Positive Affect and Mood Management in Successful Smoking Cessation

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***Objective*: To examine the influence of positive affect and mood-management in the completion and success of an Internet-based smoking cessation intervention. *Methods*: Participants were recruited online (n=1000) and randomized to 4 different interventions. Half of the participants received a mood-management tool. *Results*: Retention was predicted by positive affect at 3 and 12 months. There was a higher 12-month abstinence rate among those who were assigned to the mood-management intervention and had initial low positive affect. *Conclusions*: The study supports the inclusion of mood-management tools in smoking cessation interventions and indicates that positive affect increases persistence to quit smoking.**

***Key words*: smoking cessation, positive affect, negative affect, internet intervention, mood management**

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There are approximately 1.1. billion smokers in the world, and cigarette smoking is the single most important risk factor contributing to the disease burden in the developed countries according to estimates made by the World Health Organization.[1] Cigarette smoking increases the risk of a large number of diseases, eg, cardiovascular disease and cancer; and approximately 8.6 million people in the United States had a smoking-attributable health condition in 2000.[2] Despite the widespread knowledge about the detrimental effects of cigarette smoking, many people still start and continue to smoke, and the health risks are not enough to motivate abstinence. In addition to a multilevel approach that includes smoking cessation legislation and other public policy interventions, there is a need for effective and affordable smoking cessation interventions. Even though there are a large number of different types of behavioral and pharmacological smoking cessation interventions that all increase the likelihood of successful smoking cessation, a large majority of those who try to quit fail to do so.[3-5] To increase the effectiveness of smoking cessation interventions, there is a need to more fully understand the underlying mechanisms related to successful abstinence. Some studies have shown that negative mood and depression are related to, and may influence, smoking cessation outcome[6-9] and smoking relapse.[10] Even though current depression de-

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creases the likelihood of successful smoking cessation, a history of depression has been associated with greater likelihood of cessation.[11] A review of the field concluded that lifetime history of major depression in itself did not seem to predict smoking cessation.[12] The associations among affect, depression, and smoking cessation seem to work in complex, bidirectional ways.[13] The importance of including mood-management components in smoking cessation interventions as a way to increase quit rates and long-term abstinence has been suggested[14,15] and has been found effective in randomized control trials.[6,16-19]

An interesting recent development within the field of prevention and health-behavior change research is a focus on the role of positive affect. Until recently, most studies of mechanisms of mood and behavior change have been focused on comorbidities that inhibit successful behavior change. This research has primarily focused on the effects of negative mood, and relatively little attention has been directed at examining the influence of positive affect. This might be a consequence of the view that positive and negative affect are only opposite ends of the same mood dimension. However, there is increasing support for the idea that positive mood and negative mood are related but distinct constructs.[20,21] Emerging evidence is also showing that positive affect seems to have a stronger association with health outcome than does negative affect.[22-25] There are several hypothetical pathways through which positive affect might be connected to health outcomes. One possible mechanism for the effect of positive affect is through improved health behaviors. There are studies indicating that positive affective states are associated with greater attention to and processing of health-relevant information. According to the broaden-and-build theory, positive affect plays an important role in presenting a wider variety of thought and action alternatives and further enforces people's general resources.[20] Recent studies on levels of positive mood and cigarette smoking have shown that people with lower levels of positive mood are more likely to smoke than are those with higher levels of positive mood.[26] Further, a reduction in positive mood among smokers has been found to be linked to increased temptation to smoke.[14] There are therefore reasons to believe that positive affect plays an important role in the success or failure in peoples' attempts to quit smoking in addition to the role of negative affect.

