the game, the interface showed the goals and points participants earned. Each participant played at least one additional round, with the option of continuing to play additional round(s) (Fig. 2). At the end of each round, participants were reminded of their scores and goal achievement and asked if they would like to play again. They could not set new goals if they had not achieved their primary goal.

Table 1
Study I descriptive statistics.

Measure	No goals ($n = 85$)		One goal ($n = 71$)		Two goals ($n = 84$)	
	<i>M</i>	(<i>SD</i>)	<i>M</i>	(<i>SD</i>)	<i>M</i>	(<i>SD</i>)
<i>Outcomes</i>						
Highest score	18.54	(13.11)	21.11	(16.38)	20.99	(10.92)
Extra rounds	2.33	(3.57)	3.79	(7.98)	2.37	(3.48)
<i>Goals</i>						
Primary goal	–	–	28.93	(26.35)	30.37	(25.81)
Backup goal	–	–	–	–	17.89	(16.81)

After each participant played as many rounds as they wanted, we asked them to complete a survey which included questions about their age, gender, and the Mini-IPIP personality traits scale (Donnellan et al., 2006). Participants were entered in a raffle for one of two \$25 Amazon gift cards or one \$50 Amazon gift card if they chose to submit their email address at the end of the study.

We used the Mini-IPIP, a 20-question version of the Big Five Personality Inventory, to gather personality scores from subjects. Every question was measured using a Likert-like scale from 1 (very inaccurate) to 5 (very accurate). Aggregating the scores results in five separate scores of personality traits (extraversion, agreeableness, conscientiousness, neuroticism, and intellect/imagination), each ranging from 4 to 20.

4.2. Analysis

In this study, we examined two outcome variables. First, we examined high score, the highest number of points each participant earned before they left the study. There were no predefined maximum scores in either game. As a measure for effort, we used the number of additional rounds each participant chose to play. Participants were free to choose how many rounds they desired to play so long as they played at least two rounds.

4.3. Results

To prevent people from participating more than once, we checked IP addresses and, since IP addresses can change, saved a unique user ID in each participant's browser using cookies. We excluded 88 duplicate entries from 51 users in our analysis. After excluding participants who did not play at least two rounds of the game (21 participants) and who did not complete the survey about gender, age, and personality attributes (34 participants), we analyzed data for 240 participants (Table 1). We also re-ran the base models to include the participants who completed the games but not the survey and found no differences. Fig. 3 presents goal attainment by condition.

4.3.1. Goals vs no goals

To verify that goals had effects in these games, we first combined the two groups with at least one goal ($n = 155$) and compared their performance and effort with the no goals group ($n = 85$). We used negative-binomial regression to model highest score and zero-inflation Poisson regression to model extra rounds. There were significant differences between the two groups on extra rounds. Participants with at least one goal played an average of 1.4 more extra rounds than no goal group (4.5 rounds vs. 3.1 rounds, $b = 0.42$, $p < 0.001$, 95% CI: 0.3–1.8). Having at least one goal increased effort.

To understand the effect of number of goals, we focused our analysis on the goal groups. We use dummy coding to code the goal number as Table 2.

4.3.2. One vs. two goals and performance (highest score)

Players' highest scores had a skewed distribution and over-dispersion. Therefore, we used negative binomial regression to model

¹ Piotr Zalewa and Oskar Krawczyk. <http://jsfiddle.net/ufhr6/43/>

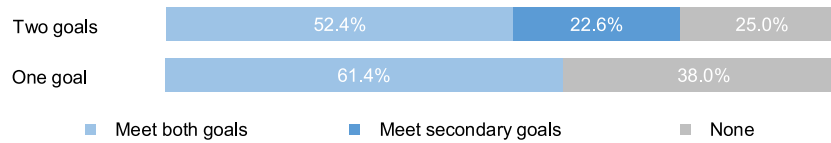


Fig. 3. Goal achievement rate in study I's goal conditions.

Table 2
Dummy coding of predictor: goal numbers.

	Goal groups		
	No goals	One goal group	Two goal group
One goal	0	1	0
Two goals	0	0	1

Table 4
Logistic regression model for chance of playing a new round.

Predictors	b	SE	p
(Intercept)	1.68	0.30	< 0.001***
Met backup goal	-1.63	0.37	< 0.001***
Met both goals	-2.14	0.35	< 0.001***
Number of rounds played so far	0.001	0.03	0.98

n = 283
* p < 0.05
** p < 0.01
*** p < 0.001.

highest score (Table 3, left). The goodness-of-fit chi-squared test compared with null model suggested that the model was appropriate, $\chi^2_{(15, n = 240)} = 888.8839, p < 0.001$.

