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Development of the PROMIS® Coping Expectancies of Smoking Item Banks

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ABSTRACT

Objective: Smoking is a coping strategy for many smokers who then have difficulty finding new ways to cope with negative affect when they quit. This paper describes analyses conducted to develop and evaluate item banks for assessing the coping expectancies of smoking for daily and nondaily smokers.

Methods: Using data from a large sample of daily ($N = 4,201$) and nondaily ($N = 1,183$) smokers, we conducted a series of item factor analyses, item response theory analyses, and differential item functioning (DIF) analyses (according to gender, age, and ethnicity) to arrive at a unidimensional set of items for daily and nondaily smokers. We also evaluated performance of short forms (SFs) and computer adaptive tests (CATs) for assessing coping expectancies of smoking.

Results: For both daily and nondaily smokers, the unidimensional Coping Expectancies item banks (21 items) are relatively DIF free and are highly reliable (0.96 and 0.97, respectively). A common 4-item SF for daily and nondaily smokers also showed good reliability (0.85). Adaptive tests required an average of 4.3 and 3.7 items for simulated daily and nondaily respondents, respectively, and achieved reliabilities of 0.91 for both when the maximum test length was 10 items.

Conclusions: This research provides a new set of items that can be used to reliably assess coping expectancies of smoking, through a SF, CAT, or a tailored set selected for a specific research purpose.

INTRODUCTION

Cigarette smoking has demonstrated links to a variety of negative affective, emotional, mood-related experiences. For example, in the laboratory, exposure to psychosocial stressors leads to increased physiological, cognitive–affective, and craving responses in smokers (Niaura, Shadel, Britt, & Abrams, 2002; Shadel et al., 1998). Unsuccessful quitters commonly report that stress is a central reason for their relapsing back to regular smoking (Shiffman, 1986). Longitudinal data on the relapse process collected in real time via electronic diaries have provided compelling evidence that lapse and relapse are heavily influenced by contexts like stress and negative affect (Shiffman, Paty, Gnys, Kassel, & Hickcox, 1996; Shiffman & Waters, 2004).

Conceptually, these relationships can be explained via cognitive social learning processes and mechanisms (Brandon, Juliano, & Copeland, 1999; Wills & Shiffman, 1985; Witkiewitz & Marlatt, 2004). For example, adolescents seem to learn about various (perceived) smoking benefits, particularly those regarding relaxation (Piko, Wills, & Walker, 2007), through exposure to media portrayals of smoking (Shadel et al., 2012).

Those beliefs about the benefits of smoking are internalized as expectancies of smoking and those expectancies predict smoking initiation in adolescents (Wills, Sargent, Stoolmiller, Gibbons, & Gerrard, 2008). In addition, among regular smokers, nicotine seems to have some of its ameliorative effects on stress and depression through its complex actions on the central nervous system (Picciotto & Mineur, 2014). Some perspectives suggest that the stress smokers experience is actually misattributed nicotine withdrawal (i.e., that smokers perceive nicotine withdrawal as stress), and that the perceived stress relief that comes from smoking is actually relief of nicotine withdrawal (see DiFranza & Wellman, 2005). In any case, due to their direct and vicarious experiences with smoking and also to the direct pharmacological actions of nicotine, smokers learn and come to expect that smoking is a seemingly viable means of coping with stress and negative affect (i.e., coping expectancies of smoking).

More intensive clinical treatment approaches for smoking cessation focus on changing coping expectancies of smoking in helping smokers quit (e.g., Brown, 2003; Copeland & Brandon, 2000; Hertel et al., 2008; Marlatt & Gordon, 1985;

Webb, Hendricks, & Brandon, 2007). Such programs often incorporate an assessment component that helps smokers to identify and recognize the beliefs and expectancies they hold about smoking and pursue a cognitive restructuring program to help smokers modify those beliefs about smoking. For example, if smokers believe that smoking helps them to cope with stress, therapeutic techniques involve helping smokers change those expectancies about the coping value of smoking and teach them alternative ways of coping with stress.

Several questionnaires and items from established scales have been developed and designed to assess coping expectancies of smoking. Some of these questionnaires and items refer to these expectancies as consequences (i.e., beliefs about the immediate and long-term sequelae of smoking) and others refer to these expectancies more broadly as smoking motives (i.e., reasons for smoking). However, the two concepts (smoking motives and smoking expectancies) are related to one another conceptually and fall under that unifying conceptual umbrella for purposes of this initiative (for a similar treatment, see Piper et al., 2004). For example, the Smoking Consequences Questionnaire (Brandon & Baker, 1991; Wetter et al., 1994) includes a subscale that assesses smokers' expectancies regarding the negative affect reduction properties of smoking and the Wisconsin Inventory of Smoking Dependence Motives (Piper et al., 2004) similarly includes content and subscales that assess this concept. Other scales, for example, the Coping with Temptations Inventory (Shiffman, 1988) and Reasons for Smoking Scale (e.g., Tate & Stanton, 1990) also include several items that measure smokers' expectancies about the coping value of smoking. Each of these measures, while possessing more or less reasonable psychometric properties, is quite lengthy and/or their content scope can be relatively narrow (i.e., only assessing a subset of potential expectancies). There is no single measure that comprehensively covers the content of this domain and assesses it in an efficient, psychometrically sound fashion.

