Original Investigation

Validity of the 12-item French version of the Tobacco Craving Questionnaire in treatment-seeking smokers

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Abstract

Introduction: The French version of the Tobacco Craving Questionnaire (FTCQ) is a valid and reliable 47-item self-report instrument that assesses tobacco craving in four factors: emotionality, expectancy, compulsivity, and purposefulness. For use in research and clinical settings, we constructed a 12-item version of the FTCQ (FTCQ-12).

Method: The FTCQ-12 was administered to treatment-seeking French smokers ($n = 310$) enrolled in the Adjustment of DOses of NIcotine in Smoking Cessation (ADONIS) trial. We conducted confirmatory factor analysis (CFA) and examined congruence in factor loadings between the FTCQ and FTCQ-12 to determine the validity and reliability of the FTCQ-12. Measures of tobacco craving, withdrawal, smoking patterns, and smoking history were included to explore the concurrent validity of the FTCQ-12. We used craving scores to distinguish participants who were highly dependent on nicotine from those less dependent on nicotine.

Results: CFA indicated excellent fit for a four-factor model, with congruence coefficients indicating moderate similarity in factor patterns and loadings between the FTCQ and FTCQ-12. Individual factors of the FTCQ-12 correlated positively with smoking history and withdrawal variables. Participants who were highly dependent on nicotine were nearly six times more likely to score >5 on the General Craving Score (maximum: 7) than those less dependent on nicotine.

Discussion: Findings suggest that the FTCQ-12 measures the same four factors as the FTCQ and TCQ, and these four constructs have unique properties. The FTCQ-12 yields valid and reliable indices of tobacco craving and has potential clinical utility for rapid assessment of tobacco craving in smokers seeking treatment.

Introduction

The French version of the Tobacco Craving Questionnaire (FTCQ; Berlin et al., 2005) is a 47-item multidimensional instrument measuring the same domain of clinically and theoretically distinct explanations for tobacco craving as its parent instrument, the English version of Tobacco Craving Questionnaire (TCQ; Heishman, Singleton, & Moolchan, 2003). The validation study of the FTCQ (Berlin et al., 2005) found that despite differences between French and American smokers: lower Fagerström Test for Nicotine Dependence (FTND) and Questionnaire on Smoking Urges-10 scores (Berlin & Singleton, 2008), the FTCQ was as valid and reliable an instrument as the original English version (Heishman et al., 2003) and assessed the same four-primary factors of tobacco craving: (a) *emotionality*, craving in anticipation of relief from withdrawal or negative mood; (b) *expectancy*, craving in anticipation of positive outcomes from smoking; (c) *compulsivity*, craving in anticipation of an inability to control tobacco use; and (d) *purposefulness*, craving coupled with intention and planning to smoke.

The FTCQ and TCQ were developed to assess the multidimensionality of tobacco craving; however, the use of a 47-item questionnaire might be limited in clinical trials or in clinical practice. Thus, a short form of the TCQ (TCQ-SF; Heishman, Singleton, & Pickworth, 2008) was developed and shown to be as valid and reliable as the 47-item TCQ. Another limitation of these studies was that none of the participants were seeking treatment for tobacco dependence. Treatment-seeking smokers may have higher levels of dependence and more difficulty quitting than smokers not seeking treatment (Ferguson et al., 2003).

The Adjustment of DOses of NIcotine in Smoking Cessation (ADONIS) clinical trial was a nicotine replacement therapy (NRT) dose optimization study of French smokers with a smoking-related disease. The goal of the trial was to compare 100%

nicotine substitution, based on saliva cotinine concentration, with standard care without any individual dose adaptation. Tobacco craving was measured using the 12-item French Tobacco Craving Questionnaire (FTCQ-12) derived from the 47-item FTCQ. Because tobacco craving is more pronounced in current smokers and has been shown to negatively predict tobacco abstinence (Harrington, 1978; Killen & Fortmann, 1997; Killen, Fortmann, Newman, & Varady, 1991; Killen et al., 2006), the FTCQ-12 might be useful as a rapid measure of craving in clinical trials and in clinical practice. However, the reliability, validity, and clinical utility of the questionnaire have not been evaluated.