The primary aim of the current study was to examine the unique contributions of positive and negative affect in the completion and success of an Internet-based smoking cessation intervention. We hypothesized that smokers with high levels of positive affect would be more successful in quitting smoking and more likely to be persistent in their attempts to quit than would smokers with a lower level of positive affect. The importance of positive affect was examined taking into account the influence of negative affect, nicotine dependence, confidence in quitting, and depression history. The second aim was to examine the additional value of providing participants with a mood-management tool in conjunction with their smoking cessation intervention. It was hypothesized that smokers with an initially low degree of positive affect would benefit more from mood management as indicated by previous research.[27]

METHOD

Sample

Participants were recruited from the general population using the Internet. The respondents were informed about the study if they made Internet searches using search keywords related to smoking cessation, either in English or in Spanish. Respondents searching for smoking cessation websites in the Google search engine between 14 November 2005 and 28 March 2006 were provided sponsored links to the free smoking-cessation study Web site (www.stopsmoking.ucsf.edu or www.dejardefumar.ucsf.edu) and were informed about the possibility of participating in a randomized smoking cessation study. If the respondents agreed to participate, they were asked to proceed and finish the recruitment procedure. The recruitment procedure consisted of 4 initial assessments: brief demographic assessment, eligibility assessment, a baseline assessment for those who were eligible and consented, and a 3-day assessment of the number of cigarettes smoked. The respondents who successfully completed all 4 initial assessments were randomized to one of the 4 conditions of the study. The recruitment for

the sample used in the current analysis was stopped when a total of 500 English-speaking respondents and 500 Spanish-speaking respondents had been randomized. After randomization the respondents received their intervention and subsequent follow-up assessments at 1, 3, 6, and 12 months. To increase the response rate, respondents were reminded to fill out the follow-ups using both e-mail and telephone. The response rates for the 4 follow-up assessments were 723 (72.3%), 656 (65.6%), 558 (55.8%), and 687 (68.7%).

Measures

Brief demographic assessment. When the respondents entered the Web page for the first time, they were requested to answer a few demographic questions regarding age, gender, level of education, ethnicity, race, country of residence, and zip code. Further the respondents were asked how they found the Web site and the type of Internet connection they were currently using.

Eligibility assessment. The respondents were subsequently asked a number of questions to assess their eligibility for the study. These questions included motivation to stop smoking, number of years the respondent had smoked, current smoking status (smoker/have quit within 6 months/have quit more than 6 months ago/have never smoked), number of cigarettes smoked per day, current plan to quit smoking (within 30 days/within 6 months/no plan to quit smoking), number of quit attempts, age at first cigarette, age at onset of regular smoking, and 2 additional questions regarding having an e-mail address and frequency of checking e-mails (number of days/week). The respondents were considered eligible for the study if they were at least 18 years of age, smoked 5 or more cigarettes per day, were committed to stop smoking within the next 30 days, and had an e-mail address that they checked at least weekly.

Baseline assessment. If the respondents were eligible for the study and provided informed consent, they were asked to fill out the baseline questionnaire. The baseline questionnaire assessed some additional background questions such as weight, height, country of birth, country of residence, number of years in country, marital status, income, previous quit attempts (yes/no), confidence in quitting (on a response scale for 1 to 10), number of people around the respondent who smoked, and some questions regarding previous attempts to stop smoking and the methods used. Nicotine dependence was assessed using the Fagerström Test for Nicotine Dependence.[28]

The respondents were also asked to fill out the Center for Epidemiologic Studies Depression Scale (CES-D). Previous studies have shown that the CES-D consists of several subscales.[29,30] A factor analysis of the scores suggested 3 subscales in this sample. In this study the subscales measuring negative affect (9 items, Cronbach's alpha coefficient = 0.90 in this sample) and positive affect (4 items, = 0.77 in this sample) will be used. The items included in the negative affect scales were "I felt that I could not shake off the blues even with help from my family or friends"; "I felt depressed"; "I thought my life had been a failure"; "I felt fearful"' "I felt lonely"; "People were unfriendly"; "I had crying spells"; "I felt sad"; and "I felt that people dislike me." The positive affect scale consisted of the following 4 items: "I felt I was just as good as other people"; "I felt hopeful about the future"; "I was happy"; and "I enjoyed life." The correlation between positive and negative affect at baseline was -0.34 ($P<0.001$). The prevalence of major depressive episodes was assessed using the major depressive episode (MDE) screener.[31,32] The MDE screener is based on the DSM-IV criteria for major depression, and it consists of 15 items. It categorizes individuals into 3 groups: no current or history of depression, previous history of a major depressive episode, and current major depression.

