

“I Think I Can”: The Relation of Self-efficacy to Cessation and Relapse  
among Smokers Utilizing a Telephone Quitline

by

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## ABSTRACT

When people pick up the phone to call a telephone quitline, they are taking an important step towards changing their smoking behavior. The current study investigated the role of a critical cognition in the cessation process—self-efficacy. Self-efficacy is thought to be influential in behavior change processes including those involved in the challenging process of stopping tobacco use. By applying basic principles of self-efficacy theory to smokers utilizing a telephone quitline, this study advanced our understanding of the nature of self-efficacy in a “real-world” cessation setting. Participants received between one and four intervention calls aimed at supporting them through their quit attempt. Concurrent with the initiation of this study, three items (confidence, stress, and urges) were added to the standard telephone protocol and assessed at each call. Two principal sets of hypotheses were tested using a combination of ANCOVAs and multiple regression analyses. The first set of hypotheses explored how self-efficacy and changes in self-efficacy within individuals were associated with cessation outcomes. Most research has found a positive linear relation between self-efficacy and quit outcomes, but this study tested the possibility that excessively high self-efficacy may actually reflect an overconfidence bias, and in some cases be negatively related to cessation outcomes. The second set of hypotheses addressed several smoking-related factors expected to affect self-efficacy. As predicted, higher baseline self-efficacy and increases in self-efficacy were associated with higher rates of quitting. However, contrary to predictions, there was no evidence that overconfidence led to diminished cessation success. Finally, as predicted,

shorter duration of quit attempts, shorter time to relapse, and stronger urges all were associated with lower self-efficacy. In conclusion, understanding how self-efficacy and changes in self-efficacy affect and are affected by cessation outcomes is useful for informing both future research and current quitline intervention procedures.

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The harmful health effects of cigarette smoking have long been recognized, with several decades' worth of indisputable evidence identifying tobacco use as the leading cause of preventable illness and premature death in the United States (U.S. Department of Health and Human Services, 1983). There has been considerable success developing and implementing policies at the local, state, and federal level that have decreased smoking initiation and use. These have included raising the price of tobacco products through tax increases, clean indoor air ordinances, and aggressive media counter-marketing campaigns. Such policy changes have contributed to the 50% decline in U.S. smokers since the release of the first Surgeon General report in 1963 (Center for Disease Control, 2008).

However, the decline in initiation and prevalence of smoking appears to have slowed down or even halted over the past decade in the U.S. (Irvin & Brandon, 2000). There is also some evidence to suggest that successful quit rates in both clinical cessation trials (Irvin & Brandon, 2000) and pharmaceutical trials (Irvin, Hendricks, & Brandon, 2003) have been declining over the years. Therefore, it is now more important than ever to identify additional approaches that will contribute to decreasing smoking rates still further. One approach that bears considerable promise is developing, improving, and increasing the use of evidence-based cessation treatments in order to reduce smoking rates.

Although effective treatment for smoking exists, success remains modest. Every year approximately 17 million smokers make a quit attempt (Halpern & Warner, 1993). Unfortunately, only about 1.3 million of these smokers successfully become nonsmokers (Halpern & Warner, 1993). This translates into

only 2.5% of smokers quitting each year (Center for Disease Control, 2002). In addition, of those who attempt to quit, only a small fraction use existing evidence-based treatment. About 20% use some form of medication, but only on average for several weeks rather than the recommended 8-12 weeks and only 2-3% of quitters receive any form of counseling (Center for Disease Control, 2008). One reason for the low utilization rates may be the perceived lack of benefit from these treatments. Despite the fact there is strong evidence for effectiveness of both medication and counseling, even when used as recommended, only about one in three quitters will remain abstinent at a year. Although these numbers seem disheartening, there is still considerable opportunity to impact smoking cessation outcomes.

There is a rich body of research that has helped shape public health efforts aimed at promoting smoking cessation and preventing relapse. Cessation is typically approached from two perspectives: biological models of addiction and cognitive-behavioral models. Biological models tend to emphasize the physical aspects of addiction and interventions are often pharmacological (e.g., Nicotine Replacement Therapy). Other studies have identified numerous cognitive and behavioral variables that are predictive of cessation outcomes, including self-efficacy, motivation, social support, and smoking in the environment (Niaura & Abrams, 2002; Prochaska, DiClemente, & Norcross, 1992; Rose, Chassin, Presson, & Sherman, 1996).

In the smoking literature, the effects of self-efficacy have been studied widely, yet self-efficacy theory remains a rich topic for further research,

especially in the area of smoking interventions. Telephone quitlines are a relatively new and promising evidence-based cessation intervention, with the potential to dramatically impact cessation efforts (McAfee, 2007). Although there has been considerable research examining the impact of quitlines on cessation success, there has been minimal research examining the mechanisms within the individual and the program that contribute to success or failure. Self-efficacy is one such mechanism that has been shown to play a critical role in other areas of cessation research and thus is of particular interest to quitline researchers.

The theoretical aim of this study was twofold: (1) to investigate the presumed positive effect of self-efficacy on cessation in quitline participants and explore the effect of cessation outcomes on self-efficacy, and (2) to investigate whether excessively high self-efficacy may actually reflect an overconfidence bias, and in some cases be negatively related to cessation outcomes. This overconfidence perspective on self-efficacy has received little empirical attention in the smoking literature. However, there are important theoretical and conceptual reasons to anticipate that overconfidence might negatively influence the maintenance of abstinence.

The practical goal of this study was to determine the usefulness of incorporating self-efficacy measures into the protocols of telephone quitlines. Data from this project will help determine whether a better understanding of self-efficacy as people progress through a quitline program can be used to enhance cessation support to callers. For example, it may be beneficial to routinely assess self-efficacy at each encounter to help determine the callers' potential for success

or failure. Such changes in self-efficacy from one call to the next may act as warning signs of relapse or future adherence failures (e.g., not answering calls), allowing the quitline to better tailor its interaction procedures. Awareness of issues such as vulnerability to relapse could result in improved program efficiency and overall success rates.

To this end, an analysis of self-efficacy during the cessation process was conducted using a population of smokers who had engaged the services of Free & Clear, a nationwide telephone quitline. By applying basic principles of self-efficacy theory to smokers utilizing a telephone quitline, this study advances our understanding of the nature of self-efficacy in a “real-world” cessation setting.

### **Review of self-efficacy theory**

Self-efficacy theory, as conceived by Bandura (1977), is an intricate part of most current theories and models (e.g., social cognitive theory, theory of planned behavior) aimed at explaining how behavior change is accomplished. Self-efficacy refers to the belief or confidence in one’s ability to successfully execute a given behavior (Bandura, 1977) and is frequently considered one of the central determinants involved in the behavior change process (Armitage & Conner, 2000). According to self-efficacy theory, individuals' beliefs about their capacity to change a behavior causally influence the outcome when they engage in a behavior change attempt (Bandura, 1977; Bandura & Wood, 1989).

Bandura found support for self-efficacy theory in numerous early studies on people with phobias (Bandura, 1977). Bandura hypothesized that higher self-efficacy would result in more success because without the belief that one has the

ability to change, there is no incentive to act or persevere when faced with difficulties (Bandura, 1977; Bandura & Locke, 2003). Based on the results of these early studies, he concluded that successful behavior change is in fact more likely when a person has high self-efficacy.

### **Formative influences of self-efficacy**

The formation of self-efficacy beliefs is influenced by several factors including ability (e.g. capacity to perform a given behavior), task magnitude (e.g., difficulty), and performance experiences (e.g., successes versus failures). These factors contribute to self-efficacy but also have independent effects on task outcomes. For example, if a person does not have the capacity to perform a given behavior, merely believing that one is capable will not produce the desired outcome. However, self-efficacy does appear to contribute independently to outcomes above and beyond ability (Bandura, 1977), which suggests that ability alone is not responsible for behavior change.

Stajkovic and Luthans (1998) found that task difficulty moderates the relation between self-efficacy and performance, supporting Bandura's theoretical framework. In their meta-analysis, the relation between self-efficacy and performance was significant across levels of task complexity. However, it was strongest for simple tasks and decreased as tasks became more complicated. This suggests that self-efficacy is critical, however, task difficulty matters too, especially when it comes to challenging or difficult tasks.

Learning from past experiences (successes or failures) contributes to the formation of current self-efficacy beliefs. When a person successfully completes a

task, his or her self-efficacy for that task increases (Bandura & Wood, 1989). In contrast, when a person fails at a task, his or her self-efficacy for that task decreases. Additionally, when a person fails early on in the process of changing a behavior or performing a specific task, self-efficacy is more likely to be adversely affected than if the failure takes place further along in the process (Bandura & Wood, 1989). The impact of success and failure should also vary depending on the cognitive attributions a person makes about the event. For example, attributing failure to external factors beyond one's control is less likely to damage self-efficacy (Bandura, 1977). In summary, self-efficacy beliefs develop out of a complex, dynamic system in which various sources of information and experiences contribute to people's overall sense of self-efficacy.

### **Consequences of self-efficacy beliefs**

Self-efficacy beliefs are thought to influence behavioral outcomes through their influence on motivation, cognitive, and affective processes (Bandura & Locke, 2003). First, self-efficacy beliefs increase the likelihood that a person will feel motivated to engage in a task or behavioral act. That is, if people feel confident in their ability they are more likely to take a step towards initiating some sort of behavioral action. Not only does self-efficacy play a major role in the initiation of behavior change, but it also influences the amount of effort people put into making that change, and how long that effort will be sustained. For example in the weight loss literature, when people have high self-efficacy, they are more likely to engage in weight control behaviors (e.g., counting calories) and put more effort into participating in a weight loss program (Linde, Rothman,

Baldwin, & Jeffery, 2006) compared to people with lower self-efficacy. Other studies (e.g., Cervone & Peake, 1986) have found that effort mediates the relation between self-efficacy and performance. That is, people with high self-efficacy put more effort into a task, which in turn increases the likelihood of success. These studies demonstrate the various ways self-efficacy beliefs may influence the critical processes involved in changing behavior.

Several large meta-analyses (Sadri & Robertson, 1993; Stajkovic & Luthans, 1998) have shown that self-efficacy beliefs contribute both to the level of motivation to perform a behavior and subsequent performance. In one meta-analysis of self-efficacy and work related performance, Stajkovic and Luthans (1998) found a 28% increase in performance due to self-efficacy across numerous domains. However, because the studies reviewed were mostly correlational, it is difficult to know whether self-efficacy caused the increase in performance, or successful performance on a given task increased people's self-efficacy. It may be that the strong positive correlations between self-efficacy and performance are actually a function of performance's influence on self-efficacy (Vancouver, Thompson, & Williams, 2001). That is, experience of mastery over something helps to raise self-efficacy. The relation between self-efficacy and behavior change (or performance) is likely bi-directional in nature (Vancouver et al., 2001).

### **Overconfidence and reduced performance**

Self-efficacy theory has evolved over the years, but the basic principle remains the same—there is a positive relation between self-efficacy and behavior change. With copious research supporting this hypothesis, it is almost universally



accepted that high self-efficacy is desirable. However, some researchers (e.g., Vancouver et al., 2001; Vancouver, Thompson, Tischner, & Putka, 2002) have argued that this conclusion may not be as indisputable as past research suggests. Vancouver and colleagues (2002) suggest that the strong association between self-efficacy and performance may be primarily a function of the effect of performance on self-efficacy. Additionally, they hypothesize that though high self-efficacy might motivate people to adopt more difficult goals, it may in some situations actually hinder performance. They base this hypothesis on goal theories (e.g., perceptual control theory), and suggest that overconfidence may lead people to shut off the resources required to achieve a goal if they are overly confident in their abilities.

In order to examine this possibility, Vancouver and colleagues (2002) have conducted several studies aimed to explore whether there is a negative impact of high self-efficacy on performance. Vancouver et al. (2002) found that after an experimental manipulation intended to increase self-efficacy for playing an analytical game, self-efficacy increased but performance did not. They further found that increasing self-efficacy between games led to a decrease in performance on subsequent tasks. In another study, Vancouver and Kendall (2006) found that high-self efficacy was negatively related to motivation to study (e.g., the time participants spent studying) and exam performance. Similar research by Stone (1994) found that participants with high self-efficacy appeared over-confident in their abilities and consequently contributed less of their resources towards a task. Participants with higher self-efficacy paid less attention

to the task and were less effortful (Stone, 1994). Thus, in certain situations, it seems that too much self-efficacy may impair performance.

The findings from these studies clearly go against the conventional and vast literature that has come out in support of self-efficacy theory. Bandura and Locke (2003) took issue with the claims made by Vancouver and colleagues, specifically their suggestion that high self-efficacy is debilitating. They pointed to the large body of research that supports the positive association between self-efficacy and performance. However, Bandura and Locke (2003) did not disagree that it is possible for high self-efficacy to have a negative effect and suggested that social cognitive theory does, in fact, consider this possibility. They left open the possibility that a negative relation between self-efficacy and performance may exist, but only under certain conditions. They stated, “In preparing for challenging endeavors, some self-doubt about one’s performance efficacy provides incentives to acquire the knowledge and skills needed to master the challenges” (Bandura & Locke, 2003, p. 96).

In conclusion, self-efficacy theory has greatly influenced a variety of research questions and continues to receive a significant amount of empirical support in the psychology literature and beyond (Ellis & Taylor, 1983; Lent, Brown, & Hackett, 1994). The debate regarding overconfidence hindering performance illustrates an especially interesting arena for further empirical study.

### **Smoking cessation treatment**

Historically, most smokers who quit do so without the help of a formal cessation program (Fiore et al., 1990). Unfortunately, fewer than 13% of smokers

who quit without any treatment were abstinent at 1 year (Fiore et al., 1990; Marlatt, Curry, & Gordon, 1988). However, in recent years, there has been an increase in the number of people who use some form of assistance to quit. In a recent study, researchers (Zhu, Melcer, Sun, Rosbrook, & Pierce, 2000) found that approximately 20% of people used at least one form of assistance (e.g., self-help, counseling, Nicotine Replacement Therapy). Research suggests that when smokers quit with the help of a cessation program, whether it is behavioral or pharmacological, they are more likely to be successful (Zhu, Tedeschi, et al., 2000; Hughes, 1996). In a review of the literature, Hughes (1996) pointed out “Twenty meta-analyses of over 300 studies have concluded that behavioral and pharmacological treatment for smoking cessation works (p. 1797).” Together these finding suggest that although many smokers do not use evidence-based support to help them quit, when they do, their chance of success increases.

### **Telephone quitlines**

One medium for receiving evidence-based cessation counseling that has important implications for helping smokers quit and that is being utilized increasingly across the United States is the telephone quitline. In 2006, over half a million people received cessation services from telephone quitlines, and quitlines can now be found in all 50 states (North American Quitline Consortium, 2006). The most recent Center for Disease Control report (2010) recognized telephone quitlines as among the most promising approaches to helping disseminate effective smoking cessation treatment. But because resources for government-

financed quitline services are limited, efforts to ensure that quitline resources are effective and efficient have become more crucial.