The purpose of this study was to determine the psychometric properties of the FTCQ-12 using data from smokers enrolled in the ADONIS trial. We conducted a confirmatory factor analysis (CFA) of the four-primary factor model, tested for congruence in factor loading patterns, and examined internal consistency reliability between the FTCQ and FTCQ-12. Any dissimilarity in the psychometric characteristics of factors derived from identical items would cast doubt on whether the FTCQ-12 assessed the same constructs as the FTCQ. We included commonly used measures of tobacco craving, withdrawal, smoking patterns, and smoking history to evaluate the concurrent validity of the FTCQ-12. Recent research (Berlin & Singleton, 2008; Heishman et al., 2008) has demonstrated a relationship between tobacco craving and nicotine dependence. Thus, to assess criterion-related validity, we examined whether FTCQ-12 scores could distinguish between those who were highly dependent from those less dependent on nicotine. Lack of validity would call into question the clinical utility of craving in the ADONIS trial.

Methods

Participants

We analyzed baseline data from 310 smokers with smoking-related diseases (coronary heart disease: history of unstable angina pectoris, myocardial infarction, stroke, stable angina pectoris, chronic obstructive pulmonary disease, peripheral arterial atherosclerosis, and upper and lower respiratory tract malignancies) who enrolled in the ADONIS trial. ADONIS aimed to answer the question: Does dose adjustment of NRT, based on the saliva concentration of cotinine, improve efficacy in quitting compared with the lack of dose adjustment (usual care) in smoking patients with a smoking-related disease? Smokers currently smoking at least 10 cigarettes/day with smoking-related diseases were included.

Procedure

The Ethics Committee of the Groupe Hospitalier Pitié-Salpétrière, Paris, France, approved the study on 23 March 2005. Details of the specific aims, design, and intervention can be found at clinicaltrials.gov (identifier: NCT00235313). Twenty-two smoking cessation clinics participated in the study. Smokers were randomized to receive either standard NRT (nicotine patch 21, 14, and 7 mg/24 h for 1 month each, respectively) or nicotine dose adjustments based on saliva cotinine (dose adaptation arm). In both arms, saliva cotinine determinations were performed every 2 weeks for 2 months. In the control arm (standard NRT), investigators were blind to saliva cotinine results. In the dose adaptation arm, investigators received saliva cotinine results and adapted the nicotine dose (milligrams of nicotine per day) according to baseline (when smoking) saliva cotinine to obtain 100% substitution. Smokers were assessed at weekly visits after the predetermined quit day for 3 months with a follow up at 6 months. The primary outcome measure was prolonged abstinence, that is, self-reported abstinence during the last (third) month of the treatment phase verified by breath carbon monoxide ($CO \leq 8$ ppm; Smokeanalyzer; Bedfont Scientific Ltd, Rochester, Kent, UK).

Smoking characteristics assessed included age of smoking initiation, age at which regular smoking began, number of cigarettes smoked during the week prior to enrollment, daily cigarette consumption, number of cigarettes smoked in the previous week, number of previous quit attempts, and breath CO. All measures reported in this paper were collected when participants were smoking (prequit) and after having given written informed consent. All questionnaires were completed as a paper and pencil data sheet. Data were entered by local investigators into the study's web-based electronic charts. Research assistants verified all data entries.

Measures

FTCQ-12

The FTCQ-12 was developed by taking the 12 items (see Table 1) with the highest significant loadings (>.30) on each of the four factors (emotionality, expectancy, compulsivity, and purposefulness) of the 47-item FTCQ (Berlin et al., 2005) and at least 2 items by factor. This strategy ensured that meaningful content coverage was preserved and that all samples of items accurately reflected the scale's original theoretical domains between full length and brief versions. The two items for Factor 4 which had the highest loading were negatively keyed. To avoid changing the questionnaire's internal structure, we followed the scoring directions for the original FTCQ. Items were rated on a Likert-type scale from 1 (*strongly disagree*) to 7 (*strongly agree*). Four of the items were reverse keyed to reduce variance due to acquiescence. Raw scores on negatively worded items of the FTCQ-12 were inverted to insure positive correlations among items. Factor scale scores for each participant were obtained by summing the items in each factor and dividing by the number of items for that factor, yielding a score ranging from 1 to 7. A General Craving Score for each participant was derived by summing all items and dividing by 12, also yielding a score ranging from 1 to 7. In the initial validation study with 226 smokers not seeking treatment and who were tobacco deprived for at least 2 hr before testing (Berlin et al., 2005), the FTCQ accounted for 11.6%, 17.1%, 9.0%, and 9.5% of the total variance in emotionality, expectancy, compulsivity, and purposefulness (Factors 1–4), respectively. Factor scale means for Factors 1–4, respectively, were 2.8, 5.6, 4.0, and 5.4, and Cronbach's alpha coefficients were .83, .79, .69, and .66.