Participants who were male, had higher base round scores, and had higher primary goals tended to reach higher scores. However, there were no significant differences in highest scores among people who had two goals, one goal, or no goal. Therefore, hypothesis H1 was not confirmed.

4.3.3. One vs. two goals and effort (extra rounds)

We would expect many participants to play no additional rounds if they met their primary goal in the second, required round, so we modeled extra rounds using zero-inflated Poisson regression (Table 3, right). The goodness-of-fit chi-squared test compared with null model suggested that the model is appropriate ($\chi^2_{(15, n = 240)} = 1626.8, p < 0.001$) and a Vuong test compared with an ordinary Poisson model also suggested the model was superior to the standard Poisson model ($p = 0.001$).

Participants who were older, had higher intellect/imagination scores, or had higher base round scores tended to play more extra rounds. Participants with one goal played an estimated 1.6 rounds more than participants with no goal (4.6 rounds vs. 3.0 rounds, 95% CI: 0.5 – 3.4). However, there were no differences in extra rounds between participants with two goals and those with no goal. Therefore, hypothesis H2 was not confirmed.

Does meeting the backup goal suffice?

To better understand the results, and in particular to evaluate whether meeting a backup goal encouraged participants to continue or stop playing, we created a model to predict whether a player would begin a new round according to whether they had met both goals (dummy coded as yes = 1 and no = 0) or the backup goal (dummy coded as yes = 1 and no = 0) in the previous round and how many rounds they had played so far. We used logistic regression to analyze every round played in the two-goal conditions, except the first round from each participant (all subjects were required to play at least two rounds), a total of 283 rounds (Table 4).

Meeting the backup goal and meeting both goals each make someone less likely to begin another round. After controlling for the number of rounds a participant had played so far, the probability of playing a new round was as follows: 38.6% if they achieved both goals in the previous round, 51.2% if they achieved just the backup goal in the previous round, and 84.3% if they achieved neither goal in the current round. Meeting a backup goal seems to be satisfying enough that more participants stop playing after achieving it than stop after achieving no goals. It appears to be less satisfying—and less likely to be a stopping condition—than when participants met their primary goal, however.

Table 3
Negative binomial regression model on highest score (left) and the zero-inflated Poisson regression on extra rounds (right).

Predictors	Highest score (n = 240)			Extra rounds (n = 240)		
	b	SE	p	Count model		
(Intercept)	3.05	0.08	< 0.001***	1.11	0.09	< 0.001***
Age (years)	-0.05	0.05	0.348	0.25	0.04	< 0.001***
Female	-0.33	0.09	< 0.001***	-0.15	0.09	0.106
Extraversion	-0.01	0.05	0.774	-0.08	0.06	0.174
Agreeableness	0.10	0.07	0.179	-0.02	0.08	0.758
Conscientiousness	0.01	0.06	0.833	-0.06	0.06	0.325
Neuroticism	-0.01	0.05	0.853	0.08	0.05	0.127
Intellect/Imagination	0.12	0.08	0.130	0.17	0.08	0.031*
Base round score	0.30	0.04	< 0.001***	0.11	0.04	0.010**
Snake	0.003	0.08	0.969	0.16	0.09	0.065
Level of primary goal	0.10	0.05	0.045*	0.02	0.05	0.706
One goal	-0.06	0.11	0.553	0.42	0.12	< 0.001***
Two goals	0.04	0.11	0.741	0.03	0.12	0.778
				Zero-inflation model		
(Intercept)				-0.83	0.15	< 0.001***
Base round score				0.45	0.14	0.001**

* p < 0.05,
** p < 0.01,
*** p < 0.001.



Fig. 4. Boggle interface.

4.3.4. Summary

The number of goals was not, on its own, predictive of participant high scores or rounds played. Meeting a backup goal, on the other hand, might make people satisfied and stop playing earlier. This finding led us to develop a new hypothesis: having two goals might increase people’s appraisals of their performance no matter what their performance is.

H3. People with two goals will perceive their performance better than those having (a) one goal (b) no goal.

