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Does Self-Efficacy Causally Influence Initial Smoking Cessation? An Experimental Study

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Abstract

Self-efficacy has been associated with smoking cessation outcomes in many correlational research studies, but strong causal inferences are lacking. This study tested whether self-efficacy affects initial smoking cessation in a laboratory experiment, which will allow for stronger causal inferences in this domain of inquiry. Participants (n = 103 motivated adult smokers) were provided with brief cessation treatment over three days in preparation for quitting on a target quit day (TQD). In addition, participants were randomized to one of two standard self-efficacy manipulations in the form of bogus feedback about their chances of quitting smoking. Participants in the Average Chances of Quitting (ACQ) condition took a computerized test and were told (falsely) that the test showed that they had the same chances of quitting as everyone else in the study. Participants in the High Chances of Quitting (HCQ) condition took the same computerized test and were told (falsely) that the test showed that they had a greater chance of quitting compared to everyone else in the study. The main outcome was whether participants were able to quit for 24 hours on the TQD. Results revealed that HCQ participants had a significantly greater chance of quitting smoking compared to ACQ participants. However, these effects were not attributable to changes in self-efficacy brought about by the manipulation. An exploration of other potential mediators showed that the manipulation actually influenced smoking outcome expectancies, and

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changes in these outcome expectancies influenced initial smoking cessation. The results highlight the conceptual and empirical challenges with manipulating self-efficacy in the smoking literature.

Keywords

Smoking cessation; self-efficacy; outcome expectancies; social-cognitive theory

1. Introduction

Self-efficacy is important in theories of smoking cessation and relapse (e.g., Brandon, Vidrine, & Litvin, 2007; Niaura, 2000; Witkiewitz & Marlatt, 2004). Self-efficacy is typically operationalized as smokers' confidence to refrain from smoking in different situations (Gwaltney, Shiffman, Norman, Paty, Kassel, et al., 2001); confidence to quit smoking (Niaura & Shadel, 2003); or confidence to maintain abstinence (Herd, Borland, & Hyland, 2009). Results from myriad cross-sectional and prospective correlational studies show that self-efficacy is a consistent predictor of smoking cessation outcomes (Gwaltney, Metrik, Kahler, & Shiffman, 2009).

Basic social-cognitive theory asserts that self-efficacy plays a central, causal role in human behavior (Bandura, 1977, 1997). Experimental research from a variety of domains outside of smoking supports this assertion (e.g., Cervone & Peake, 1986; Hansen & Wanke, 2009; McAuley, Talbot, & Martinez, 1999; Vancouver, Gullekson, Morse, & Warren, 2014). A critical problem for the smoking literature, though, is that experimental evidence supporting a strong causal inference for a relationship between self-efficacy and smoking cessation is lacking (Gwaltney et al., 2009). Further complicating matters, some studies have suggested that self-efficacy is more likely a reflection of smoking rather than a cause (Romanowich, Mintz, & Lamb, 2009) or both a reflection and driver of behavior (Perkins, Parzynski, Mercincavage, Conklin, & Fonte, 2012).

The present study experimentally evaluated whether self-efficacy influences initial smoking cessation. Based on research findings outside of smoking (e.g., Bandura, 1997, 2006), we hypothesized that smokers who were assigned to a condition that was designed to increase their self-efficacy would have greater success with initial quitting compared to smokers assigned to a condition that was designed to have no effect on their self-efficacy.

2. Methods

2.1 Participants

Individuals were recruited using media advertising and were eligible if they: (1) were 18–65 years old, (2) smoked nearly every day for the last five years, (3) currently smoked ≥15 cigarettes/day, (4) had at least one previous quit attempt lasting ≥48 hours, and (5) were motivated to quit smoking, indexed by a score ≥120 based on their responses to two questions (each scaled from 0–100, where 0=not at all and 100=extremely): "How motivated are you right now to quit smoking?" and "How confident are you right now to quit smoking?" (Shadel, Martino, Setodji, Cervone, Witkiewitz, et al., 2011). Individuals were excluded if they: (1) were currently receiving help for quitting smoking or (2) had been

treated for any serious medical and/or psychological condition in the last 12 months. Women who were pregnant or planning to become pregnant in the next 30 days were excluded.