The primary goal of the PROMIS® Smoking Initiative is to develop psychometrically sound item banks that can be used to reliably and efficiently assess key biopsychosocial constructs associated with smoking (see other papers in this supplement). In the initial phase of the PROMIS Smoking Initiative, items from existing measures of coping expectancies of smoking (reviewed above) were subjected to rigorous qualitative review, and exploratory and confirmatory factor analyses (see Edelen, Tucker, Shadel, Stucky, & Cai, 2012 for details of this approach). The current paper describes a series of analyses that were conducted on this set of coping expectancies of smoking items to arrive at a unidimensional "bank" of items that can serve as the basis for reliable assessment of this construct, functioning in the same way for smokers of either gender and across various racial/ethnic and age groups. These analyses were conducted with data from daily and nondaily smokers separately and included a final cocalibration of all items across daily and nondaily smokers to link the scales of the two item sets. We also evaluated the performance of a short form (SF) and computer adaptive tests (CATs). Our analysis plan follows closely the many procedures described by Reeve et al. (2007) in their psychometric evaluation and calibration of health-related quality of life item banks for PROMIS. A more complete description of the analytic process used to develop the daily and nondaily smoker item banks for the PROMIS Smoking Initiative is presented by Hansen et al. in this supplement.

METHODS

Sample and Procedure

A national sample of smokers ($N_{(total)} = 5,384$; $N_{(daily)} = 4,201$; $N_{(nondaily)} = 1,183$) was recruited by Harris Interactive through their online panel membership, and all assessments were completed via the Internet. All procedures were institutional review board approved. Individuals were eligible if they were 18 years or older, had been smoking for at least a year, had smoked in the past 30 days, and did not have plans to quit in the next 30 days. Based on their response to number of days smoked in past 30 days, those participants indicating smoking 28–30 days of the past 30 days were classified as daily smokers; respondents smoking less than 28 days of the past 30 days were classified as nondaily smokers. Similar groupings have been used previously (see Fish et al., 2009; Shiffman, Kirchner, Ferguson, & Scharf, 2009), though of course alternative definitions of smoker type based on level of daily smoking and/or days smoked are possible. Sample recruitment was targeted to reflect the demographic composition of U.S. adult smokers in terms of gender, race/ethnicity, and age. The survey was fielded between July and September 2011 via a randomized block design (Reeve et al., 2007). The block design was constructed to minimize respondent burden while maximizing the interitem covariance coverage. To cross-validate the dimensionality of the Coping Expectancies item bank, the daily smoker sample was randomly split into exploratory ($N_{(exploratory)} = 3,021$) and confirmatory ($N_{(confirmatory)} = 1,180$) subsamples.

Mean age was 46.4 years for daily (D) smokers and 44.1 years for nondaily (ND) smokers. Females comprised about half the sample (D: 54.8%, ND: 47.0%). Most participants were employed full time (D: 52.9%, ND: 60.6%) or part time (D: 12.2%, ND: 14.4%). The racial/ethnic composition was primarily non-Hispanic White (D: 72.2%, ND: 55.2%), African American (D: 12.1%, ND: 15.5%), and Hispanic (D: 11.3%, ND: 24.4%). Most participants had attended at least some college (D: 80.5%, ND: 84%), and many had earned a bachelors or graduate degree (D: 29.8%, ND: 42.1%). More than half were currently married or cohabiting (D: 57.7%, ND: 55.1%), with fewer being divorced/separated/widowed (D: 21.8%, ND: 18.7%) or never married (D: 20.5%, ND: 26.1%). Although most differences are not large, chi-square tests (and *t*-test for age) indicated that daily and nondaily smokers significantly differed on each of these characteristics ($p < .001$). Most notably, relative to daily smokers, nondaily smokers were less likely to be non-Hispanic White, and more likely to be employed and further educated. Table 1 compares these groups on smoking patterns. As expected, daily smokers had a longer smoking history, smoked more heavily, and reported fewer quit attempts compared to nondaily smokers ($p < .0001$).

