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Revisiting the Factor Structure of the Questionnaire on Smoking Urges

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Abstract

This study assessed the factor structure of the Questionnaire on Smoking Urges (QSU), a commonly used assessment of cravings for cigarettes, with a sample of smokers presenting for treatment in a smoking cessation trial. On the basis of previous research, three confirmatory factor analytic models were tested. Model 1 hypothesized a 26-item, 2-factor model using the items reported in the original QSU analysis by S. T. Tiffany and D. J. Drobes (1991). Model 2 hypothesized a 12-item, 2-factor model comprised of the 6 most robust items found in each of the 2 factors of the original factor analysis. Using the 12 items from Model 2, Model 3 hypothesized a 12-item, 1-factor model. The 2nd model was found to fit the data best. Reliability was also tested using values obtained in this 2nd model, and these estimates were found to be reasonably good. Future research directions for the QSU are discussed.

The Questionnaire on Smoking Urges (QSU) is a widely used measure of urges for cigarettes. Tiffany and Drobes (1991) initially reported the development of this questionnaire and provided a preliminary factor structure and reliability data. The sample used for this original study was composed of 230 community-based smokers who were not seeking treatment. The average participant was 21.4 years old, smoked 22.3 cigarettes per day, and had been smoking for 4.81 years. These researchers developed the items for this scale with the intention of representing four categories: "(1) desire to smoke; (2) anticipation of immediate positive outcome from smoking; (3) anticipation of immediate relief from nicotine withdrawal or relief from negative affect; (4) intention to smoke" (Tiffany & Drobes, 1991, p. 1468). A factor analysis yielded a two-factor structure. The first factor was deemed to relate to an intention to smoke and a desire to engage in cigarette smoking, which is believed to be pleasant, satisfying, and enjoyable. The second factor was said to be associated with the relief of negative affect or withdrawal through smoking. Typical scale items include the following: "My desire to smoke seems overpowering," "I crave a cigarette right now," "I would be less irritable now if I could smoke," "I could control things better right now if I could smoke" (Tiffany & Drobes, 1991, p. 1469). This scale has been used to measure cravings for cigarettes in numerous experimental studies (e.g., Bell, Taylor, Singleton, Henningfield, & Heishman, 1999; Willner & Jones, 1996) and has been translated to both French (Guillin et al., 2000) and German (Mueller, Mucha, Ackermann, & Pauli, 2001).

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Despite the prevalent use of this measure, only two studies have attempted to confirm the original factor structure reported by Tiffany and Drobes (1991). Davies, Wilner, and Morgan (2000) replicated this factor structure in a community-based sample of 271 smokers not seeking treatment. The average participant in this study was 21.63 years old, smoked 16.46 cigarettes per day, and had been smoking for 6.03 years. Also using a community-based sample, Kozlowski, Pillitteri, Sweeney, Whitfield, and Graham (1996) conducted a confirmatory factor analysis with 116 smokers not seeking treatment. The average participant for this study was 23 years old, smoked 16 cigarettes per day, and had been smoking for 6 years. These researchers were unsuccessful in confirming Tiffany and Drobes's (1991) initial two-factor structure. Instead they presented a two-factor model utilizing the 6 items with the highest loadings in each of the two factors found in the original analysis, and this resulted in an adequate fit between the model and the data. They also tested a model with one factor that used those same 12 items. For this latter model, they replaced the negatively worded items with identical items that were positively worded. Kozlowski et al. (1996) tentatively suggested that this one-factor model might be a better fit for their data.

Thus, little previous research has focused on attempting to replicate the factor structure of the QSU. Moreover, the two studies that tried to do so used relatively small samples as compared with the number of variables being analyzed. The present study assessed both of the two-factor models (Kozlowski et al., 1996; Tiffany & Drobes, 1991) that were assessed in previous research. Additionally, the one-factor model suggested by Kozlowski et al. (1996) was tested. It should be noted that it was not possible to conduct the exact same analyses as in Kozlowski et al. (1996) when evaluating this latter one-factor model because of the wording changes made by these researchers (i.e., Kozlowski et al., 1996, replaced negatively worded items with identical positively worded items). However, it was deemed prudent to test this third model as this issue (i.e., the number of factors related to craving) has been debated in craving research (Tiffany, 1997). All of the models were tested with a considerably larger sample than either of the two previous studies that analyzed the QSU. Model 1 hypothesized a two-factor model (i.e., the original model reported by Tiffany & Drobes, 1991), with 15 items in Factor 1 and 11 items in Factor 2. Model 2 also hypothesized a two-factor model with 6 items in Factor 1 and 6 items in Factor 2 (i.e., the 12-item model suggested by Kozlowski et al., 1996). For each of these models, it was theorized that the first factor would be associated with intention and desire to smoke and the second factor would be related to relief of negative affect or withdrawal. Model 3 hypothesized a one-factor model comprised of the 12 items used in Model 2. Further, reliability data were estimated for the model that represented the best fit for the data.