Follow-up assessments at 1, 3, 6, and 12 months. At 4 subsequent follow-up assessments the respondents were asked questions regarding 24-hour smoking cessation attempts as well as whether they had smoked any cigarettes during the last 7 and 30 days, the CES-D, and the MDE screener. In some smoking cessation trials, it is common to assume that respondents who drop out at follow-up are still smokers. This strategy was not used in this study.

Study Conditions

All participants recruited to the study were randomized to one of 4 possible conditions consisting of different smoking cessation interventions. The first condi-

Table 1
Positive and Negative Affect Among Smokers in an Internet Cessation Study[a] (N=1000)

			Positive affect at baseline (min=0, max=12)			Negative affect at baseline (min=0, max=27)		
	n	%	Mean	SD	Sig.	Mean	SD	Sig.
Gender [b]								
Men	553	55.3	7.2	3.1	n.s.	5.4	5.7	n.s.
Women	443	44.3	7.4	3.2		6.2	6.3	
Education								
High school graduate or less	170	17.0	7.0	3.1	n.s.	6.3	6.1	P<.05[c]
Some college	392	39.2	7.2	3.3		5.8	6.4	
Bachelor's degree	285	28.5	7.3	3.0		6.3	6.0	
Master's degree or higher	146	14.6	7.8	3.1		4.4	4.7	
Depression history								
No history of depression	696	69.6	7.9	2.9	P<.001	3.8	4.3	P<.001
Past major depressive episode	173	17.3	7.1	3.0		6.6	5.1	
Current depression	129	12.9	4.3	2.8		15.0	6.1	

Note.
a Measured with the CES-D
b Four participants did not indicate gender
c Difference only significant for master's degree or higher

tion was a smoking cessation guide provided via the Internet; the second condition was the same smoking cessation guide accompanied with automatic e-mail reminders of smoking cessation; the third condition was the guide, e-mail reminders, and a mood-management intervention; and the fourth condition was the guide, e-mail reminders, the mood-management intervention, and the possibility to participate in a smoking-cessation asynchronous bulletin board in conjunction with the Internet site. The study was approved by the institutional review board, and the interventions have been described in previous publications.[11] In this study, the comparisons will be made between the groups that received the mood-management intervention (condition 3 and 4, n=500) and the groups that did not (condition 1 and 2, n=500). The mood-management intervention consisted of an 8-lesson social-learning-oriented mood-management course. The intervention included written and verbal instructions on how to use the materials and a 30-minute relaxation exercise; an interactive tool to make notes on number of cigarettes smoked, register each pleasant activity they engaged in during the day, and their overall mood at the end of the day. The focus of this method was to learn to gain more control over one's mood in order to reduce the likelihood that the participant would resume smoking in response to negative mood states. To prevent negative mood states, participants were encouraged to learn and use alternative methods to influence their mood. Participants were instructed to increase their pleasant activities and to note the correspondence of pleasant activities with mood and of mood with number of cigarettes smoked. Ideas for increasing pleasant activities were given. Participants were to chart the number of pleasant activities they engaged in each day, their mood level, and each cigarette smoked.

Analysis of Positive and Negative Affect

Initial descriptive analyses were carried out on baseline positive and negative affect for different background factors such

Table 2
Positive and Negative Affect With Age, Confidence in Ability to Quit, and Nicotine Dependence (N=1000)

