Running Head: ILLUSION OF CONTROL

# Keeping the Illusion of Control under Control: Ceilings, Floors, and Imperfect Calibration

Francesca Gino[1]

Zachariah Sharek[2]

Don A. Moore[3]

[1]*Harvard University,* [2]*Carnegie Mellon University,* [3]*Universiy of California at Berkeley*

In press at *Organizational Behavior and Human Decision Processes*

The authors gratefully acknowledge the support of the staff and facilities of the Center for Behavioral Decision Research at Carnegie Mellon University and the Center for Decision Research at the University of North Carolina at Chapel Hill. For helpful feedback on previous drafts, we are grateful to Associate Editor Xiao-Ping Chen, Joachim Krueger, and two anonymous reviewers. We also thank Lamar Pierce and Joachim Vosgerau for their insightful comments regarding this research. Please address correspondence by email to fgino@hbs.edu.

Abstract

Prior research has claimed that people exaggerate probabilities of success by overestimating personal control in situations that are heavily or completely chance-determined. We examine whether such overestimation of control persists in situations where people do have control. Our results suggest a simple model that accounts for prior findings on illusory control as well as for situations where actual control is high: People make imperfect estimates of their level of control. By focusing on situations marked by low control, prior research has created the illusion that people generally overestimate their level of control. Across three studies, we show that when they have a great deal of control, people underestimate it. Implications for research on perceived control and co-variation assessment are discussed.

*Keywords*: illusion of control; attribution; comparative judgments; co-variation assessment; personal control

Keeping the Illusion of Control under Control:

Ceilings, Floors, and Imperfect Calibration

In the 1970s, the city of New York installed buttons at intersections with traffic lights. Helpful signs instructed pedestrians, “To cross street, push button. Wait for walk signal.” Since then, pedestrians in New York routinely have assumed that pushing the button speeds the arrival of the walk signal. As it happens, their faith is misplaced. Since the late 1980s, traffic signals in New York have been controlled by a computer system that determines when the walk signal is illuminated (Luo, 2004). Pushing the button has no effect. But because the city has not paid to remove the signs or the buttons, pedestrians continue to push the buttons.

According to Langer (1975; Langer & Roth, 1975), when people behave as if they have control in situations that are actually determined by chance (i.e., situations where they have no actual control), they are suffering from what she termed the *illusion of control*. Many studies have shown that when cues related to skills, such as choice, competition, practice, or familiarity, are introduced into chance situations, people behave as if the chance outcome was determined by skill (Goffman, 1967; see also Thompson, Armstrong, & Thomas, 1998 for a thorough review). For instance, choice has been shown to induce an illusion of control. People behave as if they think they have greater control when they roll dice themselves than when someone else rolls for them (e.g., Fleming & Darley, 1986). People prefer to pick their own lottery numbers than to have others pick for them (Dunn & Wilson, 1990; Langer, 1975). And pedestrians in New York push the walk button even though it will not get them across the street any faster.

Similar patterns of results have been found in research on co-variation assessment (see Alloy & Tabachnik, 1984, and Crocker, 1981 for reviews). In this literature, studies have robustly found that people substantially overestimate their degree of control over events that are heavily determined by chance (i.e, situations where actual control is low, see Crocker, 1982). When people expect to produce a certain outcome and the outcome then occurs, they often overestimate the degree to which they were instrumental in making it happen (see Miller & Ross, 1975). Taken together, these findings suggest that in situations where outcomes are largely determined by chance, people perceive more control than they actually have, and they notice co-variation where none is present (Ayeroff & Abelson, 1976; Benassi, Sweeney, & Drevno, 1979; Langer, 1975; Wortman, 1975).

While prior research has focused on people's estimates of control over heavily chance-determined events, less research has examined people's assessments of control in situations where actual control is high. These situations are quite common in organizations and broader society more generally, and they often involve high-stake consequences – such as stopping a car by stepping on the brake, working hard to increase one's odds of being promoted, or exercising in order to lose weight. Are people's estimates of their control accurate in these situations?

In this paper, we suggest they are not. We extend the literature on personal control and co-variation assessment by exploring people's perceptions of control across a full range of situations. We consider both heavily chance-determined situations where actual control is low (as in prior studies on the illusion of control and co-variation assessment), and situations characterized by high levels of actual control. Across three laboratory studies, we examine the psychological factors that may alter the relationship between actual control and perceived control. We propose a simple theoretical framework that can be used to study people's perceptions of control by suggesting that people have an imperfect sense of how much they control probabilistic events. Specifically, when they have very little control, we expect them to overestimate it, as demonstrated in prior work. But when they have high levels of control, we expect them to underestimate it, consistent with a case of imperfect calibration. Indeed, if people systematically overestimate their control when they have objectively little because they are unsure about how much control they have, then it is to be expected that they will systematically underestimate their control when they actually have a great deal of control.

*The Psychology of Personal Control*

The topic of perceived personal control is relevant in many different areas of both psychology and behavioral decision research (e.g., Jenkins & Ward, 1965; Langer, 1975; Seligman, 1975). This work has defined perceived personal control as the belief that one possesses the ability to act and achieve desired outcomes (Thompson, 1981), or one's estimate that a given behavior will lead to certain outcomes (Bandura, 1977). Over the last several decades, studies investigating the psychology of personal control have found that people often regard themselves as causal agents in their attempts to attain randomly determined outcomes (Fiske & Taylor, 1984; Taylor & Brown, 1988; Weinstein, 1980), suggesting an illusion of control (Langer, 1975).

One stream of research contributing to our understanding of illusory control is Seligman's (1975) work on the learned helplessness theory of depression. According to this theory, depressed people believe they are ineffective and powerless to control what happens to them. It follows that depressed individuals should underestimate their control (Abramson & Alloy, 1980; Alloy & Seligman, 1979). Alloy and Abramson (1979) evaluated this prediction in their first experiment. Their findings suggested, surprisingly, that depressed participants were more accurate in their estimates of control, whereas nondepressed participants overestimated their control.

However, subsequent research suggested that depressed individuals simply report believing that they lack control, whereas nondepressed individuals report being in control (Dykman, Abramson, Alloy, & Hartlage, 1989). As noted by Dykman et al. (1989), depressives perceive themselves to have less control than do nondepressives; as a result, depressives may appear accurate on uncontrollable tasks and inaccurate on controllable tasks.[1] The opposite is true for nondepressives. These findings suggest that accuracy or inaccuracy of perceptions of personal control is an accident of the match between an individual difference (i.e., depression) and task characteristics (i.e., actual difficulty or controllability). The factors that influence perceptions can move independently of the factors that influence objective performance, and accuracy depends on both.

*Miscalibration in Judgment*

Are people's perceptions of ability or performance accurate? Several studies have found that perceptions of ability and performance are poorly correlated with actual performance and therefore are regressive with respect to actual performance (e.g., Burson, Larrick, & Klayman, 2006; Moore & Healy, 2008). Research on overconfidence has suggested that there are several sources of unsystematic error in subjective confidence that influence decision makers' judgments, ranging from misleading prior experiences (Juslin, 1994; Soll, 1996) to relying on information associated with deceptive feelings of confidence (Erev, Wallsten, & Budescu, 1994; Heath & Tversky, 1991; Simmons & Nelson, 2006).

Related research has found regressive effects in comparative judgments (Moore & Small, 2007), as well as in judgments of accuracy (Dawes & Mumford, 1996). When people compare themselves with others, their imperfect knowledge of others inserts an additional source of error

[1] We use the term uncontrollable tasks to refer to pure chance or noncontingency tasks, where outcomes are objectively unrelated to the actions of the decision maker.

(Krueger, 2000; Krueger & Clement, 1997; Krueger, Acevedo, & Robbins, 2005; McFarland & Miller, 1990). Consequently, the worst performers overestimate their percentile ranks, whereas the highest performers underestimate theirs (Krueger & Mueller, 2002; Kruger & Dunning, 1999). Building on this research, Larrick, Burson, and Soll (2007) argued that some factors influence perceptions of ability and performance without influencing actual performance. For instance, certain manipulations of task difficulty may move perceptions more than actual performance.

*Theoretical Model and Research Hypotheses*

As this body of work demonstrates, the result of errors in judgments of perceived and actual performance is that people overestimate low performances and underestimate high performances. We argue that the same type of miscalibration occurs in judgments of personal control because factors that influence actual control and factors that influence perceived control can move separately. Consequently, we expect people to systematically overestimate their control when they have objectively little or no control and to systematically underestimate it when they have objectively high control.

Figure 1 illustrates the hypothetical pattern of results. As the figure shows, we expect people to have imperfect knowledge of their own control and to make regressive estimates. We also expect the linear and regressive relationship between perceived and actual control to break down as one approaches 100% actual control. Unlike the 0% control condition, in which random influences can create uncertainty about how much control one has, no such ambiguity is possible when one has perfect control, creating a structural asymmetry between conditions of no control and complete control. This non-linearity qualifies the proposed regression account. We should note that a similar non-linearity is expected in cases in which actual control is zero and decision makers have no way to influence the outcome (e.g., a button is not present in a task where pressing a button produces a desired outcome). That is, we expect people to be smart enough to realize that if there is no button present at the crosswalk, they could not have had any control over the walk signal (Matute, 1996; Shanks & Dickinson, 1987; Wasserman, 1990).