5. Study II

To evaluate the hypothesis that emerged from study I—having two goals might lead people to perceive their performance better than people who have one goal or no goals—we conducted a second study. In this study, we also sought to use a game in which performance would be limited primarily by effort, rather than by a combination of effort, reaction time, and any limitations of one’s particular computer setup, which were limitations associated with Whack-a-Mole and Snake, the games used in study I. Additionally, because we found no difference between games in study I, we decided to use only one game in this study. We chose to use an online version of the popular word-finding game, Boggle (Fig. 4). Boggle players make words by joining adjacent letters horizontally, vertically, or diagonally. Each letter can be used once for a single word; people earn scores according to the length of the words. In our version, we did not impose a time limit so that participants could spend as much effort as they wished. Participants could stop playing the game at any time.

5.1. Study design

The second study used the same recruitment methods and compensation as study I. After deciding to participate in the study, participants set goals based on the condition to which they were assigned. Participants played one ongoing game until they chose to stop; they had no opportunities to set new goals. As with study I, this game was fun and engaging for participants: they played to an average of 68 points above their goals, with a median self-reported enjoyment of 8 out of 10.

Participants were then randomly assigned to one of five variations for the Boggle board layout. All of the boards were created based on the same dictionary and each contained 1000–1500 words. After participants stopped playing, we asked them to complete a short survey. The survey asked age, gender, and three questions about participant enjoyment to the game (“How did you like the game?”), perceived performance (“How did you feel about your performance in the game?”), and perceived effort (“How much effort did you put into playing the game?”). All three questions were measured using Likert-type scales from 1 to 10. Since Boggle is an English word game, we also asked each participant to report whether they were a native English speaker to control for language proficiency.

Because we added additional questions to this survey (compared to study I), we used the shorter 10-Item Personality Inventory (TIPI) (Gosling et al., 2003) to collect data about participant personality traits. Every question is measured using a Likert scale from 1 (disagree strongly) to 7 (agree strongly). Adding up the scores results in five separate scores for personality traits (extraversion, agreeableness, conscientiousness, emotional stability, and openness to experiences), and each ranging from 2 to 14.

5.2. Analysis

We examined three outcome variables in this study. First, we examined the scores participants achieved in the game (performance). Secondly, we examined how participants appraised their performance in the game. Third, we measured how much time each participant spent playing.

5.3. Results

Similar to study I, we checked for and excluded duplicate entries from the same IP address. We also saved a unique ID in browser cookies to allow us to identify and exclude duplicate entries. We excluded 57 duplicate entries from 34 users in our analysis. After excluding 15 people who did not complete the post survey and four people who appeared to have started playing, gotten distracted, and then later returned to quickly end the game, scoring less than 10 points in more than 30 min, we had 124 participants in our data set. We also re-run the base models, based on experimental conditions, to include the participants who completed the games but not the survey and found no differences. Table 5 presents the descriptive statistics for each of the three groups and Fig. 5 shows goal attainment by study condition.

5.3.1. Goals vs. no goals

We first combined the two groups with at least one goal and compared them to no goal group’s score, perceived performance, and time. (Table 6) We used negative binomial regression to analyze score, Poisson regression to analyze perceived performance, and multiple linear regression to analyze time. There were significant differences between the two groups on score and perceived performance. Participants with one or two goals scored 137 points lower than those with no goal (157.8 points vs. 295.2 points, 95% CI: 96.5–141.0). They also played 5.5 min less than those with no goal (11.0 min vs. 16.58 min, 95% CI: 1.0–10.1). However, participants with goals perceived their performance better than those without goals (6.7 vs. 5.6, 95% CI: 0.2–2.4). Having goals increased perceived performance, but not the actual performance or effort.

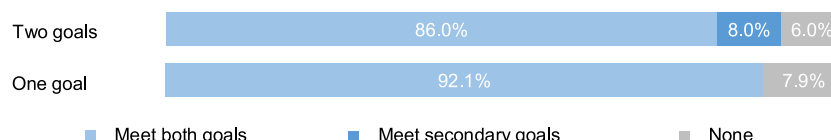


Fig. 5. Goal achievement rate in study II’s goal conditions.

Table 5
Study II descriptive statistics.