			Positive affect at baseline (min=0, max=12)	Negative affect at baseline (min=0, max=27)		
	Mean	SD	R		R	
Age	37.6	19.9	0.02	n.s.	-0.08	P<.05
Confidence in ability to quit (min=1, max=10)	6.8	2.0	0.14	P<.001	-0.16	P<.001
Nicotine dependence (min=0, max=10)	5.2	2.5	-0.06	n.s.	0.11	P<.001

as age, gender, education, and depression history. Multiple logistic regression analysis examined the importance of positive affect, negative affect, initial confidence in quitting, and nicotine dependence in the prediction of 1-, 3-, 6- and 12-month study retention and smoking cessation (defined as having made a serious quit attempt lasting at least 24 hours or having been abstinent for 7 or 30 days prior to assessment). For the analysis at 1 month, the baseline affect value was used; and at 3, 6, and 12 months, mean values of the previous assessments of positive and negative affect were used. The analyses were controlled for age, gender, level of education, English vs Spanish speaking, and depression history.

Analysis of Effectiveness of the Mood-Management Intervention

To examine the benefit of the mood-management intervention Chi-square statistics were used. Two dependent variables were used: study dropout, and smoking cessation (defined as having been abstinent for at least 7 days prior to assessment). To examine the differential effect of the mood-management intervention on people with different initial level of positive affect, separate analyses were made using groups of people categorized by median split into low and high positive affect.

RESULTS

Background Differences in Positive and Negative Affect

Positive and negative affect were both associated with depression history. Those with current depression scored highest on negative affect and lowest on positive affect, and those with no history of major depression scored lowest on negative affect and highest on positive affect; see Table 1.

There were no gender differences in positive and negative affect. The only difference between people with different education was a significantly lower negative affect among those who had a master's degree or higher. There was a negative correlation between age and negative affect, but no significant correlation between age and positive affect (Table 2). Confidence in quitting smoking was significantly and positively related to positive affect and negatively related to negative affect. Nicotine dependence was positively related to negative affect.

Positive and Negative Affect as Predictors of Retention and Smoking Cessation

The retention rate at follow-ups were 72.3 % at 1-month follow-up, 65.6 % at 3-month follow-up, 55.8 % at 6-month follow-up, and 68.7 % at 12-month follow-up. Seventy percent of the participants had made a serious quit attempt (ie, no cigarettes during 24 hours) at 1-month follow-up. The rates were 70.4 % at 3-month follow-up, 64.2 % at 6-month follow-up, and 70.6 % at 12-month follow-up. The percentage of participants who had had 7 days of successful abstinence increased over time from 23.5 % at 1-month follow-up to 25.7 % at 3-month follow-up, 26.2 % at 6-month follow-up, and 30.2 % at 12-

Table 3
Multivariate Analysis for Positive and Negative Affect

	1-month		3-month		6-month		12-month	
	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
Retention Rate in Total Sample								
Confidence to quit	1.19*	(1.03-1.38)	1.00	(0.84-1.19)	0.97	(0.83-1.13)	1.01	(0.84-1.21)
Nicotine dependence	0.92	(0.79-1.07)	0.93	(0.79-1.11)	0.87	(0.75-1.02)	0.94	(0.78-1.12)
Positive affect, mean[a]	1.05	(0.90-1.22)	1.25*	(1.02-1.52)	0.98	(0.82-1.18)	1.37**	(1.11-1.69)
Negative affect, mean[a]	1.14	(0.97-1.33)	1.02	(0.81-1.28)	0.87	(0.71-1.07)	1.12	(0.89-1.41)
Serious (24h) Quit Attempt								
Confidence to quit	1.25*	(1.05-1.50)	1.11	(0.93-1.34)	1.11	(0.92-1.35)	1.11	(0.93-1.33)
Nicotine dependence	0.75**	(0.63-0.90)	0.68***	(0.56-0.82)	0.69**	(0.57-0.84)	0.83*	(0.70-1.00)
Positive affect, mean[a]	1.01	(0.84-1.22)	1.05	(0.85-1.30)	1.32*	(1.04-1.66)	0.98	(0.80-1.21)
Negative affect, mean[a]	0.94	(0.78-1.12)	1.02	(0.79-1.31)	1.07	(0.82-1.40)	1.11	(0.89-1.39)
7-day Abstinence Rates								
Confidence to quit	1.49***	(1.23-1.80)	1.15	(0.95-1.40)	1.35*	(1.06-1.73)	1.13	(0.89-1.13)
Nicotine dependence	1.03	(0.86-1.24)	1.01	(0.84-1.22)	0.98	(0.78-1.24)	0.96	(0.77-1.19)
Positive affect, mean[a]	1.02	(0.84-1.23)	1.10	(0.88-1.38)	1.00	(0.93-1.07)	0.99	(0.93-1.05)
Negative affect, mean[a]	0.96	(0.79-1.16)	0.84	(0.64-1.11)	0.96	(0.92-1.01)	0.97	(0.93-1.01)
30-day Abstinence Rates								
Confidence to quit	1.49***	(1.19-1.86)	1.30*	(1.01-1.67)	1.27*	(1.01-1.59)	1.18	(0.92-1.52)
Nicotine dependence	1.02	(0.82-1.27)	1.04	(0.82-1.32)	1.02	(0.82-1.27)	1.09	(0.86-1.39)
Positive affect, mean[a]	1.23	(0.98-1.55)	0.99	(0.92-1.06)	1.11	(0.84-1.46)	0.98	(0.92-1.04)
Negative affect, mean[a]	0.98	(0.78-1.24)	0.98	(0.93-1.02)	0.82	(0.59-1.15)	0.96	(0.92-1.00)