2.2 Procedures

2.2.1 Design overview—This research was approved by the IRB at RAND. The study involved an authorized deception. Participants were told, during informed consent, that there were aspects of the study that they could not be told about initially because that knowledge could affect the study results (i.e., they were not told what the manipulation was designed to do). They were also told that they would be debriefed about the true purpose of the study at its end. Thus, individuals who agreed to participate did so with knowledge that they were not being told every detail about the study, but that they would receive such details at the study's end.

All participants were provided with brief smoking cessation treatment on each of three days (Days 1–3) in preparation for quitting smoking on Day 6 (TQD). Participants who quit on the TQD were followed for four more days (Days 7–10) to track time to first smoking after cessation.[1] In addition, all participants were randomized to one of two experimental conditions in which they were given bogus feedback on Days 1, 2, 3 and 6 about their chances of quitting smoking (see below). The main outcome was whether participants were able to quit for 24 hours on the TQD. Participants could earn up to $275 for completing the study procedures.

2.2.2 Brief smoking cessation treatment—A three-session, group-based cognitive-behavioral smoking cessation treatment was provided on each of three days (Days 1–3). Led by PhD-level psychologists, each session lasted 15–20 minutes. Content included managing smoking triggers, coping with high risk situations, and preparing for TQD (see Brown, 2003; Shadel & Niaura, 2003).

2.2.3 Experimental manipulation—Bogus feedback has been widely used as a way to manipulate self-efficacy in the broader social-cognitive literature (e.g., Bach, Brown, & Barlow, 1999; Hu, Motl, McAuley, Konopack, 2007; Hutchinson, Sherman, & Martinovoc, 2008; McAuley et al., 1999). Prior studies have shown that bogus negative and positive comparative feedback (i.e., compared to others) provided independent of actual performance, contribute to perceptions of competence and performance (see Bandura, 1997). We adapted these well-established experimental strategies from the broader social cognition literature for the current study. Participants were told that they would be taking a computerized test that measures "how confident people are in their ability to quit smoking and that the test results predict whether people will be able to quit or not". The test was a reaction time task in which participants were asked to quickly decide (by pressing a button) if each of a list of 24 words was related or unrelated to smoking. This test was constructed specifically for the purpose of providing bogus feedback to participants in this study, and it has no known relation to smoking outcomes. Everyone took the same computerized test on Days 1–3 and 6, and received bogus feedback each day about their chances of quitting;

[1]Too few participants achieved a 24-hour abstinence period on the TQD to support a meaningful time-to-first smoking by condition analysis through Day 10. Thus, the focus in this paper is on predicting initial 24-hour quitting.

feedback was delivered both verbally and visually via graphs. On Day 1, feedback was the same for participants in both conditions:

> All participants, Day 1: "Great! You can see here that right now the test predicts you have about the same chances of quitting as everyone else. That's about what we'd expect at this point in the study, and you are right in-line with the other participants. Your chances of quitting are the same as everyone else's."

On Days 2, 3, and 6 feedback differed depending on experimental condition. Participants in the *Average Chance of Quitting Feedback* (ACQ) condition were told the test results indicated that they had the same chances of quitting as everyone else in the study and that their chances of quitting remained about the same as it was at the previous measurement.

> ACQ, Day 2: "Ok, your score improved very little since last time – right now the test predicts that you still have about the same chances of quitting compared to everyone else. You can see that you did about as well as most of the other participants. Your chances of quitting are still about the same as everyone else's"
>
> ACQ, Day 3: "Although your score improved a little bit since last time – right now the test predicts that you still have about the same chances of quitting as everyone else. You can see that you're doing about as well as most of the other participants. Your chances of quitting are still about the same as everyone else's"
>
> ACQ, Day 6: "Hmmm. Your score is a little bit lower than last week; everyone else's scores also dipped slightly. Right now the test predicts that you have about the same chance of quitting compared to everyone else. You still did about as well as most of the other participants, and your chances of quitting are similar to everyone else's. But remember, there are a lot of things that factor into a successful quit attempt, and your score on this test is only one of them."