Measure	No goals (n = 43)		One goal (n = 37)		Two goals (n = 44)	
	M	(SD)	M	(SD)	M	(SD)
<i>Outcomes</i>						
Score	295.20	(270.11)	142.80	(175.50)	169.20	(224.85)
Perceived performance	5.63	(2.72)	6.08	(2.28)	7.20	(2.95)
Time (min)	16.58	(13.35)	10.01	(11.92)	11.81	(12.33)
<i>Goals</i>						
Primary goal	–	–	90.79	(122.96)	158.20	(234.73)
Backup goal	–	–	–	–	88.00	(140.31)

Table 6
Results from the negative binomial regression model on score, Poisson regression on perceived performance, and linear regression model on time for no-goal vs. goal group.

Measures	No-goal group n = 43		Goal group n = 81		b	p
	μ	(SD)	μ	(SD)		
Score	295.2	(270.11)	157.80	(204.32)	–0.62	< 0.001***
Perceived performance	5.63	(2.72)	6.72	(2.72)	0.17	0.018*
Time (min)	16.58	(13.35)	11.03	(12.11)	–5.55	0.016*

We then examined differences in the three outcome variables among three groups (N=124). Like Study I, we use dummy coding with two variables to code three goal groups.

5.3.2. Performance (score)

Similar to study I, score had a skewed distribution and overdispersion. Therefore, we used negative-binomial regression to model score (Table 7). The goodness-of-fit chi-squared test compared with null model indicates that the model is appropriate, $\chi^2(14, n = 124) = 13,197.5, p < 0.001$.

Participants who had lower conscientiousness score, higher emotional stability scores, had higher primary goals, or enjoyed the game more had higher scores (Table 7, left). Participants who had one or two goals had lower scores than those had no goal. Participants who had one goal had averagely 252.1 points lower than those with no goal (85.7 points vs. 337.8, 95% CI: 179.4–335.1). Participants who had two goals had averagely 270.2 points lower than those with no goal (67.5 points vs. 337.8, 95% CI: 187.4–377.8). We also compared whether number of goals affected player enjoyment; it did (p = 0.01, 95% CI: 0.3–2.1) and so we subsequently use it as a control in the models.

If we compare participants with one goal and those with two goals, we found that participants with lower conscientiousness score, had higher primary goals, or enjoyed the game more had higher scores, but there was no difference on the scores between people with one goal and those with two goals.

Similar to study I, our results were not able to confirm hypothesis H1.

5.3.3. Perceived performance

We used Poisson regression to model perceived performance. The goodness-of-fit chi-squared test compared with null model suggested that the model was appropriate ($\chi^2(14, n = 124) = 696.44, p < 0.001$).

Native English speakers, participants who enjoyed the game more, or participants who believed they spent more effort had greater perceived performance (Table 7, middle). Participants with two goals perceived their performance better than participants with no goal (95% CI: 0.1–2.8). Participants with two goals also perceived their performance better than participants with one goal (95% CI: 0.4–3.4).

This confirmed hypothesis H3: people with two goals perceived their performance better than those with one goal and no goal.

Table 7
Results from the negative binomial regression on score, Poisson regression model on perceived performance, and linear regression model on Time.

Predictors	Score			Perceived performance			Time (min)		
	b	SE	p	b	SE	p	B	SE	p
(Intercept)	5.82	0.21	< 0.001***	1.54	0.11	< 0.001***	22.59	2.88	< 0.001***
Age	0.06	0.09	0.553	0.04	0.05	0.326	2.69	1.29	0.039*
Gender	–0.03	0.16	0.851	–0.02	0.08	0.715	–0.24	2.19	0.912
Native English speaker	0.33	0.17	0.052	0.24	0.09	0.008**	–2.09	2.32	0.369
Extraversion	0.03	0.09	0.714	0.05	0.04	0.251	1.49	1.23	0.229
Agreeableness	–0.17	0.11	0.125	0.03	0.06	0.595	–0.62	1.55	0.692
Conscientiousness	–0.29	0.10	0.005**	–0.001	0.05	0.975	–1.91	1.40	0.176
Emotional stability	0.25	0.11	0.028*	0.03	0.06	0.594	1.32	1.54	0.393
Openness to experiences	–0.16	0.12	0.170	0.11	0.06	0.068	–5.65	1.57	< 0.001***
Level of primary goal	0.54	0.07	< 0.001***	–0.05	0.04	0.139	5.93	1.05	< 0.001***
Enjoyment	0.26	0.12	0.027*	0.21	0.06	< 0.001***	2.77	1.61	0.087
Perceived effort	0.04	0.09	0.670	0.16	0.05	< 0.001***	0.25	1.29	0.846
One goal	–1.37	0.19	< 0.001***	–0.09	0.10	0.359	–11.30	2.57	< 0.001***
Two goals	–1.60	0.19	< 0.001***	0.21	0.10	0.031*	–13.02	2.63	< 0.001***

n = 124,
* p < 0.05,
** p < 0.01,
*** p < 0.001.