We find support for our main hypothesis across three laboratory studies that employ common illusion-of-control paradigms. The current research focuses on two cells that have not been compared directly by most prior research on illusory control: Nondepressives on both uncontrollable and controllable tasks. Across the three studies, our results question the conclusion that nondepressives systematically overestimate their control—a conclusion that, to date, remains widely accepted in social psychology, organizational behavior, and behavioral decision research.

*Paradigms Used in Research on Personal Control*

Since the publication of Langer's (1975) classic research, numerous studies have examined moderators of subjective control. Most of this research has used pure chance or non-contingency tasks, where participants' actions are unrelated to task outcomes. These studies have relied primarily on two paradigms. The first manipulates one factor that the authors predict will influence perceptions of control (e.g., choice or familiarity) in a gambling game (e.g., dice throw). In these studies, participants are asked to bet money on the chance outcome or rate their confidence in a successful outcome. That is, they are asked to judge their control indirectly while they are attempting to execute control (e.g., roll a die). Thus, this paradigm involves no feedback for participants, one-shot tasks, and uses participants' predictions about the outcome of the task to measure control.

In the second type of paradigm, participants engage in a task over multiple rounds where they are rewarded for achieving a particular outcome (e.g., the onset of a light). Although participants are told that an action (e.g., pressing a button) controls the desired outcome, in actuality, there is no relationship between participants' actions and the outcome. Studies using this second paradigm measure control by asking participants to estimate their degree of control over the task outcome. This paradigm involves feedback for participants in each round (by pressing the button, they receive feedback on whether it produces an outcome or not) and a measure of control that is based on past behavior.

These two paradigms capture two quite different situations. In our studies, we use paradigms that are similar to the second one, but we introduce the measures of control used in each paradigm. Thus, in our studies we examine perceptions of control by giving participants feedback on their actions (e.g., pressing a button), by using tasks including multiple rounds, and by measuring control with questions about predictions of control and past behavior. Importantly, we study people's perceptions of control across a full range of situations, from situations where actual control is zero or low to situations where actual control is high or complete. In this way, our studies introduce an experimental condition that is missing from most research on the illusion of control and co-variation assessment: an objectively high-control condition.

## STUDY 1: POOR CALIBRATION IN PREDICTING ONE'S CONTROL

Our first study examined how individuals' subjective sense of control is affected by their actual degree of control. Our main goal in this study was a critical test of the claim that people overestimate their control. Our study contributes to research on this topic by including a high-control condition.

### Method

*Participants*. Participants were 80 undergraduates at a northeastern university in the United States ($M_{age}$ = 21, *SD* = 2.03; 31% female) who participated in exchange for course credit in their introductory business courses.

*Design and procedure*. The study was described to participants as an experiment on attention and visual perception. Participants performed a vigilance task on computers. Specifically, their task was to examine a series of computer screens filled with random sequences of letters and to find instances of two same consecutive letters (e.g., “e e” in the sequence “r t e e f c”) and click on them. Ten different screens were displayed, each for 90 seconds. Each of these ten rounds was divided into 18 five-second intervals. Each five-second interval began with black letters presented on a white background. We then introduced an annoyance that made it more difficult for participants to complete the task: The background went black and the letters changed from white to violet, making them more difficult to read. This change occurred at a randomly determined point during the first three seconds of the five-second interval. In addition, there was a button on the screen that read “STAY WHITE.” If the button worked when participants pressed it, then the screen would remain white with black letters for the remainder of the five-second interval. Participants could press the “STAY WHITE” button only once within each five-second interval. Participants learned all of this information in the experimental instructions (reported in Appendix A). Note that in this task, finding correct instances of two same consecutive letters did not have any impact on whether the background changed color, but pressing the “STAY WHITE” button did.

In fact, pressing the “STAY WHITE” button kept the screen white with a certain probability *p*, where *p* varied across conditions. We manipulated participants’ actual level of control by varying the value of *p*. There were four conditions in the experiment: high control (*p* =

85%), medium control ($p$ = 50%), low control ($p$ = 15%), and no control ($p$ = 0%). We predicted that people would overestimate their control only in the low- and no-control conditions.

After completing the task, participants were asked the following questions, which were designed to assess their perceived control: (1) "How much control do you think you had when trying to stop the page-color switching?" (1 = no control at all; 7 = complete control); (2) "How often do you think pressing the 'STAY WHITE' button produced the desired outcome (keep the page white with black text)? Please indicate what percentage of the time pressing the button worked." (0 = never; 100 = always).

## Results

*Task performance*. We first examine the number of correct pairs participants were able to identify and the total number of times they clicked on the page to identify instances of two same consecutive letters. There were no significant differences in total number of instances participants correctly identified across conditions, $F(3, 76) < 1$, $p = .50$, $\eta^2 = .03$. Similarly, there were no significant differences across conditions in "false alarms," or incorrectly identified instances of two same consecutive letters, $F(3, 76) < 1$, $p = .42$, $\eta^2 = .04$.

*Perceived control*. As predicted, people overestimated their control in the low-control condition (24% versus the real probability equal to 15%), $t(19) = 6.04$, $p < .001$, and underestimated it in the high-control condition (39% versus the real probability equal to 85%), $t(19) = -7.77$, $p < .001$. These results are consistent with our main hypothesis and suggest that people systematically overestimate their control when it is objectively low and systematically underestimate it when it is objectively high. These results are summarized in Table 1 and depicted graphically in Figure 2.

The study included a second measure of perceived control, which consisted of a self-reported rating. As Table 1 shows, participants reported having more control in the high-control condition than in both the low-control condition, $t(38) = 2.97$, $p = .005$, and in the no-control condition, $t(38) = 3.56$, $p = .001$. These results suggest that participants realized there were differences in control across conditions, as reflected in their judgments of perceived control. Nonetheless, their estimates were regressive.

## Discussion

The results of Study 1 support the hypothesis that people systematically overestimate their control when they have low control and underestimate it when they have high control. These findings are inconsistent with the claim that people generally overestimate how much control they have (Taylor & Brown, 1988). However, we should note that our findings are not at odds with the empirical results from research on illusion of control, which has documented many important influences on people's subjective sense of control. Indeed, illusion-of-control studies rarely ask people directly to estimate their level of control (e.g., Langer, 1975; Langer & Roth, 1975). Instead, they include other measures, such as betting choices or predictions of future success, but do not directly elicit beliefs about individuals' perceived control using measures whose accuracy can be objectively assessed (Abramson & Alloy, 1980).

In Study 1, participants' estimates of button effectiveness when the button worked (i.e., in the high-control condition) were quite low. We believe this was due to the properties of the task employed in the study. By asking participants to focus on the goal of finding two same consecutive letters, they may have not pressed the "STAY WHITE" button as frequently as we expected, and thus they may not have exploited the opportunity to learn about how often the button worked in producing the desired outcome. Indeed, on average, the "STAY WHITE" button was pressed 78 times (*SD* = 60.30) across conditions out of a possible 180 times. In addition, the annoyance we used may not have been successful in making it more difficult for participants to complete the task. We address these potential limitations in Study 2.

## STUDY 2: EXAMINING SITUATIONS OF COMPLETE CONTROL

The goal of our second study was twofold. First, we wanted to replicate the same findings of Study 1 using a modified task that addresses the limitations noted above. Second, we extended the number of conditions considered when manipulating actual control and included a condition in which actual control was 100%.

### Method

*Participants*. Two-hundred twenty undergraduates at a large southeastern university in the United States ($M_{age}$ = 21, *SD* = 2.18; 51% female) participated in exchange for $7. Participants also had the opportunity to earn an additional $5 depending on their performance on the task.

*Design and procedure*. Our second study employed the same task and procedure of Study 1, with four differences. First, we lowered the brightness of each computer monitor in the lab room to make the annoyance used in the task more effective. Second, we introduced an incentive for participants, promising an additional $5 to those who correctly found more than 90% of the two consecutive same letter instances. Third, after participants read the initial instructions to the task and before they engaged in it, we asked them to guess the percentage of the time pressing the button would keep the screen white (0 = never; 100 = always). Finally, we considered a larger number of conditions for our manipulation of actual control. Specifically, we included seven levels of actual control: complete (100%), high (90%), medium-high (75%), medium (50%), medium-low (25%), low (10%), and no control (0%).

## Results

*Task performance.* As in Study 1, we did not find significant differences in the total number of instances participants correctly identified across conditions, nor in the total number of instances participants identified incorrectly (both $F$s < 1).