Fagerström Test for Nicotine Dependence

The six-item FTND is a reliable and valid measure of nicotine dependence (Heatherton, Kozlowski, Frecker, & Fagerström, 1991) and has been validated with French smokers (Berlin et al., 2005). Scores range from 0 to 10. We used the FTND to characterize the sample and to distinguish highly dependent (≥ 6) from less dependent (≤ 5) smokers (Fagerström et al., 1996; Ferguson et al., 2003).

Table 1. Brief French version of the TCQ (FTCQ-12)

Questionnaire de manque tabagique à 12 items. The 12-item French Tobacco Craving Questionnaire (FTCQ-12)

Items	Factor 1—Emotionnalité (Emotionality)
3	Si je fumais maintenant, je pourrais réfléchir plus clairement.
	If I were smoking now I could think more clearly[a].
	If I were smoking now I could think more clearly[b].
6	Je me sentirais moins fatigué(e) si je fumais là, tout de suite.
	I would feel myself less tired if I smoked right now[a].
	Smoking right now would make me feel less tired[b].
10	Si je fumais, je me sentirais moins déprimé(e).
	If I smoked I would be less depressed[a].
	Smoking would make me less depressed[b].
12	Je pourrais mieux maîtriser les choses si je pouvais fumer maintenant.
	I could control things better if I could smoke now[a].
	I could control things better right now if I could smoke[b].

Items	Factor 2—Attente (Expectancy)
1	Une cigarette maintenant n'aurait pas un bon goût.←
	A cigarette would not have a good taste now[a].
	A cigarette would not taste good right now[b].
4	Fumer une cigarette ne serait pas agréable.←
	Smoking a cigarette would not be pleasant[a].
	Smoking a cigarette would not be pleasant[b].
7	Je fumerais dès que j'en aurais l'occasion.
	I would smoke as soon as I had an occasion[a].
	I am going to smoke as soon as possible[b].

Items	Factor 3—Compulsion (Compulsivity)
2	S'il y avait une cigarette ici, devant moi, il serait très difficile de ne pas la fumer.
	I could not stop myself from smoking if I had a cigarette here before me[a].
	I could not stop myself from smoking if I had some cigarettes here[b].
5	Je ferais n'importe quoi pour une cigarette là maintenant.
	I would do everything to get a cigarette right now[a].
	I would do almost anything for a cigarette now[b].
8	Je ne serais pas capable de contrôler combien je fumerais si j'avais des cigarettes.
	I would be unable to control how much I smoked if I had cigarettes[a].
	I would not be able to control how much I smoked if I had some cigarettes here[b].

Items	Factor 4—Anticipation (Purposefulness)
9	Si j'avais une cigarette allumée en main, je ne la fumerais probablement pas.←
	If I had a lit cigarette in my hand, I would not smoke it[a].
	If I had a lit cigarette in my hand, I probably wouldn't smoke it[b].
11	Il me serait facile de laisser passer l'occasion de fumer.←
	It would be easy to pass up the occasion to smoke[a].
	It would be easy to pass up the chance to smoke[b].

Note. ← = reverse-keyed question; TCQ = Tobacco Craving Questionnaire.
[a]Backtranslation.
[b]English version of the TCQ.

Minnesota Nicotine Withdrawal Scale

We used the French version of the 8-item Minnesota Nicotine Withdrawal Scale (MNWS; Hughes & Hatsukami, 1986) to assess craving and *DSM-IV* withdrawal symptoms (American Psychiatric Association, 2000). Items were rated on a 1–4 interval scale (*not present* to *severe*). Following the recommendations of its developers (Hughes & Hatsukami, 1998), the one item assessing tobacco craving (MNWS craving) was scored separately. The remaining seven items (depression, insomnia, irritability/frustration/anger, anxiety, difficulty concentrating, restlessness, and increased appetite) were summed, then averaged to yield a total score (*DSM-IV* withdrawal). The individual craving item and the total score have high reliability and good construct validity (Cappelleri et al., 2005; Hughes & Hatsukami, 1986; West, Ussher, Evans, & Rashid, 2006).