Table 8
Results from the Poisson regression model on perceived performance in two-goal condition.

Predictors	<i>b</i>	<i>SE</i>	<i>p</i>
(Intercept)	1.59	0.17	< 0.001***
Age	0.01	0.04	0.793
Female	−0.01	0.09	0.952
Native English speaker	0.05	0.10	0.636
Extraversion	0.04	0.05	0.352
Agreeableness	0.01	0.04	0.910
Conscientiousness	−0.01	0.05	0.859
Emotional Stability	0.01	0.05	0.863
Openness to Experiences	0.001	0.05	0.975
Level of primary goal	0.0001	0.04	0.998
Enjoyment	0.07	0.05	0.166
Perceived effort	0.03	0.05	0.589
Met both goals	0.48	0.19	0.011*
Met backup goal	0.15	0.24	0.514

n = 81. * *p* < 0.05

** *p* < 0.01

*** *p* < 0.001.

Does meeting the backup goal suffice?

To further understand this result, we analyzed whether participants perceived their performance differently based on whether they achieved both goals, their backup goal, or neither goal. We used Poisson regression to model perceived performance for participants in the two-goal condition (*n* = 81). In this model, we used the previously described control variables and whether participants achieved both goals or achieved their backup goal as predictors (Table 8).

Participants who achieved both goals had higher self-appraisals of their performance. This result shows that having two goals increased participants' perceived performance, but only if participants achieve both goals. Participants who met their backup goal did not perceive their performance better than participants who met no goals. It is likely that failing to achieve the primary goal was more salient to participants than their achievement of their backup goal. Also, since the average difference between primary goals and backup goals in the two-goal conditions was only 72 points (153 points vs. 81 points), participants who met backup goals may have felt that since they were already more than halfway to the primary goal, they should continue. Future studies should investigate this result by setting primary goals much higher than backup goals.

5.3.4. Effort (time spent playing)

We used multiple linear regression to model time. Participants who were non-native speakers, who were less open to new experiences, or who had a higher primary goal spent more time playing the game (Table 7, right).

Participants who had two goals played 4.5 min longer than participants with one goal (17.9 min vs. 13.4 min, 95% CI: 0.5–8.5 min). On average, participants in the two-goal condition set higher primary goals ($M = 154$, $SD = 166.1$) than the participants in the one-goal condition ($M = 117$, $SD = 88.5$), which also caused them to spend more time playing as they strove toward this higher goal. This confirmed our hypothesis H2.

6. Discussion

Overall, we did not find evidence to support hypothesis H1; people having two goals did not perform better than people with only one goal. However, they spent more effort (H2) and perceived their performance higher (H3) than those with only one goal or no goal. People were more likely to give up after achieving a backup goal than after achieving no goals. In this section, we discuss how these results might be applied in game design and suggest how future studies should be conducted to verify some difference we saw in two studies. Finally, we discuss

how these results may have implications for other domains that use goal setting.

6.1. Goals and games

Many game designs use goal setting to promote performance, learning opportunities, and experience. Having two goals might enhance one or more of these objectives.

6.1.1. Achieving two goals improved perceived performance and satisfaction

Although having a backup goal does not improve performance directly, players who achieved two goals perceived their performance higher. Believing that one can and has performed well can support development of self-efficacy. While our study was not longitudinal, prior work shows that greater self-efficacy can make people more likely to return to an activity and to set higher goals in the future (Bandura, 1997).

To balance the purpose of promoting learning and engaging players, games are not always designed to be difficult and challenging. Instead, many studies showed that having variations of level difficulties by inserting “breaks”—less difficult levels—in-between difficult levels might provide a better gaming experience and make games more fun (Gee, 2003; Sorenson and Pasquier, 2010). Break levels help people feel better about their performance and enjoy the game, and they then stay in the game for more challenging levels (Sorenson and Pasquier, 2010).

Backup goals may have the potential to serve as those less difficult levels, even at times when people cannot predict they need a break. This could increase player satisfaction. However, there is a possibility that players might quit the game after meeting the backup goal. Future studies should investigate how far apart the primary goal and backup goal should be to balance satisfaction with encouragement to continue trying. One limitation of our study was that participants may have perceived the experience as both a task and a game. However, participants were informed that their performance would not affect the likelihood of earning the compensation. Future studies should replicate our work in unincentivized gameplay in the wild.