*Initial predictions.* We first examined the initial predictions participants made regarding the percentage of the time pressing the "STAY WHITE" button would keep the screen white. Such predictions did not differ across conditions ($F < 1$). As shown in Table 2, on average participants predicted the button would work almost 45% of the time.

*Estimates of control.* The mean values for our measures of perceived control are reported in Table 2 and depicted graphically in Figure 3. Replicating the results of Study 1, people overestimated their control in the no-control condition (22% versus the real probability equal to 0%, 95% confidence interval of the difference=[17.49, 25.74]), in the low-control condition (26% versus the real probability equal to 10%, $t[30] = 5.04$, $p < .001$), and in the medium-low condition (34% versus the real probability equal to 25%, $t[31] = 2.19$, $p < .04$). At the same time, they underestimated their control in the high-control condition (73% versus the real probability equal to 90%, $t[30] = -10.91$, $p < .001$) and in the medium-high control condition (56% versus the real probability equal to 75%, $t[31] = -8.87$, $p < .001$). Interestingly, in the medium-control condition, participants still underestimated their level of control (42% versus the real probability equal to 50%, $t[31] = -2.76$, $p = .01$). In the complete-control condition, all participants except for one indicated that the button worked 100% of the time. This result is consistent with our proposed model for people's perceptions of control (see Figure 1).

Study 2 also included the second measure of perceived control used in Study 1. As Table 2 shows, the results for the self-reported measure of perceived control are consistent with participants' estimates of button efficacy. Participants' ratings of perceived control suggest that they realized there were differences in control across conditions. Nonetheless, their estimates were regressive.

## Discussion

The results of Study 2 provide further support for our main hypothesis. We find two opposite errors that occur at the floor and the ceiling of actual control: people overestimate their control when they have low control and underestimate it when they have high control. Consistent with our proposed model, the linear and regressive relationship between perceived and actual control broke down as the level of actual control approached 100%. At a 90% level of actual control, we still observed underestimation of perceived control, but when actual control was complete (100% actual control condition), participants' estimates of control were accurate.

When describing our proposed model, we suggested that another condition under which the model would break down is the one in which actual control is zero and there is no opportunity for participants to influence the desired outcome. We conducted a study on a non-overlapping group of participants from the same population as in Study 1 ($N = 32$) and presented them with the same task used in Study 2. However, this time there was no "STAY WHITE" button they could press. As one would expect, when asked to estimate their control over the action producing the desired outcome (page color-switching), all participants indicated they had no control.

## STUDY 3: MOTIVATION AND ILLUSION OF CONTROL

As we have noted, almost all the past research on illusory control has employed tasks in which participants had little or no actual control. Yet one of the more important studies in the literature on perceived control actually did include a high-control condition: Alloy and

Abramson's (1979) first experiment. The authors used a paradigm in which participants were presented with a series of events—e.g., a green light that either came on or not over a series of rounds—and were asked to estimate how much they could control the appearance of the light by pressing a button. Participants had to decide whether or not to press the button and then observed whether the light came on. In the high-control condition, the light came on with 75% probability when a participant pushed the button and never came on when the participant didn't push it. Alloy and Abramson's (1979) first experiment also included a no-control condition and a moderate-control condition in which the light appeared with 0% or 25% probability, respectively, when a participant pushed the button.

*Measuring Perceived Control*

Alloy and Abramson asked their participants to estimate how much control they had in the experiment; however, the researchers' measure has problems that limit its value as a measure of the accuracy of participants' perceived control.[2] Specifically, it lacks a clear normative benchmark, thus rendering it mute on the issue of bias. Alloy and Abramson (1979) gave their participants a button to press and varied two contingencies: (1) the percentage of the time the light came on after the button had been pressed, and (2) the percentage of the time the light came on without the button having been pressed. They then asked their participants to estimate (in percentage terms) how much control the button gave them over the illumination of the light. Alloy and Abramson asserted that the correct answer to this question was the absolute difference between (2) and (1). So, for example, if the light comes on 60% of the time when you press the button and 40% of the time when you don't, then Alloy and Abramson's difference formula says you have 20% control (60% minus 40%). However, this formula is normatively questionable,

---

[2] Thanks in part to the influence of Alloy and Abramson's work, others have followed their example (Thompson et al., 2007).

and there is no evidence that the study's participants agreed that it represented the right way to quantify control. Researchers have rightly criticized such difference scores for their numerous methodological problems, which can contribute to errors in the interpretation of research findings (e.g., Edwards, 1993; 1994; Johns, 1981; Nunnally, 1962).[3]

Our third study employed Alloy and Abramson's (1979) popular "button-light" paradigm. However, we used a less controversial measure of perceived control. In Study 3, we asked participants to estimate both the probability the light would come on when they pressed the button and when they did not press the button. One benefit of this approach is that it allows us to "unconfound" the extremes of control with the extremes of the response scale. For example, if both pressing and not pressing the button produce the desired outcome (in our study, the appearance of a blue circle on a computer screen) with 50% probability, then pushing the button exerts no control over the outcome. However, it is still possible to underestimate the efficacy of button-pushing by reporting that the button comes on less than 50% of the time following a button-push. For Alloy and Abramson's difference measure, by contrast, this situation represents zero control, and the only possible error participants could make would be to overestimate control. Thus, our third study includes measures related to estimates of contingency between one's responses and outcomes as well as estimates of perceived control.

In addition to employing better measures of perceived control than those used in prior research, our study also allows us to assess a recent theoretical account of the illusion of control. We describe this theory next.

---

[3] As noted by Thompson et al., 2007 (p. 76), Alloy and Abramson's (1979) first experiment also had a significant flaw: "Reinforcement—the number of times in which the light came on—was confounded with the degree of control the participants had. Participants received fewer green lights as the extent of control they had over the task increased, so reinforcement and control were negatively correlated and, therefore, confounded in the study. Because reinforcement has a strong effect on control judgments, it is possible that the low rate of reinforcement when actual control was high depressed control judgments in the actual control conditions."

*The Control Heuristic*

Langer's (1975) original explanation for the illusion of control was based on people's confusion of skill and chance situations. In their 1998 review of the literature on illusion of control, Thompson, Armstrong, and Thomas criticized this explanation for being more descriptive than explanatory. In addition, they suggested that the factors that increase or reduce illusions of control are broader than those factors that promote confusion between skill and chance situations.

Other explanations for the illusion of control have focused on motivation and self-efficacy beliefs (e.g, Alloy & Abramson, 1979; Bandura, 1977; Crocker, 1981; Langer, 1975). Building on these approaches, Thompson et al. (1998) suggested a new explanation for the illusion of control. The authors argued that people use a control heuristic when estimating their control over obtaining a certain outcome; namely, people estimate perceived control based on their judgments of *connection* (between their action and the outcome) and *intention* (of obtaining the desired outcome). Thus, according to this heuristic, perceived control is high when people can see a connection between their actions and an outcome and when they act with the intention of obtaining the outcome (Thompson et al., 1998; Thompson et al., 2007). The following example nicely depicts how this heuristic works (see Thompson et al., 2004: p. 316):

> If Peter is highly motivated to believe he can control his health, he might take an herbal supplement, echinacea, with the goal of avoiding colds and the flu. Every time taking the supplement is followed by a period of good health, the connection between his behavior and the outcome is established. The outcome is also one he intended by taking the supplement, so Peter is likely to judge that he has control, regardless whether taking echinacea was responsible for his good health.

In an experiment that manipulated desire for the outcome, Thompson et al. (2004) used the control heuristic to explain differences in the degree to which people overestimate their control. This study was well designed, and its results are both useful and important. However, it is of limited value for helping us test our theory because it provided participants with zero control in all conditions. Thus, the study leaves unanswered the question of how well the control heuristic explains people's perceptions of control when actual control is greater than zero. In our third study, we used a manipulation of motivation similar to that used by Thompson et al. (2004, 2007). We tested whether their results generalize to a circumstance in which people actually have some control, and we used more interpretable measures of control than the problematic difference measure used by Alloy and Abramson (1979) or by Thompson et al. (2007).

Method

*Participants*. One hundred and two college students at a large southeastern university in the United States ($M_{age}$ = 21, *SD* = 1.83; 53% female) participated in the study for pay. On average, participants received $10 for their participation in the study (including a $3 show-up fee).

*Design and procedure*. The experiment employed a 2 (actual control: high control vs. low control) x 2 (motivation: pay vs. no-pay) between-subjects design. Upon arriving at the laboratory, participants were seated at computers and were randomly assigned to one of the four experimental conditions.

Participants were presented with one of two contingency problems, which differed in their degree of contingency or control. The procedure and instructions for each of the two contingency-problem groups were identical. Participants could make one of two possible responses (using a computer mouse to press or not press a button shown on the screen) and receive one of two possible outcomes (the appearance of a blue circle or no blue circle). As in Alloy and Abramson's (1979) study, all participants were told that in this problem-solving experiment, their task was to learn what degree of control they had over whether or not a blue circle appeared on the screen and that they had the option of pressing or not pressing the button in each trial. In addition, participants in the pay condition were told that they would receive $.20 every time the blue circle appeared on the screen during the 40 trials, for a maximum possible payment of $8.