Method

Participants

The sample for this study was composed of 649 daily smokers who were screened for participation in smoking cessation clinical trials. The QSU was completed at the baseline screening assessment before participants made an attempt to quit smoking. All participants completed a single administration of the QSU as part of a larger battery of questionnaires. Of those participants who identified their gender, 326 were male and 295 were female. From the 612 participants who identified their age, the mean age was 45.12 years ($SD = 11.80$). The average number of cigarettes smoked per day, of the 601 participants who reported this data, was 26.54 ($SD = 11.40$). Of the 613 participants who identified how long they had smoked, the mean number of years was 21.82 ($SD = 13.12$).

Materials

The QSU (see Appendix for a list of the items; Tiffany & Drobes, 1991) was designed to assess urges and cravings to smoke, with higher scores indicating stronger urges. This instrument is

a 32-item self-report questionnaire. Respondents are asked to indicate how strongly they agree or disagree with each item on the questionnaire using a scale from 1 (*strongly disagree*) to 7 (*strongly agree*). Although the QSU is a 32-item questionnaire, only 26 items were retained in the initial factor analysis due to the criteria set forth by Tiffany and Drobles (1991). Specifically, an item was assigned to a factor “if it loaded .40 or greater on a given factor and less than .25 on the other factor, and if the item’s loading for the two factors differed by at least .20” (Tiffany & Drobles, 1991, p. 1471). Consequently, the original two-factor model reported by Tiffany and Drobles (1991) contained 15 items in Factor 1 and 11 items in Factor 2. Studies using the QSU typically have reported the scores for these two factors (e.g., Bell et al., 1999; Morgan, Davies, & Willner, 1999). The QSU showed excellent reliability for each of these factors (Cronbach’s α s = .95 for Factor 1 and .93 for Factor 2).

Procedure

Confirmatory factor analyses were performed using SAS 8.0 for Windows (SAS Institute, 1999). Both covariance and correlation matrices were computed with the CALIS procedure and parameters were estimated using maximum likelihood. The correlation matrix was analyzed to assess the root-mean-square residual (RMSR) fit index, and the covariance matrix was used for all other fit indices. The following model fit indices were considered: the chi-square statistic (Hatcher, 1994), the goodness-of-fit index (GFI; Mulaik et al., 1989), the nonnormed fit index (NNFI; Bentler & Bonett, 1980), the comparative fit index (CFI; Bentler, 1990), the RMSR (Hu & Bentler, 1999), and the root-mean-square error of approximation (RMSEA; Brown & Cudeck, 1993). The chi-square statistic should be nonsignificant to show a good fit for the model (Floyd & Widaman, 1995). The GFI, NNFI, and CFI range between 0 and 1, with values closer to 1 indicating a better fit for the model. Although some researchers (Hu & Bentler, 1999) have suggested that values of .95 or higher are most desirable and that values of .90 or greater represent an acceptable model fit to the data, no formal rule has been established, and values in the high .80s are often considered adequate (McDonald & Ho, 2002; Mulaik et al., 1989). To demonstrate good fit, the RMSR should be less than .08 (Hu & Bentler, 1999). With regard to the RMSEA as a measure of good fit, Hu and Bentler (1999) suggested a cutoff of close to .06 to show good fit. However, Brown and Cudeck (1993) posited that the RMSEA should be close to .05, but they also state that they are “of the opinion that a value of about .08 or less for the RMSEA would indicate a reasonable error of approximation and would not want to employ a model with a RMSEA greater than .1” (p. 144). Additionally, values obtained from the model representing the best fit were used to assess reliability.

Results

Confirmatory Factor Analysis

Fit indices are shown in Table 1. The fit indices for Models 1 and 3 showed an overall inadequate fit. Model 2 presented a much more reasonable fit for the data. Although the chi-square for this model was significant, $\chi^2(53, N = 649) = 314.77, p < .05$, with large samples and real world data, the chi-square value will often be significant even when the model provides an acceptable representation of the data (Floyd & Widaman, 1995; Hatcher, 1994). The RMSEA was less than the .1 cutoff value suggested by Brown and Cudeck (1993), and it approached the .08 criterion recommended as reasonable. Each of the indices that should approach “unity” (i.e., the GFI, NNFI, and CFI) appeared adequate in Model 2. In addition, the RMSR in this model indicated an acceptable fit. Therefore, Model 2 was considered the best explanation of the data.

Table 2 shows the standardized factor loadings and t values for Model 2. The factor structure coefficient for each item ranged from .39 to .76. To assess convergence of manifest indicators on a common factor in this confirmatory factor analysis, t tests were conducted on the factor

loadings. It is considered meaningful when a t value is greater than 2.0 (Jöreskog & Sörbom, 1993). All t values in Model 2 were above 2.0; therefore, this suggests that all items are likely measuring a common construct.

