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# College Smokers' Estimates of Their Probabilities of Remaining a Smoker in the Near Future

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## Abstract

Community college and university smokers ( $N = 662$ ) estimated their probability (0% to 100%) of remaining a smoker one and six months later and reported their confidence in their estimates. Smoking status was assessed at each time point. Analyses controlled for several correlates of both smoking status and probability estimates of remaining a smoker. Estimates of smoking status interacted with confidence to predict smoking status at one month, but only estimates predicted smoking status at six months. Findings suggest that: 1) personal estimate of future smoking status is a unique correlate of continued smoking; and 2) confidence in personal estimates is a strong moderator for short-term projections of smoking status.

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## Keywords

- *confidence*
- *probability judgments*
- *smoking*

RESEARCHERS have traditionally used personal estimates of future smoking status to assess whether individuals, especially adolescents and young adults, appreciate the addictive nature of cigarettes and to predict cessation. Longitudinal studies assessing smoking behaviors (e.g. cessation) find that adolescent smokers underestimate how long they will be smoking; further, these estimates predict cessation (Johnston, O'Malley, & Bachman, 1993; Sanders, Peveler, Mant, & Fowler, 1993; Slovic, 2001; Wakefield et al., 2004; Zhu, Sun, Billings, Choi, & Malarcher, 1999; see also Weinstein, Slovic, & Gibson, 2004).

Researchers typically assume that estimates of future behavior are precise indicators of what participants believe will transpire. Although this may hold for some participants, it is likely not true for others. Some people feel confident that the future they predict will occur (e.g. that they will no longer be smokers), others may be less confident. That is, just as estimates may vary across individuals, so too may confidence in those estimates. Ratings of confidence about probability estimates can be viewed as metacognitions (i.e. metacognitive confidence), that is, thoughts about one's thought. Of import, metacognitions can influence social judgments (Petty, Brinol, Tormala, & Wegener, 2007 for review). For example, individuals who are confident in their beliefs and attitudes are more resistant to persuasion (Tormala & Petty, 2002).

To date researchers have asked smokers to predict their future smoking status without assessing confidence in their predictions. The degree of confidence that underlies estimates may be an important moderator of how well estimates predict future smoking status. Although people can be overly confident and optimistic in their predictions (Fischhoff, Slovic, & Lichtenstein, 1977), an estimate should predict future behavior more accurately when confidence in the estimate is high rather than low. Thus, we hypothesized that smokers who predict a high probability that they will remain smokers in the near future (e.g. within a month) will continue to smoke if they report being more rather than less confident in their prediction. Similarly, smokers who predict a low probability that they will remain smokers will be more likely to have quit if they report being more confident rather than less confident in their predictions.

Importantly, the interaction of probability estimates and confidence judgments in predicting future smoking status may vary as a function of how

far into the future people are predicting. According to temporal construal theory, people construe distant events more abstractly, focusing on what is important to them and what they want to happen, yet construe near events more concretely, focusing on specific, contextual issues (Trope & Liberman, 2003). Consequently, when smokers are asked whether they will be a smoker one month hence, they are more likely to contemplate concrete factors that make quitting easy vs hard as well as their degree of motivation to quit. When asked whether they will be a smoker six months hence, they are more likely to contemplate abstract issues such as how much they value their health. The greater focus on abstract issues at the expense of concrete issues should lead to less accurate predictions for distant events (i.e. events six months hence) than for near events (i.e. events one month hence). Moreover, people likely recognize the uncertainty inherent in making predictions about distant future events and thus should display less confidence in predictions for distant than for near events.

We tested whether college smokers' probability estimates of remaining a smoker one and six months in the future interacted with confidence in these estimates to predict actual smoking status. Further, we tested the assumption that probability estimates, and possibly confidence, reflect factors that take into account the motivation and ability to quit. For example, smokers who have a stronger desire to quit, are more self-efficacious, less tempted to smoke and feel less addicted to cigarettes, should provide lower estimates of remaining a smoker. Finally, we tested whether the predicted interaction between probability estimates and confidence holds in multivariate analyses after controlling for desire to quit, self-efficacy, temptation to smoke, perceived addiction and years and amount smoked.