Participants in the *High Chances of Quitting Feedback* (HCQ) were told that the test results suggested that they had greater chances of quitting compared with everyone else in the study and that their chances of quitting improved over the three days before the TDQ.

> HCQ, Day 2: "This looks good. Your score improved since last time – right now the test predicts you have a slightly better chance of quitting compared to everyone else. That's great! Also, you can see that you did better than most of the other participants. Your chances of quitting are slightly better than everyone else's."
>
> HCQ, Day 3: "Great! Your score improved again – right now the test predicts you have a much better chance of quitting compared to everyone else. This is really good news. And just like last time, you did better than most of the other participants. Your chances of quitting are much better than everyone else's."
>
> HCQ, Day 6: "Wow! Your score has really improved since last time! Right now the test predicts that your chances of quitting are better than almost everyone else. Your hard work is paying off. And just like before, you did better than most of the other participants. Your chances of quitting are very good, and much better than almost everyone else's."

2.3 Measures

2.3.1 Demographics—Gender, age, race/ethnicity, and education were assessed on Day 1.

2.3.2 Smoking and quitting history—Number of cigarettes smoked per day in the last month, number of years smoked, and past year 24-hour quit attempts were assessed on Day 1.

2.3.3 Nicotine dependence—Nicotine dependence was assessed on Day 1 with the reliable and valid Fagerstrom Test for Nicotine Dependence (FTND, Heatherton, Kozlowski, Frecker, & Fagerstrom, 1991).

2.3.4 Self-efficacy—Self-efficacy was measured on Days 1 and 6 using the 14-item short form of the Relapse Situation Efficacy Questionnaire (Gwaltney et al., 2001) which assesses self-efficacy to keep from smoking in diverse circumstances (e.g., negative affect, positive affect, social situations, craving). Responses were made on a four point scale where 1 = not at all confident and 4 is extremely confident. Internal reliability (α) for this scale exceeded 0.81 at both time points in this study and the scale demonstrates adequate construct and predictive validity in other research (Gwaltney et al., 2001; Gwaltney, Shiffman, Paty, Liu, Kassel, et al., 2002; Gwaltney, Shiffman, Balabanis, & Paty, 2005). Item responses were averaged to produce a mean self-efficacy score for each time point, with higher scores indicating greater confidence to resist smoking (see Table 1).

2.3.5 Alternative mediators considered—We also included measures that would allow us to explore whether any observed experimental effects could be attributed to self-efficacy specifically rather than to other conceptually related variables, affect (Cervone, Kopp, Schaumann, & Scott, 1994; Seo & Ilies, 2009) and outcome expectancies (Bandura, 1997; Williams, 2010).

The *Positive and Negative Affect Scales* (PANAS; Watson, Clark, & Tellegen, 1988) were used to assess positive (10 items) and negative (10 items) affect on Days 1 and 6. Participants responded to a series of valenced adjectives (e.g., interested, strong, scared, guilty), indicating to how they felt that day (1 = very slightly; 5 = extremely). Responses were averaged to produce a mean positive and negative affect score for each time point, with higher scores indicating greater levels of positive and negative affect, respectively. Internal reliability (α) for these scales exceeded 0.85 at both time points. *Outcome expectancies* were measured on Days 1 and 6 using a seven item measure (Gwaltney et al. (2005) adapted from the Smoking Consequences Questionnaire (Brandon & Baker, 1991). Participants indicated the likelihood (1 = completely unlikely to 10 completely likely) that smoking leads to different outcomes (e.g., smoking tastes good; smoking helps me relax, smoking satisfies my cravings). Item responses were averaged to produce a mean smoking outcome expectancies score for each time point, with higher scores indicating the belief that more positive outcomes are associated with smoking (see Table 1). Internal reliability (α) for this scale exceeded 0.74 at each time point.