Note.
*** P < .05, ** P < .01, *** P < .001,**
a For the analysis at 1 month, the baseline affect value was used; and at 3, 6, and 12 months, mean values of the previous assessments of positive and negative affect were used. All analyses were controlled for age, gender, level of education, English vs Spanish speaking, and depression history.

month follow-up. The 30-days abstinence rate also increased over time from 16.6 % at 1-month follow-up to 17.2 % at 3-month follow-up, 20.8 % at 6-month follow-up, and 22.3 % at 12-month follow-up.

In Table 3, multiple logistic regression analyses are presented for the association between mean levels of positive and negative affect, baseline levels of confidence in quitting smoking, and baseline measure of nicotine dependence with study retention and abstinence rates. Study retention was significantly predicted by positive affect at 3 and 12 months.

The most predictive variable for a serious quit attempt (defined as 24-hour abstinence since the last assessment) was nicotine dependence. Nicotine dependence was significantly associated with less likelihood of a serious quit attempt at 1, 3, and 6 months. Confidence in quitting smoking was only predictive of a serious quit attempt at the 1-month follow-up. Positive affect predicted a serious quit attempt at 6 months.

Initial degree of confidence in quitting was predictive of 7-day abstinence at 1 and 6 months, and predictive of 30-day abstinence at 1, 3, and 6 months.

Differential Effect of Mood-Management Intervention Among Respondents With Different Baseline Levels of Positive Affect

There were no significant direct differences in smoking cessation between those who were assigned to the mood-management intervention (32.2 %, n = 109) and those who were not (28.3 %, n = 97). However, when analyses were made separately among those with initial high and low positive affect, among those with initially lower positive affect, there was a significantly higher quit rate for those who were assigned to the mood-management intervention and used it (ie, viewed half or more of the 8 mood-management lessons), see Table 4.

Further, among those with initial low positive affect, an increase in positive

Table 4
Proportion of Respondents Retained to Assessment at 12 Months, 7-Day Abstinence at 12 Months

Total sample	High initial positive affect n = 374	Low initial positive affect n = 597	
	% (n)	**% (n)**	**Sig.**
Retention to assessment at 12 months	72.7 (272)	66.5 (397)	P = 0.04
7-Day abstinence at 12 months	% (n)	% (n)	Sig.
	30.1 (82)	30.4 (119)	P = 0.95
	Mean (SD)	**Mean (SD)**	**Sig.**
Mean lessons attended	4.6 (3.3)	4.2 (3.2)	P = 0.23
7-Day abstinence at 12 months	**% (n)**	**% (n)**	
Mood management	29.8 (39)	33.8 (67)	
No mood management	30.5 (43)	26.8 (52)	
Sig.	P = 0.90	P = 0.13	
7-Day abstinence at 12 months	**% (n)**	**% (n)**	
Participated in mood management	30.0 (27)	38.3 (44)	
Did not participate	30.2 (55)	27.1 (75)	
Sig.	P = 0.97	P = 0.03	