Measures

Smoking Items

A total of 277 unique smoking items were administered. These items were developed according to PROMIS procedures from extant items in the literature as well as direct feedback from smokers. This process, described in more detail in Edelen et al. (2012), employed a rigorous qualitative approach that included systematic literature review, binning and winnowing of items, item standardization, solicitation of feedback from smokers via focus groups and cognitive interviews, and final

Table 1. Smoking Characteristics of Daily and Nondaily Smokers

Smoking variable	Daily smokers ($N = 4,201$)	Nondaily smokers ($N = 1,183$)
Years smoked, %		
1–10 years	11.7	29.2
More than 10 years	88.3	70.8
Number of days smoked in past 30 days, %		
1 or 2 days	0.0	15.8
3–5 days	0.0	9.6
6–9 days	0.0	9.6
10–19 days	0.0	23.2
20–27 days	0.0	41.9
28–30 days	100.0	0.0
Average number of cigarettes per day in past 30 days, %		
<1 per day	0.2	13.0
1–5	8.0	48.3
6–10	22.0	22.3
11–20	47.3	13.5
20+	22.6	3.9
Number of times quit for at least 24 hr, %		
Never	18.0	14.7
1 time	12.3	6.2
2–3 times	30.7	19.1
4–5 times	19.7	12.7
6–9 times	7.4	7.8
10 or more times	12.0	40.1
Quitting contemplation, %		
Not thinking about quitting	40.1	42.3
Thinking about quitting, but no plans to quit	37.1	29.0
Plans to quit in next 6 months	22.7	28.7

item revisions. All respondents completed 13 of the 277 smoking items which assessed their smoking behavior and quitting history. The remaining 264 items were candidate items that were being considered for inclusion in one of the smoking item banks. These items were distributed across 26 overlapping forms containing an average of 147 items (range = 134–158); each respondent was randomly assigned one of the 26 forms.

Other Measures

All respondents supplied basic demographic information and completed one of eight PROMIS health-related quality of life SF measures (alcohol consumption, anger, anxiety, depression, fatigue, physical functioning, sleep disturbance, and global health; Cella et al., 2007). These PROMIS measures were collected to provide preliminary validity evidence and results are reported elsewhere in this supplement (Edelen, Stucky, et al.).

Item Factor Analyses

Previous analyses of the daily smoker exploratory subsample identified a set of 30 items to be considered for inclusion in the Coping Expectancies of Smoking item bank for daily smokers (Edelen et al., 2012). The same 30 items were also considered for nondaily smokers.

Using the exploratory subsample of daily smokers ($N = 3,021$) and the full sample of nondaily smokers ($N = 1,183$), we examined the underlying factor structures of the 30-item sets with the software IRTPRO (Cai, du Toit, & Thissen, 2011). Local dependence (LD) diagnostic indices (Chen & Thissen, 1997) and high-dimensional exploratory item factor analyses

(Cai, 2010) were used to identify clusters of related items, or LD departures from unidimensionality. Item bifactor models (e.g., Cai, Yang, & Hansen, 2011; Gibbons & Hedeker, 1992) were then specified to account for these LD clusters.

Examining model results for each smoker type, study team members evaluated items within each specific factor in order to select subsets of items that would collectively be more unidimensional than the initial sets of 30 and 30 items. We primarily considered each item's substantive contribution, but also considered the magnitude of the item's loading on the coping expectancies of smoking factor and the percentage of common variance accounted for by the coping expectancies factor (i.e., item explained common variance [ECV]; Stucky, Thissen, & Edelen, 2013). The two resulting item subsets for daily and nondaily smokers were selected to more closely conform to the unidimensional structure assumed in the final item response theory (IRT) models.

After selecting items for inclusion and removal in this way, the dimensionality of the two resultant item sets was reevaluated by testing the fit of a one-factor model using the Mplus software (Muthén & Muthén, 1998–2010) with weighted least squares mean- and variance-adjusted (WLSMV) estimation for categorical response items and standard model fit indices and criteria (root mean squared error of approximation [RMSEA] ≤ 0.08, Tucker–Lewis index [TLI] ≥ 0.095, comparative fit index [CFI] ≥ 0.95; Browne & Cudeck, 1993; Hu & Bentler, 1999). For daily smokers, model fit was assessed first in the exploratory subsample ($N = 3,021$) and then confirmed using the validation subsample ($N = 1,180$); the analysis for nondaily smokers used the full nondaily sample ($N = 1,183$).

