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Nicotine Dependence as a Moderator of a Quitline-Based Message Framing Intervention

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Abstract

High nicotine dependence is a reliable predictor of difficulty quitting smoking and remaining smoke-free. Evidence also suggests that the effectiveness of various smoking cessation treatments may vary by nicotine dependence level. Nicotine dependence, as assessed by Heaviness of Smoking Index baseline total scores, was evaluated as a potential moderator of a message-framing intervention provided through the New York State Smokers' Quitline (free telephone based service). Smokers were exposed to either *gain-framed* (n = 810) or *standard-care* (n = 1222) counseling and printed materials. Those smoking 10 or more cigarettes per day and medically eligible were also offered a free 2-week supply of nicotine patches, gum, or lozenge. Smokers were contacted for follow-up interviews at 3-months by an independent survey group. There was no interaction of nicotine dependence scores and message condition on the likelihood of achieving 7-day point prevalence smoking abstinence at the 3-month follow-up contact. Among continuing smokers at the 3-month follow-up, smokers who reported higher nicotine dependence scores were more likely to report smoking more cigarettes per day and this effect was greater in response to *standard-care* messages than *gain-framed* messages. Smokers with higher dependence scores who received *standard-care* messages also were less likely to report use of nicotine medications compared with less dependent smokers, while there was no difference in those who received *gain-framed* messages. These findings lend support to prior research demonstrating nicotine dependence heterogeneity in response to message framing interventions and suggest that *gain-framed* messages may result in less variable smoking outcomes than *standard-care* messages.

Keywords

Nicotine dependence; smoking cessation; tobacco; message framing; quitline

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1. Introduction

There is growing interest in optimally tailoring smoking cessation treatments to smokers' characteristics (Batra et al., 2010; Haug et al., 2010; Schnoll and Patterson, 2009; Strecher et al., 2006). Studies have reported that the effectiveness of smoking cessation interventions may vary by several smoker characteristics including nicotine metabolic rate (Schnoll et al., 2009a), depression history (Haas et al., 2004), gender (Schnoll and Patterson, 2009), employment status, quit intentions (Haug et al., 2010), alcohol use, history of tobacco-related illness, household makeup (Strecher et al., 2006), and social support (Turner et al., 2008).

Nicotine dependence is an independent risk factor for smoking cessation failure (Baker et al., 2007; Killen and Fortmann, 1994) and may also moderate the impact of different smoking cessation treatments. For example, higher dose nicotine gum was found to increase quit rates among high dependent smokers but not among low dependent smokers (Herrera et al., 1995). Likewise, high dependent smokers may respond differentially to counseling interventions emphasizing either the benefits of quitting smoking (i.e., *gain-framed*) or the losses of continued smoking (i.e., *loss-framed*). In a smoking cessation trial of message framing to augment sustained-release (SR) bupropion therapy, high and low dependent smokers had similar smoking abstinence rates in response to *gain-framed* messages but high dependent smokers were less likely to be abstinent in response to *loss-framed* messages than low dependent smokers (Fucito et al., 2010). A study of non-treatment seeking smokers, however, demonstrated that *loss-framed* messages were more persuasive for increasing quit intentions and positive smoking cessation attitudes among high dependent smokers whereas *gain-framed* messages were more persuasive for low dependent smokers (Moorman and van den Putte, 2008).

In this study, we examined nicotine dependence as a potential moderator of the effects of a message-framing intervention among smokers seeking cessation assistance through a state quitline. Stemming from previous research (Fucito et al., 2010), we hypothesized that high dependent smokers exposed to *standard-care* messages and printed materials (i.e., mostly non-framed content with minimal discussion of either quitting benefits or smoking costs) would be less likely to achieve short-term smoking abstinence, more likely to report smoking more cigarettes, and less likely to adhere to NRT medication after attempting to quit than low dependent smokers who received *standard-care* messages. We also anticipated that *gain-framed* messages (i.e., content emphasizing quitting benefits) would be equally persuasive for promoting smoking cessation among high and low dependent smokers.

2. Materials and methods

2.1. Participants

This is a secondary analysis of data from a randomized controlled study of telephone specialists (n = 28) and their smoking clients (n = 2032) who contacted the New York State Smokers' Quitline (NYSSQL) for smoking cessation assistance from March 10, 2008, through June 13, 2008 (Toll et al., 2010). The study compared smoking cessation outcomes between clients assigned to receive either *gain-framed* (n = 810) or *standard-care* (n = 1222) counseling and printed materials. All medically eligible clients in both conditions were also offered NRT (i.e., patch, gum, or lozenge). Eligibility requirements included being: (1) a New York State resident ≥ 18 years of age, (2) an English speaker, (3) a current smoker seeking quitting assistance, (4) not enrolled in the NYSSQL extended callback program, and (5) not enrolled in any other smoking cessation programs. The 2032 clients (56.8% female, 43.2% male) were primarily Caucasian (79.2%), had a mean age of $46.70 \pm$

13.73 years, smoked an average of 20.13 ± 11.05 cigarettes per day for a mean of 25.99 ± 14.26 years, and had a mean Heaviness of Smoking Index (HSI) score of 3.21 ± 1.56 ; range = 0-6) (Heatherton et al., 1989).