6.1.2. Different uses and effects of two goals between studies

Overall, people with two goals set higher primary goals, but participants used the primary and backup goals differently in study I than in study II. Also, more people stopped after achieving their backup goal in study I than study II. We discuss these different uses and effects, their possible explanation and suggest future studies for evaluation.

6.1.2.1. Different uses of primary and backup goals. In both studies, participants who had the option to set two goals set their primary goals higher than participants who could set only one goal, suggesting that having a backup goal encouraged them to take somewhat more risk with their primary goal.

However, participants used their backup goals in different ways in our two studies. Although participants in study I set higher primary goals than those in the one-goal condition, they set lower, less risky backup goals (Table 1). On the other hand, participants in Study II set their backup goal as high as participants in the one-goal condition set their goals, and set their primary goal much higher than the participants in the one-goal condition (Table 4). One possible explanation is that participants in study I had the chance to play a base round, which let them better predict their performance and made them aware that their physical reaction time would limit performance, so they used the backup goal as a fallback. On the other hand, participants in study II did not have knowledge about how well they could perform but knew that it would be limited primarily by the amount of time they wanted to play, and therefore they set a slightly less risky but still challenging backup goal and were more inclined to set a very challenging primary goal.

6.1.2.2. Different effects of backup goals on stopping. Many participants in study I stopped playing after achieving their backup goal while many participants in study II continued to play toward their primary goal, even after achieving their backup goal. One possible explanation is that participants played several rounds in study I and had a choice of stopping or continuing after each round. When confronted with this choice, participants who had achieved their backup goal may have decided that this was a good time to stop. On the other hand, participants in Boggle played one, ongoing game until they explicitly chose to stop looking for words and end the game, and so they did not have as obvious an opportunity to evaluate whether to continue playing.

Another possible explanation is that participant reaction time limited their performance in the games in study I, but their performance in study II was limited only by the amount of time they wanted to play (the number of words was sufficiently large that it was never a practical constraint). Thus, participants in study I may have become more frustrated or seen limited improvement even with subsequent rounds, and thus been more likely to give up as soon as they achieved either of these goals.

One way to test these possible explanations would be to modify the Boggle game to ask study II participants whether they wish to continue playing upon achieving their backup goal. If our first possible explanation is correct, then more should quit with this prompt than without. Understanding the effect of this prompt might help game designers encourage people to play longer—or to stop and take a break.

6.1.3. Limited measures

Factors we did not measure in this study, such as the addiction effect (Boyle et al., 2012), might affect game performance or interact with goal condition. We also did not find evidence that the measured personality traits affect game performance in different goal conditions, but have included them for transparency in reporting of our study design, analysis, and results. Future studies could investigate the interaction between these other factors and two goals on motivating and promoting game performance.

6.2. Future work: goals, other types of games, other domains, and long-term effects

Goal setting is also widely used in other types of games and other domains such as health behavior change, learning, and in the workplace. Further long-term studies should assess the effects of primary and secondary goals in a diversity of games and domains. It will also be particularly valuable to evaluate whether having both primary and backup goals promotes people's self-efficacy and encourages them to continue performing in the long term.

6.2.1. Other types of games

Players may approach a game with a variety of motivations, such as performance, social interactions, or exploring, and this can also vary based on the type of game (Yee, 2006; Kultima, 2009). For example, we conducted this study using casual games, in which people often focus on having fun and rather than on performance. Despite selecting a setting in which players often do not emphasize performance goals, our results show that having both primary and backup goals encouraged participants to continue playing even these casual games.

Future research should assess the effects of multiple goals among players with a variety of goals and in a variety of game types. Doing so will require richer games than our casual, single-player games that had no social elements. Future work might also examine how self-set goals or how machine-set goals compare to implied social goals, such as those presented through leaderboards, cooperative play, or head-to-head challenges.

6.2.2. Other domains

The studies presented in this paper were motivated by prior research in health behavior change technologies, and so we briefly return to

possible implications and future work in that domain. Many health behavior change interventions include goal-setting features (Eakin et al., 2007; Strecher et al., 1995). Combined with self-monitoring and performance feedback, goal-setting has been shown to be effective for increasing physical activity (Michie et al., 2009), improving diet (Baker and Kirschenbaum, 1993), and promoting weight loss (Bravata et al., 2007).