## Methods

### *Study eligibility and participants*

Participants were college smokers between the ages of 18–24 who had smoked at least one cigarette each day during the last week and at least 100 cigarettes in their lifetime. We recruited study participations from five community college campuses and four universities in central North Carolina through a research assistant who approached smokers in areas where smokers congregate, or through campus advertisements (i.e. flyers, newspapers), or a booth

Table 1. Sample characteristics ( $N = 662$ )

Characteristic	Percent
Age (means)	20.4 (SD = 1.6)
Sex (male)	52.4
<i>Race</i>	
White	56.9
African-American	32.4
Hispanic	3.7
Asian	1.4
Other	6.1
<i>Class rank</i>	
Freshman	31.5
Sophomore	33.9
Junior	18.9
Senior	14.4
Graduate school	1.4
<i>Smoking pattern</i>	
Years smoked (mean)	4.2 (SD = 2.5)
Average daily cigarettes smoked (mean)	11.4 (SD = 7.4)

Note: The samples consisted of 46.2 percent and 53.8 percent community college or university student smokers, respectively

on campus that smokers could visit to inquire about the study. Smokers who expressed interest completed a brief screener. Those who met study eligibility and consented, completed a baseline survey, and then came to the Risk Communication Laboratory to watch either a gain- or loss-frame video (Schneider et al., 2001). This manipulation did not affect the pattern of findings reported here and is not discussed further. This report is based on the 662 smokers who attended this session. Their baseline characteristics appear in Table 1. The study was approved by the Institutional Review Board at Duke University Medical Center.

### Procedure and measures

After watching the video, participants completed the following measures relevant to this report.

**Probability estimates** Participants reported, 'How likely is it that you will be smoking one month/six months from now on a scale from 0 percent to 100 percent where 0 percent = definitely not and 100 percent = definitely?' Participants responded first to the six-month then to the one-month time frame. Time frame was underlined and bolded.

**Confidence ratings** Immediately after each probability estimate participants reported, 'How

confident are you in your answer?' anchored by 1 = *not at all confident* and 7 = *extremely confident*. For example, they responded to the six-month probability question followed by the confidence rating.

**Desire to quit smoking** Participants reported, 'How strong is your desire to stop smoking altogether at this time?' anchored by 1 = *not at all strong* and 7 = *extremely strong*.

**Temptation to smoke** Participants completed the nine-item temptation to smoke scale (Velicer, Diclemente, Rossi, & Prochaska, 1990), which asks smokers how tempted they are to smoke in different situations such as, 'When you first get up in the morning', and 'When you are very anxious and stressed'. Response anchors ranged from 1 = *not at all tempted* to 5 = *extremely tempted*. Items were summed and averaged ( $\alpha = .70$ ).

**Self-efficacy** We assessed self-efficacy with two items: 'Overall, how confident are you that you can stop smoking altogether right now?', anchored from 1 = *not at all confident* to 7 = *extremely confident*, and 'You know you can quit smoking whenever you want to', anchored from 1 = *strongly disagree* to 7 = *strongly agree*. The two correlated items ( $r = .49$ ,  $p < .001$ ) were summed then averaged.

**Perceived addiction** We assessed perceived addiction by the item: 'You are not as likely to become physically dependent on cigarettes as other smokers your age, race and sex.' Response options were on seven-point Likert scales from 1 = *strongly disagree* to 7 = *strongly agree*.

**Point-prevalence cessation** We defined cessation as not having smoked a cigarette, not even a puff, during the last seven days. Participants responded during a one-month and six-month follow-up telephone survey.

## Results

### Probability estimates and confidence rating of remaining a smoker

Among the 662 participants who watched the video, 532 (80% of the 662) and 465 (70% of the 662) were reached as part of the one- and six-month post-laboratory visit. There were no differences between those reached and not reached at follow-up on any of the main variables reported here (e.g. self-efficacy, temptation to smoke, desire to quit, probability

Table 2. Correlates of probability estimates of remaining a smoker and confidence in estimates

Correlate	Mean	SD	Probability estimate		Confidence	
			One month	Six month	One month	Six months
Desire to quit	4.44	1.73	-.45**	-.49**	-.24**	.04
Temptation to smoke	3.54	0.66	.21**	.18**	.08*	-.04
Self-efficacy to quit	3.89	1.59	-.22**	-.17**	.03	.19**
Perceived addiction	3.17	1.74	-.03	.04	-.04	.02

Note: Observations ranged from 633 to 661

\* $p < .05$ ; \*\* $p < .001$

estimates and confidence ratings). At one month, there were 460 smokers and 72 nonsmokers; at six months, there were 381 smokers and 84 nonsmokers. Thus, observed cessation rates were 13.5 percent and 20.9 percent at one month and six months, respectively; intent-to-treat cessation rates were 10.8 percent and 12.7 percent at one month and six months, respectively.