2.2. Procedure

All clients received an initial intake telephone call that included medical screening for a 2-week starter pack of NRT. Based on the random assignment of their telephone specialist, they then received a web-based structured interview and either: (1) *gain-framed* or (2) *standard-care* counseling. Fidelity of counseling delivery was tested and revealed a high level of interrater reliability (mean intraclass coefficients ranged from .87-.99). All callers were mailed NYSSQL smoking cessation printed materials consistent with their experimental condition. Clients then received a 2-week follow-up telephone call and counseling by an NYSSQL specialist consistent with their experimental condition and a 3-month follow-up telephone interview by an independent survey group blind to message condition. The Institutional Review Boards of the Roswell Park Cancer Institute and the Yale University School of Medicine approved this study. More detail about study procedures is available in the original paper (Toll et al., 2010).

2.3. Measures

Heaviness of Smoking Index (HSI) (Heatherton et al., 1989)—This standardized measure of nicotine dependence includes 2 items from the Fagerström Tolerance Questionnaire - time to the first cigarette of the day and number of cigarettes smoked per day. It yields scores between 0 and 6 and is a reliable predictor of smoking cessation outcomes (Kozlowski et al., 1994). Total centered HSI scores were evaluated in analyses.

Smoking-related outcomes included—(1) point prevalence abstinence over the last 7 days at 3-month follow-up, (2) number of cigarettes smoked per day at 3-month follow-up, and (3) medication adherence at 3-month follow-up (i.e., number of patches, gum pieces, or lozenges used). At the 3-month follow-up, smoking abstinence during the specified period after quitting was defined as self-reported abstinence (i.e., no smoking, not even a puff in the last 7 days). Abstinence was coded categorically ($0 = abstinent$, $1 = smoking$). Clients who dropped out were coded as smoking.

2.4. Statistical Analysis

A t-test evaluated baseline differences in nicotine dependence between message conditions. Logistic regression analyses examined the effects of message condition and nicotine dependence centered scores on 7-day point prevalence abstinence at 3-months. Linear regression analyses evaluated the effects of message condition and nicotine dependence centered scores on: (1) number of cigarettes smoked per day at 3-months and (2) NRT use at 3-months. Regression models were fitted in steps. In Step 1, message condition and nicotine dependence centered scores were entered. In Step 2, the 2-way interaction of message condition and nicotine dependence centered scores was entered. Simple slope analyses were conducted for post-hoc probing of significant interactions (Holmbeck, 2002).

Three-month follow-up data were obtained for 63.3% of the sample ($n = 1286$) (Toll et al., 2010). The attrition rate was equivalent between conditions. The potential moderating effect of nicotine dependence on smoking abstinence was conducted as an intention-to-treat (ITT) analysis ($n = 2032$) with enrolled participants who dropped out considered to be smoking. This conservative approach is in accordance with the smoking field standard and other large-scale smoking cessation studies (Gonzales et al., 2006; Ahluwalia et al., 2002; Hurt et al., 1997). Analyses of other smoking-related outcomes were conducted using all available follow-up data at 3-months ($n = 1286$); ITT analyses were more difficult to conduct given

the challenge of imputing values for several variables. We chose not to impute baseline smoking values for missing values at 3 months due to criticisms of this approach (Little, 1992); there was no baseline value to impute for NRT adherence.

3. Results

Analyses confirmed conditions were equivalent at baseline on nicotine dependence. There was no significant interaction of nicotine dependence scores and message condition on the likelihood of achieving 7-day point prevalence smoking abstinence at the 3-month follow-up [Wald = .02, $p = .90$, OR = 1.10]. Among continuing smokers at 3-months, there was a significant interaction of nicotine dependence scores and message condition on number of cigarettes smoked per day [$R^2 = .10$; $F(3, 1233) = 45.96$, $p < .001$]. The simple slope of nicotine dependence scores was significant for *standard-care* messages [$b = 2.07$; $t = 10.01$, $p < .001$] and *gain-framed* messages [$b = 1.41$; $t = 5.82$, $p < .001$]. The direction and magnitude of both slopes suggested that daily cigarette intake at 3-months was greater among smokers with higher nicotine dependence scores and that this effect was larger in the *standard-care* condition than the *gain-framed* condition (see Figure 1).

There was also a significant interaction of nicotine dependence scores and message condition on NRT use at 3-months [$R^2 = .01$, $F(3, 1199) = 25.52$, $p = .05$]. The simple slope of nicotine dependence scores was significant for *standard-care* messages [$b = -3.05$; $t = -2.29$, $p = .02$] but not *gain-framed* messages [$b = 1.59$; $t = 1.00$, $p = .32$]. The direction of the slope for the *standard-care* condition suggested that NRT use was lower among smokers with higher levels of nicotine dependence (see Figure 2).