Data analyses

We conducted CFA using maximum Wishart likelihood estimation and oblique rotation without normalization to a least squares fit to match the four-factor FTCQ target matrix. Target specification for the assignment of FTCQ-12 items to each respective factor matched the manner in which items were assigned to the same factor in the FTCQ: Factor 1 (emotionality) included Items 3, 6, 10, and 12; Factor 2 (expectancy) included Items 1, 4, and 7; Factor 3 (compulsivity) included Items 2, 5, and 8; and Factor 4 (purposefulness) included Items 9 and 11. Models assumed no higher order factors, correlated first-order factors, and uncorrelated residuals. Goodness of fit for the unrotated factors was examined using the Steiger–Lind root mean squared error of approximation statistic (RMSEA; Steiger, 1980). We used hypothesis tests developed to test the statistical significance of the fit (Browne & Cudeck, 1993) for the four-factor model, with exceedance probabilities for excellent fit and close fit (H_0: RMSEA = 0 and H_0: RMSEA ≤ 0.05, respectively; Browne, Cudeck, Tateneni, & Mels, 2008).

We compared next the rotated matrices of factor loadings obtained for the four-factor FTCQ-12 model (comparison) and for the assigned items in the original FTCQ model (target) using Tucker's average coefficient of congruence (mean *f* = sum of the products of the paired loadings divided by the square root of the product of the two sums of squared loadings across factors) as a statistical index of similarity in factor patterns and magnitude of factor loadings between sets of factors derived from identical items (Wrigley & Neuhaus, 1955). Empirical studies indicate that *f* values of 0.70–0.79 represent moderate, 0.80–0.89 high, and >0.90 very high similarity between target and comparison factors (Koschat & Swayne, 1991; ten Berge, 1986). For reliability estimates, Cronbach's alpha coefficients, average interitem correlations, and factor intercorrelations were calculated.

Generalized linear modeling (GLM) was used to estimate standard multiple regression models with the four factors as predictors. GLM was estimated separately for the criterion variables: MNWS craving, MNWS *DSM-IV* withdrawal symptoms, age of smoking initiation, age at which regular smoking began, number of cigarettes smoked during the week prior to enrollment, daily cigarette consumption, number of cigarettes smoked in the previous week, previous quit attempts, and breath CO. Only factors with significant ($p < .05$) beta weights (partial *r*) were interpreted. Logistic regression analysis was performed to test whether the general FTCQ-12 factor scale score (General

Craving Score) would be useful in distinguishing between those who were highly dependent (coded 1) from those less dependent on nicotine (coded 0). To assess clinical utility (Akobeng, 2007), we calculated first the positive likelihood ratios (LR+) for the range of craving scores as an estimate of predictive accuracy. Guidelines for interpreting LRs (Sackett, 2000) are LR+ = 1, 1–2, 2–5, 5–10, and >10 correspond with no, minimal, small, moderate, and large evidence of the ability to distinguish between those that were highly dependent from those that were less dependent on nicotine. We calculated Bayes theorem–based estimates of the differences between pretest probability and the posttest probability over the range of scores to analyze predictive efficiency in the diagnosis of being highly dependent on nicotine, where posttest probability = $p2/(1 + p2)$ and $p1$ (pretest probability) = prevalence and pretest odds = $p1/(1 - p1)$ and $p2$ (posttest odds) = pretest odds × LR+.

CFA was performed using Comprehensive Exploratory Factor Analysis software (Browne et al., 2008). The coefficient of congruence, positive LRs, and measures of predictive efficiency were calculated using Excel (Microsoft Corporation, Redmond, WA). Reliability estimates, GLM, and the logistic regression analysis were conducted with STATISTICA (StatSoft, Inc., Tulsa, OK).

Results

Participant characteristics

Table 2 compares characteristics of participants in this study with those in the initial FTCQ validation study (Berlin et al., 2005). The sample in the initial validation study was different in many aspects from the smokers seeking treatment in this study. Visual inspection shows that smokers in the ADONIS trial were older, smoked more cigarettes per day, had a higher FTND score, more were highly dependent on nicotine, and more had tried to quit compared with participants in the initial validation study.

Table 3 shows characteristics of the subgroups in the present sample. Men scored higher on purposefulness ($p < .05$), were 3 years older ($p < .001$), smoked 3 more cigarettes/day on average ($p < .05$), and tried their first cigarette and started smoking regularly about 2 years earlier than women (both $p < .001$). Highly dependent smokers (FTND ≥ 6) smoked 10 more cigarettes/day on average; smoked three packs more during the week prior to enrollment; and had higher levels of MNWS craving, MNWS (*DSM-IV*) withdrawal symptoms, and CO than less dependent smokers (all $p < .001$).