Participants underestimated the likelihood that they would remain a smoker one and six months later. For the entire sample, the mean one- and six-month estimate of remaining a smoker was 71.5 percent (SD = 32.7) and 54.2 percent (SD = 30.7), respectively, compared to the actual observed rates of 86.5 percent and 79.1 percent. These data suggest that smokers were optimistic in predicting being a nonsmoker, especially when predicting six months into the future. Indeed, 69 percent of the sample gave a lower estimate of remaining a smoker at six months than at one month. This compares to 11 percent of the sample who believed they were less likely to be a smoker at one month than at six months, reflecting the possibility of relapse. Twenty percent of the sample gave the same estimate for both time periods. Confidence ratings for the one- and six-month estimates were relatively high ( $M = 5.7$ ,  $SD = 1.3$  one month,  $M = 5.2$ ,  $SD = 1.3$  six months). However, confidence ratings were lower at six months than at one month ( $M_{diff} = .47$ ,  $SD = 1.35$ ,  $t = 8.9$ ,  $p < .0001$ ).

### Preliminary analyses

Preliminary analyses explored whether participants who had quit smoking one month and six months after the initial estimates differed significantly in the probability estimates and confidence judgments made during the lab session. Participants who remained smokers reported higher probability estimates than did participants who quit at one month

( $M = 73.0$ ,  $SD = 28.7$  vs  $M = 36.6$ ,  $SD = 35.4$ ,  $t_{(528)} = 7.80$ ,  $p < .0001$ ) and at six months ( $M = 55.6$ ,  $SD = 29.3$  vs  $M = 35.4$ ,  $SD = 30.4$ ,  $t_{(399)} = 4.6$ ,  $p < .0001$ ). Participants who remained smokers did not differ from participants who quit in their confidence ratings at one month ( $M = 5.7$ ,  $SD = 1.2$  vs  $M = 5.2$ ,  $SD = 1.3$ ,  $t_{(528)} = 1.69$ ,  $p < .10$ ) or six months ( $M = 5.2$ ,  $SD = 1.2$  vs  $M = 5.3$ ,  $SD = 1.1$ ,  $t_{(398)} = < 1$ ,  $p = .45$ ).

### Correlates of probability estimates

Probability estimates of future smoking status presumably take into account several factors that may affect the motivation and the ability to quit. We tested this hypothesis by correlating the probability estimates with desire to quit, temptation to smoke, self-efficacy and perceived assessment of addiction. We expected that higher probability estimates would correlate with lower desire to quit, lower self-efficacy, higher temptation to smoke and perceiving oneself as more addicted to cigarettes. For purposes of comparison, we also correlated these constructs with confidence ratings (see Table 2). With the exception of perceived addiction at six months, all the hypothesized relations were supported in the predicted direction. Confidence in estimates correlated significantly only with desire to quit and temptation to smoke at one month and with self-efficacy beliefs at six months. In addition, one month confidence and probability ratings correlated positively ( $r_{(659)} = .34$ ,  $p < .001$ ); thus, participants gave higher confidence ratings in relation to higher probability estimates. Six-month confidence and probability estimates were uncorrelated ( $r_{(660)} = .02$ ,  $p < .65$ ).

Many of the correlates of the probability estimates discriminated between smokers and nonsmokers at each time point—thus serving as potential mediators. As shown in Table 3, participants who remained smokers at the one-month follow-up expressed lower desires to quit, poorer self-efficacy and were

Table 3. Factors that discriminated smoking status by time frame (observed data)

Outcome	One month			Six months		
	Smokers	Nonsmoker	<i>p</i> <	Smokers	Nonsmoker	<i>p</i> <
Desire to quit	5.2 (1.6)	4.1 (1.2)	.0001	4.1 (1.5)	4.8 (1.7)	.0001
Temptation to smoke	3.5 (0.6)	3.1 (0.6)	.0001	3.6 (0.6)	3.2 (0.6)	.007
Self-efficacy	3.7 (1.5)	4.3 (1.3)	.0001	3.6 (1.5)	3.7 (1.4)	NS
Perceived addiction	3.0 (1.6)	2.9 (1.5)	NS	3.0 (1.6)	3.1 (1.6)	NS

Note: Means differences were tested via two group independent *t*-tests. Numbers in parentheses represent standard deviations

more tempted to smoke. The same pattern held at six months except that self-efficacy no longer discriminated between smokers and nonsmokers.