Quitlines vary in the type of services they provide. Programs range from a single counseling call, to multiple in-depth calls across the quitting process, and many provide a pharmacological (Nicotine Replacement Therapy) component through mail order or pharmacy vouchers (McAfee, 2007). The majority of the counseling is provided by paraprofessionals called Quit Coaches, who use a semi-structured protocol based on recommendations from the U.S. Public Health Services Clinical Practice Guidelines (McAfee, 2007). Quitlines are relatively easy to disseminate and are cost-effective (Lichtenstein, Glasgow, Lando, Ossip-Klein, & Boles, 1996).

There are several important characteristics of quitlines to consider. First, research suggests that there is a “dose-response” effect (Zhu, Tedeschi, Anderson, & Pierce, 1996). That is, the more calls a person receives, the more likely they are to successfully quit. Second, the timing of the calls is important. If the focus of the quitline is on preventing early relapse, the calls are frontloaded around the quit date. An alternate approach is to follow up with people over an extended period of time in order to reach people who have relapsed and encourage them to recycle back into the program. Some programs are hybrids of these two timing approaches.

Quitlines remain a rich area for further research. Numerous research studies have shown that telephone quitlines are efficacious (e.g., Ossip-Klein & McIntosh, 2003). A study by Orleans et al. (1991) found a quit rate of 23% at 16

months for participants receiving a combination of brief telephone counseling and self-help materials. Lichtenstein and colleagues (1996) conducted a meta-analysis of telephone quitlines and found both significant short- (3-6 months) and long-term effects. These researchers also found that cessation rates for both reactive quitlines (i.e., a phone line is available for a specific population to call) and proactive (i.e., calls are initiated by someone who is part of the intervention program) quitlines were higher for the treatment conditions compared with control conditions. This early meta-analysis not only demonstrated the efficacy of telephone quitlines, it also encouraged further research on telephone interventions.

One challenge for researchers has been to test the effectiveness of quitlines using a randomized control trial, without compromising established standard of care procedures and raising ethical issues regarding withholding proven treatments from treatment-seekers. Zhu and colleagues (2002) used a unique design that allowed them to test whether telephone counseling is effective in a “real-world” setting by embedding a randomized control group into a quitline. Callers were assigned to a control group only when the call volume was high and services were not available. Participants in the control group received counseling only if they called back, whereas those randomized to a treatment group received a proactive offer of up to seven phone counseling sessions. The researchers found that abstinence rates were relatively higher in the treatment group at 12 months. This study demonstrated that telephone quitlines are efficacious in real world treatment settings.

When people pick up the phone to call a telephone quitline, they are taking an important step towards changing their smoking behavior. Yet each individual begins the process with a unique set of individual characteristics (e.g., gender, age, ethnicity) as well as smoking-related characteristics (e.g., nicotine dependence, past quit attempts) that will inevitably influence the likelihood that they will make a successful quit attempt. Thus, one important area of research is to improve our understanding of the factors that influence who sets a quit date, who follows through and makes a quit attempt, who is likely to relapse, and who is likely to adhere to the quitlines' program protocol.

### **Self-efficacy theory and smoking behavior**

Self-efficacy theory has been studied widely in the smoking cessation literature. For decades, this theory has been used to help identify how confidence in one's ability to quit smoking influences smoking cessation behavior, specifically with regard to initial cessation and relapse. Because self-efficacy is thought to be associated with both the initiation of behavior change (quit attempts) and the persistence with which a person is able to maintain the change (abstinence), research has focused on self-efficacy at various points during the cessation process (Gwaltney, Metrik, Kahler, & Shiffman, 2009). Consistent with this, the first section below addresses the effect of self-efficacy as a predictor of different cessation outcomes, including quit intentions, quit attempts, and relapse. That section is followed by a discussion of the reverse direction of influence—how self-efficacy is itself affected by the challenges associated with the cessation process.

## **Self-efficacy and smoking cessation outcomes**

### **Quit intentions**

Quitting smoking first involves setting a goal and taking action toward achieving that goal. It follows that intention to quit smoking is an important step in the cessation process. The basic principles of self-efficacy theory (Bandura, 1977) would suggest that smokers with higher self-efficacy are more likely to express intentions to quit (a goal) and to set a quit date (an action). Indeed, one of the most robust findings in the smoking literature is that when people feel confident in their ability to quit smoking, they are more likely to plan to quit (Prochaska et al., 1992; Schnoll et al., 2005). For example, in a study on intentions to quit smoking in a work setting, researchers found a significant positive correlation between self-efficacy and intention to quit smoking in the next 6 months (Willemsen, De Vries, Van Breukelen, & Oldenburg, 1996). The correlation was significant but somewhat weak ( $r = .09$ ). This was likely due to the long time horizon used in these researchers' definition of intention to quit. A related study (Dijkstra, De Vries, & Bakker, 1996) found that the relation between self-efficacy and intention is stronger the closer a smoker is to quitting (e.g., intend to quit in the next month). Taken together, these studies suggest that self-efficacy is positively correlated with making plans to quit, especially in the short-term.

### **Maintenance versus relapse**

Once a person makes a quit attempt, the challenge then becomes maintaining abstinence. Unfortunately, the majority of smokers who quit smoking

will relapse within the first few weeks (Piasecki, Fiore, McCarthy, & Baker, 2002). Relapse is defined as the return to smoking after a quit attempt, and represents treatment failure (Shiffman, 2005). The problem of high rates of relapse has puzzled and intrigued researchers, causing some to wonder if “our poor treatment success rates reflect a lack of understanding of addiction processes and will be best alleviated by a rededication to basic research efforts” (Piasecki et al., 2002, p. 1093). Because relapse is so common in smoking cessation, much empirical work has been dedicated to investigating the relapse process. Current cognitive models of relapse often use a framework guided by the principles of self-efficacy theory.

The early studies on self-efficacy and smoking cessation outcomes confirmed that pre-quit self-efficacy predicts success (Candiotte & Lichtenstein, 1981). That is, smokers who have higher self-efficacy prior to making a quit attempt are more likely to achieve long-term abstinence (> 6 months), whereas smokers with lower levels of pre-quit self-efficacy are more prone to relapse (Baer, Holt, & Lichtenstein, 1986; Gwaltney et al., 2002; Shiffman et al., 2000). However, some studies have not found a strong relation between pre-quit self-efficacy beliefs and cessation outcomes (Gwaltney, Shiffman, Balabanis, & Paty, 2005). A recent meta-analysis (Gwaltney et al., 2009) of 87 analyses that used a pre-quit self-efficacy assessment found only a small effect size (Cohen’s  $d = -.21$ ) of pre-quit self-efficacy on smoking status (i.e., higher self-efficacy is associated with less smoking). One possible explanation for these mixed findings is that pre-quit confidence in ability to



quit may be necessary to motivate smokers to take on a difficult task (i.e., make a quit attempt), high pre-quitting confidence may not be the most important predictor of successfully quitting long-term. Simply stated, confidence must be high in order to make an attempt (e.g., Baer et al., 1986). However, the relation between pre-quitting confidence and quit outcomes may be mediated by other processes (e.g., withdrawal, urges, post-quit confidence) that occur after a quit attempt is made.

In the same meta-analysis (Gwaltney et al., 2009), post-quit measures of self-efficacy had a small to medium effect size (Cohen's  $d = -.47$ ) on smoking status. People with higher self-efficacy after they quit were less likely to be smoking. Similarly, studies on cessation programs, post-treatment measures of self-efficacy are often associated with cessation outcomes. Among people who had quit at the end of treatment, higher levels of self-efficacy were associated with continued abstinence and lower levels of self-efficacy were associated with eventual relapse in the future (Brandon, Tiffany, Obremski, & Baker, 1990; Candiotte & Lichtenstein, 1981). Although it is difficult to unravel causation because the data in these studies were correlational, such findings are suggestive of vulnerability for relapsing among people who quit, but who continue to have low self-efficacy.

### **Changes in self-efficacy and quit outcomes**

The literature on how changes in self-efficacy during a quit attempt influence cessation outcomes is somewhat limited. One study found that decreases in self-efficacy from baseline to 12-month follow up were associated

with relapse (K. B. Carey & M. P. Carey, 1993). However, this study only looked at changes in self-efficacy measured at two distant time points, which may not fully capture the impact of changes in self-efficacy on smoking. Therefore, researchers have begun to explore the dynamic nature of self-efficacy as a person moves through the cessation process. In particular, Shiffman and colleagues (Gwaltney et al., 2002; Gwaltney, Shiffman, & Sayette, 2005; Shiffman et al., 2000) have focused on whether a drop in self-efficacy foreshadows both lapses and relapse.

Lapses are usually defined as a temporary slip back to smoking after a period of abstinence (Piaseki, 2006). A lapse can result in a return to abstinence or, more commonly, lead to full relapse (Brandon et al., 1990). Brandon and colleagues (1990) found that 88% of participants relapsed after smoking just one cigarette. Therefore, understanding the progression from lapse to relapse is critical in order to help people recover from slips during a quit attempt.

Several important findings have come out of these groundbreaking research studies on changes in self-efficacy (Gwaltney et al., 2002; Gwaltney et al., 2005; Shiffman et al., 2000). In one study, researchers found that self-efficacy changed little prior to a lapse, and changes in daily ratings did not predict initial lapse (Shiffman et al., 2000). However, self-efficacy did fall steadily after the lapse. Decreases in self-efficacy predicted progressing to relapse, suggesting that self-efficacy may have a causal role in determining smoking outcomes following a lapse. However, in a later study by Shiffman and colleagues (2005), self-efficacy began to drop on the day preceding the first lapse. This study also

replicated the results from the 2000 paper in that day-to-day decreases in self-efficacy following the initial lapse were associated with an increased rate of subsequent relapse. The authors hypothesized that lapses may be caused in part by decreases in self-efficacy that undermine people's ability to maintain the effort required to maintain abstinence.

The above studies demonstrate the ways in which self-efficacy changes both prior to and following cessation failure. One would also expect that increases in self-efficacy would be associated with successful cessation. Indeed, Shiffman and colleagues (2000, 2005) found that when people were abstinent, their self-efficacy remained high and stable. Specifically, participants who were continually abstinent over the entire 6 months reported relatively high self-efficacy scores. In another study, people who were quit had high self-efficacy at the end of treatment and their self-efficacy remained high at post treatment assessments (Baer et al., 1986).

To summarize, given the fact that most smokers who successfully quit smoking have done so only after multiple quit attempts (U.S. Department of Health and Human Services, 1983), it seems that the road to becoming a non-smoker is paved with failed cessation attempts. Therefore, in order to achieve success, smokers must be able to pick themselves up after a failed quit attempt and eventually try again. Drawing on these ideas, the goal of the current study is to better understand how self-efficacy and changes in self-efficacy affect cessation outcomes in order to identify possible points and strategies for intervention.

## **Overconfidence and smoking outcomes**

As discussed above, research on self-efficacy in the smoking literature has consistently found that smokers who have high self-efficacy are more likely to quit and are more likely to be successful in their endeavor to maintain abstinence. Though much of the research supports this relation between high self-efficacy and successful outcomes, some research suggests that high self-efficacy may sometimes be detrimental.

Despite the limited empirical data in the smoking literature, there is some evidence that overconfidence prior to and at the end of treatment can lead to relapse (e.g., Brandon et al., 1990). Staring and Breteler (2004) found that higher levels of post-treatment (8 group sessions) self-efficacy positively predicted cessation success. However, these researchers also found that smokers with *very* high post-treatment self-efficacy were more likely to relapse compared to smokers who were simply high in self-efficacy. In their research, Staring and Breteler (2004) found the optimal level of high self-efficacy to be approximately 79% of the maximum value on confidence scales. Twenty-nine percent of their participants scored higher than this value, and those who did were more likely to relapse than participants whose self-efficacy was close to the optimal level.

Consistent with this, an earlier study found that ex-smokers who had a moderate level of self-efficacy for recovery from a lapse were more likely to have abstained from smoking (29%), compared to both high confident (12.5%) and low confident (9.4%) groups at a one year follow-up period (Haaga & Stewart, 1992). Another study found that pre-treatment confidence was negatively correlated with

lapse to relapse latency (Brandon et al., 1990). That is, people with higher pretreatment self-efficacy relapsed sooner following a lapse. Taken together, these studies question the conventional role of self-efficacy and suggest that self-efficacy may better predict outcomes when analyses take into account a negative association between particularly high levels of self-efficacy and cessation.

Staring and Breteler (2004) noted that the reason for this decrease in success within very high self-efficacy people has not yet been explained. One possibility is that people with high self-efficacy underestimate the difficulty of quitting smoking and give up when the actual challenges exceed their expectations (e.g., they experience high urges to smoke and don't have adequate coping responses). Another possibility is that people who are overly confident may take more risks after they quit (e.g., they may maintain exposure to environmental smoking cues), which could make them more likely to relapse. Lastly, overly confident smokers might feel that they need less assistance quitting than other smokers, and consequently they may not use enough of the resources necessary to maintain abstinence (e.g., lower adherence to treatment protocol).

In the meta-analysis discussed above (Gwaltney et al., 2009) the authors concluded that exploring the possible curvilinear relation between self-efficacy and outcomes may add more to the literature than additional assessments of the linear model. As the majority of smokers will ultimately fail at any given attempt, one has to wonder if high confidence going into an attempt is a reflection of an accurate assessment of skills and ability or a cognitive bias. Bandura (1986) may have articulated it best when he wrote that self-efficacy should be "sufficient to

counteract judgment of complete self-inefficacy should a slip occur, but not so strong to embolden trial of the substance” (p. 437).

### **Determinants of self-efficacy**

Given the importance of self-efficacy in the cessation process, it is particularly useful to understand the range of factors that raise and lower confidence. The following section reviews trait, affect, motivational, and cessation-related predictors of self-efficacy.

#### **Individual traits**

A number of trait-level predictors of confidence in one’s ability to quit smoking have been identified. High self-efficacy for quitting is associated with several individual differences including being older, having higher education, lower levels of nicotine dependence, quitting for longer in the past, lower depression, and greater social support (Baer et al., 1986; Berg, Sanderson, Cox, Mahnken, Greiner, & Ellerbeck, 2008; Schnoll et al., 2005). Understanding what factors are predictive of self-efficacy is a useful starting point for both research and interventions.

#### **Negative affect**

Studies investigating the role of negative affect on self-efficacy have been largely inconclusive. Some researchers have found no association between negative affect and self-efficacy (Niaura & Adams, 2002). However, other studies (Rabois & Haaga, 2003) did find a relation between negative affect and self-efficacy. People with lower baseline negative affect had higher baseline self-efficacy compared to participants with higher levels of negative affect. Additional

studies (e.g., Gwaltney et al., 2005) have also found that lower self-efficacy appears to be associated with negative affect.