Factor analysis and reliability of the FTCQ-12

Table 4 compares the rotated factor loadings for the FTCQ-12 with those of the initial FTCQ (Berlin et al., 2005) and TCQ (Heishman et al., 2003) validation studies. CFA of the FTCQ-12 items showed an excellent fit with the four-primary factors FTCQ target model, $\chi^2(24) = 34.8$; RMSEA = 0.038 (90% CI = 0.000–0.064), excellent fit $p > .07$, close fit $p > .74$. We also derived models for one higher order factor and one, two, three, and five factors. Models with one to five factors provided a poor fit to our sample data (all excellent fit $p < .001$). The five-factor model did not converge. The mean congruence coefficient between FTCQ-12 Factors 1–4 and the corresponding four factors

Table 2. Participant characteristics in the initial FTCQ validation study and the FTCQ-12 validation study

	FTCQ study[a]	FTCQ-12 study
Number of participants	226	310
Male, %	49	63
Mean age (*SD*), years	29.7 (10.4)	36.6 (10.0)
Mean age at initiation of daily smoking (*SD*), years	14.4 (3.8)	18.0 (4.0)
Mean cigarettes per day (*SD*)	19.6 (9.3)	25.5 (11.2)
At least one previous attempt to quit, %	21	82
Mean FTND total score (*SD*)	4.6 (2.2)	6.6 (2.0)
Highly dependent (FTND ≥6), %	37	72
Mean factor scores (*SDs*)		
Factor 1 scale (Emotionality)	2.8 (1.4)	2.7 (2.0)
Factor 2 scale (Compulsivity)	5.6 (1.5)	5.2 (1.5)
Factor 3 scale (Expectancy)	4.0 (1.4)	3.5 (1.6)
Factor 4 scale (Purposefulness)	5.4 (1.2)	4.5 (1.3)
General Craving Score	4.4 (1.0)	3.8 (1.1)

Note. FTCQ = French version of the Tobacco Craving Questionnaire; FTND = Fagerström Test for Nicotine Dependence.
[a]Berlin et al. (2005).

on the FTCQ was $f = 0.78$ (FTCQ-12 vs. TCQ, $f = 0.77$). The variance accounted for was 27.1%, 8.8%, 6.6%, and 4.0% for Factors 1–4, respectively. There were moderate positive correlations for Factor 3 with Factor 1 ($r = .46$) and with Factor 2 ($r = .42$), respectively (all $p < .001$). There was a low positive correlation for Factor 1 with Factor 2 ($r = .24$, $p < .001$), and a slight positive correlation between Factor 2 and Factor 4 ($r = .13$, $p < .05$). Cronbach's alpha coefficients and average interitem correlations (in parentheses) were .78 (.47), .62 (.35), .60 (.34), and .44 (.21) for Factors 1–4, respectively. Cronbach's alpha coefficient (average interitem correlation) for the General Craving Score was .79 (.25).

Concurrent validity of the FTCQ-12

Factor 1 was the best predictor of MNWS (*DSM-IV*) withdrawal symptoms score (partial $r = .32$, $p < .001$). Factor 2 was the best predictor of daily cigarette consumption and the number of cigarettes smoked during the week prior to enrollment (both partial $r = .21$, $p < .001$). Factor 3 was the best predictor of MNWS craving (partial $r = .21$, $p < .01$). Factor 4 was the best predictor of the number of previous quit attempts (partial $r = .13$, $p < .05$). None of the factors were associated with either age of smoking initiation, age of smoking regularly, or breath CO (all $p > .24$).

Criterion-related validity of the FTCQ-12

Increased craving was associated with increased risk of being classified as highly dependent on nicotine, $\chi^2(1) = 17.81$, $p < .001$, odds ratio (*OR*) = 1.70, 90% *CI* = 1.31–2.32. A one-unit increase in General Craving Score raised the level of risk by a factor of 0.53 (β_1). Positive LRs increased as the intensity of General Craving Score increased. A General Craving Score at a cutoff of 6 was nearly six times more likely (LR+ = 5.83) to come from participants who were highly dependent on nicotine than those less dependent on nicotine.