### Multivariate analyses predicting remaining a smoker

We hypothesized a main effect of probability estimates such that smokers who gave higher probability estimates were more apt than smokers who gave lower probability estimates to remain smokers one and six months later. We had no a priori main effect hypothesis for confidence in estimates. We ran logistic regression models for each time point regressing smoking status onto the main effects of probability estimates, confidence ratings and their interaction. The analyses controlled for variables that correlated with the probability estimates and discriminated smoking status at each time point. In addition, we controlled for amount of cigarettes smoked on average/day and length of time participants had smoked. Table 4 presents the results of the

regression analyses. Analysis of one-month smoking status revealed a main effect for Confidence qualified by a Probability by Confidence interaction. Analysis of participants' six-month smoking status revealed a main effect of Probability and no Probability by Confidence interaction.

Figure 1 displays the Probability (0% to 100%) by Confidence (1–7) interaction predicting hypothetical probabilities of remaining a smoker at one month using the regression equation created from the observed data. Among smokers who report high confidence in their estimates, increases in smoking probability estimates correspond to a higher probability of remaining a smoker. Among smokers who report low confidence in their estimates, increases in smoking probability estimates correspond to a lower probability of remaining a smoker. More to the point, among highly confident participants, smoking estimates accurately predict smoking status one month later. Among nonconfident participants, smoking estimates do not accurately predict smoking status

Table 4. Multivariate Logistic Regression Models Predicting Remaining a Smoker

Model	One Month			Six Months		
	Beta	(SE)	Odds ratio (95% CI)	Beta	(SE)	Odds ratio (95% CI)
Amount smoked	.01**	(.03)	1.10 (1.04, 1.17)	.02	(.02)	1.03 (0.98, 1.07)
Years smoked	.09	(.07)	1.09 (0.96, 1.24)	.06	(.06)	1.07 (0.96, 1.19)
Desire to quit	-.26*	(.11)	.77 (0.62, 0.95)	-.20*	(.09)	0.82 (0.68, 0.98)
Temptation to smoke	.17	(.24)	1.19 (0.74, 1.90)	.30	(.22)	1.35 (0.88, 2.07)
Self-efficacy	-.11	(.11)	0.89 (0.72, 1.11)	—	—	—
Probability estimate	-.03	(.02)	0.97 (0.94, 1.01)	.01**	(.01)	1.01 (1.00, 1.02)
Confidence in estimate	-.30*	(.20)	0.74 (0.50, 1.10)	—	—	—
Probability estimate by Confidence Interaction	.008*	(.003)	1.01 (1.00, 1.01)	—	—	—

Note. Models are based on the observed data. Results pertain to predicting a one percent increase in probability of remaining a smoker. \* *p* < .05, \*\* *p* < .01.