Differential Item Functioning

After identifying and confirming two sufficiently unidimensional item sets to represent coping expectancies of smoking, the item sets were further evaluated for differential item functioning (DIF). These evaluations were conducted using the full daily ($N = 4,201$) and nondaily ($N = 1,183$) smoker samples with IRTPRO (Cai et al., 2011). DIF was evaluated for significance according to gender, race/ethnicity (White, Black, Hispanic), and age (18–30, 31–50, 51+) using established procedures (Edelen, Thissen, Teresi, Kleinman, & Ocepek-Welikson, 2006; Orlando & Marshall, 2002). Items with significant DIF were further evaluated for "impact" by considering the *w*eighted *a*rea *b*etween the expected score *c*urves ("wABC") and the expected *d*ifference in *e*xpected *a posteriori* score ("dEAP"), indices described in more detail in Hansen et al. Items with wABC values greater than 0.30 were screened for potential removal by evaluating graphical illustrations of the subgroups' expected scores curves, along with the values of the wABC and dEAP indices. Items judged to have non-ignorable DIF were removed from further consideration in their respective item banks (i.e., daily or nondaily).

Calibration of Item Banks

The Coping Expectancies of Smoking item banks for daily and nondaily smokers were concurrently calibrated using data from the full combined sample ($N = 5,384$, $N_{(daily)} = 4,201$, $N_{(nondaily)} = 1,183$). We estimated a two-group IRT model with groups distinguishing daily and nondaily smokers. This calibration, which specified the daily smokers as the reference group, fixed the daily coping expectancies *M* to 0 and the *SD* to 1 and estimated unique nondaily *M* and *SD*. Following PROMIS standards, IRT scores were subsequently rescaled using the T-score metric to have a *M* of 50 and a *SD* of 10 for daily smokers. The scale for the daily–nondaily group difference was set based on preidentified anchor items whose parameter estimates were constrained to be equal across the groups. Item parameters for nonanchor items were estimated separately for the two groups (see Hansen et al. for more details). The utility of the item banks was determined using IRT-based test information, score precision and marginal reliability (MR).

Short Form Development

Item parameters from the final calibration were used in the development of a coping expectancies of smoking fixed-item SF. In order to simplify the administration and scoring of this form, only those items with equal parameters for daily and nondaily smokers (i.e., anchor items in the two-group calibration) were considered for SF inclusion. Among all the possible combinations of eligible items, candidate SFs were identified using selection criteria related to overall content balance, inclusion of items favored by the study team, and the reliability of score estimates across a broad range of coping expectancies. Following PROMIS procedures, SF scoring was based on a transformation of the sum of responses to SF items. The use of summed scores has the particular advantage of allowing for the creation of translation tables by which researchers may convert an observed sum into an IRT-scaled score (Thissen, Nelson, Rosa, & McLeod, 2001). The performance of the SFs was evaluated using simulated data. For both the daily and nondaily item banks, we examined the reliability of each SF and obtained correlations of SF scores with scores based on the patterns of responses to the full sets of items.

CAT Simulation

CAT utilizes item selection algorithms to administer items that are tailored to the respondent's estimated standing on the measured construct, often resulting in reductions in test length and respondent burden. We conducted CAT simulations using Firestar (Choi, 2009) to evaluate the utility of computer adaptive administration of the daily and nondaily smoker Coping Expectancies of Smoking item banks. These simulations: (a) provide an indication of the average number of items from the Coping Expectancies item banks that would be administered under typical CAT conditions, (b) indicate which items would be most routinely selected for CAT administration, and (c) characterize the expected CAT-based score reliability.

RESULTS

Item Factor Analyses

Bifactor models, each with seven specific factors, were selected to characterize the structure of both the 30 daily smoker items (using the exploratory daily smoker sample) and the 30 nondaily smoker items. In both cases, these models were selected based on their interpretability, comparisons of fit indices, and LD chi-squares. The specific factors identified in the bifactor model represent the content "clusters" in the coping expectancies item sets.

The study team reviewed the bifactor model results for all 30 daily smoker and 30 nondaily smoker items and selected at least one item per specific factor to retain for further consideration in the item banks. Item selection was based on the strength of the general factor loading and item content.

This process led to the selection of 20 daily smoker items, and 20 nondaily smoker items that balanced item content and closely represented the coping expectancies dimension. Next, one-factor models were fit to the selected item sets to confirm that they were sufficiently unidimensional. Relative to the original 30 daily smoker items (CFI = 0.968, TLI = 0.965, RMSEA = 0.07), the reduced set of 20 daily smoker items showed improved fit in both the exploratory and confirmatory subsamples (exploratory: CFI = 0.982, TLI = 0.980, RMSEA = 0.06; confirmatory: CFI = 0.979, TLI = 0.976, RMSEA = 0.07) with only a trivial reduction in reliability (MR went from 0.98 to 0.97). Furthermore, in the exploratory subsample the test-level ECV (Reise, 2012) associated with the coping expectancies (general) factor increased from 0.714 to 0.753, indicating a more strongly unidimensional model. Fit indices for the nondaily smokers also suggest a strongly unidimensional item set (CFI = 0.992, TLI = 0.991, RMSEA = 0.056), with improvement in fit compared to the 30-item set (CFI = 0.969, TLI = 0.967, RMSEA = 0.072) and minimal loss in precision (MR went from 0.98 to 0.97). The ECV associated with the coping expectancies (general) factor in the nondaily sample solution increased from 0.773 to 0.876.