### **Urges to smoke**

Once a smoker quits, they will likely experience withdrawal symptoms and strong urges to smoke, both of which have been shown to predict lapse and relapse (Shiffman et al., 1997; Swan, Ward, & Jack, 1996). Experiencing strong urges during a quit attempt may be interpreted as a threat to abstinence, making people feel less confident that they will be able to maintain the effort required to stay quit. Alternatively, higher urges to smoke may be a function of actually being more nicotine dependent, which is also associated with relapse. Indeed, researchers have found that high urges to smoke were associated with lower self-efficacy in both participants who were abstinent and in those who had relapsed (Gwaltney et al., 2005; Shadel & Cervone, 2006). On the other hand, lower urges to smoke are associated with higher self-efficacy (Shadel & Cervone, 2006). One possible explanation for this is that confident smokers may feel more capable of coping with urges to smoke. These studies illustrate the complex nature of the relations among urges, self-efficacy, and cessation.

### **Outcomes of quit attempts**

Based on the tenets of self-efficacy theory, self-efficacy is expected to change in response to goal-relevant experiences, and thus after smokers quit, their confidence is likely to be impacted by the type of outcome (e.g., success versus relapse). That is, if people fail to achieve their goal (i.e., quitting smoking), their self-efficacy should decrease. Indeed, the majority (80%) of participants who

relapsed reported that relapsing had a negative impact on their confidence (Baer et al., 1986). Again, correlational data make it difficult to determine cause, however it does appear that relapsing has a negative relation to self-efficacy.

### **Duration of quitting**

Duration of quitting may serve as a measure of ability to succeed once a person achieves initial abstinence. That is, the longer people are able to remain quit, the more likely they are to feel capable of achieving success, which should lead to increase in self-efficacy. In one study (Baer et al., 1986), participants who remained abstinent at 3 months had higher self-efficacy scores compared to participants who relapsed prior to the 3 month follow up. Similarly, participants who reported being abstinent at 6 months had higher self-efficacy scores compared with those who relapsed between 3 and 6 months. This pattern suggests that maintaining cessation was associated with higher self-efficacy. However, among participants who eventually relapsed, quit duration was also positively associated with self-efficacy. Self-efficacy among participants who relapsed 3-6 months following treatment was higher compared to those who relapsed prior to 3 months. This seems to suggest that self-efficacy may be resilient following a relapse when a person is able to maintain cessation for a longer period of time. One explanation for this “resilience” in spite of relapsing may be that quitting for longer gives people more confidence because they feel a greater sense of ability to quit in the future.

In summary, the above literature review highlights the important role of self-efficacy on the cessation process. However, because the majority of the



studies were correlational, it is difficult to know if self-efficacy causes cessation outcomes, if successfully quitting increases people's self-efficacy, or both. It may be that the positive correlations between self-efficacy and performance (i.e., quitting) are actually a function of how quit outcomes influence self-efficacy. Of course, it is also possible that the relation between self-efficacy and behavior change is bi-directional in nature.

### **Cessation programs' influence on self-efficacy**

One way intervention programs may work is by enhancing people's self-efficacy. An early study on self-efficacy and smoking cessation programs (Candiotte & Lichtenstein, 1981) found that self-efficacy scores increased significantly in the treatment conditions (participants were involved in several short cessation programs, including individual and group counseling) compared to the minimal treatment condition. Additionally, self-efficacy scores, averaged across the various treatment conditions, increased from pre-treatment to post-treatment. Brendren and Kraft (2008) found similar positive effects of cessation programs. In this study, the treatment group received a digital cessation program (e.g., cessation help via emails, webpages, and text messages), compared to a control group who only received a self-help booklet. They found a significant increase in self-efficacy at the end of the program for the treatment group compared to the control group. Although the above treatment programs did not specifically target self-efficacy, these findings highlight the important role cessation programs play in increasing self-efficacy.

## **Self-efficacy and quitlines**

Research on self-efficacy and quitlines is limited. One study (Segan, Borland & Greenwood, 2006) investigated smoking cessation outcomes among quitline callers after 3, 6, and 12 months and found that low self-efficacy consistently predicted relapse. Self-efficacy was also related to length of quit attempt, with those who had quit for less than a week reporting lower self-efficacy compared to ex-smokers who had been abstinent for 4-6 months. Additionally, lower levels of self-efficacy at 3 months predicted relapse at 6 months, suggesting that the negative effects of low self-efficacy may build over time. However, these researchers did not explore the role of self-efficacy early in the cessation process, which is when the majority of smokers relapse. These findings do lend support to the utility of self-efficacy theory for understanding the process of cessation within the arena of telephone quitlines and suggest the need for further research.

## **Current research**

### **Hypotheses**

The following hypotheses are presented according to outcomes. The first hypothesis concerned the predictors of baseline self-efficacy prior to making a quit attempt. The second group of hypotheses (H2 through H6) explored how self-efficacy and changes in self-efficacy are associated with cessation outcomes. Lastly, the third set of hypotheses (H7 through H10) addressed several factors expected to affect self-efficacy.

**Hypothesis 1: Predictors of baseline self-efficacy.** The predictors of initial self-efficacy at the call prior to making a quit attempt included gender,

nicotine dependence, and stress. Consistent with the existing literature on self-efficacy and smoking (e.g., Baer et al., 1986) it was expected that being male, having lower nicotine dependence, and less stress would be associated with higher self-efficacy for quitting (H1).

**Hypothesis 2 - 6: Self-efficacy's association with cessation outcomes.**

Research has shown that self-efficacy is positively associated with intentions to quit, making quit attempts, and successful long-term cessation (Dijkstra et al., 1996; Shiffman et al., 2000). In the current study, it was predicted that higher self-efficacy would be associated with improved cessation outcomes. Self-efficacy at baseline was used to predict initial quit attempts, with higher self-efficacy at the baseline call associated with a greater likelihood of being quit at the first completed call (H2).

Several studies (e.g., Gwaltney et al., 2002; Gwaltney, Shiffman, & Sayette, 2005) have also found that *changes* in self-efficacy predict cessation outcomes. Therefore it was predicted that changes in self-efficacy from baseline to Call 1 would predict current and future quit status, with increases in self-efficacy associated with better quit outcomes (H3). Change from baseline to Call 1 was expected to continue to predict quit outcomes, even at later calls. Similarly, for participants who achieved initial abstinence at the first call, changes in self-efficacy from Call 1 to Call 2 were hypothesized to predict subsequent quit status, with increases in self-efficacy associated with maintaining abstinence and decreases in self-efficacy associated with more relapse (H4).

Despite the large literature highlighting the positive influence self-efficacy has on quitting, overconfidence in one's ability to quit may actually impair successful behavior change (Staring & Breteler, 2004) and thus could be associated with increased levels of failure to quit smoking. It was hypothesized that an overconfidence bias would exist such that self-efficacy would be positively related to quitting up to high levels of self-efficacy, at which point the relation between self-efficacy and quitting would become negative. Thus, smokers with overconfidence at the baseline call would be less likely to quit at the next call (H5). Based on the findings of Staring and Breteler (2004), there is also reason to believe that an overconfidence bias might affect relapse after treatment has ended. Specifically, participants who were able to maintain successful cessation one month into treatment would be more likely to have relapsed at follow-up calls than participants with less extreme self-efficacy scores (H6).

**Hypothesis 7 - 10: Factors associated with self-efficacy.** Based on previous research (e.g., Baer et al., 1986), it was predicted that the longer participants persisted in staying quit (duration of quit attempt), the higher their self-efficacy would be for maintaining abstinence (H7). Several studies (e.g., Gwaltney et al., 2000) have also demonstrated the negative impact of relapse on self-efficacy. Therefore, it was predicted that relapse would adversely influence self-efficacy beliefs (H8). Similarly, early relapse may be an indicator that a person has struggled more with cessation, with such inferences leading to decreases in reported self-efficacy. It follows that the immediacy with which participants relapsed after quitting would influence self-efficacy beliefs. For

participants who quit, those who relapse relatively early were hypothesized to have a more significant decrease in their self-efficacy beliefs compared to those who relapse after maintaining abstinence for a longer period of time (H9).

Finally, factors that increase arousal are likely to play a role in participants' sense of their own ability to maintain quitting behavior. For example, after quitting, stress and urges to smoke may be interpreted as (negative) indicators of one's ability to maintain that cessation attempt (Gwaltney et al., 2005). Thus, for participants who quit smoking at the first call, higher stress and stronger urges at Call 1 would predict lower self-efficacy at both Call 1 and Call 2 (H10).

## **Methods**

### **Overview of Free & Clear and Quit for Life**

Free & Clear is a telephone quitline based in Seattle, Washington and is one of the nation's leading tobacco cessation programs. Free & Clear enrolls approximately 200,000 smokers a year, with half coming from state-funded contracts and the other half from health plans and employers. Free & Clear's Quit for Life Program utilizes an evidence-based approach to treatment, combining biological, psychological and behavioral strategies to help smokers quit smoking. Quit coaches provide medication support, phone-based cognitive behavioral coaching (e.g., identifying thought patterns and situational triggers that cause the desire to smoke), and additional supporting material (via the internet and through the mail). Participants in Quit for Life receive up to five outbound follow-up phone calls made proactively by a team of Quit Coaches (Free & Clear, 2008).

## **Participants**

All participants were smokers who enrolled in Free and Clear's pro-active Quit For Life Program between November 24, 2009 and February 20, 2010. The initial data set consisted of 7357 participants. In order to control for several issues (specified below), 2066 participants were excluded from the analyses. This resulted in a total of 5291 participants. See Table 1 for demographic information.

**Inclusion/Exclusion criteria.** Individuals were eligible for participation if they were at least 18 years of age, actively smoking at the time of the baseline intervention call, and planning to set a quit date in the next 30 days.

People were excluded for several reasons. A total of 939 participants were sent a letter following the registration call, which meant that a quit coach was unable to contact them during the initial round of call attempts following registration. Additionally, 83 participants had registration call data, but the remainder of the data was missing. A total of 672 participants had already quit at the time of the baseline call and were excluded because they quit prior to receiving any intervention through Free & Clear. Lastly, 372 participants did not have scores on the baseline nicotine dependence measure (necessary for several main hypotheses) so they were dropped as well.

## **Measures**

Concurrent with the initiation of this study, three items (confidence, stress, and urges) were added to the standard telephone protocol. To standardize the delivery and timing of the questions, quit coaches received multiple in-depth

trainings for this new protocol, and were provided instructions for how to incorporate these new items into follow-up calls.

Self-efficacy was assessed at all phone calls using the following item: “On a scale of 1 to 10, where 1 is not at all confident and 10 is highly confident, how confident are you that you can quit (or stay quit if already quit) for good?” Because of the limitations imposed by the challenge of adding multiple items to the Quit Coaches protocol, a single item was selected. This single self-efficacy item allowed for an assessment of general self-efficacy for quitting (or staying quit). Spanier, Shiffman, Maurer, Reynolds, and Quick (1996) used an item similar to this item in order to assess smoking abstinence self-efficacy. The use of a general self-efficacy item is supported by studies that show this single item accounts for most of the variance in the larger self-efficacy scales (e.g., Baer et al., 1986; Baer & Lichtenstein, 1988).

Additionally, a general stress item was added at every call and asked of all participants regardless of smoking status. Participants were asked, “On a scale from 1 to 10, in the last week, how often have you felt difficulties were piling up so high that you could not overcome them?” (1 = Never; 10 = Very Often). This item was similar to the general stress item on the Perceived Stress Scale (Cohen, Kamarck, & Mermelstein, 1983). The time frame was changed from one month to one week in order to assess for stress in the week preceding the phone call.

Lastly, a smoking urge item was added and asked of participants who reported having quit at the time of the call. Participants rated their urge to smoke using a single item, “On a scale from 1-10 where 1 is ‘no urges’ and 10 is

‘strongest urges’, how strong have your urges or cravings been to smoke during the past day?” This item is similar to the urge item used by Shiffman et al. (2002). A single item assessing urges is recommended by Shiffman, West, and Gilbert (2004), as additional items are highly correlated with the single urge measure and do not appear to add to construct validity. A measure of urges to smoke does not constitute a specific measure of withdrawal severity, however, urges to smoke are commonly observed following cessation and have been shown to predict relapse (Shiffman et al., 1997).

In addition to the new items, demographic and smoking data were collected on all participants and included gender, age, number of years smoked (1 = < 1 year, 2 = 1 to 5 years, 3 = 6 to 19 years, 4 = 20+years) number of cigarettes smoked per day, and nicotine dependence. Nicotine dependence was assessed with the item “How soon after you wake up do you use tobacco for the first time in the day?” with the following response options: 1 = >60 minutes, 2 = 31-60 minutes, 3 = 6-30 minutes, 4 = <5 minutes (based on the first item from the Fagerstrom Test for Nicotine Dependence).

**Smoking variables.** Participants’ quit status was assessed at every call. Participants were asked “Are you currently quit?” (yes or no). For people who responded yes, they were asked “How long have you been quit?” with the following response options: quit for at least 24 hours but less than 7 days, at least 7 days but less than 30 days, at least 30 days but less than 6 months, and 6 months or longer.



**Definition of a quit attempt.** People who reported not smoking for 24 hours on the quit duration item at any of the intervention calls were considered to have made a quit attempt. Surveys used by the Center for Disease Control use 24 hours to define a serious quit attempt (CDC, 2008).

**Definition of successful cessation.** Successful cessation was defined as not using tobacco in the last 30 days (Free & Clear, 2008).

**Definition of relapse.** Relapse was defined as a smoker who made a deliberate attempt to quit (“yes” to “Are you currently quit”) but failed to achieve abstinence (as reported by a return to smoking at a subsequent phone call).

**Adherence measures.** Adherence was assessed by number of calls completed. Participants in this study received between 0 and 4 calls following their initial call with a Quit Coach.

### **Procedure for Phone Calls**

When a smoker called the quit line at Free & Clear, he or she was screened by staff, assigned an ID number, and entered into the data system. During this initial registration call, data were collected on a range of items including contact information, referral source, and demographics (gender, age). After this initial registration process, the caller was either transferred to a Quit Coach to complete the baseline intervention call or, if the caller could not be transferred (e.g., he or she did not have time or no quit coaches were available), a Quit Coach would attempt to call back the participant within 1 to 2 days. A total of 75.2% of participants (N = 3981) spoke to a quit coach on the same day as their registration call and the majority of study participants (98.7%) spoke to a quit

coach within a week of their registration call (as noted in inclusion/exclusion criteria, those not successfully reached during this first cycle of call attempts were excluded from the study).

The majority (75%) of participants spoke to a quit coach on the same day as their registration call and 25% of participants received a call back at a later date. An independent samples t-test comparing the baseline self-efficacy score of participants who spoke to a quit coach the same day as the registration call ( $M = 7.71$ ,  $SD = 2.09$ ) compared to those who spoke with a quit coach at a later date ( $M = 7.74$ ,  $SD = 2.01$ ) found no significant difference between these groups ( $t = .43$ ,  $p = .18$ ).