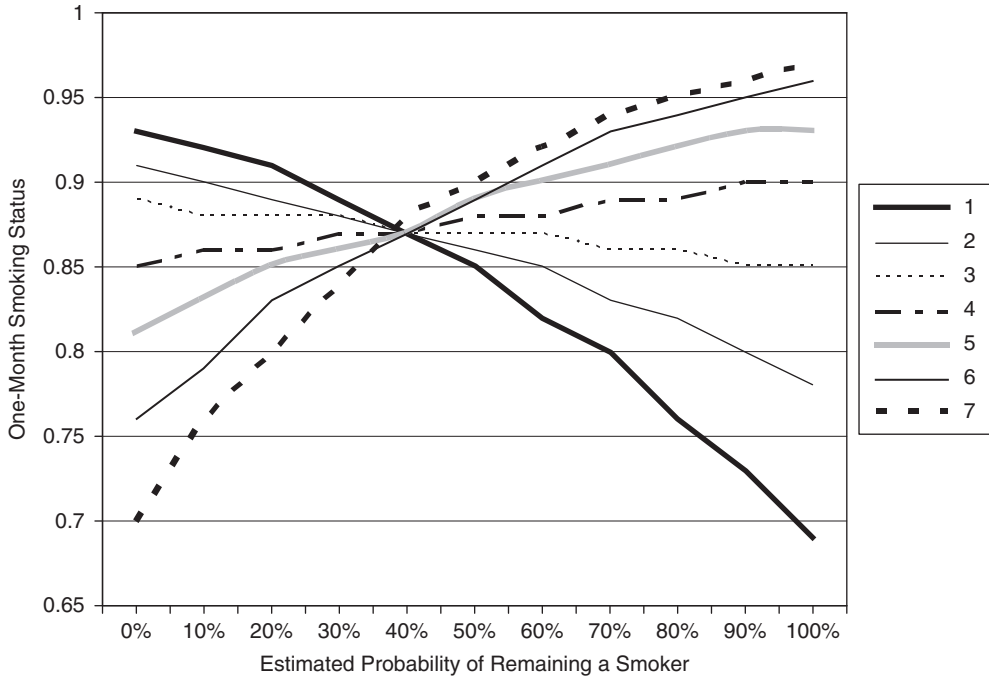


Figure 1. Predicting hypothesized probability of remaining a smoker (one-month smoking status) from the interaction between subjective estimates (estimated probability of remaining a smoker) and confidence ratings based on the regression model.

one month later; rather, smoking estimates are inversely related to smoking status. The intent-to-treat analyses revealed the same pattern of results.

We computed the hypothesized likelihood of remaining a smoker at six months using the regression equation created from the observed data. For example, among participants who estimate a 0 percent, 50 percent and 100 percent probability during the lab session, the predicted likelihood of remaining a smoker is 67 percent (95% CI: 54%, 78%) among participants who estimate a 0 percent probability, 80 percent (95% CI: 75%, 84%) among participants who estimate a 50 percent probability and 89 percent (95% CI: 82%, 93%) among participants who estimate a 100 percent probability.

### Discussion

To our knowledge this is the first study to ask college smokers to predict their probability of remaining a smoker in the near future and rate their confidence in their estimates. Probability estimates interacted with confidence ratings to predict one-month smoking

status. Consistent with temporal construal theory, participants as a whole were more accurate at predicting their short- rather than longer-term smoking status. In both instances, the sample underestimated the true probability of remaining a smoker. In essence, participants overestimated the likelihood of quitting. This may reflect their poor appreciation of the addictive qualities of smoking and perhaps other factors, such as wishful thinking for a desirable outcome (i.e. cessation, Krizan & Windschitl, 2007).

Probability estimates correlated, especially in the short term, with several factors deemed important to the process of cessation, such as self-efficacy, temptation to smoke and desire to quit. This finding indicates that probability estimates reflect smokers' considerations of these and perhaps other facets related to smoking (such as, perceived harm of smoking; Ortendahl & Näsman, 2008), and in so doing, provides construct validity for the probability measure. Indeed, the greater accuracy of the one- than six-month estimate in predicting actual smoking status may reflect smokers' greater considerations of these factors in computing their estimates. Given that

probability estimates highly discriminated future smoking status, and remained significant predictors—albeit as either a main effect or interaction—in multivariate models controlling for multiple factors found to affect smoking behaviors, probability estimates can be viewed as a unique correlate of future smoking behaviors. As such, this study controls for alternative explanations that probability estimates merely reflect desire to quit or self-efficacy to quit (Zhu et al., 1999). We recommended that future studies incorporate probability estimates as a method to discern which smokers may be at higher risk of not quitting.

The lower probability estimates for remaining a smoker at six months than at one month may reflect differences in perceived control over distant vs near outcomes. With distant outcomes, perceived control is generally higher because people can imagine many routes and few barriers to success (Buehler, Griffin, & Ross, 1994). It is undoubtedly easier to imagine mastering one's nicotine cravings and resisting social pressures to smoke when the future is still far away. However, as the future draws near (e.g. as people imagine circumstances in one month vs six months), some routes to success become more daunting or perhaps disappear entirely. Mastering one's cravings for nicotine becomes an impending, difficult struggle, rather than distant, easy goal. With fewer routes available and with the remaining routes appearing more challenging, perceptions of control likely decline, perhaps producing a commensurate decline in probability estimates. Although changes in perceived control may contribute to changes in probability estimates over time, it is unlikely that it contributes to the Probability by Confidence interaction because it likely has little bearing on confidence judgments.