Differential Item Functioning

Next, the 20 daily and 20 nondaily smoker items underwent DIF testing according to gender, race/ethnicity (White, Black, Hispanic), and age (18–30, 31–50, 51+). For the daily smokers, across all comparisons, six items met the wABC criterion for consideration of removal (i.e., wABC > 0.30), and five items were ultimately removed because of DIF. For the nondaily smokers, two items were considered for removal, and both were ultimately removed. Notably, one item was identified as having DIF in both the daily and nondaily smoker samples and thus removed from both item banks. DIF information for the removed items is summarized in Table 2. Figure 1 displays the expected score curves for two of the DIF items. The pattern of gender DIF for the "weight control" item (top panel of Figure 1), suggests that weight control is a more important coping expectancy for women, as women tend to provide higher ratings of this statement at all levels of the coping expectancies

continuum. The bottom panel of Figure 1 shows that the notion of cigarettes as a "good friend" is more salient to respondents 51 and older, relative to those aged 31–50.

Calibration of Item Banks

Using the two-group IRT model with daily smokers as the reference group, 21 total items were calibrated. Within this set, 11 were anchor items (identical item parameters for daily and nondaily smokers) and one item had unique item parameters for daily and nondaily smokers. In addition, there were nine items per bank that were nonoverlapping (i.e., items that only occur for that particular smoker group). This process resulted in two Coping Expectancies item banks (one for daily and one for nondaily smokers) with a total of 15 and 18 items, respectively. As can be seen in Table 3, the final items tended to be strongly related to the underlying coping expectancies construct (a parameters for items in both banks ranged from

Table 2. Coping Expectancies of Smoking Items Removed Because of DIF

Item stem	Number of comparisons with wABC > 0.3	DIF variable	wABC	dEAP
Daily smokers				
I'm worried that if I quit smoking I'll gain weight	2	Female vs. male	0.58	0.14
		White vs. Black	0.36	−0.09
If I quit smoking I would lose a way to handle stress	1	White vs. Black	0.36	−0.17
If I try to stop smoking I'll be irritable	1	White vs. Black	0.44	−0.19
If I quit smoking I will feel less calm	1	White vs. Black	0.35	−0.16
Giving up cigarettes would be like losing a good friend	1	Age 31–50 vs. age 51+	0.41	0.17
Nondaily smokers				
If I quit smoking I would lose a way to handle stress	2	White vs. Black	0.63	−0.20
		Hispanic vs. Black	0.44	−0.16
If I'm feeling irritable, a cigarette will help me relax	1	Age 18–30 vs. age 51+	0.39	−0.26

Note. dEAP = difference in expected a posteriori score; DIF = differential item functioning; wABC = weighted area between the expected score curves.
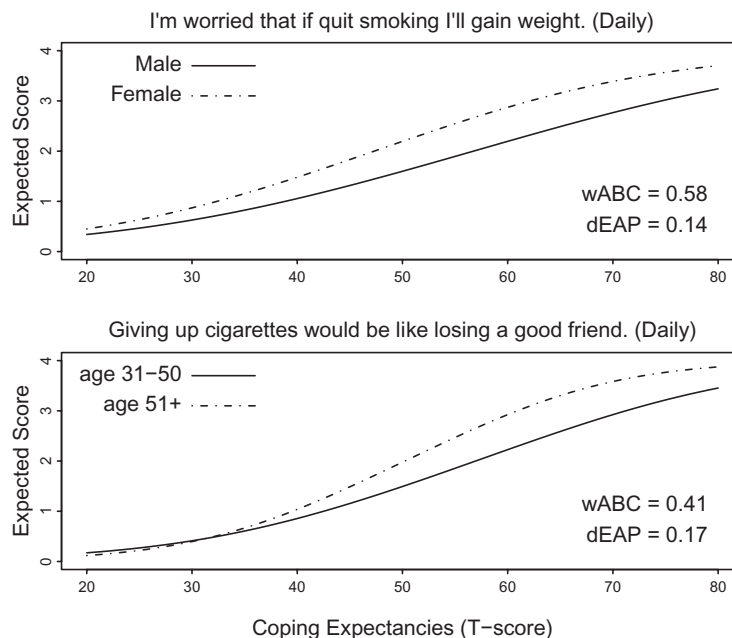

Figure 1. Expected score curves for two of the DIF items. DIF = differential item functioning.