**Baseline call.** For the purpose of this study, the first contact with a Quit Coach was considered the “baseline intervention call.” During the baseline call, the Quit Coaches collected information on smoking variables (e.g., current smoking status), nicotine dependence (e.g., time to first use, average number of cigarettes smoked per day), confidence to quit (i.e., self-efficacy), and current stress level. After establishing rapport and reviewing past experiences quitting, participants were given the opportunity to set a quit date and the Quit Coach helped the participant develop a personalized plan to prepare for his or her quit date. Barriers to success were identified and problem-solved. Dysfunctional cognitions were identified, such as “I probably won’t succeed because I failed in my last attempt,” with the opportunity to develop alternative cognitions such as “quitting is like learning to ride a bike, falling off is part of the process.” Practical advice such as getting rid of cigarettes and paraphernalia from the house and car

was also given. Use of medication to assist during the quit attempt was explored, with a tightly-scripted review of appropriateness and potential contraindications for those interested. During the baseline call, participants set a quit date and the next phone call was scheduled.

**Follow-up intervention calls.** After the initial baseline intervention call, participants received between 1 and 4 follow up intervention calls initiated by the Quit Coaches. Following the baseline call, the Quit Coach would attempt to call on or within a few days of the set quit date (Call 1). Assuming the participant reported being quit at Call 1, the Quit Coach called them again within 7 to 10 days (Call 2). If at Call 2 the participant was still quit, the Quit Coach followed up in 2 to 3 weeks (Call 3). If at Call 3, the participant was still quit, the Quit Coach attempted to reach the participant in another 2 to 3 weeks (Call 4). Follow-up calls were less structured than the initial baseline call. During these intervention calls, information was collected on multiple variables including the date of call, how call attempts were completed (intervention or letter if unable to reach), quit status, duration of quit attempt, self-efficacy, urge to smoke, stress, and medication status.

Quit Coaches followed a standardized time schedule for attempting each of the intervention calls. However, call intervals were adjusted as needed based on the circumstances of the phone call. For instance, if a person was not quit at Call 1 or had relapsed at a follow-up call, the next call would be scheduled based upon a new quit date. If the person had relapsed but was not ready to set a new quit date, the next follow-up call would be scheduled in 3-4 weeks. When participants could

not be reached during a call cycle, they were sent a letter and Quit Coaches would attempt to reach them at their next call cycle. See Figure 1 for a breakdown of call outcomes (intervention or letter) at each call cycle.

### **Shifted Call Variables**

Participants missing phone calls at the different call cycles led to variation in the timing of the calls. One way to more accurately conceptualize “Call 1,” “Call 2,” “Call 3” and “Call 4,” was to identify when the participants actually had their first, second, third and fourth completed call (CC) with a Quit Coach. For example, for participants who were sent a letter at the first call attempt but received an intervention at the second call attempt, the second call and the data collected during that call were shifted and thereafter considered their first completed call (CC1). When using this approach, participants’ “Call 1” was considered their first completed call (CC1) following the baseline call, even if the call did not occur at the first cycle of attempted calls (AC1). This process is illustrated in Figure 2.

In Figure 2, the diagonal represents the people who completed the call (i.e., received an intervention) at the corresponding attempted call (i.e.,  $CC1 = AC1$ ). The off-diagonal represents the number of people who completed intervention calls at a different call attempt (i.e.,  $CC1 = AC2$ ). For instance, of the 3317 people who received an intervention at attempted call 2 (AC2), 2703 received a CC2 (as scheduled at AC2), but 614 were just receiving their CC1. These 614 participants received a letter following the first call attempt, but were successfully reached during the second attempt. If the intervention data had been

analyzed by time of attempted call, these 617 participants would have been included in the analyses at AC2 although these people would have received only one intervention, whereas all other participants at AC2 had received 2 interventions. By shifting the data to match the number of the intervention, the 614 people were analyzed along with all the other people receiving the CC1 call.

**Number of Completed Calls.** Shifting the data as described above helped to standardize the timing of interventions and control for issues related to differences between number of interventions. Of the 5291 participants with baseline data, 620 (11.7%) never received any additional intervention calls following the baseline call. A total of 4671 (88.3%) participants received at least one completed intervention call (CC1) after baseline, 3591 (67.8%), received at least two completed intervention calls (CC2), 2338 (44.2%) received at least three completed intervention calls (CC3), and 1119 (21.1%) received four completed intervention calls (CC4).

### **Statistical analysis**

Analyses were performed according to a set of a priori hypotheses focused on two primary outcomes: (1) effects of self-efficacy on quitting behavior and (2) predictors of self-efficacy. Findings are grouped together by their relevance for each of these predictions. For quit outcomes, logistic regression analyses were done to determine how self-efficacy influenced quitting and relapse behaviors. For outcomes addressing predictors of self-efficacy, a combination of ANCOVAs and multiple regression analyses were conducted depending on the type of predictors tested. In each of these analyses, a number of baseline variables, such

as gender, nicotine dependence, baseline stress, and initial self-efficacy, were controlled for when appropriate (specific covariates are identified in each section below). Additionally, because of the large sample size, effect sizes for specific tests were included in order to determine strength of the hypothesized relations.

Due to the inherent challenges associated with reaching participants via telephone, as described above, there was variation in the duration between phone calls. For example, the time period between the baseline intervention call and Call 1 varied partly because people set different quit dates during their baseline call, but also because Call 1 (i.e., the first completed call with a Quit Coach) may have taken place after numerous call attempts. All participants were required to set a quit date within 30 days of the baseline call. However, the duration between the baseline call and Call 1 ranged from 0 to 175 days ( $M = 24.46$ , Median = 17,  $SD = 21.59$ ). Therefore, duration between all calls (*inter-call interval*) was included as a variable in the following analyses when appropriate.

## **Results**

### **Descriptive statistics**

General demographic information and baseline characteristics of the participants are presented in Table 1. Descriptive statistics for the variables included in the analyses are broken down by Call number in Tables 2-5.

### **Number of completed calls: Baseline characteristics and quit outcomes**

Number of completed calls can be conceptualized as a measure of adherence during this period of enrollment. As suggested by the breakdown of completed calls above, participants received between 0 and 4 completed calls

following their baseline intervention call. 620 participants received only a baseline call, 1080 received 1 call, 1253 received 2 calls, 1219 received 3 calls, and 1119 received 4 calls (see Figure 3).

To better understand whether participants who received varying number of “doses” (i.e., number of calls) differed in meaningful ways, several analyses were conducted. First, correlations between the baseline characteristics of participants who received different numbers of calls (0 to 4) were investigated (See Table 6). Analyses revealed that being female, younger, higher nicotine dependence, self-efficacy and stress were all associated with fewer calls completed.

A Chi-square analysis was conducted on the effect of gender. Women were less likely than men to be adherent (i.e., received fewer calls) and were more likely to only receive a baseline call ( $\chi^2(1, N = 620) = 29.83, p < .001$ ), one call ( $\chi^2(1, N = 1080) = 10.40, p = .001$ ), and two calls ( $\chi^2(1, N = 1253) = 4.49, p < .05$ ). This pattern gradually shifted, however, with no gender difference emerging for three calls ( $\chi^2(1, N = 1219) = .007, ns$ ) and men being more likely to complete all four calls ( $\chi^2(1, N = 1119) = 12.23, p < .001$ ). Several ANOVAs were then conducted on the remaining continuous variables. With respect to age, younger participants were less adherent at all call cycles (see Figure 4), (overall:  $F(4, 5286) = 73.30, p < .001, \eta_p^2 = .05$ ; individual contrasts:  $ps < .001$ ). There was no difference in adherence due to varying degrees of nicotine dependence, ( $F(4, 5286) = 1.19, ns$ ). For self-efficacy at baseline, a significant overall effect emerged (see Figure 5), ( $F(4, 5028) = 7.62, p < .001, \eta_p^2 = .006$ ). Participants who received only one call ( $p < .001$ ) began the program with higher confidence

than participants who received two, three or four calls (additionally, participants receiving 3 or 4 calls did not differ on degree of baseline self-efficacy). For stress at baseline, a significant main effect emerged (see Figure 6), ( $F(4,4035) = 3.31, p = .01, \eta_p^2 = .003$ ) with higher stress being associated with quicker attrition. However, the only contrast to reach significance was between people who received just one call and those who received more than one call ( $p < .01$ ), suggesting that stress peaked among those participants who dropped out after one call.

Out of 5291 participants, 3128 (68%) reported being quit at some point during this period of enrolment. Number of calls (controlling for gender, nicotine dependence, baseline self-efficacy, and baseline stress) was positively associated with quitting ( $B = .97, Wald \chi^2(1, N = 3949) = 795.50, p < .001, OR = 2.64$ ). People who received more calls were more likely to have quit at least once during the data collection period.

### **Causes of missing data**

Two issues caused missing data. First, missing data were the result of Quit Coaches not assessing self-efficacy, urge, or stress, during the phone calls. Second, different analyses excluded people because of attrition (i.e., number of calls received). As analyses included more completed calls, the sample size became more restricted because not everyone received every call. Participants excluded at each hypothesis because of call attrition are identified below.



## Primary hypotheses

A summary of the findings of the primary hypotheses is presented in Table 7.

**Hypothesis 1: Influences of baseline self-efficacy.** It was hypothesized that self-efficacy at baseline would be associated with the participant's gender, level of nicotine dependence, and stress. Specifically, it was predicted that being male, less nicotine dependant, and having lower stress would be associated with higher levels of self-efficacy at baseline. To test for this, a multiple regression analysis was conducted, with gender, dependence, and stress all predicting baseline self-efficacy. This analysis included all 5291 participants who received a baseline call. Any missing data were the result of pairwise deletion on the confidence and stress items.

Nicotine dependence ( $B = -.13$ ,  $t(3944) = -4.22$ ,  $p < .001$ ,  $sr^2 = .004$ ) and stress ( $B = -.05$ ,  $t(3944) = -4.14$ ,  $p < .001$ ,  $sr^2 = .004$ ) were related to baseline self-efficacy, with higher dependence and higher stress associated with lower self-efficacy for being able to quit in the future. Gender was correlated with baseline self-efficacy, with men reporting more confidence at baseline. However, this result was only marginally significant after controlling for nicotine dependence and stress ( $B = .12$ ,  $t(3944) = 1.86$ ,  $p < .06$ ,  $sr^2 = .001$ ). Although statistically significant, these variables accounted for just 1% of the variance of baseline self-efficacy ( $R^2 = .01$ ).

Because correlations suggested that gender, dependence, and stress were all associated with self-efficacy at baseline (see Table 8), these were controlled in the following analyses on self-efficacy when appropriate.

**Hypotheses 2-6: Self-efficacy's association with quit outcomes.** Five hypotheses were tested that explored self-efficacy as a predictor of quit outcomes. Additionally, because correlations suggested that gender, nicotine dependence, and baseline stress were correlated with quit status at Call 1 (see Table 8), these were controlled in the following analyses on quit outcomes.

***Hypothesis 2: Baseline self-efficacy positively predicts making a quit attempt.*** It was hypothesized that participants with higher self-efficacy at the baseline call would be more likely to have quit smoking at Call 1. This analysis included only participants who received at least one call (N = 4671). Missing data were the result of 620 people with no Call 1 data and pairwise deletion on the confidence and stress items.

A logistic regression was conducted with gender, nicotine dependence, stress at baseline, self-efficacy at baseline, and inter-call interval predicting quit status at Call 1 (Nagelkerke  $R^2 = .05$ ). Self-efficacy at baseline did significantly predict quit status, with higher confidence associated prospectively with more quitting ( $B = .11$ , Wald  $\chi^2(1, N = 3490) = 40.66$ ,  $p < .001$ , OR = 1.12). Additionally, all other predictors were significant as well,  $ps < .01$ . Men were more likely to have quit, higher nicotine dependence was associated with less quitting, higher stress was associated with less quitting, and longer time between baseline and Call 1 was associated with more quitting. In this analysis, baseline

self-efficacy was the strongest predictor of being quit at Call 1 (the next highest Wald  $\chi^2$  value was 26.51 for nicotine dependence).

***Hypothesis 3: Increases in self-efficacy from baseline to Call 1 are associated with higher rates of quitting.***

It was hypothesized that changes in self-efficacy from baseline to Call 1 would be associated with quit status at Call 1, with increases in self-efficacy associated with more quitting. To detect this, change scores were calculated (Call 1 self-efficacy - baseline self-efficacy). This analysis included only participants who received at least one call (N = 4671). Missing data were the result of the 620 people with only baseline data and pairwise deletion on the confidence and stress items.

Quit status at Call 1 was regressed on changes in self-efficacy from baseline to Call 1, controlling for gender, nicotine dependence, baseline stress, and inter-call interval (Nagelkerke  $R^2 = .05$ ). Change in self-efficacy was correlated with quitting at Call 1 ( $B = .11$ , Wald  $\chi^2(1, N = 2822) = 31.18$ ,  $p < .001$ , OR = 1.11), with increases in self-efficacy associated with more quitting at Call 1.<sup>1</sup> Additionally, all covariates remained significant,  $ps \leq .001$ .

To test the hypothesis that changes in self-efficacy from baseline to Call 1 would prospectively predict quitting at later calls, a series of logistic regression

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This analysis was repeated by replacing change scores with residual scores that were formed by regressing call 1 self-efficacy on baseline self-efficacy. The results of this analysis lead to the same conclusion as the analysis that used change scores.

analyses were conducted (controlling for gender, nicotine dependence, baseline stress, and relevant inter-call intervals).

Quit status at Call 2 was the criterion for the first analysis, which included only participants who received at least two follow-up calls ( $N = 3591$ ). Missing data were the result of the 620 people with no Call 1 data, 1080 with no Call 2 data, and pairwise deletion on the confidence and stress items. Increases in self-efficacy from baseline to Call 1 were associated with more quitting at Call 2 ( $B = .08$ ,  $Wald \chi^2(1, N = 2179) = 13.11, p < .001$ ,  $OR = 1.08$ ). In fact, among people not quit at Call 1, increases in self-efficacy from baseline to Call 1 predicted more quitting at Call 2 ( $B = .06$ ,  $Wald \chi^2(1, N = 1182) = 3.97, p < .05$ ,  $OR = 1.06$ ).

The second analysis involved quit status at Call 3. This analysis included only participants who received at least three follow-up calls ( $N = 2338$ ). Missing data were the result of the 620 people with no Call 1 data, 1080 with no Call 2 data, 1253 with no Call 3 data, and pairwise deletion on the confidence and stress items. The overall effect of change from baseline to Call 1 was again significant, ( $B = .13$ ,  $Wald \chi^2(1, N = 1419) = 17.60, p = .001$ ,  $OR = 1.14$ ), with increases associated with more quitting at Call 3. Again, among people not quit at Call 1 and Call 2, increases in self-efficacy from baseline to Call 1 predicted more quitting at Call 3 ( $B = .14$ ,  $Wald \chi^2(1, N = 424) = 6.62, p = .01$ ,  $OR = 1.15$ ), suggesting that self-efficacy changes from baseline to Call 1 continued to predict quit status at Call 3.