To further probe potential mechanisms that may have contributed to different smoking cessation outcomes in the *standard-care* condition, correlations were conducted between nicotine dependence scores and baseline quitting attitudes (i.e., quitting confidence and importance on 10-point scales). Nicotine dependence scores were modestly, negatively correlated with confidence [$r = -.08$, $p < .001$] and unrelated to quitting importance scores.

Specialist was also tested as a factor in the regression models and yielded no significant results [p 's $> .10$].

4. Discussion

Among smokers who received *standard-care* messages, those who reported higher baseline nicotine dependence scores reported smoking more cigarettes per day and less frequent NRT use at 3-months follow-up than smokers who reported lower nicotine dependence scores. Contrary to our hypothesis, this interaction was not observed for 7-day point prevalence smoking abstinence rates at 3-months. As anticipated, smoking abstinence rates and NRT use did not vary by nicotine dependence scores among smokers exposed to *gain-framed* smoking messages; however more dependent smokers also reported smoking more cigarettes per day in this condition than less dependent smokers.

Higher nicotine dependence is associated with greater difficulty quitting smoking so it would be expected that high dependent smokers would have reported lower adherence and greater smoking than low dependent smokers (Baker et al., 2007; Killen and Fortmann, 1994; Kozlowski et al., 1994). However, there was less variability in medication adherence and smoking rates between high and low dependent smokers in the *gain-framed* condition. These results partially replicate previous research in which high dependent smokers were less likely to be abstinent than low dependent smokers in a *loss-framed* condition but were equally likely to be abstinent as low dependent smokers in a *gain-framed* condition (Fucito et al., 2010). Taken together, these findings suggest that delivering gain-framed messages

may result in less variable smoking cessation outcomes than *loss-framed* or *standard-care* messages.

Potential differences in smoking cessation outcomes between high and low dependent smokers in response to *gain-framed* messages may have been reduced for several reasons. Greater nicotine dependence is a risk factor for smoking-related illnesses, health concerns are among the key motives for quitting smoking, and high dependent smokers have likely experienced smoking consequences (Deheinz et al., 2005; Duncan et al., 1992; Jimenez-Ruiz et al., 2001). Thus, high dependent smokers may have perceived smoking cessation as less risky (i.e., a more certain outcome) and effective for health improvement.

High dependent smokers may have also construed *gain-framed* messages as less threatening than *standard-care* messages. Nicotine dependence was negatively correlated with quitting confidence suggesting a slight tendency for more dependent smokers to report lower confidence to quit. Presenting *loss-framed* messages, believed to convey a greater sense of threat than *gain-framed* messages, to individuals who perceive themselves less capable of avoiding the threat may result in message avoidance or rejection (Van 't Riet et al., 2008; Witte, 1992). Thus, presenting smoking messages in *gain-framed* terms to high dependent smokers may have facilitated message acceptance.

Several study limitations should be noted. Moderator effects were modest. No adjustments were made for multiple comparisons of multiple outcomes because this was an exploratory secondary analysis. The assessment of smoking abstinence was limited to 7-day point prevalence abstinence at 3-months. Future studies may wish to incorporate more robust smoking cessation measures such as continuous abstinence over a number of months. Analyses of secondary smoking-related outcomes were limited to the subsample of participants who completed the 3-month follow-up. Although the follow-up rate is consistent with that of other large-scale quitline studies (An et al., 2006; Hollis et al., 2007), the generalizability of results for cigarette intake and NRT adherence is restricted to this subset of quitline participants. Finally, specialist enthusiasm for the *gain-framed* condition relative to *standard-care* may have also influenced results, though standardized training and supervision methods and high specialist adherence reduce this concern. In future research, it would be valuable to include a measure of specialist enthusiasm for the intervention in order to address whether there are condition differences, and if so, whether they affect study outcomes.

Quitlines have several advantages including cost-effective smoking cessation treatment that is accessible to all smokers. This study provides preliminary evidence that smokers' nicotine dependence level may moderate quitline intervention effectiveness, and it is possible that tailored interventions to high dependent callers could enhance smoking-related outcomes. More research is needed to examine the feasibility and effectiveness of such tailoring in the context of a tobacco quitline.

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Figure 1.
Regression Lines for Association between Daily Smoking Rate at 3-Month Follow-up and
Message Condition as a Function of Centered Nicotine Dependence Scores
Note. *** < .001, b = unstandardized regression coefficient

Figure 2.
Regression Lines for Association between Nicotine Replacement Therapy (NRT) Use at 3-Month Follow-up and Message Condition as a Function of Centered Nicotine Dependence Scores

Note. * < .05, b = unstandardized regression coefficient