Table 3. Participant characteristics by gender and nicotine dependence (*n* = 310)

	Men (*n* = 194)	Women (*n* = 116)	Highly dependent (*n* = 222)	Less dependent (*n* = 88)
Percent of *n*	62.6	37.4	71.6	28.4
Mean age (*SD*), years	51.0 (9.0)	48.0 (10.1)	50.0 (8.6)	49.4 (11.5)
Mean age first tried a cigarette (*SD*), years	15.0 (3.1)	16.8 (4.6)	15.7 (4.2)	15.5 (2.9)
Mean age of initiation of daily smoking (*SD*), years	17.2 (3.1)	19.3 (5.1)	18.0 (4.5)	18.0 (2.7)
Mean number of cigarettes smoked per day (*SD*)	26.8 (12.0)	23.5 (9.5)	28.3 (11.7)	18.5 (5.5)
Mean total number of cigarettes smoked last week (*SD*)	177.3 (82.9)	162.0 (66.0)	188.8 (80.9)	128.0 (43.4)
Mean expired-air carbon monoxide (*SD*), ppm	27.3 (12.2)	26.8 (12.1)	29.1 (11.6)	21.9 (12.0)
At least one previous attempt to quit (%)	77.6	84.5	79.3	88.6
Mean FTND total score (*SD*)	6.5 (2.2)	6.8 (1.8)	7.6 (1.3)	4.0 (1.2)
Mean MNWS scores (*SD*s)				
MNWS craving	3.0 (1.0)	3.0 (1.0)	3.2 (1.0)	2.6 (1.0)
DSM-IV withdrawal	2.0 (0.7)	2.0 (0.7)	2.1 (0.7)	1.8 (0.7)
Mean FTCQ-12 scores (*SD*s)				
Factor 1 (Emotionality)	2.8 (1.6)	2.6 (1.6)	3.0 (1.7)	2.2 (1.3)
Factor 2 (Compulsivity)	5.2 (1.5)	5.0 (1.6)	5.4 (1.5)	4.8 (1.5)
Factor 3 (Expectancy)	3.5 (1.7)	3.3 (1.7)	3.7 (1.7)	2.8 (1.5)
Factor 4 (Purposefulness)	4.5 (1.3)	4.3 (1.4)	4.4 (1.2)	4.8 (1.4)
General Craving Score	3.9 (1.0)	3.7 (1.1)	4.0 (1.1)	3.4 (1.0)

Note. DSM-IV = *Diagnostic and Statistical Manual of Mental Disorders*, 4th Edition, Revised (American Psychiatric Association, 2000); FTCQ-12 = 12-item French Tobacco Craving Questionnaire; FTND = Fagerström Test for Nicotine Dependence; MNWS = Minnesota Nicotine Withdrawal Scale.

Discussion

We developed the TCQ (Heishman et al., 2003) and FTCQ (Berlin et al., 2005) to be multidimensional questionnaires using clinically based categories of craving and found that four factors best characterized tobacco craving. We derived an abbreviated French version of the Tobacco Craving Questionnaire (FTCQ-12) by taking 12 items with the highest loadings on the four factors comprising the FTCQ (Berlin et al. 2005). CFA indicated excellent fit with a four-factor model. A one-factor, two-factor, and three-factor model fit the data poorly, and a more complex five-factor model did not fit. Findings

Table 4. Rotated factor matrix for the TCQ, FTCQ, and FTCQ-12

	Factor 1 emotionality			Factor 2 expectancy			Factor 3 compulsivity			Factor 4 purposefulness		
Item	TCQ[a]	FTCQ[b]	FTCQ-12[c]	TCQ[a]	FTCQ[b]	FTCQ-12[c]	TCQ[a]	FTCQ[b]	FTCQ-12[c]	TCQ[a]	FTCQ[b]	FTCQ-12[c]
1	.12	.13	−.06	**.51**	**.69**	**.65**	.13	.01	−.05	.25	.21	.54
2	.15	.18	.11	.14	.01	.20	**.69**	**.49**	**.30**	.13	.43	.12
3	**.74**	**.62**	**.93**	.04	.24	−.12	.23	.18	−.14	.05	.12	.08
4	.17	.09	−.06	**.52**	**.68**	**.71**	.00	−.01	.03	.27	.32	.66
5	.45	.29	−.14	.08	.19	−.24	**.45**	**.68**	**1.09**	.15	.14	.17
6	**.53**	**.67**	**.60**	.12	.06	−.11	.07	.16	.05	.15	.08	.06
7	.19	.19	−.17	**.55**	**.52**	**.83**	.56	.14	.16	.09	.45	−.35
8	.24	.03	.00	.00	−.08	.16	**.49**	**.38**	**.41**	.02	.14	.02
9	−.03	.07	.04	.11	.26	.48	−.05	.04	−.01	**.48**	**.60**	**.30**
10	**.64**	**.76**	**.80**	.09	.01	−.07	.14	.08	−.25	.02	.14	−.11
11	.09	.26	−.03	.10	.29	.18	.04	.25	.26	**.48**	**.45**	**.30**
12	**.69**	**.74**	**.87**	.12	.22	−.20	.24	.18	.05	.02	.11	.05