Table 3. Coping Expectancies of Smoking Item Banks for Daily and Nondaily Smokers

Item	D/ND	CAT		Item parameters				
		D	ND	a	b_1	b_2	b_3	b_4
When I'm angry, a cigarette can calm me down (SF)[a]	Both	0.28	0.10	3.32	−1.82	−1.06	0.01	0.90
I am tempted to smoke when I feel depressed (SF)[a]	Both	0.06	0.04	2.51	−1.93	−1.13	−0.14	0.66
I rely on smoking to deal with stress (SF)	Both	0.11	0.04	2.36	−1.59	−0.75	0.04	0.81
Smoking allows me to take a break from my problems for a few minutes (SF)	Both	0.10	0.04	2.06	−1.54	−0.78	0.10	0.88
Smoking helps me when I'm upset about something[a]	Both	0.14	0.05	4.16	−1.79	−1.12	−0.12	0.72
When I'm upset with someone, a cigarette helps me cope	Both	1.00	0.94	3.69	−1.44	−0.67	0.01	0.68
When I am worrying about something, a cigarette is helpful[a]	Both	0.10	0.02	3.63	−1.88	−1.15	−0.11	0.79
Smoking helps me deal with anxiety	Both	0.19	0.09	3.42	−1.48	−0.71	−0.04	0.67
Smoking helps me reduce tension	Both	0.43	0.28	3.41	−1.83	−0.82	−0.06	0.72
Smoking calms me down	Both	0.02	0.05	3.33	−1.84	−0.82	−0.02	0.77
I am tempted to smoke when I am anxious[a]	Both	0.09	0.03	3.02	−2.11	−1.40	−0.40	0.48
When I go too long without a cigarette I lose my temper more easily[a]	D[b]	0.72		1.48	−1.44	−0.33	0.75	1.76
When I go too long without a cigarette I lose my temper more easily[a]	ND[b]		0.67	1.45	−0.95	0.05	1.18	2.10
If I'm feeling irritable, a cigarette will help me relax	D	0.85		3.90	−1.75	−0.82	−0.07	0.68
If I quit smoking I would be more likely to feel depressed	D	0.13		1.60	−0.75	0.07	0.95	1.60
If I quit smoking I will be less able to concentrate	D	0.07		1.38	−0.46	0.36	1.46	2.30
I am tempted to smoke when I am stressed[a]	ND		1.00	4.55	−2.20	−1.55	−0.58	0.28
When I feel stressed I want a cigarette[a]	ND		0.18	3.74	−2.16	−1.42	−0.54	0.36
I am tempted to smoke when I experience an emotional crisis[a]	ND		0.09	3.65	−2.09	−1.34	−0.50	0.36
I am tempted to smoke when I have arguments or conflicts with others[a]	ND		0.02	3.30	−1.83	−1.11	−0.16	0.58
I am tempted to smoke when I feel nervous[a]	ND		0.03	3.29	−1.95	−1.16	−0.23	0.61
Smoking keeps me from overeating	ND	0.01	0.01	1.17	−0.72	0.16	1.10	1.81

Note. SF = short form item; CAT = computer adaptive test. D/ND column indicates if the item parameters were identical in daily and nondaily groups (both), unique to only the daily group (D), or unique to only the nondaily group (ND). CAT column indicates the rate of item administration for the 10-item maximum.
[a]Indicates items that used the following response options: 0 = never, 1 = rarely, 2 = sometimes, 3 = often, 4 = always. All other items used the following response options: 0 = not at all, 1 = a little bit, 2 = somewhat, 3 = quite a bit, 4 = very much.
[b]Indicates items with unique item parameters in both the daily and nondaily groups.

2.06 to 4.16) and covered a wide range of the coping expectancies continuum (*b* parameters ranged from −2.11 to 0.90) that is fairly symmetric around the coping expectancies mean.

Figure 2 illustrates the score reliability for the daily and nondaily smoker Coping Expectancies of Smoking item banks (and SF) on a standard T-score scale. Full bank scores have reliability values greater than 0.80 from about 3 *SD* below the mean to 2 *SD* above the mean (i.e., from 20 to 70, in the T-score scale). Nondaily smokers had a *M* value of 44.6, 0.54 *SD* below the daily smoker *M* of 50. In addition, the nondaily smoker sample had slightly more coping expectancies variability (*SD* = 10.16) compared to daily smokers (*SD* = 10).

Coping Expectancies Short Form

Evaluation of candidate item sets indicated that four items could provide adequate content coverage and reliability across the coping expectancies of smoking continuum. The items comprising the 4-item SF are indicated in Table 3, and the summed score to IRT score translation table for the SF is contained in Table 4. Figure 2 shows the reduction in score reliability when going from the complete item banks (of 15 and 18 items) to the SF.