More specifically, for each round, after the word "START" appeared on the screen, participants had the option of pressing a button. If they wanted to press the button on a given round, they had to press it within two seconds after the word "START" appeared. In the last second of each three-second trial, after participants had pressed the button (or not), a blue circle sometimes appeared on the screen. Its appearance depended on their response and on the contingency problem to which they had been assigned. The interval between trials lasted half a second.

Before the experiment started, participants learned that there were four possibilities for any given round: "1) you press and the blue circle does appear; 2) you press and the blue circle does not appear; 3) you don't press and the blue circle does appear; 4) you don't press and the blue circle does not appear." Participants also read, "You will play 40 rounds. After the 40 rounds, you will be asked to indicate how much control you think you had over the appearance of the blue circle. It may turn out that you will have no control, that is, your responses will not affect the appearing of the blue circle, or it may turn out that you will have some degree of control, either complete or intermediate, that is, one response produces the appearing of the blue circle more often than does the other."

After completing 40 trials, participants answered a series of questions that appeared in a different randomly determined order for each participant. Specifically, we asked participants to (1) "rate the degree of control your actions (pressing and not pressing the button) exerted over the outcome (appearance of the blue circle)" using a percentage between 0 and 100%. This question replicates the way that Alloy and Abramson (1979) and Thompson et al. (2007) elicited perceptions of control. In addition, we asked participants: (2) "Please estimate the percentage of rounds on which the blue circle appeared regardless of which response you made," (3) "Please estimate the percentage of rounds on which the blue circle appeared when you pressed," and (4) "Please estimate the percentage of rounds on which the blue circle appeared when you did not press."

We manipulated control by varying the rate at which the two possible actions (pushing or not pushing the button) produced a blue circle on the screen. In the high-control condition, one action produced the blue circle 90% of the time, whereas the other one produced the blue circle 10% of the time. In this condition, actual control was 80%, according to Alloy and Abramson's (1979) difference measure. In the low-control condition, one action produced the blue circle 60% of the time, whereas the other action produced the blue circle 40% of the time. In this condition, actual control equaled 20%, according to Alloy and Abramson. We counterbalanced whether pressing or not pressing the button was more likely to produce the blue circle in order to rule out the possibility that attributions of control would be biased by a natural tendency to associate action (pushing the button) with producing a consequence.

## Results

*Button-pressing*. On average, people pressed the button in 23 of the 40 rounds. Our manipulations affected button-pressing, as revealed by a 2 (control) x 2 (action: press vs. no-press) x 2 (motivation) ANOVA. Participants pressed the button more often when pressing improved their chances of getting the blue circle ($M$ = 27.96, $SD$ = 9.78) than when it did not ($M$ = 17.50, $SD$ = 11.23), $F$ (1, 94) = 30.52, $p$ < .001, $\eta^2$ = .25. The motivation x action interaction emerged as highly significant, $F$ (1, 94) = 15.40, $p < .001$, $\eta^2 = .14$, since payment led the action manipulation to have a strong effect. This is because when participants knew they would be paid for getting a blue circle, they pressed the button a great deal when pressing improved their chances of getting the blue circle ($M$ = 30.62, $SD$ = 8.38), and when *not* pressing improved their chances of getting a blue circle, they pressed much less ($M$ = 12.67, $SD$ = 10.53), $t(51) = 6.85$, $p < .001$. When they weren't being paid for getting a blue circle, the action manipulation did not have a significant effect on participants' overall rate of button-pushing ($M$ = 25.08, $SD$ = 10.53 vs. $M$ = 22.72, $SD$ = 9.65), $t(47) < 1$, $p = .42$. Finally, the control x action interaction was also significant, $F$ (1, 94) = 15.25, $p < .001$, $\eta^2 = .14$. When participants had high control, they pressed the button more often when pressing improved their chances of getting the blue circle ($M$ = 29.81, $SD$ = 8.51) than when it did not ($M$ = 11.69, $SD$ = 9.61), $t(50) = 7.20$, $p < .001$. But when participants had low control, they did not differ in their button-pushing behavior ($M$ = 25.96, $SD$ = 10.82 vs. $M$ = 23.31, $SD$ = 9.73), $t(48) < 1$, $p = .37$.

*Perceptions of control*. The first question on the post-task questionnaire asked participants to rate their level of control over the outcome. We submitted their answers to a 2 (control) x 2 (action: press vs. no-press) x 2 (motivation) ANOVA. The results revealed a main effect for control: Those in the high-control condition estimated they had 64% control ($SD$ = 26.75), whereas those in the low-control condition estimated they had 30% control ($SD$ = 17.42), $F$ (1, 94) = 55.21, $p < .001$, $\eta^2 = .37$. The main effect for motivation was also significant, $F$ (1, 94) = 5.64, $p = .02$, $\eta^2 = .06$: participants with a monetary incentive estimated their level of control as higher ($M$ = 53.57, $SD$ = 23.54) than did those in the no-pay condition ($M$ = 40.41, $SD$ = 30.97). This result is consistent with the "control heuristic" theory of Thompson and her colleagues, which suggests that the motivation to exert control leads to increases in perceived control. We found no other significant effect in this analysis.[4]

*Estimates of contingency*. Our concerns regarding the correct interpretation of this first vague question led us to include more specific questions. We asked our participants to estimate (a) the percentage of the time the blue circle appeared on the screen after they pressed the button and (b) the percentage of time the blue circle appeared when they did not push the button. Based on these two questions, we created a measure for perceived success of the efficacious action (either pressing or not pressing the button). This measure was equal to participants' answer to either question (a) or (b), depending on whether they were in the condition in which pressing (or not pressing) the button was more likely to produce the blue circle. This measure allows us to determine whether participants over- or underestimated control. Participants' responses do not appear to show overestimates of control. In the high-control condition, efficacious action produced the blue circle with 90% probability, and participants estimated that it worked 60% of the time ($SD$ = 33.68). A one-sample t-test shows that this figure is significantly below the actual value of 90%, $t(51) = -6.37$, $p < .001$.

In the low-control condition, the efficacious action was followed by the blue circle 60% of the time, but participants estimated that the action worked only 41% of the time ($SD$ = 18.17). This is a significant underestimate, $t(50) = -7.30$, $p < .001$. Our paradigm made it possible even for those in the low-control condition to underestimate their level of control, and they did.

A 2 (control) x 2 (motivation) ANOVA revealed that the perceived success rate of the efficacious action was influenced by our manipulation of control ($F$ [1, 98] = 11.49, $p = .001$, $\eta^2$

[4] While we have previously discussed the limitations of the commonly used measure of perceived control, we report the following additional analyses for the reader interested in the results we obtained using the measure in our third study. In the high-control condition, participants significantly underestimated their level of control (64% versus the "real" probability equal to 80%, $t[51] = -4.33$, $p < .001$). And in the low-control condition, participants significantly overestimated their level of control (30% versus the "real" probability equal to 20%, $t[49] = 4.02$, $p < .001$).

= .11) and by motivation ($F$ [1, 98] = 4.00, $p < .05$, $\eta^2 = .04$) in the expected direction. The control x motivation interaction was insignificant. These results are summarized in Table 3. The presence of an effect for motivation is consistent with the “control heuristic” posited by Thompson and her colleagues (1998, 2004, 2007).

*Additional analyses*. We conducted further analyses to test the influence of pressing the button on perceptions of control as measured by participants’ perceived success of the efficacious action. We hypothesized that such button pressing would moderate the relationship between actual control and perceived control, such that actual control would be associated with perceived control only when participants had engaged in enough trials to gather information about the outcomes of their actions. We tested this hypothesis using the moderated regression procedures recommended by Aiken and West (1991). We standardized the button-pressing behavior variable and then multiplied it by the actual control variable to create an interaction term. In our regression analyses, we controlled for the motivation manipulation and its interactions with actual control. The results of our regression analyses are displayed in Table 4. We found a significant interaction between actual control and button pressing. To interpret the form of this interaction, we plotted the simple slopes for the relationship between actual control and perceived control at one standard deviation above and below the mean of button pressing (see Figure 4). When participants pressed the button rarely, actual control was not associated with perceived control ($\beta = .16$, $p = .20$). When participants pressed frequently, the simple slopes indicated that actual control was associated with perceived control ($\beta = .61$, $p < .001$). Thus, the number of times participants pressed the button moderated the relationship between actual control and perceived estimated success of the blue-circle-producing action.

## Discussion

The results of our third study provide further support for our main hypothesis: individuals have inaccurate perceptions of control and their estimates of contingency are also miscalibrated. Our third study also casts further doubt on the conclusion that people generally overestimate how much control they have. Indeed, we observe a general *underestimation* of control. Consistent with the control heuristic theory proposed by Thompson and her colleagues, our third study also finds support for the role of motivation in inflating people's estimates of personal control: Participants' judgments of control were higher when they had an incentive to be effective (i.e., participants were paid when the blue circle appeared on the screen). However, even those paid for blue circles underestimated their control in the high-control condition. And the effect of motivation did not interact with the actual degree of control, suggesting that these two influences on perceived control are most appropriately modeled with these two parameters as main effects (see Krueger & Clement, 1997).