Note. Bolded factor loadings indicate match for significant loadings (≥.30; Berlin et al., 2005) between the FTCQ (target) and FTCQ-12 (comparison) item patterns. FTCQ = 47-item French Tobacco Craving Questionnaire; FTCQ-12 = 12-item French Tobacco Craving Questionnaire; TCQ = 47-item English Tobacco Craving Questionnaire.
[a]Initial TCQ validation study (Heishman et al., 2003).
[b]Initial FTCQ validation study (Berlin et al., 2005).
[c]Current validation study.

support the four-factor model of craving for tobacco (Heishman et al., 2003) and other drugs, including alcohol (Singleton, Tiffany, & Henningfield, 2003), amphetamine (James, Davies, & Willner, 2004), cocaine (Tiffany, Singleton, Henningfield, & Haertzen, 1993), heroin (Heinz et al., 2006), and marijuana (Heishman, Singleton, & Liguori, 2001),

Congruence coefficients indicated moderate similarity in the pattern of factor loadings between the FTCQ-12 and FTCQ. Visual inspection indicated that factor patterns for significant items (>.30) loaded exactly between target (FTCQ) and comparison (FTCQ-12) factors, suggesting convergent validity (Kline, 2005). Congruence coefficients also demonstrated moderate similarity in the pattern of factor loadings between the FTCQ-12 and TCQ. We expected that the oblique rotation would produce correlated factors with cross loadings, but the common practice of assigning items to the factor with the highest loading would have resulted in Item 9 being assigned incorrectly to Factor 2 rather than Factor 4. Further inspection revealed cross loadings significantly different from zero for Items 1, 4, and 9 across Factors 2 and 4 for the FTCQ-12, FTCQ, and TCQ. Additionally, all three items were reverse keyed on the three instruments, suggesting that negative wording accounted for at least some of inconsistency in Item 9. Cronbach's alpha coefficients and average interitem correlations for the four-primary factors were lower for the abbreviated version compared with the 47-item FTCQ. However, we expected alpha and interitem correlations to decrease because the FTCQ-12 contained fewer items and was administered to a sample other than the one used in the development of the original FTCQ (DeVellis, 2009).

GLM provide additional evidence that the FTCQ-12 reliably measures the same specific constructs of tobacco craving as the FTCQ and TCQ. Factor 1 (emotionality) made the greatest independent contribution to the prediction of MNWS (*DSM-IV*) withdrawal symptoms. In the initial validation of the TCQ, emotionality was strongly correlated with negative affect (Heishman et al., 2003), and negative affect and craving both increase in anticipation of quitting (McCarthy, Piasecki, Fiore, & Baker, 2006). In this study, emotionality also accounted for more than twice the variance found for the same emotionality factor in the initial validation sample of nontreatment-seeking smokers, and this factor loaded substantially higher on three of four items (3, 10, and 12) than either the FTCQ and TCQ. There is significant worsening of anxiety related to smoking cessation (Erickson, Thomas, Blitz, & Pontius, 2004), and post-hoc analysis indicated that anxiety was the most prominent *DSM-IV* withdrawal symptom associated with craving in anticipation of relief from withdrawal or negative mood ($r = .35$, $p < .001$).

Factor 2 (expectancy) made the greatest independent contribution to the prediction of daily cigarette consumption. Liking smoking has been associated with regular smoking (O'Connor et al., 2005), and Heishman et al. (2003) have shown that expectancy or craving in anticipation of positive outcomes from smoking is strongly associated with liking to smoke a cigarette right now. Previous studies also reported that a greater level of smoking was associated with greater ratings of positive smoking outcome expectancies linked to the positive reinforcing characteristics of nicotine (Cohen, McCarthy, Brown, & Myers, 2002; Copeland, Brandon, & Quinn, 1995; Sayette, Martin, Wertz, Shiffman, & Perrott, 2001).