The final analyses involved quit status at Call 4. This analysis included only participants who received at least 4 follow-up calls ( $N = 1119$ ). Missing data

were the result of the 620 people with no Call 1 data, 1080 with no Call 2 data, 1253 with no Call 3, 1291 with no Call 4 data, and pairwise deletion on the confidence and stress items. The overall effect of change remained significant, ( $B = .20$ ,  $Wald \chi^2(1, N = 682) = 17.34$ ,  $p < .001$ ,  $OR = 1.22$ ), suggesting that self-efficacy changes from baseline to Call 1 were associated with quit status at Call 4. However, among people not quit at Call 1, Call 2, and Call 3, increases in self-efficacy from baseline to Call 1 did not predict quitting at Call 4, likely because of the low numbers of people who did not quit at all calls (in this analysis,  $N = 131$ ).

***Hypothesis 4: Increases in self-efficacy from Call 1 to Call 2 are associated with positive cessation outcomes.***

It was hypothesized that changes in self-efficacy from Call 1 to Call 2 would be associated with quit status, with increases in self-efficacy associated with more quitting. For this analysis, change scores were calculated (Call 2 self-efficacy - Call 1 self-efficacy). The first analysis tested the association between change and quit status at Call 2. This analysis included only participants who received at least two calls ( $N = 3591$ ). Missing data were the result of the 620 people with no Call 1 data, 1080 with no Call 2 data, and pairwise deletion on the confidence and stress items.

Quit status at Call 2 was regressed on changes in self-efficacy from Call 1 and Call 2, controlling for baseline self-efficacy, gender, dependence, baseline stress, and inter-call interval (Nagelkerke  $R^2 = .09$ ). Increases in self-efficacy were positively associated with being quit, ( $B = .14$ ,  $Wald \chi^2(1, N = 1883) =$

21.10,  $p < .001$ , OR = 1.15), with greater increases in self-efficacy from Call 1 to Call 2 associated with more quitting at Call 2.

To test the hypothesis that changes in self-efficacy from Call 1 to Call 2 would prospectively predict quitting at later calls, a series of logistic regression analyses were conducted (controlling for baseline self-efficacy, gender, nicotine dependence, baseline stress, and inter-call interval).

The first analysis used quit status at Call 3 as the criterion. This analysis included only participants who received at least three calls ( $N = 2338$ ). Missing data were the result of the 620 people with no Call 1 data, 1080 with no Call 2 data, 1253 with no Call 3, and pairwise deletion on the confidence and stress items. Change from Call 1 to Call 2 was associated with quit status at Call 3 ( $B = .09$ ,  $Wald \chi^2(1, N = 1242) = 5.12$ ,  $p = .02$ , OR = 1.09). The second analysis involved quit status at Call 4. This analysis included only participants who received a baseline call and at least four calls ( $N = 1119$ ). Here, change from Call 1 to Call 2 did not significantly predict quit status at Call 4 ( $p > .16$ ).

Beyond quitting, changes in self-efficacy after initial quitting may influence people's tendency to relapse. To test this, quit status at Call 2 was regressed on changes in self-efficacy from Call 1 and Call 2, only among participants quit at Call 1, controlling for gender, dependence, stress, and inter-call interval. Additionally, the duration of quitting at Call 1 was included because of its association with quit status at Call 2 ( $r = .11$ ,  $p < .001$ ). Missing data were the result of 620 people with no Call 1 data, 1080 with no Call 2 data, and

pairwise deletion on the confidence and stress items. Additionally, 2731 participants were not quit at Call 1 so they were not included in this analysis.

Change in self-efficacy was correlated with whether people relapsed, ( $B = .40$ ,  $Wald \chi^2(1, N = 892) = 27.04$ ,  $p < .001$ ,  $OR = 1.48$ ), with greater decreases in self-efficacy from Call 1 to Call 2 associated with relapsing prior to Call 2 (Nagelkerke  $R^2 = .18$ ). All other predictors were significant as well,  $ps \leq .05$ , except gender ( $p > .83$ ) and baseline stress ( $p = .07$ ). Higher dependence was associated with more relapse and longer time between Call 1 and Call 2 was associated with more relapse. In this analysis, decreases in self-efficacy from Call 1 to Call 2 were the strongest predictor of relapse at Call 2.

***Hypothesis 5: Overconfidence at baseline negatively predicts quitting at Call 1.*** Overconfidence in one's ability to quit may actually impair successful behavior change and thus may be associated with increased failure to quit smoking. It was hypothesized that an overconfidence bias would exist such that self-efficacy would be positively related to quitting up to high levels of self-efficacy, at which point a downward trend would emerge indicating that smokers with overconfidence at baseline would be less likely to quit at Call 1. Thus, the relation between self-efficacy and quit success would follow a curvilinear, inverted U-shaped function. Missing data were the result of the 620 people with no Call 1 data, and pairwise deletion on the confidence and stress items.

To test this hypothesis, a logistic regression was conducted with gender, dependence, stress at baseline, self-efficacy at baseline, inter-call interval (these variables were all mean centered) and as well as the term for the quadratic effect

of self-efficacy predicting quitting behavior at Call 1 (Nagelkerke  $R^2 = .05$ ). The quadratic term was not significant, indicating no evidence for the predicted over confidence effect ( $p = .69$ ). The linear effect of self-efficacy at baseline still significantly predicted quit status, with higher confidence leading to more quitting ( $B = .12$ , Wald  $\chi^2(1, N = 3490) = 31.08$ ,  $p < .001$ , OR = 1.12). Additionally, all other predictors were still significant as well,  $ps < .01$ . Men were more likely to have quit, higher dependence was associated with less quitting, higher stress was associated with less quitting, and longer time between baseline and Call 1 was associated with more quitting.

***Hypothesis 6: Overconfidence after quitting for one month negatively predicts quitting.*** It was originally hypothesized that an overconfidence bias may also exist after treatment and quitting has taken place. Specifically, participants who were able to quit smoking but who were overconfident one month into quitting may be more likely to have relapsed at the follow-up call. The same curvilinear effect of overconfidence at baseline was predicted for smokers who reported being quit for one month.

At Call 1, of the people who had been quit for 1 month (144), only 3 participants had relapsed at Call 2. At Call 2, of the people who had been quit for 1 month (412) only 7 had relapsed at Call 3. Lastly, at Call 3, of the people who had been quit for 1 month (706), only 7 had relapsed at Call 4. As a result, it was not possible to test this hypothesis in people quit for a month.



**Hypotheses 7-10: Predictors of self-efficacy.** Four hypotheses were tested concerning the correlates and predictors of self-efficacy in participants who reported being quit at Call 1 (N = 1940).

***Hypothesis 7: Longer duration of abstinence will be associated with higher self-efficacy.*** It was hypothesized that the longer participants persisted in maintaining abstinence, the higher their self-efficacy would be for maintaining abstinence. The effect of quit duration on self-efficacy within each call period was tested. Gender, dependence, baseline stress, baseline self-efficacy, urges and inter-call interval, were controlled for in all the analyses. A series of multiple regression analyses with duration of quit attempt at each call predicting self-efficacy at that call indicated that being quit for longer at all calls was associated with higher self-efficacy at the corresponding call cycle (see Tables 9-12).

***Hypothesis 8: Relapse prior to Call 2 will be associated with lower self-efficacy at Call 2.*** In comparison to smokers who maintain abstinence, relapse may adversely influence self-efficacy beliefs. A univariate ANCOVA with quit status at Call 2 (relapsed or not relapsed), as well as covariates of baseline self-efficacy and time between Call 1 and Call 2, revealed a significant main effect of relapse ( $F(1, 1243) = 119.84, p < .001, \eta_p^2 = .09$ ). Participants who relapsed prior to Call 2 had lower self-efficacy at Call 2 (M = 8.10, SD = 1.85) than participants who did not relapse (M = 9.17, SD = 1.19).

A follow up analysis of participants who quit at Call 1 distinguished relapsers who reported being quit again at Call 2 from those who remained relapsed. A univariate ANCOVA with relapse status at Call 2 (relapsed, relapsed

but quit again, or remained quit), as well as covariates of baseline self-efficacy and time between Call 1 and Call 2, revealed a significant main effect of relapse status ( $F(2, 1242) = 74.77, p < .001, \eta_p^2 = .11$ ) on self-efficacy at Call 2. Contrasts showed that differences between each level were significant ( $ps < .001$ ). Participants with the highest self-efficacy were those who had maintained abstinence at Call 2 ( $M = 9.17, SD = 1.19, N = 984$ ), followed by participants who relapsed in between Call 1 and Call 2 but quit again by Call 2 ( $M = 8.46, SD = 1.53, N = 153$ ). Those who relapsed and were still smoking at Call 2 reported the lowest confidence ( $M = 7.58, SD = 2.12, N = 110$ ).

***Hypothesis 9: Early relapse will be associated with lower self-efficacy.***

Early relapse may be an indicator that participants struggled more with their cessation attempt, with such inferences leading to decreases in reported self-efficacy. Specifically, it was predicted that those smokers who relapsed early would have a more significant decrease in their self-efficacy beliefs compared to those who relapsed after maintaining abstinence for a longer period of time. To test the hypothesis that early relapse (relapse at Call 2) affected self-efficacy more severely than later relapse (Call 3 and Call 4), analyses were conducted on participants who had quit smoking at Call 1. A univariate ANCOVA was conducted with self-efficacy as the dependent variable (assessed at whichever time point the participant reported relapsing) and the call at which the participant reported relapsing as the independent variable, controlling for baseline self-efficacy. Although the main effect of time to relapse was not significant ( $F(2, 148) = 1.71, p = .18, \eta_p^2 = .02$ ), the means suggested a pattern consistent with the

hypothesis. A contrast comparing self-efficacy of relapsers at Call 2 to relapsers at Call 3 and Call 4 was marginally significant, ( $p = .07$ ).

***Hypothesis 10: Higher stress and urges will be associated with lower self-efficacy.*** Factors that increase arousal may play a role in participants' sense of their own ability to maintain quitting behavior. For example, after quitting, stress and urges to smoke may be interpreted as impediments to maintaining abstinence. Several sub-hypotheses were tested on participants who reported quitting at Call 1 ( $N = 1940$ ). Because quit duration and baseline self-efficacy were previously found to affect self-efficacy, both were controlled in the following two analyses.

First, it was hypothesized that higher stress and stronger urges at Call 1 would be related to lower self-efficacy at Call 1. A multiple regression analysis ( $R^2 = .17$ ) indicated that stronger urges at Call 1 was associated with lower self-efficacy at Call 1, ( $B = -.10$ ,  $t(1400) = -6.82$ ,  $p < .001$ ,  $sr^2 = .03$ ), however, stress was not a significant predictor ( $p = .70$ ). Missing data were the result of the 620 people with only baseline data and pairwise deletion on the confidence, stress and urge items.

Second, it was hypothesized that stronger urges and higher stress levels at Call 1 would predict lower self-efficacy at Call 2. A multiple regression analysis was conducted with urges and stress at Call 1 predicting self-efficacy at Call 2, controlling for inter-call interval between Call 1 and Call 2 ( $R^2 = .10$ ). Only two significant predictors emerged. Stronger urges at Call 1 predicted lower self-efficacy at Call 2, ( $B = -.08$ ,  $t(979) = -4.63$ ,  $p < .001$ ,  $sr^2 = .02$ ). Additionally, as

would be expected, self-efficacy at baseline predicted self-efficacy at Call 2 ( $B = .19$ ,  $t(3944) = 8.58$ ,  $p < .001$ ,  $sr^2 = .07$ ). Again, higher stress did not predict lower self-efficacy at the follow up call ( $B = .01$ ,  $t(3944) = .42$ ,  $p = .68$ ). Missing data were the result of the 620 people with no Call 1 data, 1080 with no Call 2 data, and pairwise deletion on the confidence, stress, and urge items.

### **Ancillary analyses**

**Inter-call intervals and quit status.** Although time between calls was not of primary interest here, significant effects for this factor emerged in several places (as noted above, but specified in more detail here). Inter-call time interval positively predicted quit status at Call 1. A longer time between baseline and Call 1 was associated with more quitting ( $B = .01$ ,  $Wald \chi^2(1, N = 2884) = 14.93$ ,  $p < .001$ ,  $OR = 1.01$ ) at Call 1. An effect of inter-call interval also emerged on quit status at Call 2. However, the opposite pattern emerged for this latter interval. Longer time between Call 1 and 2 was associated with less quitting ( $B = -.01$ ,  $Wald \chi^2(1, N = 2320) = 17.96$ ,  $p < .001$ ,  $OR = .99$ ). This inverse relation between call interval and quitting continued at Calls 3 and 4 (although it was only marginally significant at both,  $ps = .06$ ). When interpreting these significant results, caution should be used when trying to determine the importance of the effect, because the effect sizes are very small.

**Quit duration and quit status.** Previous research has shown that the longer people stay abstinent, the less likely they are to relapse (Baer et al., 1986). As expected, abstinence duration at Call 1 predicted sustained abstinence. The longer participants had been abstinent at Call 1, controlling for inter-call interval,

the less likely they were to relapse at Call 2 ( $B = .51$ ,  $Wald \chi^2(1, N = 1495) = 21.50$ ,  $p < .001$ ,  $OR = 1.66$ ), the longer participants had been abstinent at Call 2 the less likely they were to relapse at Call 3 ( $B = .96$ ,  $Wald \chi^2(1, N = 894) = 22.95$ ,  $p < .001$ ,  $OR = 2.6$ ), and the longer amount of time participants had been abstinent at Call 3 the less likely they were to relapse at Call 4 ( $B = .78$ ,  $Wald \chi^2(1, N = 436) = 9.33$ ,  $p < .01$ ,  $OR = 2.17$ ). Thus, not only does duration of quitting improve one's self-efficacy for quitting, abstinence duration positively predicted maintaining abstinence at later time points.

**Stress and quit status at Call 1.** Previous research also has shown that stress is associated with quitting. A logistic regression with stress at baseline predicting quitting at Call 1, controlling for baseline self-efficacy and inter-call interval, showed that higher stress at baseline was associated with less quitting ( $B = -.07$ ,  $Wald \chi^2(1, N = 3490) = 27.13$ ,  $p < .001$ ,  $OR = .94$ ). However, when stress at Call 1 was included in the model, higher stress at Call 1 was associated with less quitting ( $B = -.09$ ,  $Wald \chi^2(1, N = 2674) = 30.56$ ,  $p < .001$ ,  $OR = .92$ ), but baseline stress now only marginally predicted quitting at Call 1 ( $p = .06$ ).

## Discussion

The current study was designed to investigate an important factor in the smoking cessation process—self-efficacy. Two sets of hypotheses were tested using participants enrolled in a telephone-based cessation program. The first set of hypotheses explored how self-efficacy and changes in self-efficacy were associated with cessation outcomes. As predicted, higher baseline self-efficacy and increases in self-efficacy were associated with more success (i.e., quitting).