2.3.6 Smoking status—Smoking status on TQD (Day 6) was determined by asking participants whether they smoked in the past 24 hours on Day 7. Abstinence self-reports

were confirmed using expired air CO values < 8 ppm (SRNT Subcommittee on Biochemical Verification, 2002). One participant had to be reclassified as having smoked on TQD based on these CO results.

3. Results

3.1 Descriptive Analyses

A total of 840 individuals were screened; 294 met inclusion criteria and 181 of those eligible attended the Day 1 session and were randomized to an experimental condition. Seventy-eight participants dropped out and did not have data for Day 6, the TQD. There were no differences between experimental conditions in the percentage of individuals who dropped or who had complete data (46% in ACQ vs 38% in HCQ; $p = 0.29$). There were no significant differences between those who dropped out and those who continued with the study on any Day 1 variables.

As such, a total of 103 individuals had complete data and were included in the study. Table 1 presents baseline characteristics of participants in the two conditions, including demographics, baseline smoking status, and baseline and Day 6 standing on potential mediating variables. Randomization was successful at ensuring parity across conditions.

3.2 Effect of Experimental Condition on Quitting

The raw percentage of participants who quit for 24 hr was 8.9% for ACQ and 24.6% for HCQ. Logistic regression was used to predict quitting (coded as: 0 = quit; 1 = not quit) from experimental condition (coded as: ACQ = 0; HCQ = 1). These results revealed that experimental condition was significantly associated with quitting: participants assigned to the HCQ condition were more likely to quit than participants in the ACQ condition ($b = -1.20$, $SE = 0.61$; 95% CI [−2.40, −0.01], Wald $\chi^2 = 3.94$, $p < 0.05$).

3.3 Mediation Analysis

We conducted a mediation analysis to test whether the effects of the experimental manipulation on quit rates were mediated by changes in self-efficacy, as hypothesized. Mediation analyses were conducted using Hayes' SPSS macro PROCESS (Hayes, 2012, 2013) with 10,000 bootstrap re-samplings. We used this macro to examine the effect of experimental condition on self-efficacy, the effect of self-efficacy on quitting, and the indirect effect of experimental condition on quitting through its effects on self-efficacy. These three effects are essential in establishing mediation (Hayes, 2013). Experimental condition was not significantly related to changes in self-efficacy (coefficient = −0.16, $SE = 0.12$, $t = -1.28$, $p = 0.20$), and self-efficacy was not related to quitting after controlling for baseline levels of self-efficacy and experimental condition (coefficient = 0.40, $SE = 0.45$, $z = 0.90$, $p = 0.37$, 95% CI [−0.47, 1.28]). The indirect effect of experimental condition on quitting through self-efficacy was not significant (coefficient = −0.06, $SE = 0.14$, 95% CI [−0.53, 0.11]). Thus, this analysis found no evidence of a mediating role for self-efficacy.

We explored positive and negative affect and smoking outcome expectancies as possible mediators of the experimental manipulation. Experimental condition was unrelated to

positive affect (coefficient = −0.14, *SE* = 0.15, *t* = −0.88, *p* = 0.38) and positive affect was unrelated to quitting after controlling for baseline levels of positive affect and experimental condition (coefficient = −0.71, *SE* = 0.46, *z* = −1.56, *p* = 0.12, 95% CI [−1.60, 0.18]). The indirect effect of experimental condition on quitting through positive affect (as mediator) was not significant (coefficient = 0.10, *SE* = 0.16, 95% CI [−0.08, 0.60]). Similarly, experimental condition was unrelated to negative affect (coefficient = −0.18, *SE* = 0.14, *t* = −1.24, *p* = 0.22) and negative affect was not significantly related to quitting after controlling for baseline levels of negative affect and experimental condition (coefficient = 1.61, *SE* = 0.85, *z* = 1.89, *p* = 0.06, 95% CI [−0.06, 3.29]). The indirect effect of experimental condition on quitting through negative affect was not significant (coefficient = −0.29, *SE* = 0.41, 95% CI [−1.51, 0.15]). Thus, neither positive nor negative affect mediated the effect of condition on initial smoking cessation.