# GENERAL DISCUSSION

The issue of whether people overestimate their control over probabilistic events has obvious implications for a number of important domains. For instance, people who overestimate their control over others will make incorrect attributions regarding their influence over others' behavior (Morris, Sim, & Girotto, 1998). Those who overestimate their personal control may make bad decisions about where to direct their efforts (Ajzen, 1991; Vroom, 1964), whether or not to listen to others' opinions (Gino & Moore, 2007; Tost, Gino, & Larrick, 2010), or about whether to enter a market or start a new business (Moore & Cain, 2007; Moore, Oesch, & Zietsma, 2007). Overestimates of control may make people too slow to respond to feedback that suggests their efforts are misplaced (Pearce & Porter, 1986). On the other hand, the positive illusions literature claims that an exaggerated sense of personal control is conducive to mental health and persistence through life's many frustrations (Taylor & Brown, 1988).

Given the relevance of accuracy in estimation of personal control, it is probably no surprise that many scholars have studied when and why people overestimate their control. This research has found that people behave as if they think they can exert more control over avoiding accidents when they are driving (Horswill & McKenna, 1999), over games of chance (Langer, 1975, 1977), and over the onset of a light in laboratory tasks (Alloy & Abramson, 1979) than objective circumstances warrant. Based on this and related evidence, scholars have concluded that people suffer from an illusion of control. In the words of Russo and Shoemaker (1989, p. 173): "People often exaggerate the extent to which they control events." Thompson's 2008 textbook tells us: "The illusion of control refers to the tendency for people to believe that they exert more influence over situations than they actually do." And Gilbert (2006) writes, "Our desire for control is so powerful, and the feeling of being in control is so rewarding, that people often act as though they can control the uncontrollable" (p. 22).

Do people systematically overestimate their control? We believe there is reason to doubt that they do. We found little evidence of systematic overestimation of control in our three studies. Indeed, the only circumstance in which our participants overestimated their control was when they had very little control and when our measure made it difficult or impossible for them to underestimate their control. We have presented a theoretical model for understanding people's perceptions of control. The model is based on a very simple assumption: It is common for people to make errors regarding how much control they have. Consequently, when control is objectively low, people tend to overestimate it. When control is objectively high, however, we expect people to underestimate it. By focusing on domains in which people have little control, prior research has created the illusory impression that overestimation of control is more frequent than it actually is. Here, we have provided what we believe is a more comprehensive account of control perceptions by examining a full range of situations where actual control vary from 0% to 100%.

It is also interesting to note that, contrary to prior research on the illusion of control, the grand mean of the estimates participants provided for perceived control was too low across our studies. This mean-level effect is orthogonal to our regression account, but it is important to point out, as it suggests that the general tendency of people to overestimate control may not be universal.

*Limitations*

Our model has little to say about the many moderators of perceived control that previous research has documented. For instance, Gollwitzer has shown that people are more likely to perceive control where there is none when they are in an implemental rather than a deliberative mindset (Gollwitzer & Kinney, 1989; Heckhausen & Gollwitzer, 1987; Taylor & Gollwitzer, 1995).[5] Furthermore, it may be the case that depression and/or dysphoria are associated with reductions in perceived control (Alloy & Abramson, 1979; Alloy, Abramson, & Viscusi, 1981). A number of other factors also influence the tendency for people to feel they have control, including the presence of competition or skill-related performance (Thompson et al., 1998). We do not question that these factors are important, and we believe future research would benefit from examining how they interact with actual level of control to influence perceived control.

We do question, however, whether there is a general tendency to overestimate one's level of control. The results of previous studies in which participants have zero control provide weak

[5] An implemental mindset involves thinking about an object (e.g., vacation) in the context of a plan (e.g., How will I plan my vacation?), while a deliberative mindset involves thinking about the same object using a deliberative choice (e.g., Should I go on a vacation or not?). The two types of mindset can influence how people handle available information.

evidence on the question, since the designs of these experiments usually make it impossible for people to underestimate control. Any error in participants' estimates of control must result in overestimates. In our third experiment, where our design makes it possible for participants in the low-control condition to underestimate their degree of control, we do in fact find that they underestimate their control.

Our findings need to be qualified by a number of limitations that suggest directions for future research. First, across our experiments, we asked participants to estimate their level of control over the link between *past* actions and outcomes. As we noted earlier, the classic studies by Langer and colleagues on the illusion of control employed paradigms in which participants estimated their level of control over the link between *future* actions and outcomes. Thus, if we restrict the use of the label "illusion of control" for cases in which perceptions of control are measured by using this classic paradigm, then we still cannot draw conclusions about people's tendency to over or under-estimate their control over future actions in the presence of uncertainty based on the results of our studies. Future studies investigating individuals' perceptions of control over both future and past events characterized by different levels of objective control may further advance our understanding of people's judgments of perceived control.

Second, in presenting our model, we did not provide details on how exactly regressive judgments might arise in illusion of control or co-variation assessment tasks. We believe that regressive judgments result from the following simple model: Observed frequency on an event (which may be close to the true frequency of the event) plus error plus prior beliefs. In this model, the error term would incorporate both psychological factors and random noise. Our studies cannot clearly demonstrate whether this type of model and errors are the ones people are using in estimating personal control. Future research could explore this model directly with the goal of identifying the weight each of the factors has in determining the degree of control people perceive they have over outcomes that are completely or partly determined by chance. Future research could also examine other mechanisms that may lead people to make regressive estimates. One such factor is uncertainty; people may be uncertain about how much control they have over outcomes. These two mechanisms, error and uncertainty, differ in an important way: while error leads to increased variance in individuals' estimates, uncertainty leads to reduced variance.[6] Future research investigating these mechanisms directly would deepen our understanding of how people make regressive judgments when they estimate their level of control over outcomes.

Future work on people's perceptions of control could also examine individuals' estimate at a higher level of granularity. In our studies, we compared participants' estimates of success rates by representing control to the objective level of control. In the future, studies could compare participants' estimates directly to their observations over the rounds included in the task. In addition, as we did in Study 3, future studies could employ various measures of control that include both self-reports and estimates of contingency and success. Finally, research could examine the types of heuristics people use to form their estimates of control and the factors that led them to choose one heuristic over another. These various investigations would advance our understanding of the psychology of perceived control.

*Theoretical Implications*

The results of our three studies cast doubt on the claim that people systematically overestimate their control. Our research underscores the importance of examining the complete range of actual control in the study of judgments of personal control. We suggested that a complete picture takes into account both task characteristics (e.g., the level of actual control) and

[6] We thank an anonymous reviewer for making this suggestion.

different influences on perceptions (e.g., depression). Future research could investigate the role of other factors, such as task familiarity or dispositional optimism, in estimation of personal control.

Our work contributes to decision-making research on overconfidence and better-than-average effects. This body of work has found that perceptions of ability and performance are driven powerfully by characteristics of the task (e.g., its difficulty). Here, we have demonstrated that similar errors in judgment occur when people estimate their personal control over outcomes. Our results do not suggest that people are necessarily directionally biased (to either overestimate or underestimate control), but they are nevertheless inaccurate in their estimation of personal control. Furthermore, to the best of our knowledge, our research provides the first attempt to clearly distinguish between perceptions of personal control and general regression effects in individuals' assessment of co-variation, as actual control varies from low to high levels.

Finally, our work contributes to prior literature on personal control. Across disciplines, ranging from psychology and anthropology to sociology and organizational behavior, various scholars have examined the effects that personal control over one's work environment has on both the individual and the organization (e.g., Deci & Ryan, 1985; Holzberg & Giovannini, 1981; Thomas, 1989). For instance, this research has found that personal control facilitates work involvement and workplace satisfaction (see Ashforth & Saks, 2000 for in-depth discussion). Our research suggests that perceptions of control are often inaccurate, with potentially relevant consequences for people's behavior in the workplace. Future research could investigate how organizations and their managers can successfully reduce inaccuracies in workers' perceptions of control.

### *Practical Implications*

There are a great many important situations in life over which people have very little control. Some of these situations have relevant implications for both group and organizational processes and outcomes. For instance, people might overestimate the control they have in hiring excellent employees, the success of a new product, or the chances their entrepreneurial venture will succeed. It ought not be surprising that people are eager to find ways of influencing these events and that some inevitably will adopt superstitious beliefs that overestimate their control (Matute, 1994, 1995). To a great extent, this is simply a product of the fact that it is not possible to underestimate control when one has none; any mistake in estimating control can only lead to overestimation. We are reluctant to accuse pedestrians in New York of suffering from the illusion of control if they push the "walk" button, as it is reasonable for them to believe that pushing the button could speed their crossing.