Despite this reduction, the MR of the SF scores remains quite good (0.85). In addition, these scores correlate strongly (0.94) with those obtained from the complete banks. The results suggest that the 4-item SF provides an efficient and reliable measure of the coping expectancies of smoking construct.

CAT Simulations

CAT simulations were conducted on the daily and nondaily smoker Coping Expectancies of Smoking item banks. Table 5 provides the results of simulations that used a *SE* of 3.0 (in the T-score metric) as the CAT stopping criterion, which corresponds to a reliability of slightly greater than 0.90, and a range of limits on the maximum number of items allowed to be administered (4, 6, 8, 10, 12). Across these conditions, the correlation between CAT and full bank scores is greater than 0.97, and the CAT terminates with a *SE* of 3.0 when an average of less than five items have been administered (less than four items for nondaily smokers). Table 3 displays the administration rates for each item under the 10-item stopping rule condition. Rates of administration vary both within and across the two smoker types, although the item "When I'm upset
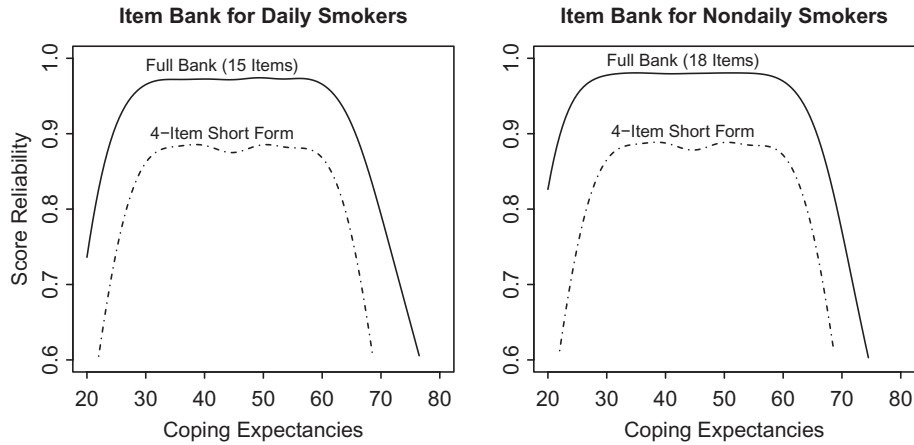
Figure 2. Score reliability for daily and nondaily smokers for the Coping Expectancies full bank and short forms.

Table 4. Coping Expectancies Summed Score to Scaled Score Translation Table for 4-Item Short Form

Four-item short form		
Summed Score	Scaled Score (T)	Standard Error
0	25.9	4.9
1	30.5	4.0
2	33.3	3.8
3	35.7	3.7
4	37.9	3.6
5	40.0	3.7
6	42.0	3.7
7	44.0	3.7
8	45.9	3.7
9	47.8	3.7
10	49.7	3.7
11	51.7	3.7
12	53.7	3.7
13	55.9	3.8
14	58.4	4.0
15	61.3	4.2
16	66.5	5.4

with someone a cigarette helps me cope" is highly likely to be administered in a CAT for either smoker type. For both smoker types, only a small subset of the items are likely to be administered; administration rates are above 0.5 for only three items in each bank. If more than three items are needed, the rate of subsequent selection is similar across the remaining items.

DISCUSSION

The purpose of this paper was to present the further development and refinement of new item banks to assess the coping expectancies of smoking for daily and nondaily smokers. These item banks were constructed as part of the PROMIS Smoking Initiative, a comprehensive effort designed to advance a more unified framework for smoking assessment by providing clear guidance regarding which assessment items to use for which construct and for which specific purpose (Edelen et al., 2012). In the current paper, a core set of 15 and 18 items were

calibrated for daily and nondaily smokers, respectively. For both daily and nondaily smokers, scores from items comprising the Coping Expectancies of Smoking item banks are highly reliable, strongly unidimensional, and perform similarly for men and women, smokers of different ages, and for smokers of different race and ethnic backgrounds. Item content covers a range of conceptually relevant domains that represent smoking to manage stress, depression, anxiety, anger, and tension; other items refer to smoking explicitly as a coping strategy.