However, contrary to predictions, there was no evidence that overconfidence led to diminished quit rates. The second set of hypotheses addressed several factors expected to affect self-efficacy. As predicted, shorter duration of quit attempts, relapse, and stronger urges all were associated with lower self-efficacy.

This study helps to inform existing research by detailing the role of self-efficacy within the unique environment of a telephone quitline. Prior research on pre-quit self-efficacy and quit outcomes has been somewhat inconsistent.

Although some researchers (e.g., Baer, Holt, & Lichtenstein et al., 1986; Gwaltney et al., 2002) have found that smokers who have higher self-efficacy prior to making a quit attempt are more likely to be successful, other studies have not found a strong relation between pre-quit self-efficacy and cessation outcomes. A recent meta-analysis (Gwaltney et al., 2009) found only a small effect of baseline self-efficacy on quit outcomes. In the current study, smokers with higher self-efficacy at baseline did report more quitting at Call 1. In fact, baseline self-efficacy was the strongest predictor of being quit at Call 1, above even nicotine dependence. This suggests that among smokers calling a quitline, confidence coming into the program was related to their initial success. At least among smokers enrolling in such programs, self-efficacy may be especially indicative of who will make a quit attempt.

Beyond single, static measures of self-efficacy, researchers (e.g., Gwaltney et al., 2005) have also been interested in the dynamic nature of self-efficacy and how changes in self-efficacy relate to quitting and relapse. The current study's findings about self-efficacy change reflect those of Shiffman and

colleagues (2005) who demonstrated that increases in self-efficacy are related to more successful cessation outcomes. Relapse was also associated with decreases in self-efficacy. One of the challenges in this area of research is determining the cause of the positive association between self-efficacy and quitting. Does self-efficacy rise before quitting or does successful quitting subsequently boost confidence? Conversely, does self-efficacy drop prior to relapse or does relapse cause a decrease in self-efficacy?

Despite this, the prospective analyses of changes in self-efficacy on quit outcomes at later calls did show that, in some cases, an increase in self-efficacy predicted future quitting. Specifically, change in self-efficacy from baseline to Call 1 predicted quitting at future calls. As self-efficacy increased between baseline and Call 1, participants were not only more likely to quit at Call 1, but also at subsequent phone calls. However, later changes in self-efficacy from Call 1 to Call 2 did not prospectively predict quitting. This suggests that raising self-efficacy early in an intervention program might be an important facilitator of smoking cessation. Taken together, these results provide information about intervention opportunities and suggest that self-efficacy is not just an outcome of “performance” (i.e., success or failure).

Another common issue that cessation programs face is the high likelihood that participants will relapse. In this study, of the people who were quit at Call 1, those who maintained abstinence at Call 2 reported the highest self-efficacy at Call 2, followed by participants who relapsed in between Call 1 and Call 2 but quit again by Call 2. People who relapsed and were still smoking at Call 2

reported the lowest confidence. These findings suggest that relapsing between Call 1 and Call 2 was associated with a decrease in self-efficacy. Similarly, early relapse (relapsing before Call 2) led to a more significant decrease in self-efficacy beliefs compared to relapsing after maintaining abstinence for a longer period of time (relapsing after Call 2). This highlights the association between relapsing early in cessation programs and a person's self-efficacy.

In the current study, self-efficacy and quit status were measured at the same time during each call, making it impossible to determine temporal precedence in analyses conducted within the same call. Because of this, it was also impossible to distinguish between lapsing and relapsing. Others (Shiffman et al., 2005) have found that decreases in self-efficacy following a lapse are associated with eventual relapse. It follows that the time period between lapse and relapse may be especially important for interventions that focus on recovery from a lapse (e.g., normalizing lapsing). Quit Coaches are the primary sources of support to help people recover from relapse and encourage them to make another quit attempt. Therefore, how Quit Coaches address decreases in self-efficacy when they are on the phone with a person who reports a failed cessation attempt is likely very important for the prospects of future quit attempts.

Although many of the hypotheses in this study were supported, one particularly interesting hypothesis, that being overconfident would actually be detrimental to quitting, was not. Several possible explanations exist for the failure to find a curvilinear effect of confidence. In a study on this topic by Staring and Breteler (2004), these researchers found evidence for an overconfidence bias by



testing whether post-treatment self-efficacy predicted relapse 12 months later. In contrast, the current study examined baseline self-efficacy and quit outcomes at Call 1 (and later calls) and found only a linear effect. That is, as self-efficacy increased, quitting was consistently more likely. Unlike the Staring and Breteker study, the data collection period here did not extend long enough to test a curvilinear relation between post-treatment self-efficacy and long-term cessation outcomes. In the future, using end of program data (12 month follow up) would allow for a more direct comparison with previous findings. It may also be that this particular population of smokers was not ideal for testing for a curvilinear effect. The characteristics of quitline participants are likely not representative of the “typical” smoker. These smokers have initiated the services of a quitline and are particularly motivated to quit. Overconfidence may be more of a factor among smokers who are not participating in a cessation program, and report a wider range of self-efficacy and motivation.

Despite not finding a curvilinear effect of self-efficacy on quitting, an interesting pattern emerged that may be indicative of an overconfidence effect on a different outcome - adherence (number of calls completed). Participants who reported high self-efficacy at baseline and Call 1 adhered less (i.e., took fewer calls). One possible explanation is that participants who had high confidence were indeed likely to quit and may have needed fewer calls to succeed. These individuals would have needed only one call, and thus not taking more calls did not hurt their ability to achieve abstinence. However, another explanation is that some of the people who completed fewer calls actually may have been

overconfident. These individuals may have believed that they needed fewer calls to succeed when, in fact, leaving the program contributed to their cessation failure. This latter possibility is supported by the finding that, despite the fact that higher baseline self-efficacy led to fewer calls taken, taking more calls was positively associated with quitting. Thus, people with high self-efficacy who adhered less may indeed have been less successful.

Finally, contrary to predictions, stress was not associated with self-efficacy when measured at the same call. Although the findings on aspects of negative affect and self-efficacy have been mixed (e.g., Niaura & Adams, 2002; Rabois & Haaga, 2003), this result was unexpected. It may be that Free & Clear is already addressing strategies for coping with daily stress, which may eliminate an association between stress and self-efficacy.

### **Limitations**

This study has several limitations. First, participants did not answer all attempted phone calls, resulting in issues with missing data and unknown cessation outcomes. Missing data present a nearly universal challenge for longitudinal studies and are a common problem in smoking research (Nelson, Partin, Fu, Joseph, & An, 2009). Missing data arising from attrition have been treated historically in one of two ways (Hedeker, Mermelstein, & Demirtas, 2007). Researchers either omit participants with missing outcome data (complete case analysis) or participants with missing data are recoded as “smoking” (on the presumption that people have missed a data collection cycle because they are or have returned to smoking). Though widely used in the smoking literature, both

approaches have several disadvantages. Complete case analysis leads to loss of power and may distort differences between groups. Taking a “missing = smoking” approach has long been considered a conservative strategy because it assumes the worst outcome is true. However, recent research suggests this strategy may actually not be conservative and, in fact, can bias outcomes and lead to unpredictable and inaccurate estimates (Nelson et al., 2009). In essence, this approach assumes that missing-ness and smoking are related, and although this can be true (i.e., people who go back to smoking are more likely to drop out), the potential for bias still looms large.

In the current study, there are many explanations for why participants may not have answered calls. One possible reason was that these participants returned to smoking and were avoiding phone calls out of guilt. Alternatively, these participants may have quit successfully and felt the assistance of a quit coach was unnecessary. Lastly, the quitline environment may exaggerate missing data because participants need to answer the phone (which may not happen for a variety of unrelated reasons) in order to be counted. To avoid making assumptions about participants who completed different numbers of phone calls, this study only analyzed available data. However, this approach may have lead to biased results because the data were not Missing Completely at Random. In fact, data analysis revealed that several variables (e.g., age, gender, self-efficacy, and stress) were related to the number of completed calls. Because of the biases related to the treatment of missing data, there is reason to use caution when interpreting these results.

There have been significant advances in the development of statistical methods for dealing with missing data (Enders, 2010; Hedeker et al., 2007). However, these methods are used infrequently in the study of smoking (Hall et al., 2001). Most longitudinal studies in the leading journals use analytical techniques that are not the most sophisticated for handling multiple time points and missing data (Hedeker et al., 2007). This study used regression and ANOVAs to predict quit outcomes. Some (Hall et al., 2001) argue that this approach is not ideal for longitudinal studies with more than two time points. For the purpose of this study, these analytic strategies were deemed appropriate based on the scope of the research questions.

Next, another potential limitation relates to effect size. Reporting effect size has become a common adjunct to statistical significance (Prentice & Miller, 1992). Effect size is often considered a superior way to quantify the importance of statistically significant findings and allows researchers to determine the magnitude of the effect (small, medium, or large). There were several statistically significant findings reported here that had small effect sizes. This suggests the need to use caution when interpreting several of the significant findings. On the other hand, in the medical and public health literature, small effect sizes can nevertheless have a big impact at a population level. Some have argued that even a small effect size can be strongly consequential (Prentice & Miller, 1992). A frequently cited example of this is the recommendation to take aspirin to reduce the risk of a heart attack, which was based on a very small correlation of .03, but still can have important outcomes across large numbers of people (Rosenthal,

1990). This is especially important for dichotomous outcomes (e.g., quit versus not quit), where the goal is move people past a clinically relevant threshold.

Therefore, the question for the current study in those cases where the effect size was small is, how much of an increase in self-efficacy would make a clinically meaningful difference in improving cessation outcomes? It could be argued that it would not be a good investment to try and target self-efficacy as part of call interventions because the effect size is small. For example, the time required to retrain Quit Coaches may not be cost effective if increasing self-efficacy does not lead to substantially greater rates of quitting. However, it could also be argued that even a small increase (or decrease) in self-efficacy might have a major impact on cessation outcomes. In a large-scale intervention like Free & Clear, broad interventions aimed at raising self-efficacy have the potential to affect many people in the long run. Therefore, even small increases in self-efficacy may have an important effect at the population level. Although this study does not address this possibility specifically, future research could answer such a question.

Another limitation involved balancing data collection (e.g., by adding items to the Free & Clear protocol) with the practical limitations of the quitline. To address this issue, it was decided that using a single item to assess self-efficacy was necessary. From a psychometric standpoint, one-item measures might have limited reliability and content validity. However, there are reasons to believe this concern is minimal. Other studies (e.g., Brandon et al., 2003) have relied on single item self-efficacy measures. In a meta-analysis on studies that

used both multiple and single self-efficacy scales, the authors (Gwaltney et al., 2009) concluded that a single self-efficacy response is an accurate measure of self-efficacy. Individual items in larger scales that assess self-efficacy in different smoking relevant situations are highly correlated with global self-efficacy items. Therefore, the extra time and effort required to add a larger scale may not be warranted.

Next, the wording of the questions that measured self-efficacy and urges pose some potential for bias. Self-efficacy was assessed with the following item: “On a scale of 1 to 10, where 1 is not at all confident and 10 is highly confident, how confident are you that you can quit (or stay quit if already quit) for good?” Although the wording may imply different goals for different people (achieving long term abstinence or maintaining long term abstinence), people are likely considering some of the same behaviors required to “quit for good.” Additionally, for those analyses restricted by quit status (e.g., looking only at participants who quit during the program), this issue did not arise because the self-efficacy item was assessing the same goal for all participants. However, a self-efficacy measure that assesses confidence about the current quit attempt instead of long term quitting should be considered. With regard to urges, it may have been better to use an item that asked people to assess their strongest smoking urge since they quit.

Finally, the current study was limited to a certain subset of smokers. The smokers who call Free & Clear are likely motivated to quit because they have initiated the services of a quitline. Additionally, to be included in this study, participants had to be willing to set a quit date in the next month. Previous

research on the relation between self-efficacy and quit intentions (Dijkstra et al., Bakker, 1996) would suggest that these smokers should be relatively high on baseline self-efficacy. Indeed self-efficacy prior to quitting was high among participants. The current findings may be less applicable to smokers who have little motivation to quit.

### **Future directions**

The data from the current study suggest a number of interesting possibilities for future investigation. Though research on the benefits of raising self-efficacy through interventions is mixed (Gwaltney et al., 2009), the question remains: Would deliberate attempts by Quit Coaches to raise self-efficacy improve cessation outcomes? To answer this question, several sub-questions must be answered first. For example, does the current phone call intervention already help to raise self-efficacy? This question could be addressed by adding one or two additional items to the current call procedures. Participants could rate their self-efficacy twice, once at the beginning of a call and once at the conclusion of the call. The resulting data could be useful in determining if the specific call intervention has an impact on raising self-efficacy.

Consistent with prior research (e.g., Baer et al., 1986), several individual characteristics (e.g., being male, less dependent, and less stressed) were associated with higher baseline self-efficacy. Although it was useful to identify these, many other important factors in the formation of self-efficacy beliefs were not assessed in this study. For example, knowing a participant's quit history (e.g., number of past quit attempts) and smoking in the environment would be useful

from an intervention standpoint. Quit history may reflect performance experiences (i.e., successes versus failures), that are typically considered determinates of self-efficacy (Bandura, 1977). Smoking in the environment may make quitting more difficult, thus taking into account the magnitude of the task, which is considered another determinant of self-efficacy (Stajkovic & Luthans, 1998). If quit history and smoking in the environment are associated with baseline self-efficacy, Quit Coaches could provide smokers with more strategies for increasing their self-efficacy around past failures and coping with being around others who smoke.

The finding that people who adhere less have higher self-efficacy was surprising and has not been reported prior to this study. In fact, the Free & Clear program has debated how it should deal with participants whom they have difficulty contacting. The working hypothesis had been that lack of success re-contacting was often a marker of people who have failed (Free & Clear, 2008). This is also often presumed to be the case in follow-up analyses of aggregate quit status, where those not successfully reached are assumed to be smoking. Although by no means definitive, these data may suggest an alternate hypotheses--people are not connecting for follow-up because they are doing well and don't feel like they need the assistance. Future analyses that include six-month or 12-month quit status can help to investigate these two different hypotheses.

How these findings can be put to use requires future investigation, including clinical trials. Directions include interventions that target self-efficacy and varying the intensity and timing of follow up calls based on self-efficacy. Although quit coaches already address self-efficacy as part of the calls, this is not



done as a standardized controlled intervention. Therefore, comparing current practice with an intervention that directly focuses on raising self-efficacy is an important next step. For example, those identified to have lower self-efficacy may benefit from more focused interventions to bolster factors contributing to low self-efficacy (e.g., past failures). This type of trial would also help address the questions and concerns about the small effect sizes. That is, if an experimental manipulation aimed at raising self-efficacy does not produce a significant change in behavior (i.e., improve quit outcomes), one conclusion is that self-efficacy does not drive the process of quitting. Other factors may be more clinically relevant. For example, strong urges at Call 1 were associated with lower self-efficacy at Call 1 and Call 2. Perhaps a more focused effort to help people deal with their urges, psychologically, behaviorally, and pharmacologically, is needed.