A question arises concerning the Probability by Confidence interaction. Why would the interaction exist at one month but not at six months? One explanation is that people are more mindful of the likelihood and consequences of achieving or failing to achieve their goals when events are proximal than when they are distant. As such, they may engage more often in metacognitive processes; perceived confidence is one such metacognitive process (Petty et al., 2007). For more distant events, such metacognitive processes may occur less often. While our data cannot speak directly to this issue, if one assumes that the number of constructs related to confidence serves as an indirect measure of metacognitive activity, we find little support that the

amount of activity differs between the two time points. As shown in Table 2, unlike probability estimates, there is weak evidence to suggest at either time point that ratings of confidence are correlated highly with several factors that may affect smoking status. Admittedly, confidence may have been related to other constructs that we did not assess.

The Probability by Confidence interaction—or lack thereof—can be viewed more broadly within the context of how confidence judgments are related to behaviors. For example, in the attitude literature, there is strong interest in identifying moderators of attitude–behavior correspondence (Cooke & Sheeran, 2004). In this context, attitudes held with more rather than less confidence (i.e. certainty) yield greater attitude–behavior correspondence (e.g. Bizer, Tormala, Rucker, & Petty, 2006; Fazio & Zanna, 1978; Rucker & Petty, 2004; Tormala & Petty, 2004). Although probability judgments are not attitudes per se, the interaction with confidence mirrors the findings shown in the attitudinal literature. Of interest, researchers (Petrocelli, Tormala, & Rucker, 2007) have empirically separated attitude certainty into two domains: attitude clarity (the subjective sense that one knows what one's attitude is) and attitude correctness (the subjective sense that one's attitude is correct or valid). Applying these distinctions to the current situation, future studies may ask smokers to identify the degree to which they think they know their chances of remaining a smoker in the future and to then rate the degree to which they feel their response is correct.

Our results have practical implications, especially for predicting smoking behaviors in the near future. The probability of remaining a smoker was highest in two, polar-opposite groups: participants who gave low probability estimates of remaining a smoker and expressed low confidence, and participants who gave high probability estimates of remaining a smoker and expressed high confidence. Clearly, probability estimates and confidence can be used together to identify smokers needing special attention. Further, approximately 11 percent of the sample believed they had a higher probability of remaining a smoker at six months than at one month, reflecting the possibility of relapse. Identifying the reasons for this pattern could inform interventions as well.

There are several caveats in the interpretation of our findings. First, the main outcomes were about remaining a smoker rather than about quitting. It is unclear to what extent participants were reframing the question in terms of quitting. This reframing may explain, in part, why estimates of remaining a

smoker were lower than observed. Thus, future studies should ask for probabilities of quitting and compare the pattern of results to those found herein. Second, we did not counterbalance the questions; it is possible that rating one's six-month probability influenced responses to the one-month estimate. Third, participants answered the questions as part of a larger survey. As a result, they probably did not spend a lot of time thinking carefully of all the factors that may have differentially affected their estimates for the two time points. Fourth, we were unable to reach a substantial number of participants, especially at six months. Although those reached and not reached did not differ on the main variables in this report, they may have differed on other constructs that could have influenced the results. Fifth, there were few or no values for some combinations between subjective probability estimates and confidence ratings. Hence, the values representing one-month smoking status in Fig. 1 may have in some instances significant error. Fortunately, the patterns for the hypothesized probability estimates based on the observed data and the intent-to-treat models were very similar. Nonetheless, it is important to try to replicate our pattern of results in another large sample of college smokers. Finally, we used one to two items to assess many of the constructs. Whether, the same findings would be found using a more extensive battery of measures remains to be seen.

In sum, our data suggest the utility of assessing both probability estimates and confidence ratings to predict future smoking status. Importantly, our study is the first to show in this population that confidence in one's estimates versus confidence in one's abilities to quit (Moore & Healy, 2008), affect future smoking status. As found with earlier studies with other populations, college smokers were optimistic in their estimated future smoking (many seeing themselves as not smoking). Aligning these optimistic perceptions with the reality that many will continue to smoke will no doubt pose a formidable challenge in this understudied population.