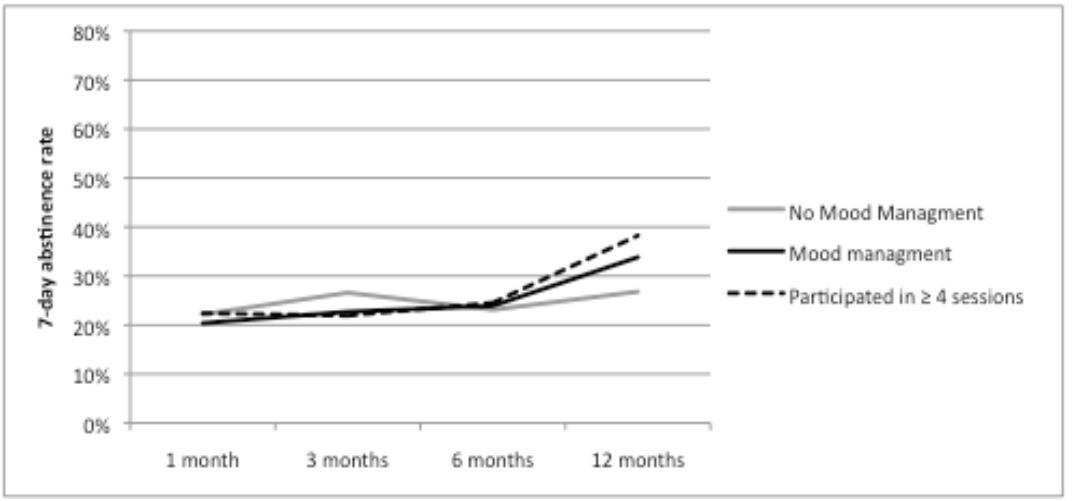
affect from baseline to 12-month follow-up increased the likelihood of successful smoking cessation even when controlling for changes in negative affect (OR $_{positive\ affect}$=1.65, 95% confidence interval = 1.22-2.23; OR $_{negative\ affect}$=1.04, 95% confidence interval = 0.77-1.39, n.s.).

In figures 1 and 2, the percentages of 7-day abstainers at 1, 3, 6, and 12 months are presented. The results are presented for those randomized to the mood-management intervention and those who were not. In addition, the results for the subgroup of people randomized to the intervention groups that used at least 4 of the mood-management sessions are presented. Among those respondents randomized to the mood management who used at least 4 of the mood-management sessions, the likelihood of being abstinent at 12-month follow-up increased.

DISCUSSION

The main goal of this study was to examine the importance of positive affect and mood management on successful smoking cessation. Previous studies of smoking cessation interventions have in general not measured positive affect; and this is, to our knowledge, the first Internet-based study to report on the additional effect of mood management to promote smoking cessation. There are, however, some previous studies indicating that smokers with a previous history of depression would benefit from mood-management training in their cessation efforts.[14,33] The results indicate the importance of both positive affect and mood management in smoking cessation success. Positive affect seems to be important in the pursuit of smoking cessation, through increasing persistence and increasing retention. As smoking cessation is a process that takes time, persistence in trying to quit is essential. Previous studies of Web-based smoking cessation interventions have shown that the frequency by which participants use interactive smoking-cessation Web resources is particularly important in predicting successful cessation, and activities to promote retention are highly warranted.[34-37] Therefore, our finding that positive affect is predictive of study retention might be helpful in understanding the mechanisms of smoking cessation. Fur-

Figure 1
Percentage of 7-day Abstinence Rates at 1-, 3-, 6- and 12-month Followup Among Respondents with Low Initial Positive Affect (n=597)