However, one common way that goal setting can break down is the so-called “lost day” problem or “what the hell effect” (Cochran and Tesser, 1996). For example, if someone has a daily step goal, but for some reason, that goal becomes unachievable for the day, people often give up on walking until the next day when the goal “resets,” and may remain sedentary for the rest of the day even if they could still have gotten many more steps.

One explanation for the lost day problem is that people's goal commitment, and thus goal striving, decreases when they no longer feel that it is possible to achieve their goal. Using proximate subgoals that provide progress feedback was one way to help increase long-term performance (Cochran and Tesser, 1996). Having a secondary, backup goal may give people a fallback goal that they believe is still achievable, toward which they can continue to strive, even when their primary goal is no longer possible. As indicated by gains in perceived performance for participants with backup goals in study II, achieving both a primary and backup goal might promote their self-efficacy, which might result in both higher goals and greater goal-striving in the future. Unfortunately, there may be a tradeoff: someone who achieves the backup goal but not the primary goal may perceive their performance similar to someone who achieved the same level of activity but had no goal.

6.2.3. Long term effects

Everyday health goals, however, present important differences from the online casual games we used in this study. In the games, people spent a single, continuous session pursuing their goal. Everyday behaviors consist of a series of ongoing decisions – do I walk or watch TV now? Do I have the burger or the salad? Motivations are also different. These differences may allow the performance appraisal and self-efficacy benefits we identified in this study to have a long-term effect on effort and performance, in ways that were not possible during a single session of gameplay. Given our results, and that our use of two goals was inspired by prior research on physical activity applications, we believe that the use of one versus two goals in health and wellness interventions should be rigorously evaluated through future field studies.

7. Conclusion

Through two studies using online casual games, we contribute, the first experiment measuring actual effects of simultaneous primary and secondary goals on performance and perception. Specifically, we found that having a backup goal can encourage people to take more risk with their primary goal. However, prior experience (playing a base round) and game types (limited by reaction speed/time) affect this behavior. Also, players who achieved two goals perceived their performance better than those who achieved no goals or who achieved just one goal. This is important as prior work shows a link between self-efficacy and likelihood of returning to the activity or the difficulty of goals people set in the future. Achieving a backup goal, however, can be sufficiently satisfying that some people stop when meeting it. These contributions provide guidance for design of goals in games, such as allowing users to simultaneously pursue two different levels of achievement to increase return rate. They also set the ground for future work: now that we know that having two simultaneous goals can affect both behavior and performance perceptions, researchers may also evaluate their effects in other domains and use our results to guide design of their studies. Future studies should also investigate how far apart primary and backup goals should be to balance satisfaction with encouragement to continue trying.