Another direction for future research would be a randomized trial that assigns people to different “doses” and timing of the program. For example, people with low baseline self-efficacy or declines in self-efficacy between calls may need more intense and frequent follow-up. Similarly people identified with high baseline self-efficacy or whose self-efficacy has increased from baseline to Call 1 may require less intense and frequent follow-up. Without actually testing the impact of hypotheses such as these, it will not be possible to ensure that changes in intervention content, intensity, or frequency actually lead to improved outcomes. For example, perhaps people with high self-efficacy actually benefit more from additional assistance as they have the cognitive resources available to make behavioral changes. Perhaps people with low self-efficacy are relatively

hopeless for this type of intervention, and resources should be reserved for those who benefit. The only way to determine this is via a controlled trial with randomization to a control condition or low-contact intervention versus a standard or higher intensity condition.

## **Conclusions**

Given the challenges associated with quitting, it is critical to increase our understanding of the factors that influence cessation success and failure. People engage in the quitting process with a range of individual traits, past experiences, and current beliefs and attitudes that will undoubtedly influence the outcome of any given quit attempt. One important, dynamic characteristic investigated here was self-efficacy. The long history of self-efficacy research in the broader literature on behavior change suggests that feeling confident about the potential for success is virtually indispensable for achieving one's goals. Interventions that help to manage self-efficacy, perhaps those involving multiple contact points such as telephone quitlines, therefore represent an important area for future empirical and practical investigation. When a person calls a quitline such as Free & Clear, he or she is taking a significant first step towards becoming a non-smoker. Understanding the principles of self-efficacy theory and its role in this complicated process appears to be a promising direction for evidence-based practices that can help these individuals cope with difficult challenges and improve their chances for eventual cessation success.

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Table 1

## Demographic data from registration and baseline call

	N	Mean	SD	Min	Max	Skew	Kurtosis
Age	5291	44.91	11.91	18	86		
Gender							
Female	2747 (51.9%)	--	--	--	--	--	--
Male	2544 (48.1%)	--	--	--	--	--	--
Years of Tobacco Use (categories)	5285 Missing=6	3.64	.58	1	4	--	--
Nicotine Dependence	5291	2.92	1.04	1	4	--	--
Cigarettes Smoked Per Day	5291	17.77	9.33	1	80	--	--
Quit Status	5291						
Not Quit		--	--	--	--	--	--
Quit		--	--	--	--	--	--
Confidence to Quit Smoking	5033 Missing=258	7.72	2.06	1	10	-.87	.29
Stress	4040 Missing=1249	5.90	2.81	1	10	-.10	-1.13

*Note.* Number of years smoked: 1 = < 1 year, 2 = 1 to 5 years, 3 = 6 to 19 years, 4 = 20+years. Baseline dependency: "How soon after you wake up do you use tobacco for the first time in the day?" with the following response options: 1 = >60 minutes, 2 = 31-60 minutes, 3 = 6-30 minutes, 4 = <5 minutes. Confidence: "On a scale of 1 to 10, where 1 is not at all confident and 10 is highly confident, how confident are you that you can quit for good?" Stress: "In the last week, how often have you felt difficulties were piling up so high that you could not overcome them?" (1 = Never; 5 = Sometimes; 10 = Very Often).

Table 2

Descriptive statistics of main variables at call 1 by quit status

Measures	N	Mean	SD	Min	Max	Skewness	Kurtosis
<hr/>							
Call closed as							
Intervention	4671						
Letter	473						
Missing	147	--	--	--	--	--	--
Total	5291						
Quit status							
Not Quit	2731						
Quit	1940	--	--	--	--	--	--
Total	4671						
Confidence							
Quit/Stay Quit							
Not Quit	2067	7.79	1.91	1	10	-.85	.33
Quit	1689	8.68	1.55	1	10	-1.52	2.98
Total	3756	8.19	1.81	1	10	-1.11	1.05
Stress							
Not Quit	1923	6.03	2.82	1	10	-.16	-1.11
Quit	1614	5.23	2.77	1	10	.13	-1.06
Total	3537	5.66	2.83	1	10	-.02	-1.12
Urges	1661	4.57	2.84	1	10	.33	-1.06

*Note.* Quit status, confidence to quit/stay quit, and stress were collected on participants who received an intervention. Urge to smoke was collected only on people who reported being quit at time of call. Missing data for confidence, stress, and urges was the result of items not being asked by quit coaches.

Table 3

Descriptive statistics of main variables at call 2 by quit status

Measures	N	Mean	SD	Min	Max	Skewness	Kurtosis
<hr/>							
Call closed as							
Intervention	3591						
Letter	914	--	--	--	--	--	--
Missing	786						
Total	5291						
Quit status							
Not Quit	1373						
Quit	2218	--	--	--	--	--	--
Total	3591						
Confidence							
Quit/Stay Quit							
Not Quit	1037	7.58	2.01	1	10	-.84	.45
Quit	1978	8.92	1.38	1	10	-1.67	3.51
Total	3015	8.46	1.74	1	10	-1.38	1.95
Stress							
Not Quit	956	6.59	2.80	1	10	-.44	-.93
Quit	1881	5.16	2.84	1	10	.13	-1.15
Total	2840	5.64	2.90	1	10	-.06	-1.20
Urges	1894	3.87	2.74	1	10	.67	-.67

*Note.* Quit status, confidence to quit/stay quit, and stress were collected on participants who received an intervention. Urge to smoke was collected only on people who reported being quit at time of call. Missing data for confidence, stress, and urges was the result of items not being asked by quit coaches.

Table 4

Descriptive statistics of main variables at call 3 by quit status

Measures	N	Mean	SD	Min	Max	Skewness	Kurtosis
Call closed as							
Intervention	2338						
Letter	918						
Missing	2035	--	--	--	--	--	--
Total	5291						
Quit status							
Not Quit	697						
Quit	1641	--	--	--	--	--	--
Total	2338						
Confidence							
Quit/Stay Quit							
Not Quit	500	7.35	2.16	1	10	-.82	.23
Quit	1447	9.12	1.24	1	10	-2.02	5.72
Total	1947	8.67	1.71	1	10	-1.73	3.28
Stress							
Not Quit	480	6.40	2.78	1	10	-.35	-.94
Quit	1385	5.24	2.79	1	10	.09	-1.10
Total	1865	5.54	2.83	1	10	-.02	-1.12
Urges	1384	3.44	2.64	1	10	.91	-.28

*Note.* Quit status, confidence to quit/stay quit, and stress were collected on participants who received an intervention. Urge to smoke was collected only on people who reported being quit at time of call. Missing data for confidence, stress, and urges was the result of items not being asked by quit coaches.

Table 5

Descriptive statistics of main variables at call 4 by quit status

Measures	N	Mean	SD	Min	Max	Skewness	Kurtosis
Call closed as							
Intervention	1119						
Letter	619	--	--	--	--	--	--
Missing	3553						
Total	5291						
Quit status							
Not Quit	285						
Quit	834	--	--	--	--	--	--
Total	1119						
Confidence							
Quit/Stay Quit							
Not Quit	198	7.42	2.21	1	10	-.53	-.57
Quit	751	9.18	1.22	1	10	-2.12	6.34
Total	949	8.81	1.64	1	10	-1.74	3.03
Stress							
Not Quit	179	6.78	2.76	1	10	-.58	-.78
Quit	705	5.10	2.84	1	10	.12	-1.14
Total	884	5.44	2.90	1	10	-.01	-1.20
Urges	635	3.03	2.40	1	10	1.11	.36

*Note.* Quit status, confidence to quit/stay quit, and stress were collected on participants who received an intervention. Urge to smoke was collected only on people who reported being quit at time of call. Missing data for confidence, stress, and urges was the result of items not being asked by quit coaches.

Table 6

Correlations of baseline variables and number of completed calls (0 to 4)

Scale	Number of calls
Gender	.10***
Age	.23***
Nicotine dependence	-.03*
Confidence at baseline	-.07***
Stress at baseline	-.05**

*Note.* \* $p < .05$ , \*\*  $p < .01$ , \*\*\*  $p < .001$

Table 7

## Summary of the results of the primary hypotheses

	Hypotheses	Confirmed?
Predictors of baseline SE	H1: Self-efficacy prior to quitting would be higher among men, those with lower nicotine dependence, and those with less stress	Yes
Baseline SE predicting quit status at Call 1	H2: Participants with higher self-efficacy at the baseline call would be more likely to have quit smoking at Call 1	Yes
Changes in SE predicting quit status	H3: Changes in self-efficacy from baseline to Call 1 would be associated with quit status, with increases associated with more quitting	Yes
	H4: Changes in self-efficacy from Call 1 to Call 2 would be associated with quit status, with increases associated with more quitting	Yes
Effect of overconfidence at baseline on quitting	H5: Smokers with overconfidence at baseline would be less likely to quit at Call 1	No
Effect of overconfidence at 1 month	H6: Smokers with overconfidence at one month would be more likely to relapse	No
Duration of quitting predicting SE	H7: The longer participants persisted in staying quit, the higher their self-efficacy would be for maintaining abstinence	Yes
Relapse predicting SE	H8: Relapse would adversely influence self-efficacy beliefs	Yes
Early relapse predicting SE	H9: Smokers who relapsed early would have a more significant decrease in their self-efficacy beliefs compared to those who relapsed after maintaining abstinence for a longer period of time	Yes
Stress and urges predicting SE	H10: Higher stress and stronger urges at Call 1 would predict lower self-efficacy at Call 1 and Call 2	Partial (urges only)



Table 8

## Correlations of baseline variables and call 1 variables

Scale	Quit Status Call 1	Gender	Dep	Confidence Baseline	Stress Baseline	Confidence Call 1	Stress Call 1
Quit Status Call 1	1						
Gender	.08**	1					
Dep	-.10**	-.05**	1				
Confidence at Baseline	.18**	.04**	-.07**	1			
Stress at Baseline	-.09**	-.14**	.07**	-.07**	1		
Confidence Call 1	.26**	.25**	.06**	-.06**	.44**	1	
Stress Call 1	-.14**	-.14**	.07**	-.09**	.43**	-.11**	1

*Note.* \*\*  $p < .01$ .

Table 9

Effect of abstinence duration on self-efficacy at Call 1

	<i>B</i>	SE	<i>p</i>	<i>sr</i> <sup>2</sup>
Call 1				
Quit duration	.22	.05	< .001	.011
Gender	.15	.08	.06	.003
Nicotine dependence	.03	.04	.46	.0003
Stress at baseline	-.02	.02	.30	.0007
Self-efficacy at baseline	.24	.02	< .001	.092
Inter-call interval	-.001	.002	.52	.0002

Note.  $R^2 = .12$ . Each predictor tested with  $df = 1, 1269$

Table 10

Effect of abstinence duration on self-efficacy at Call 2

	<i>B</i>	SE	<i>p</i>	<i>sr</i> <sup>2</sup>
Call 1				
Quit duration	.42	.04	< .001	.061
Gender	.02	.07	.81	.000
Nicotine dependence	.03	.03	.39	.0004
Stress at baseline	-.02	.01	.09	.0017
Self-efficacy at baseline	.20	.02	< .001	.073
Inter-call interval	-.01	.001	.001	.006

*Note.*  $R^2 = .16$ . Each predictor tested with  $df = 1, 1474$

Table 11

Effect of abstinence duration on self-efficacy at Call 3

	<i>B</i>	SE	<i>p</i>	<i>sr</i> <sup>2</sup>
Call 1				
Quit duration	.38	.05	< .001	.058
Gender	.05	.07	.45	.0004
Nicotine dependence	.05	.03	.14	.0017
Stress at baseline	-.01	.01	.26	.001
Self-efficacy at baseline	.14	.02	< .001	.048
Inter-call interval	-.004	.001	< .01	.006

Note.  $R^2 = .12$ . Each predictor tested with  $df = 1, 1080$

Table 12

Effect of abstinence duration on self-efficacy at Call 4

	<i>B</i>	SE	<i>p</i>	<i>sr</i> <sup>2</sup>
Call 1				
Quit duration	.49	.07	< .001	.087
Gender	-.002	.10	.98	.000
Nicotine dependence	.04	.05	.41	.001
Stress at baseline	-.02	.02	.34	.001
Self-efficacy at baseline	.15	.02	< .001	.059
Inter-call interval	-.004	.002	< .05	.007