There are a number of practical implications of the effects observed in our studies. When people overestimate their degree of control, they may engage in easy strategies to achieve a particular outcome and avoid the more difficult actions that may be needed. For instance, if a manager overestimates her control over the success of a merger or the launch of a new product, she may spend too little time questioning the project's viability at the outset. Similarly, if a prospective perceives that she has more control over her negotiated salary than is warranted, she may use ineffective strategies in the negotiation. Similar inefficiencies in the use of time, strategies, and resources may also occur when people *underestimate* their control. In this case, people may not exert the maximum effort required to successfully accomplish a task (e.g., working extra hours) because they underestimate their control over the outcome (e.g., obtaining a promotion). A better understanding of when judgments of personal control are likely to be inaccurate may help to educate people about the ways in which their estimates of personal control are miscalibrated.

*Conclusion*

Most studies of the illusion of control and co-variation assessment have used contexts or tasks in which participants had little or no control (e.g., Alloy & Abramson, 1979; Langer, 1975; Thompson et al., 2004). This research has found that people tend to overestimate their control. In this paper, we suggest that by focusing on situations marked by low control, prior research has created the illusion that people systematically overestimate their level of control. Consistent with this previous research, we find that people overestimate their control when their actual control is low or zero. However, when their actual control is high, we find that they tend to underestimate it. These results suggest a simpler and more mundane explanation of how people judge their degree of control over desired outcomes: they inaccurately estimate their personal control.

# Appendix A

## Instructions used in Study 1

ATTENTION AND VISUAL PERCEPTION

In this experiment, we are interested in understanding the impact of distractions on visual perception. You will play 10 rounds of the same game.

In each round, you will be presented with a screen full of letters in random sequence.

Your goal in each round is to find all the instances of two same consecutive letters (for example "g g" or "r r"). Click on the letters with the mouse to get them to count. Each round will last for 90 seconds.

Every few seconds, the colors on your screen may change: from black ink on white page it changes to violet ink on black page.

There is a button on the screen that says "STAY WHITE". The button will appear on the top left corner of your computer screen.

You can press this button only once in every five-second interval.

Pressing the "STAY WHITE" button may help keep the screen white. If it works, then the screen will stay white with blank ink for the remainder of the 5-second interval.

To start the experiment, press the "CONTINUE" button below.

Good luck!

References

Abramson, L. Y., & Alloy, L. B. (1980). Judgment of contingency: Errors and their implications. In A. Baum & J. E. Singer (Eds.), *Advances in environmental psychology* (Vol. 2, pp. 111). New York: Erlbaum.

Aiken, L. S., & West, S. G. (1991). *Multiple Regression: Testing and interpreting interactions*. Newbury Park, CA: Sage.

Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes, 50*(2), 179-211.

Alloy, L. B., & Abramson, L. Y. (1979). Judgment of contingency in depressed and nondepressed students: Sadder but wiser? *Journal of Experimental Psychology: General, 108*, 441-485.

Alloy, L. B., Abramson, L. Y., & Viscusi, D. (1981). Induced mood and the illusion of control. *Journal of Personality and Social Psychology, 41*(6), 1129-1140.

Alloy, L. B., & Seligman, M. E. P. (1979). On the cognitive component of learned helplessness in animals and man. In G. Bower (Ed.), *The psychology of learning and motivation*. New York: Academic Press, 219-276.

Alloy, L. B., & Tabachnik, N. (1984). Assessment of co-variation by humans and animals: The joint influence of prior expectations and current situational information. *Psychological Review*, *91*, 112-149.

Ashforth, B. E., & Saks, A. M. (2000). Personal control in organizations: A longitudinal investigation with newcomers. *Human Relations, 53*, 311-339.

Ayeroff, F., & Abelson, R. P. (1976). ESP and ESB: Belief in personal success at mental telepathy. *Journal of Personality and Social Psychology*, *34*, 240-247.

Bandura, A. (1977). Self-efficacy: Toward a unifying theory of behavioral change. *Psychological Review, 84*, 191-215.

Benassi. V. A., Sweeney, P. D., & Drevno, G. E. (1979). Mind over matter: Perceived success at psychokinesis. *Journal of Personality and Social Psychology*, *37,* 1377-1386.

Burson, K. A., Larrick, R. P., & Klayman, J. (2006). Skilled or unskilled, but still unaware of it: how perceptions of difficulty drive miscalibration in relative comparisons. *Journal of Personality and Social Psychology*, *90*(1), 60-77.

Crocker, J. (1981). Judgment of covariation by social perceivers. *Psychological Bulletin, 90*(2), 272-292.

Crocker, J. (1982). Biased questions in judgment of covariation studies. *Personality and Social Psychology Bulletin*, *8,* 214–220.

Dawes, R. M., & Mulford, M. (1996). The false consensus effect and overconfidence: Flaws in judgment or flaws in how we study judgment? *Organizational Behavior and Human Decision Processes*, *65*, 201-211.

Deci, E. L., & Ryan, R. M. (1985). The general causality orientations scale: Self-determination in personality. *Journal of Research in Personality*, *19*, 109-134.

Dunn, D. S., & Wilson, T. D. (1990). When the stakes are high: A limit to the illusion-of-control effect. *Social Cognition, 8*(3), 305-323.

Dykman, B. M., Abramson, L. Y., Alloy, L. B., & Hartlage, S. (1989). Processing of ambiguous and unambiguous feedback by depressed and nondepressed college students: Schematic biases and their implications for depressive realism. *Journal of Personality and Social Psychology*, *56,* 431-445.

Edwards, J. R. (1993). Problems with the use of profile similarity indices in the study of congruence in organizational research. *Personnel Psychology*, 46, 641-665.

Edwards, J. R. (1994). The study of congruence in organizational behavior research: Critique and a proposed alternative. *Organizational Behavior and Human Decision Processes*, 58, 51-100.

Erev, I., Wallsten, T. S., & Budescu, D. V. (1994). Simultaneous over- and underconfidence: the role of error in judgment processes. *Psychological Review*, 101, 519-527.

Fiske, S. T., & Taylor, S. E. (1984). *Social cognition* (1st ed.). Reading, MA: Addison-Wesley.

Flming, J., & Darley, J.M. (1989). Perceiving choice and constraint: The effects of contextual and behavioral cues on attitude attribution. *Journal of Personality and Social Psychology, 56*, 27-40.

Gilbert, D. T. (2006). *Stumbling on happiness*. New York: Random House.

Gino, F., & Moore, D. A. (2007). Effects of task difficulty on use of advice. *Journal of Behavioral Decision Making*, *20*(1), 21-35.

Goffman, E. (1967). *Interaction ritual: Essays on face-to-face behavior*. Garden City, NY: Anchor.

Gollwitzer, P. M., & Kinney, R. F. (1989). Effects of deliberative and implemental mind-sets on illusion of control. *Journal of Personality and Social Psychology, 56*(4), 531-542.

Heath, C., & Tversky, A. (1991). Preference and belief: Ambiguity and competence in choice under uncertainty. *Journal of Risk and Uncertainty, 4*, 5-28.

Heckhausen, H., & Gollwitzer, P. M. (1987). Thought contents and cognitive functioning in motivational versus volitional states of mind. *Motivation and Emotion, 11*(2), 101-120.

Holzberg, C. S., & Giovannini, M. J. (1981). Antropology and industry: Reappraisal and new directions. In B. J. Siegel, A. R. Beals and S. A. Tyler (Eds), *Annual review of anthropology*, Vol. 10, Palo Alto, CA: Annual Reviews (pp. 317-360).

Horswill, M. S., & McKenna, F. P. (1999). The effect of perceived control on risk taking. *Journal of Applied Social Psychology*, *29*, 377–391.

Jenkins, H. H. & Ward, W. C. (1965) Judgement of contingency between responses and outcomes. *Psychological Monographs*, *79* (1, Wole No. 79).

Johns, G. (1981). Difference score measures of organizational behavior variables: A critique. *Organizational Behavior and Human Performance, 27*, 443-463.

Juslin, P. (1994). The overconfidence phenomenon as a consequence of informal experimenter guided selection of almanac items. *Organizational Behavior and Human Decision Processes, 57*, 226-246.

Krueger, J. I. (2000). The projective perception of the social world: A building block of social comparison processes. In J. Suls & L. Wheeler (Eds.), *Handbook of social comparison: Theory and research* (pp. 323-351). Dordrecht, Netherlands: Kluwer Academic Publishers.

Krueger, J. I., Acevedo, M., & Robbins, J. M. (2005). Self as sample. In K. Fiedler & P. Juslin (Eds.), *Information sampling and adaptive cognition* (pp. 353-377). New York: Cambridge University Press.

Krueger, J. I., & Clement, R. W. (1997). Estimates of social consensus by majorities and minorities: The case for social projection. *Personality and Social Psychology Review, 1*(4), 299-313.

Kruger, J., & Dunning, D. (1999). Unskilled and unaware of it: How difficulties in recognizing one's own incompetence lead to inflated self-assessments. *Journal of Personality and Social Psychology*, *77*(6), 1121–34.