A significant mediating effect was found, however, for smoking outcome expectancies. Experimental condition was significantly related to outcome expectancies (coefficient = −0.56, *SE* = 0.29, *t* = −1.96, *p* = 0.05): participants in the HCQ condition had more negative smoking outcome expectancies (i.e., had fewer positive expectancies for smoking) compared to participants in the ACQ condition. Moreover outcome expectancy scores were significantly related to quitting after controlling for baseline outcome expectancies and experimental condition (coefficient = 0.45, *SE* = 0.21, *z* = 2.12, *p* = 0.03, 95% CI [0.03, 0.86]); more negative outcome expectancies for smoking predicted greater chances of quitting. The indirect effect of experimental condition on quitting through outcome expectancies was significant (coefficient = −0.24, *SE* = 0.20, 95% CI [−0.80, −0.01]).

4. Discussion

This goal of this study was to test whether self-efficacy influences initial smoking cessation using an experimental design. We employed an established self-efficacy manipulation - provision of bogus performance feedback (see Bandura, 1997) - to examine this relationship. Although the manipulation had its intended effects on initial smoking cessation, this effect was not attributable to changes in self-efficacy.

Having failed to find a mediating effect of self-efficacy, we investigated potential mediating roles for constructs related to self-efficacy: positive and negative affect and outcome expectancies. Affect is associated with self-efficacy (Cervone et al., 1994; Seo & Ilies, 2009) and relates both to smoking behavior and smoking cessation (Niaura, Britt, Shadel, Goldstein, & Abrams, 2001; Shiffman & Waters, 2004). Although it is conceivable that the manipulations in this study which explicitly sought to alter perceptions of success with smoking cessation could have influenced quitting by altering positive and negative affect (e.g., participants in the ACQ could have experienced increased negative affect and less positive affect because of a perceived lack of progress toward cessation success), affect was uninfluenced by the manipulations.

The effect of the manipulation on initial smoking cessation was, however, mediated by smoking outcome expectancies. Smoking outcome expectancies are beliefs about the consequences that result from smoking (e.g., Smoking helps with relaxation, with weight

control) and have been shown to predict cessation outcomes (e.g., Gwaltney et al, 2005; Wetter et al., 1994). We described our manipulation to participants as a measure of "how confident people are in their ability to quit smoking" and told them that "the test results predict whether people will be able to quit or not." Elements of the manipulation delivered on subsequent days also included information on participants' chances of quitting smoking. Participants in the HQC condition may have focused more on the positive outcome of quitting and as such shifted their orientation toward a more negative view of outcomes associated with smoking during their quit attempt. For example, as they received increasingly positive feedback about their chances of quitting and came to believe that they would quit, they may have started to believe that smoking would taste less good, be less helpful in helping them relax, etc. In contrast, participants in the AQC condition may have focused more on the outcome of continuing to smoke and as such shifted their orientation toward the perceived positive outcomes of smoking (e.g., that quitting would be difficult because smoking tastes good, is useful in helping them relax, etc.). This interpretation is consistent with research has shown that smokers' outcome expectancies become more negative during a quit attempt, particularly among those who eventually achieve abstinence (e.g., Copeland, Brandon, & Quinn 1995; Gwaltney et al., 2005).