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References

- Andersen, E., Liu, Y.E., Snider, R., Szeto, R., Cooper, S., Popović, Z., 2011. On the harmfulness of secondary game objectives. In: Proceedings of the 6th International Conference on Foundations of Digital Games, pp. 30–37.
- Baker, R.C., Kirschenbaum, D.S., 1993. Self-monitoring may be necessary for successful weight control. *Behav. Ther.* 24 (3), 377–394.
- Bandura, A., Cervone, D., 1983. Self-evaluative and self-efficacy mechanisms governing the motivational effects of goal systems. *J. Personality Social Psychol.* 45 (5), 1017.
- Bandura, A., 1991. Social cognitive theory of self-regulation. *Organ. Behav. Hum. Decis. Process.* 50 (2), 248–287.
- Bandura, A., 1997. *Self-efficacy: The Exercise of Control*. Macmillan.
- Boyle, E.A., Connolly, T.M., Hainey, T., Boyle, J.M., 2012. Engagement in digital entertainment games: a systematic review. *Comput. Hum. Behav.* 28 (3), 771–780.
- Bravata, D.M., Smith-Spangler, C., Sundaram, V., Gienger, A.L., Lin, N., Lewis, R., Stave, C.D., Olkin, I., Sirard, J.R., 2007. Using pedometers to increase physical activity and improve health: a systematic review. *JAMA* 298 (19), 2296–2304.
- Clarke, D., Duimering, P.R., 2006. How computer gamers experience the game situation: a behavioral study. *Comput. Entertainment* 4 (3), 6.
- Cochran, W., Tesser, A., 1996. The “what the hell” effect: some effects of goal proximity and goal framing on performance. In: *Striving And Feeling: Interactions Among Goals, Affect, And Self-Regulation*, pp. 99–120.
- Consolvo, S., Klasnja, P., McDonald, D.W., Avrahami, D., Froehlich, J.E., LeGrand, L., Libby, R., Mosher, K., Landay, J.A., 2008. Flowers or a robot army? encouraging awareness & activity with personal, mobile displays. In: Proceedings of the 10th International Conference on Ubiquitous Computing, pp. 54–63.
- Donnellan, M.B., Oswald, F.L., Baird, B.M., Lucas, R.E., 2006. The mini-IPIP scales: Tiny-yet-effective measures of the big five factors of personality. *Psychol. Assess.* 18 (2), 192.
- Eakin, E.G., Lawler, S.P., Vandelanotte, C., Owen, N., 2007. Telephone interventions for physical activity & dietary behavior change: a systematic review. *Am. J. Preventive Med.* 32 (5), 419–434.
- Elliot, A.J., Harackiewicz, J.M., 1994. Goal setting, achievement orientation, and intrinsic motivation: a mediational analysis. *J. Personality Social Psychol.* 66 (5), 968.
- Gee, J.P., 2003. What video games have to teach us about learning and literacy. *Comput. Entertainment* 1 (1) 20–20.
- Gosling, S.D., Rentfrow, P.J., Swann, W.B., 2003. A very brief measure of the Big-Five personality domains. *J. Res. Personality* 37 (6), 504–528.
- Hoffman, B., Nadelson, L., 2010. Motivational engagement and video gaming: a mixed methods study. *Educ. Technol. Res. Dev.* 58 (3), 245–270.
- Latham, G.P., Locke, E.A., 1991. Self regulation through goal-setting. *Org. Behav. Hum. Dec. Process.* 50 (2), 212–247.
- Kultima, A., 2009. Casual game design values. In: Proceedings of the 13th international MindTrek conference: Everyday life in the ubiquitous era, pp. 58–65.
- Locke, E.A., Latham, G.P., 1990. *A Theory of Goal Setting and Task Performance*. Prentice Hall.
- Locke, E.A., Latham, G.P., 1994. Goal setting theory. In: *Motivation: Theory and Research*, pp. 13–29.
- Mento, A., Locke, E.A., Klein, H., 1992. Relationship of goal level to valence and instrumentality. *J. Appl. Psychol.* 77 (4), 395.
- Meyer, J.P., Becker, T.E., Vandenberghe, C., 2004. Employee commitment and motivation: a conceptual analysis and integrative model. *J. Appl. Psychol.* 89 (6), 991.
- Michie, S., Abraham, C., Whittington, C., McAteer, J., Gupta, S., 2009. Effective techniques in healthy eating and physical activity interventions: a meta-regression. *Health Psychol.* 28 (6), 690.
- Munson, S.A., Consolvo, S., 2012. Exploring goal-setting, rewards, self-monitoring, and sharing to motivate physical activity. In: *Pervasive Computing Technologies for Healthcare (PervasiveHealth)*, pp. 25–32.
- Nothwehr, F., Yang, J., 2007. Goal setting frequency and the use of behavioral strategies related to diet and physical activity. *Health Educ. Res.* 22 (4), 532–538.
- Piccolo, R.F., Colquitt, J.A., 2006. Transformational leadership and job behaviors: The mediating role of core job characteristics. *Acad. Manage. J.* 49 (2), 327–340.
- Schunk, D.H., 1996. *Learning Theories*. Prentice Hall Inc., New Jersey.
- Sorenson, N., Pasquier, P., 2010. The evolution of fun: automatic level design through challenge modeling. In: Proceedings of the First International Conference on Computational Creativity (ICCCX). ACM, Lisbon, Portugal, pp. 258–267.
- Strecher, V.J., Seijts, G.H., Kok, G.J., Glasgow, R., DeVellis, B., Meertens, R.M., Bulger, D.W., 1995. Goal setting as a strategy for health behavior change. *Health Educ. Behav.* 22 (2), 190–200.
- Thompson, D., Baranowski, T., Buday, R., Baranowski, J., Thompson, V., Jago, R., Griffith, M.J., 2008. Serious video games for health: how behavioral science guided the design of a game on diabetes and obesity. *Simul. Gaming* 41 (4), 587–606.
- Yee, N., 2006. Motivations for play in online games. *CyberPsychol. Behav.* 9 (6), 772–775.