The best predictor of current (MNWS) craving and the number of cigarettes smoked during the week prior to enrollment was Factor 3 (compulsivity). Compulsivity has previously been found to correlate strongly with another single-item measure of the intensity level of current craving (Heishman et al., 2003). Consistent with our findings, research has shown that the frequency of smoking correlates directly with degree of self-reported compulsive behaviors (Spinella, 2005) and that automatic smoking behavior is associated with increased smoking (Berlin et al., 2003).

Factor 4 (purposefulness) correlated positively with number of previous quit attempts. Craving measures that take into account purposefulness or intent and planning to use likely provide a more sensitive index of relapse susceptibility (Paliwal, Hyman, & Sinha, 2008), and craving has been viewed as an indication of failure to abstain (Killen and Fortmann, 1997; Killen et al., 1991, 2006; Shiffman et al., 1997). Unlike the FTCQ sample, these participants had committed to quitting smoking. Factor scale means were higher on the FTCQ than on the FTCQ-12, especially for purposefulness (5.4 vs. 4.5). Additionally, there were small to substantial positive relationships among all factors on the FTCQ, yet there was an almost negligible relationship between purposefulness and expectancy, and no significant relationship for purposefulness with either compulsivity or emotionality on the FTCQ-12. There was also a negative loading for craving coupled with intention and planning to smoke with FTCQ-12 Item 7 (I would smoke as soon as I had an occasion). Desire was positively correlated with craving coupled with purposefulness in the TCQ validation study (Heishman et al., 2003). Taken together, our findings are consistent with cognitive explanations of drug use (Tiffany, 1990; Tiffany and Drobes, 1991), which state that desire and intention to smoke cigarettes (i.e., purposefulness) are uncoupled in individuals attempting to quit smoking (West & Hardy, 2006). This might also explain why the variance accounted for by purposefulness in the FTCQ validation study was more than twice that of the FTCQ-12.

There is evidence that the FTCQ-12 yields a measure of specific factors and general tobacco craving as well. Our results indicated that highly dependent smokers experienced heightened craving. We could rule in with 94.7% certainty (analysis not shown) that a participant with a General Craving Score ≥6 was highly dependent on nicotine. These findings also indicate that craving is an important element of nicotine dependence and smoking-related health outcomes (Berlin & Singleton, 2008).

Findings are based on a sample of French smokers with smoking-related diseases, which limits generalizability. Another shortcoming of the study is the cross-sectional design (assessment only at baseline). Like the FTCQ, TCQ, and TCQ-SF (Heishman et al. 2008), the FTCQ-12 was developed to assess state-level changes in craving (Berlin et al., 2005; Heishman, Saha, & Singleton, 2004; Heishman et al., 2008; Singleton, Anderson, & Heishman, 2003) as opposed to trait-like concepts, such as situational outcome expectancies. Whether increases in craving found in repeated measure designs using the FTCQ-12 indicate actual increases in craving intensity or whether the factor structure of craving varies with this increase is unknown. The most common clinical endpoint in tobacco cessation is abstinence, but we did not evaluate the predictive utility of the FTCQ-12 for successful quitting. The aim of this paper was to determine the psychometric characteristics of the FTCQ-12, then use it in

the next phase of analyses in the ADONIS trial as a valid measure to potentially predict abstinence.

Because the abbreviated version of the TCQ was derived from different items, we were unable to compare factor loadings between the FTCQ-12 and TCQ-SF (Heishman et al. 2008). Research has demonstrated the reliability and validity of the 47-item FTCQ (Berlin et al., 2005) and the 47-item TCQ from which it was derived (Heishman et al., 2003, 2004; Singleton, Anderson, & Heishman 2003). The replicable factor structure across different conditions, samples, and instruments suggests that the FTCQ-12, like its English counterpart (Heishman et al., 2008), is also a rapid, reliable, and valid measure of the same four constructs of tobacco craving.

In summary, we reported the development of a brief version of the FTCQ and examined its reliability, validity, and potential clinical utility. The FTCQ-12 was a significant predictor of several physiological and behavioral correlates of nicotine dependence. Its use is recommended in clinical settings and smoking cessation clinical trials where time may be limited, yet a multidimensional assessment of tobacco craving is desired. Further analyses are needed to assess the predictive value of the FTCQ-12 for quitting successfully, maintaining abstinence, or relapsing to previous smoking.

Declaration of Interests

EGS and SJH report no competing interests. IB reports having received occasional honoraria for participating in advisory panels of Sanofi-Aventis and Pfizer Ltd.

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