Krueger, J. I., & Mueller, R. A. (2002). Unskilled, unaware, or both? The better-than-average heuristic and statistical regression predict errors in estimates of own performance. *Journal of Personality and Social Psychology, 82*(2), 180-188.

Langer, E. J. (1975). The illusion of control. *Journal of Personality and Social Psychology, 32*(2), 311-328.

Langer, E. J. (1977). The psychology of chance. *Journal for the Theory of Social Behaviour*, 7, 185–207.

Langer, E. J., & Roth, J. (1975). Heads I win, tails it's chance: The illusion of control as a function of the sequence of outcomes in a purely chance task. *Journal of Personality and Social Psychology, 32*(6), 951-955.

Larrick, R. P., Burson, K. A., & Soll, J. B. (2007). Social comparison and confidence: When thinking you're better than average predicts overconfidence (and when it does not). *Organizational Behavior and Human Decision Processes*, 102, 76-94.

Luo, M. (2004, February 27). For exercise in New York futility, push button. *New York Times*.

Matute, H. (1994). Learned helplessness and superstitious behavior as opposite effects of uncontrollable reinforcement in humans. *Learning and Motivation, 25*(2), 216-232.

Matute, H. (1995). Human reactions to uncontrollable outcomes: Further evidence for superstitions rather than helplessness. *The Quarterly Journal of Experimental Psychology B: Comparative and Physiological Psychology, 48*(2), 142-157.

Matute, H. (1996). Detecting response-outcome independence in analytic but not in naturalistic conditions. *Psychological Science, 7*(5), 289-293.

McFarland, C., & Miller, D.T. (1990). Judgments of self-other similarity: Just like others only more so. *Personality and Social Psychology Bulletin*, *16*, 475-484.

Miller, D. T., & Ross, M. (1975). Self-serving biases in the attribution of causality: fact or fiction? *Psychological Bulletin*, *82*, 213-225.

Moore, D. A. & Cain, D. M. (2007). Overconfidence and underconfidence: When and why people underestimate (and overestimate) the competition. *Organizational Behavior and Human Decision Processes*, *103*, 197-213.

Moore, D. A., & Healy, P. J. (2008). The trouble with overconfidence. *Psychological Review*, 115(2), 502-517.

Moore, D. A., Oesch, J. M., & Zietsma, C. (2007). What competition? Myopic self focus in market entry decisions. *Organization Science*, *18*(3), 440-454.

Moore, D. A., & Small, D. (2007). Error and bias in comparative social judgment: On being both better and worse than we think we are. *Journal of Personality and Social Psychology*, 92(6), 972-989.

Morris, M. W., Sim, D. L. H., & Girotto, V. (1998). Distinguishing sources of cooperation in the one-round prisoner's dilemma: Evidence for cooperative decisions based on the illusion of control. *Journal of Experimental Social Psychology, 34*(5), 494-512.

Nunnally, J. C. (1962). The analysis of profile data. *Psychological Bulletin, 59*, 311-319.

Pearce, J. L., & Porter, L. W. (1986). Employee responses to formal performance appraisal feedback. *Journal of Applied Psychology, 71*(2), 211-218.

Russo, J. E., & Shoemaker, P. J. H. (1989). *Decision traps*. New York: Simon & Schuster.

Seligman, M. E. P. (1975). *Helplessness: On depression, development, and death*. San Francisco: W.H. Freeman & Company.

Shanks, D. R., & Dickinson, A. (1987). Associative accounts of causality judgment. In G. H. Bower (Ed.), *The psychology of learning and motivation: Advances in research and theory, Vol. 21.* (pp. 229-261): Academic Press: San Diego.

Simmons, J. P., & Nelson, L. D. (2006). Intuitive confidence: Choosing between intuitive and nonintuitive alternatives. *Journal of Experimental Psychology: General, 135*(3), 409-428.

Soll, J. B. (1996). Determinants of overconfidence and miscalibration: The roles of random error and ecological structure. *Organizational Behavior and Human Decision Processes, 65,* 117-137.

Taylor, S. E., & Brown, J. D. (1988). Illusion and well-being: a social psychological perspective on mental health. *Psychological Bulletin, 103*(2), 193-210.

Taylor, S. E., & Gollwitzer, P. M. (1995). Effects of mindset on positive illusions. *Journal of Personality and Social Psychology, 69*(2), 213-226.

Thomas, R. J. (1989). Participation and control: A shopfloor perspective on employee participation. In R. J. Magjuka (Ed.), *Research in the sociology of organizations*, Vol. 7. Greenwich, CT: JAI Press (pp. 117-144).

Thompson, L. (2008). *Organizational behavior today*. Upper Saddle River, N.J.: Prentice Hall.

Thompson, S. C. (1981). Will it hurt less if I can control it? A complex answer to a simple question. *Psychological Bulletin*, *90*, 89-101.

Thompson, S. C., Armstrong, W., & Thomas, C. (1998). Illusions of control, underestimations, and accuracy: A control heuristic explanation. *Psychological Bulletin, 123*(2), 143-161.

Thompson, S. C., Kyle, D., Osgood, A., Quist, R. M., Phillips, D. J., & McClure, M. (2004). Illusory control and motives for control: The role of connection and intentionality. *Motivation and Emotion, 28*(4), 315-330.

Thompson, S. C., Nierman, A., Schlehofer, M. M., Carter, E., Bovin, M. J., Wurzman, L., Tauber, P., Trifskin, S., Marks, P., Sumner, J., Jackson, A., & Vonasch, A. (2007). How do we judge personal control? Unconfounding contingency and reinforcement in control judgments. *Basic and Applied Social Psychology*, *29*(1), 75 – 84.

Tost, L. P., Gino, F., & Larrick, R. (2010). Power, competitiveness and advice taking: Why the powerful don't listen. *Under review*.

Vroom, V. H. (1964). *Work and motivation*. New York: Wiley.

Wasserman, E. A. (1990). Detecting response-outcome relations: Toward an understanding of the causal texture of the environment. In G. H. Bower (Ed.), *The psychology of learning and motivation* (Vol. 26, pp. 27-82). San Diego: Academic Press.

Weistein, R. M. (1980). The favorableness of patients' attitudes toward mental hospitalization. *Journal of Health and Social Behavior*, *21*(4), 397-401.

Wortman, C. B. (1975). Some determinants of perceived control. *Journal of Personality and Social Psychology, 31*, 282-294.

# Tables

Table 1

*Responses to post-task questionnaire, by condition, Study 1. Standard deviations appear in parentheses. Figures in the same column with different subscripts are significantly different from one another.*

| Condition | Actual button efficacy | Perceived button efficacy: How often do you think the button worked? (0-100) | Perceived Control: How much control do you think you had? (1-7) |
|---|---|---|---|
| High Control | 85% | $39.00\%_a$ (21.95) | $2.75_a$ (1.55) |
| Medium Control | 50% | $36.11\%_a$ (20.32) | $2.60_a$ (1.00) |
| Low Control | 15% | $24.05\%_b$ (17.70) | $1.65_b$ (0.59) |
| No Control | 0% | $25.01\%_b$ (18.19) | $1.45_b$ (0.51) |

Table 2

*Responses to post-task questionnaire, by condition, Study 2. Standard deviations appear in parentheses. Figures in the same column with different subscripts are significantly different from one another.*

| Condition | Actual button efficacy | Predicted button efficacy: How often do you think the button will work? (0-100) | Perceived button efficacy: How often do you think the button worked? (0-100) | Perceived Control: How much control do you think you had? (1-7) |
|---|---|---|---|---|
| Complete Control | 100% | 41.52% (15.60) | 99.94%$_a$ (0.36) | 6.81$_a$ (0.40) |
| High Control | 90% | 46.61% (20.44) | 72.52%$_a$ (8.93) | 5.26$_a$ (1.03) |
| Medium-High Control | 75% | 44.38% (21.93) | 56.22%$_b$ (11.98) | 4.00$_a$ (1.19) |
| Medium Control | 50% | 45.06% (21.83) | 42.34%$_a$ (15.68) | 2.88$_a$ (1.10) |
| Medium-Low Control | 25% | 48.62% (21.26) | 33.91%$_b$ (23.06) | 2.16$_b$ (1.30) |
| Low Control | 10% | 41.68% (21.38) | 25.55%$_b$ (17.19) | 1.71$_b$ (1.37) |
| No Control | 0% | 44.94% (23.73) | 21.61%$_b$ (11.25) | 1.29$_b$ (0.46) |

Table 3

*Participants' perceived estimated success of the efficacious action by condition, Study 3. Standard deviations appear in parentheses. Figures in the same column with different subscripts are significantly different from one another.*

| Level of Control | Motivation | Actual success rate | Estimated success rate |
|---|---|---|---|
| High Control | Pay | 90% | 64.83%$_a$ (29.83) |
| | No Pay | 90% | 54.43%$_a$ (37.87) |
| Low Control | Pay | 60% | 47.00%$_b$ (16.68) |
| | No Pay | 60% | 35.96%$_c$ (18.17) |

Table 4

*Hierarchical regression results on perceived estimated success of the blue-circle producing action, Study 3. The table reports standardized coefficients*

| | *Model 1* | *Model 2* |
|---|---|---|
| Controls | | |
| Age | .10 | .08 |
| Sex (Male =1, Female = 0) | .14 | .13 |
| Independent variables | | |
| Control (1 = high, 0 = low) | .36*** | .33** |
| Motivation (1 = pay, 0 = no pay) | .26** | .23 |
| Button pressing | .42*** | .15 |
| 2-way interactions | | |
| Control X Motivation | | .05 |
| Control X Button pressing | | .33* |
| $R^2$ | .34 | .38 |
| *Overall* $R^2$ | .58 | .62 |
| $F(5,96)$ | 9.82*** | 8.21*** |

*Notes.* * $p < .05$, ** $p < .01$,*** $p < .001$. When we entered the interaction terms in a separate step between the first and second model, variance explained increased by 4% from $R^2 = .34$ to $R^2 = .38$, $F(2, 94) = 3.11$, $p < .05$.