A key part of this investigation was developing a SF and using CAT to identify shorter, more efficient psychometrically sound sets of items that could be administered in clinical settings or in research settings where assessment using the full item bank was not desired or perhaps not feasible. A highly reliable SF (four items) was developed that reasonably covered the content relevant to this domain; importantly, scores on the SF were strongly correlated with scores on the longer scale. CAT simulations showed that as few as five items on average could be administered to efficiently assess coping expectancies. It is also interesting to note that the most frequently administered items in the CAT simulation do not correspond very closely with the SF items. This is because the SF construction considered content balance as well as reliability, and required that items be identical across smoker types. In either case, CAT administration or administration of the SF provides a highly reliable option for measuring coping expectancies of smoking if use of the long form scale (15–18 items) is untenable. The item banks and SF are available for public use via the project Web site (http://www.rand.org/health/projects/promis-smoking-initiative.html), as well as through inclusion in the larger PROMIS library, and a free online tool for administering adaptive tests is available through the PROMIS Assessment Center (www.assessmentcenter.net).

Other questionnaires and items exist to assess coping expectancies of smoking (or facets thereof), for example, the Smoking Consequences Questionnaire (Brandon & Baker, 1991; Wetter et al., 1994), the Wisconsin Inventory of Smoking Dependence Motives (Piper et al., 2004), Coping with Temptations Inventory (Shiffman, 1988), and Reasons for Smoking Scale (e.g., Tate & Stanton, 1990). The PROMIS Coping Expectancies of Smoking item banks are similar to several of these existing scales in that both classes of instrument have good psychometric properties and some have solid short

Table 5. Simulated Adaptive Tests for the Coping Expectancies of Smoking Item Banks

	Maximum no. of items					
	4	6	8	10	12	All items
Daily smokers						
Average items administered	3.42	3.82	4.08	4.29	4.47	15
Proportion receiving maximum items	0.42	0.17	0.13	0.10	0.09	1
Marginal reliability	0.89	0.90	0.91	0.91	0.91	0.96
$r\,(T_{CAT}, T_{full})$	0.97	0.97	0.98	0.98	0.98	1.00
Nondaily smokers						
Average items administered	3.23	3.44	3.57	3.68	3.77	18
Proportion receiving maximum items	0.27	0.09	0.06	0.05	0.05	1
Marginal reliability	0.91	0.91	0.91	0.91	0.92	0.97
$r\,(T_{CAT}, T_{full})$	0.97	0.97	0.97	0.97	0.97	1.00

versions. Items in the PROMIS item banks were drawn from these scales, so the current banks can be seen as employing the "best of the best" items from prior scales. In addition, several important features distinguish the PROMIS items above and beyond existing scales. First, PROMIS is developing item banks (not only fixed instruments) with published item parameters. This allows for administration and scoring of fixed forms (similar to other existing instruments) but it also makes it possible for researchers to utilize adaptive testing or to assemble study-specific forms, while still maintaining score comparability (i.e., a common scale). Second, the analytic procedures used provided item banks that are strongly unidimensional, highly reliable, and perform evenly across key demographic groups. Third, the SF was derived through procedures that were unique compared to procedures used to define short versions of the other scales. Future research will compare the PROMIS item banks to these "legacy" measures from the smoking literature.

There are several applications for these item banks. For example, assessing expectancies of smoking is an important concern for helping smokers to quit (e.g., Marlatt & Gordon, 1985). As with other measures of expectancies (e.g., Brandon et al., 1999), the Coping Expectancies of Smoking item banks could be utilized in treatment to give providers and their smoking patients clear targets for change in terms of coping skills training (see Niaura & Shadel, 2003). In addition, the SF provides public health research with a reliable brief measure to include in large scale surveys where questionnaire space and participant burden are at a premium.

Limitations of this work need to be noted. First, although the sample was recruited by Harris to be consistent with the demographics of smokers in the United States, the procedures did not ensure complete sample representativeness. For example, about 80% of the sample had attended some college and population surveys have indicated that smoking is increasingly clustered in smokers with less than a college education (Centers for Disease Control and Prevention, 2012). Future analyses will need to check for DIF according to level of education. Second, predictive validity (i.e., showing that item bank scores predict smoking outcomes) was not presented in this paper. The final report in the Original Investigations section of this supplement (Edelen et al.) presents some data on validity, though information on predictive validity will be addressed in future research.

The PROMIS Smoking Initiative used existing measures or items from existing measures to develop the Coping Expectancies item banks and these items were supplemented with new items generated from focus groups of current smokers (Edelen et al., 2012). Thus, the content of these item banks represents the range of areas considered to be relevant for this domain by both experts in the field and smokers alike. The use of contemporary psychometric methods (e.g., IRT, DIF) was unique and novel in this measurement domain, and the results yielded item banks that have high levels of psychometric strength, perform well for smokers from a range of demographic backgrounds, and have flexibility in administration options (e.g., full bank, SF; CAT; computerized or paper and pencil). Finally, to the extent that other items or content areas become relevant for the coping expectancies domain, new items can be easily added to the item banks for further evaluation and testing.

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