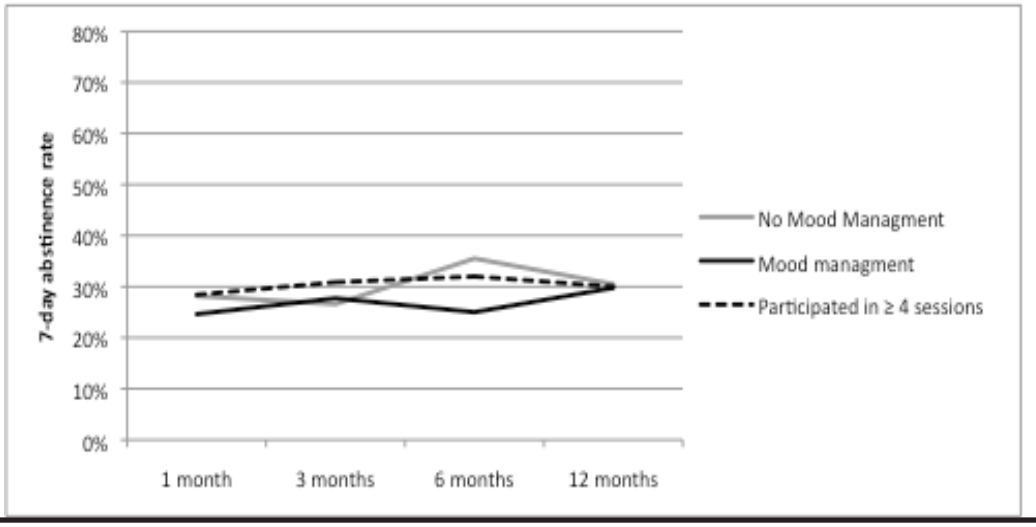
ther, initial confidence in quitting seems to be important in successful smoking cessation, perhaps as a reflection of feelings of self-efficacy. Confidence was significantly predictive of 30-day abstinence at 1, 3, and 6 months.

Further, this study indicates that mood-management interventions can be particularly beneficial for participants with initial low levels of positive affect. A previous study has also shown that positive affect increases the likelihood of quitting successfully in a study of pharmacological smoking cessation treatment.[27]

This study is innovative in the use of an online search engine to recruit participants, but it is not without several limitations. The use of self-selected participants recruited through the Internet is problematic as it reduces the possibility to generalize the findings to other populations. However, the randomized design of the study enables efficient evaluation of intervention effects within this population, and the recruitment strategy used is very relevant for the way in which people become exposed to health information and behavior change tools. Even though the dropout rates are low compared to similar studies, it is still possible that the dropout is selective. This makes predictions of the exact proportion of successful quitters difficult. Another potential problem is the self-assessment method of measuring depression, affect, and smoking cessation. More objective measures such as clinical assessment of depression and biological confirmation of nicotine abstinence would have strengthened the results. However, the large interest in online smoking-cessation tools shown in this study is encouraging and gives support to future efforts of constructing effective smoking cessation interventions. The potential for this type of tool is great, as it is open to smokers globally. The effect we find regarding higher rates of smoking cessation among the subgroup of respondents with initially low positive affect and mood-management is also somewhat problematic. It is possible that those who successfully participate in the mood-management intervention are generally more compliant and would do better irrespective of the type of treatment received. Further, even though the CES-D has been used successfully as a measure of positive and negative affect,[22,29,30,38] there are better scales specifically developed for this purpose.

In sum, the importance of developing effective smoking-cessation Internet in-

Figure 2
Percentage of 7-day Abstinence Rates at 1-, 3-, 6- and 12-month Followup Among Respondents with High Initial Positive Affect (n=374)



terventions open to smokers globally is important. This study contributed to our understanding of some of the mechanisms behind smoking cessation and how it relates to positive and negative affect. It supports the inclusion of mood management in interventions that aim at helping smokers quit and, in particular, smokers with initial low positive affect. The study also indicates that positive affect plays an important role in keeping people engaged in smoking cessation interventions.

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