Figure Captions

*Figure 1*. Estimates of perceived control as a function of actual control (hypothetical data).

*Figure 2*. Participants' estimates of perceived control as a function of actual control, Study 1. Error bars show standard errors.

*Figure 3*. Participants' estimates of perceived control as a function of actual control, Study 2. Error bars show standard errors.

*Figure 4*. Simple slopes for participants' perceived estimated success of the blue-circle-producing action, Study 3.

Figure 1

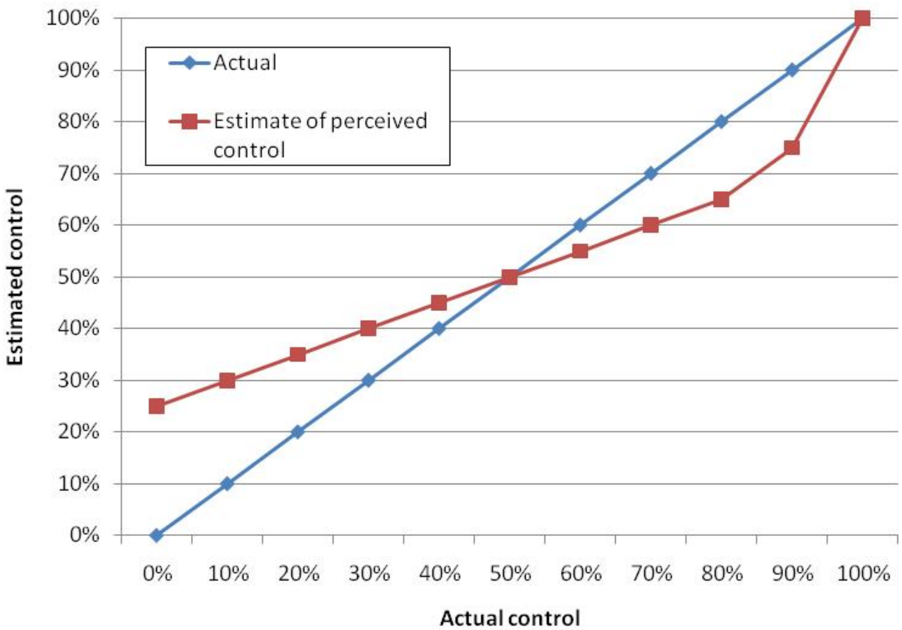

Actual
Estimate of perceived control
Estimated control
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%
Actual control

Figure 2

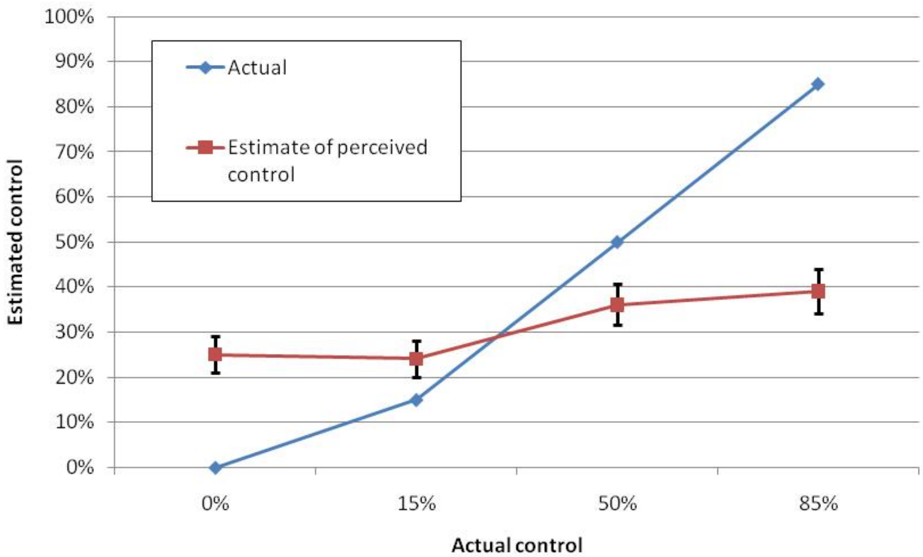

100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Actual
Estimate of perceived control
Estimated control
0%
15%
50%
85%
Actual control

Figure 3

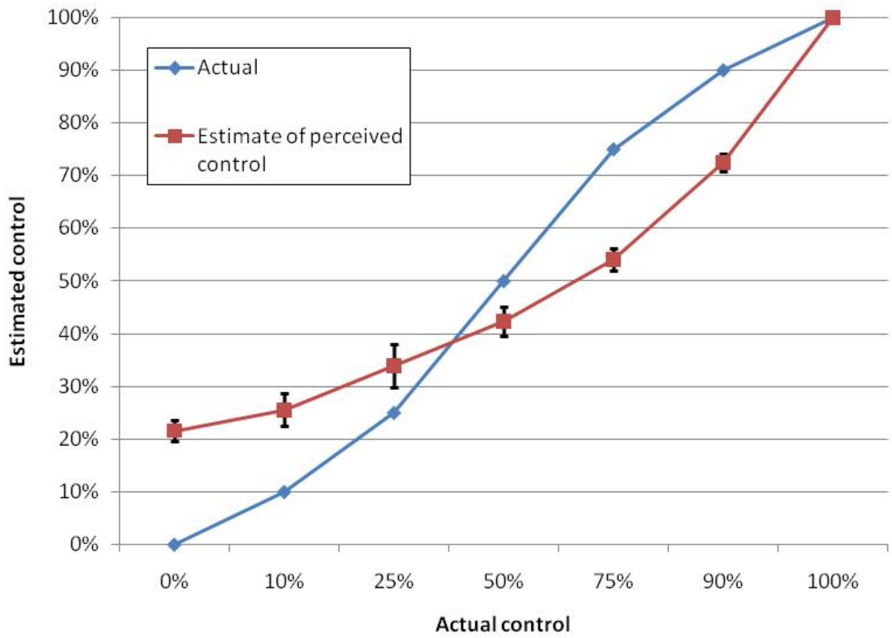
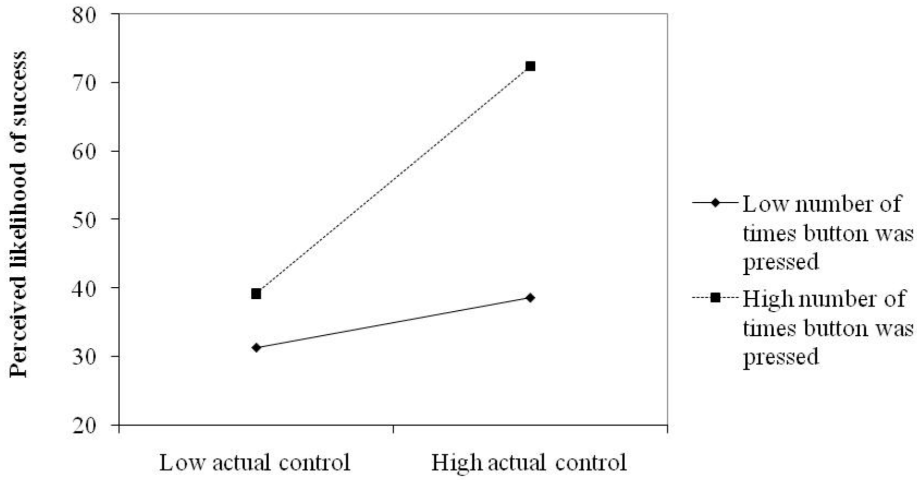

100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Actual
Estimate of perceived control
Estimated control
0%
10%
25%
50%
75%
90%
100%
Actual control

Figure 4


80
70
60
50
40
30
20
Perceived likelihood of success
Low actual control
High actual control
Low number of times button was pressed
High number of times button was pressed