## References

- Bizer, G. Y., Tormala, Z. L., Rucker, D. D., & Petty, R. E. (2006). Memory-based versus on-line processing: Implications for attitude strength. *Journal of Experimental Social Psychology, 42*, 646–653.
- Buehler, R., Griffin, D., & Ross, M. (1994). Exploring the 'planning fallacy': Why people underestimate their task completion times. *Journal of Personality and Social Psychology, 67*, 366–381.
- Cooke, R., & Sheeran, P. (2004). Moderation of cognition–intention and cognition–behaviour relations: A meta-analysis of properties of variables from the theory of planned behaviour. *British Journal of Social Psychology, 43*, 159–186.
- Fazio, R. H., & Zanna, M. P. (1978). Attitudinal qualities relating to the strength of the attitude–behavior relationship. *Journal of Experimental Social Psychology, 14*, 398–408.
- Fischhoff, B., Slovic, P., & Lichtenstein, S. (1977). Knowing with certainty: The appropriateness of extreme confidence. *Journal of Experimental Psychology: Human Perception and Performance, 3*, 552–564.
- Johnston, L. D., O'Malley, P. M., & Bachman, J. G. (1993). *National survey results on drug use from the Monitoring the Future Study* (NIH Publication No. 93–3598). Rockville, MD: National Institute on Drug Abuse.
- Krizan, Z., & Windschitl, P. D. (2007). The influence of outcome desirability on optimism. *Psychological Bulletin, 133*, 95–121.
- Moore, D. A., & Healy, P. J. (2008). The trouble with overconfidence. *Psychological Review, 115*, 502–517.
- Ortendahl, M., & Näsmän, P. (2008). Judgments of risk for consequences of continuing or quitting smoking: A study of pregnant and nonpregnant women intending and not intending to quit. *American Journal of Drug and Alcohol Abuse, 34*, 225–233.
- Petrocelli, J. V., Tormala, Z. L., & Rucker, D. D. (2007). Unpacking attitude certainty: Attitude clarity and attitude correctness. *Journal of Personality and Social Psychology, 92*, 30–41.
- Petty, R. E., Brinol, P., Tormala, Z. L., & Wegener, D. T. (2007). The role of metacognition in social judgment. In A.W. Kruglanski & T. E. Higgins (Eds.), *Social psychology: Handbook of basic principles* (2nd edn, pp. 254–284). New York: Guilford Press.
- Rucker, D. D., & Petty, R. E. (2004). When resistance is futile: Consequences of failed counter arguing for attitude certainty. *Journal of Personality and Social Psychology, 86*, 219–235.
- Sanders, D., Peveler, R., Mant, D., & Fowler, G. (1993). Predictors of successful smoking cessation following advice from nurses in general practice. *Addiction, 88*, 1699–1705.
- Schneider, T. R., Salovey, P., Apanovitch, A. M., Pizarro, J., McCarthy, D., Zullo, J., & Rothman, A. J. (2001). Visual and auditory message framing effects on tobacco smoking. *Journal of Applied Social Psychology, 31*, 667–682.
- Slovic, P. (2001). *Smoking: Risk, perception and policy*. Los Angeles, CA: SAGE.
- Tormala, Z. L., & Petty, R. E. (2002). What doesn't kill me makes me stronger: The effects of resisting persuasion on attitude certainty. *Journal of Personality & Social Psychology, 83*, 1298–1313.

- Tormala, Z. L., & Petty, R. E. (2004). Source credibility and attitude certainty: A metacognitive analysis of resistance to persuasion. *Journal of Consumer Psychology, 14*, 427–442.
- Trope, Y., & Liberman, N. (2003). Temporal construal. *Psychological Review, 110*, 403–421.
- Velicer, W. F., Diclemente, C. C., Rossi, J. S., & Prochaska, J. O. (1990). Relapse situations and self-efficacy: An integrative model. *Addictive Behaviors, 15*, 271–283.
- Wakefield, M., Kloska, D. D., O'Malley, P. M., Johnston, L. D., Chaloupka, F., Pierce, J. Giovino, G., Ruel, E., & Flay, B. R. (2004). The role of smoking intentions in predicting future smoking among youth: Findings from Monitoring the Future data. *Addiction, 99*, 914–922.
- Weinstein, N. D., Slovic, P., & Gibson, G. (2004). Accuracy and optimism in smoker's beliefs about quitting. *Nicotine and Tobacco Research, 6*, 349–355.
- Zhu, S. H., Sun, J., Billings, S. C., Choi, W. S., & Malarcher, A. (1999). Predictors of smoking cessation in U.S. adolescents. *American Journal of Preventive Medicine, 16*, 202–207.

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## Author biographies

DR. LIPKUS is Professor of Psychiatry at Duke University Medical Center. He researches how persuasive messages, including those evolving risk, affect behavior change related to cancer prevention and screening.

DR. SHEPPERD is Professor of Psychology at the University of Florida, Gainesville. His research includes work on the optimistic bias and how people prepare and respond to potentially threatening information.

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