These findings also make sense if one considers a larger theoretical context. In Bandura's social cognitive theory (1977; 1997; 2006), self-efficacy and outcome expectancies are distinct but work together to regulate behavior (Bandura, 1997). This distinction is inherent in conceptual accounts of the smoking cessation and relapse process (Brandon et al., 2007; Niaura, 2000; Witkiewitz & Marlatt, 2004). However, alternative perspectives have raised concerns about the potential for overlap in the conceptualization and measurement of these two constructs (Eastman & Marzillier, 1984; Kirsch, 1985; Williams, 2010; Williams & Rhodes, 2014). For a health-related behavior like smoking where an individual's consideration of his/her capabilities to resist smoking (i.e., self-efficacy) is inherently tied to a valued outcome (i.e., not smoking/abstinence) the problem may be particularly pronounced (see Devins & Edwards, 1988). In some of these perspectives (see Williams & Rhodes, 2014) outcome expectancies are seen as the dominant regulatory force, subsuming self-efficacy as part of some larger construct of "motivation"; in some approaches, the constructs are largely indistinguishable from one another (e.g., Kirsch, 1985). Such conceptual and measurement issues may make it challenging to uniquely manipulate or measure self-efficacy, at least in ways that are not confounded with outcome expectancies.

This study has limitations. First, generalizability is limited given that participants were a community-based sample of heavier smokers who were motivated to quit smoking; the results may not be applicable to other populations of smokers (e.g., to unmotivated, lighter smokers). Second, the design did not include "negative" or "no manipulation" conditions, which limits the scope of our conclusions. Third, the manipulation framed participant's likelihood of successfully quitting in terms of success relative to others; a manipulation that framed likelihood of quitting in terms of success relative to their own past attempts might have yielded different results. Finally, it is not known whether these results would apply to longer term outcomes.

It is important to note that our findings do not suggest that self-efficacy is unimportant to smoking cessation. Rather the findings suggest that explicitly manipulating self-efficacy in experimental smoking research is a methodological challenge. Establishing a causal role of self-efficacy in regulating smoking cessation outcomes may require a refinement of concepts and methods of assessment. A promising approach may be to use structural equation modeling to isolate variation and measurement error in the constructs under investigation so that the unique role of self-efficacy in smoking cessation can be evaluated.

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Highlights

- An experimental test of whether self-efficacy causally influences initial smoking cessation was conducted
- Although the manipulation influenced initial smoking cessation, self-efficacy did not mediate these effects
- Smoking outcome expectancies mediated the effects of the experimental manipulation on smoking cessation
- These results highlight the challenges of experimentally studying self-efficacy in the context of smoking cessation

Table 1

Baseline Characteristics of Participants in the Two Conditions

Characteristic	Average Chance of Quitting Feedback (*n* = 46)	High Chance of Quitting Feedback (*n* = 57)	*p*
Baseline variables			
Age (*M, SD*)	47.84 (8.27)	46.44 (9.84)	0.45
Gender (% female)	64%	56%	0.40
Race			0.73
% Caucasian	30%	25%	
% African-American	57%	64%	
% Other	13%	11%	
% > high school education	74%	67%	0.43
nicotine dependence (FTND) (*M, SD*)	5.78 (2.09)	5.72 (1.74)	0.87
cigarettes smoked/day (*M, SD*)	21.40 (14.10)	21.61 (13.81)	0.94
number of years smoked (*M, SD*)	27.36 (9.64)	25.68 (11.56)	0.44
Past year 24-hour quit quits (*M, SD*)	1.82 (3.18)	1.98 (2.30)	0.77
Day 1 and Day 6 values on hypothesized mediating variables			
Self-efficacy, Day 1 (*M, SD*)	2.04 (0.43)	1.99 (0.43)	0.55
Self-efficacy, Day 6 (*M, SD*)	2.58 (0.69)	2.40 (0.61)	0.16
Positive affect, Day 1 (*M, SD*)	3.21 (0.69)	3.03 (0.76)	0.22
Positive affect, Day 6 (*M, SD*)	3.31 (0.75)	3.15 (0.67)	0.29
Negative affect, Day 1 (*M, SD*)	1.81 (0.74)	1.87 (0.80)	0.75
Negative affect, Day 6 (*M, SD*)	1.69 (0.74)	1.59 (0.69)	0.51
Outcome expectancies, Day 1 (*M, SD*)	6.08 (1.75)	6.13 (1.51)	0.89
Outcome expectancies, Day 1 (*M, SD*)	5.31 (1.70)	4.80 (1.82)	0.15