*Note.*  $R^2 = .16$ . Each predictor tested with  $df = 1, 548$

Figure 1

Flow diagram of type of contact (intervention or letter) at each call attempt

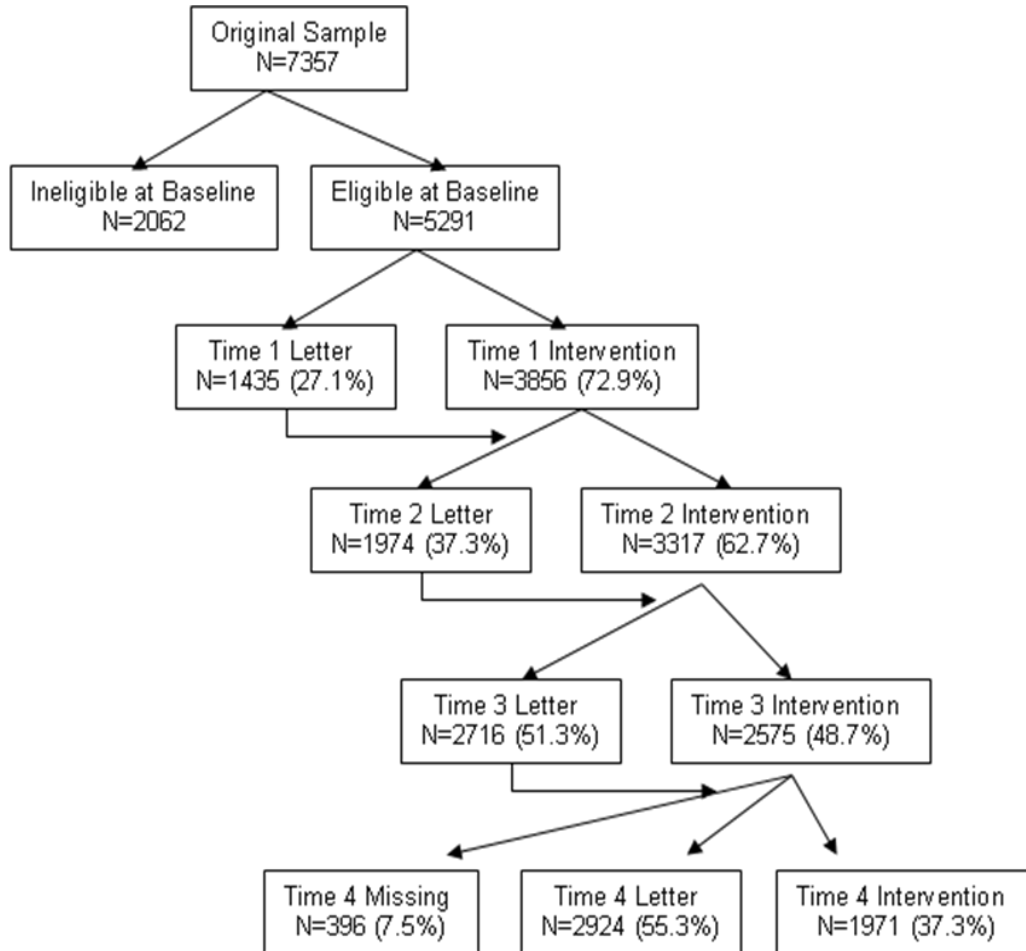


Figure 2

Breakdown of shifted calls comparing attempted calls and completed calls

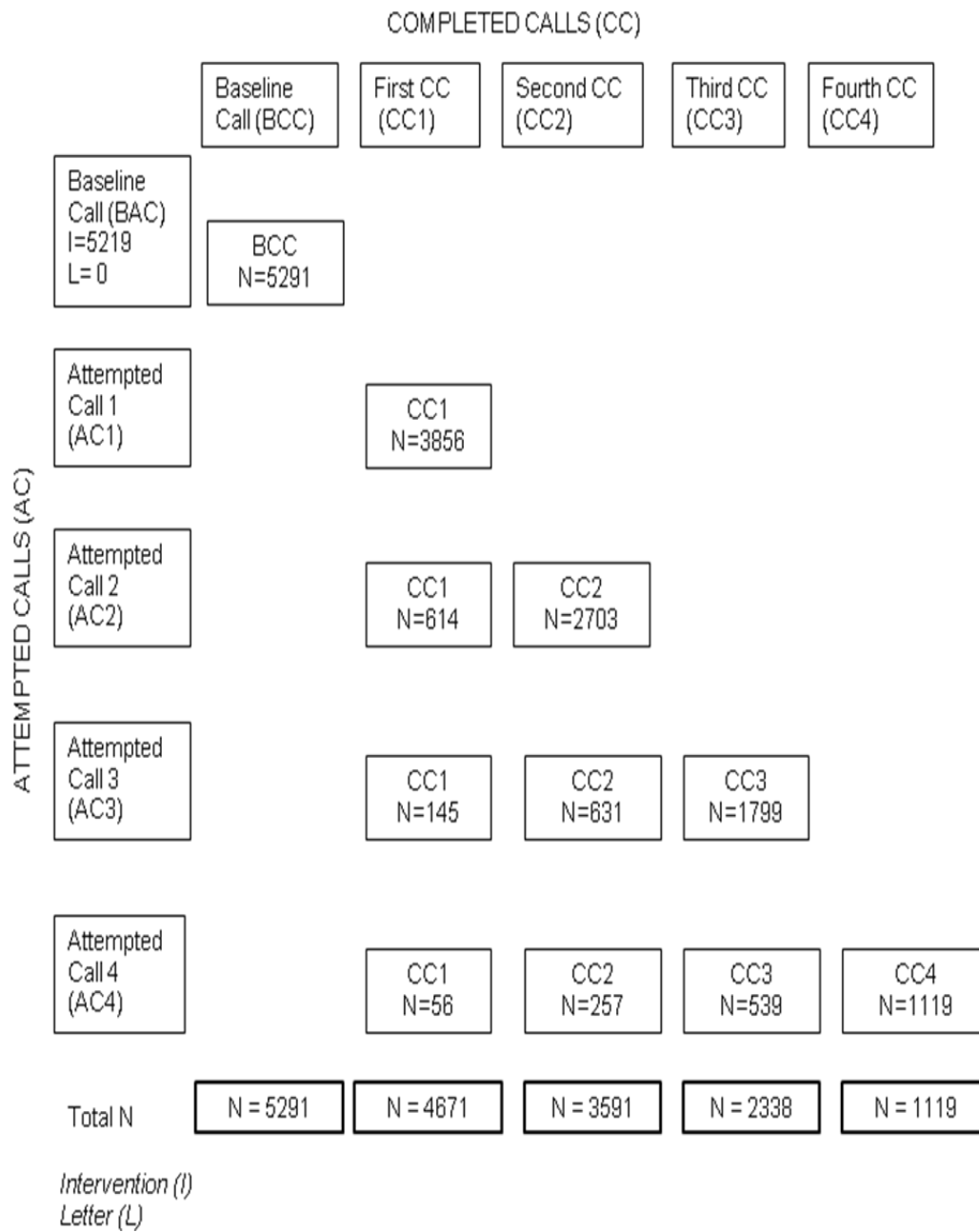


Figure 3

Flow diagram of program attrition rates across call cycles

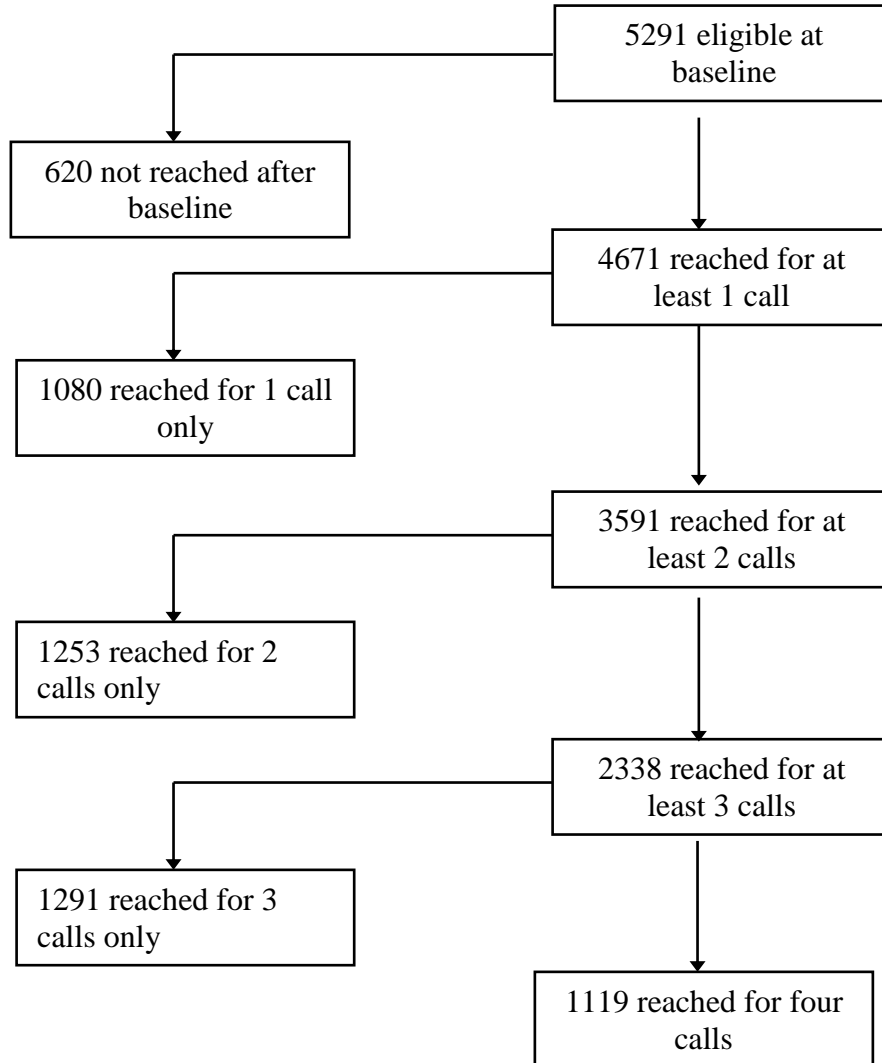




Figure 4

Mean age by number of calls received

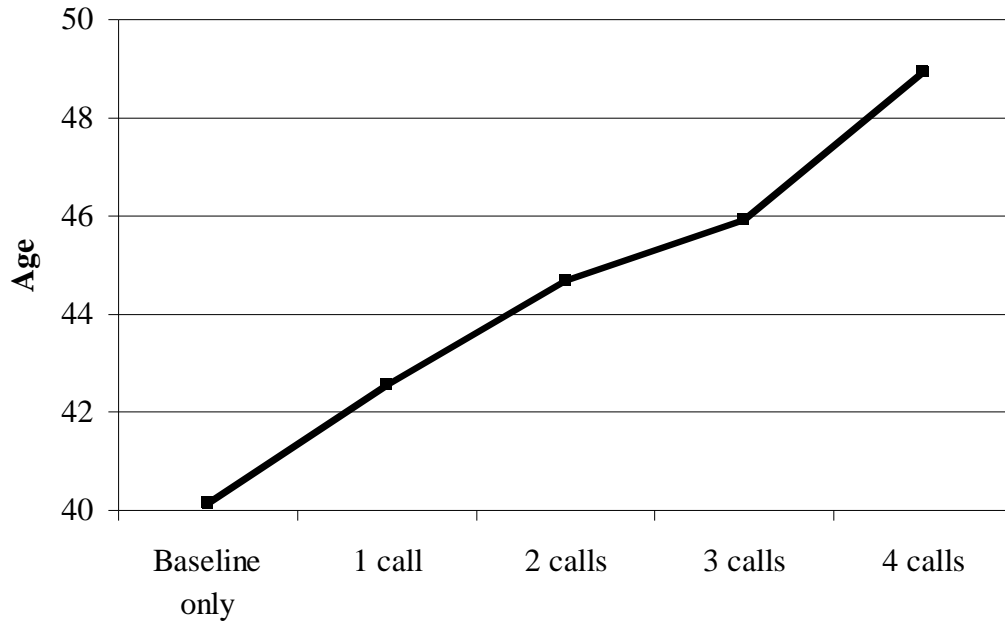


Figure 5

Mean nicotine dependence by number of calls received

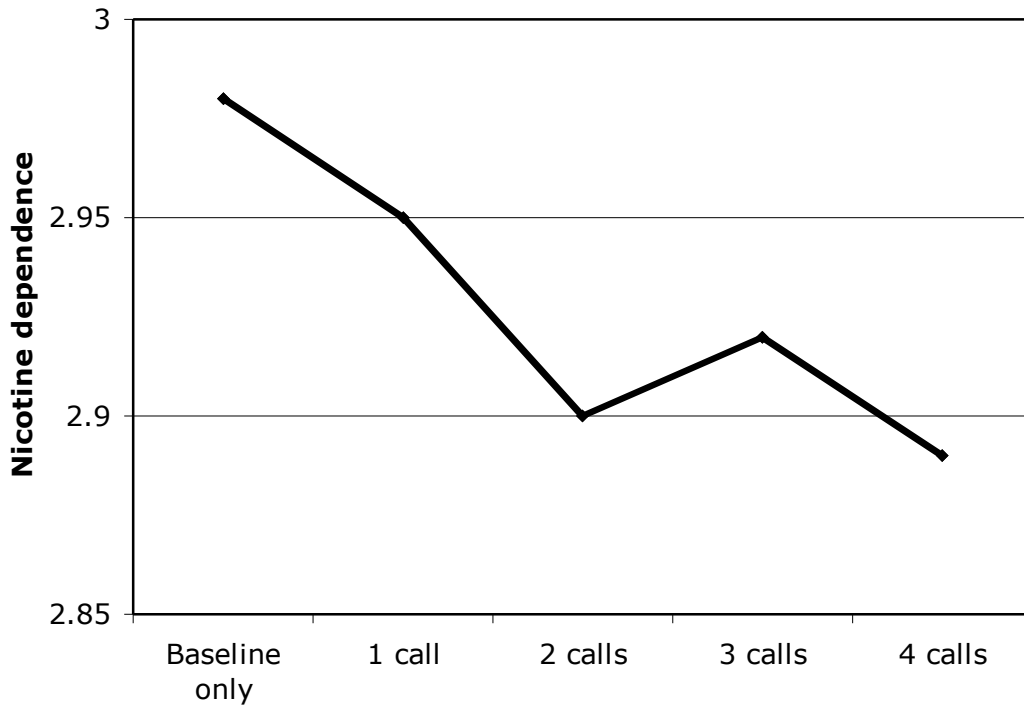


Figure 6

Mean baseline self-efficacy by number of calls received

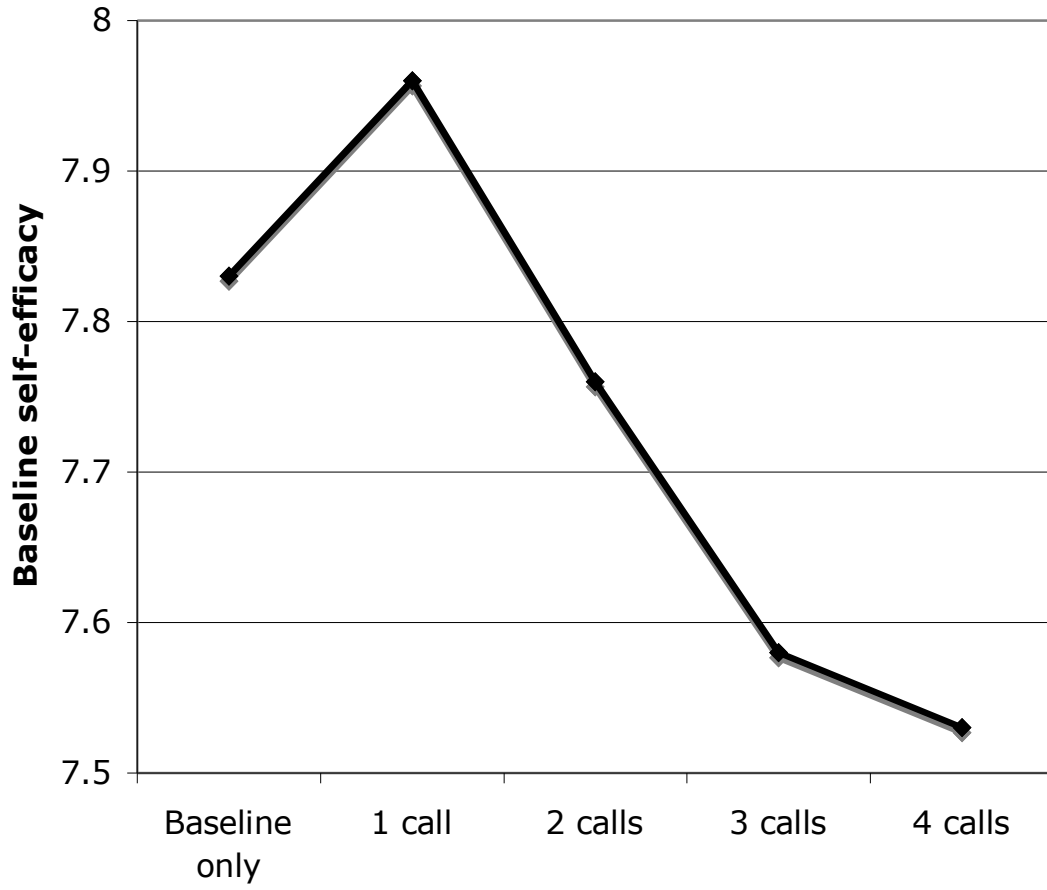


Figure 7

Mean baseline stress by number of calls received