The correlation between the two factors in Model 2 was .67 ($p < .05$; i.e., 45% variation shared between the factors). Discrimination between two factors can be tested in confirmatory factor analysis with a confidence interval test. With this test, a confidence interval of plus or minus two standard errors around the correlation between the factors is calculated. If this interval does not include 1.0, then good discrimination is demonstrated (Hatcher, 1994). In Model 2, the confidence interval was .61 to .73. Therefore, since the confidence interval does not include 1.0, the two-factor structure measured with this model demonstrated good discrimination between the factors, indicating that the two factors of interest are distinct constructs.

Reliability

Composite reliability is analogous to coefficient alpha, and composite reliability refers to the internal consistency reliability of the items measuring a factor (Hatcher, 1994). For Model 2, these indices were .78 and .83 for Factors 1 and 2, respectively, indicating that both factors had reasonably good reliability, given that each was represented by only six items.

Discussion

Using a sample of smokers presenting for treatment in clinical trials, the original factor structure of the QSU reported by Tiffany and Drobes (1991) was not replicated in this study. It is possible that this could be explained by differences in sample characteristics. Previous factor analytic studies used younger community-based samples who had been smoking less than 6 years, and who smoked between 16 and 22.3 cigarettes per day, on average. In contrast, the current sample included only treatment-seeking individuals, with participants averaging more than 45 years of age, 20 years of smoking, and 26 cigarettes smoked per day. It is possible that the original two-factor structure reported by Tiffany and Drobes (1991) and replicated by Davies et al. (2000) cannot be confirmed with older, treatment-seeking individuals who have been smoking larger quantities of cigarettes over a longer period of time. It will be important for future studies to test whether or not this original two-factor structure using all 26 items can be confirmed in such samples.

In the present study, an alternative model, initially proposed by Kozlowski et al. (1996), using the 12 most robust items from the original analysis appeared to represent an adequate fit for the data. Structural equation models, because they are merely an approximation of reality, are not generally expected to fit the data perfectly (Floyd & Widaman, 1995). Indeed, for this model, most, but not all of the fit indices showed a good fit. The overall reliability of the constructs for this revised two-factor model was reasonably good.

This study showed that the model using the 12-item version of the QSU fit the data better than the full 26-item scale. There is an ongoing debate regarding the number of items needed to measure urges for drugs in self-report scales and the number of factors that should be measured by such a scale (see Kozlowski et al., 1996, for a review). Though they are used frequently, one- or two-item scales have been strongly criticized because their reliability is often low, or, with regard to single-item scales, impossible to ascertain. It has been argued that unreliable urge questionnaires limit the capacity to detect and replicate effects of craving that may be clinically or theoretically important (Tiffany, 1997). To address this problem, several studies have developed longer urge scales with as few as 5 items or as many as 30 items, using more traditional psychometric approaches (e.g., Flannery, Volpicelli, & Pettinati, 1999; Tiffany & Drobes, 1991; Tiffany, Singleton, Haertzen, & Henningfield, 1993). These scales, designed to assess either a single unidimensional factor (e.g., the Penn Alcohol Craving Scale; Flannery

et al., 1999) or several factors (e.g., the Cocaine Craving Questionnaire; Tiffany et al., 1993) associated with cravings have demonstrated good psychometric properties. However, longer questionnaires have been criticized for their limited utility in clinical and laboratory settings because of their length (Cox, Tiffany, & Christen, 2001; Kozłowski et al., 1996). Therefore, a questionnaire that is short enough for practical use but long enough to provide a reliable measure of craving is ideal.

With regard to the number of factors to assess, a multifactorial approach to measure drug craving may be beneficial. Several studies have documented differential outcomes across QSU factors supporting a multifactorial approach to the measurement of tobacco craving. For example, Corrigan, Zack, Eissenberg, Belsito, and Scher (2001) tested the subjective and physiological effects of smoking following overnight abstinence. They found that items in the first QSU factor were rated stronger than items in Factor 2 for both nondaily and daily smokers during abstinence. Using the QSU to test urges to smoke during abstinence and exposure to cues, Morgan et al., (1999) found that Factor 1 scores were significantly higher in females than males. Eissenberg, Adams, Riggins, and Likness (1999) investigated the relationship between smoker gender and tobacco use, and found a Gender $\times$ Time interaction for Factor 2 of the QSU, with women reporting significantly lower scores than men at the final time point of the study. Clearly, the assessment of both factors of the QSU enabled a more thorough examination of the effects of cigarette craving in each of the studies listed above, and this evaluation found key differences between the two factors. These disparities suggest that it may be beneficial to tailor clinical treatments to account for these effects. To facilitate a better understanding of such differences between the two factors, future studies should continue to use both factors of the QSU to explore smoking urges.

Certainly, the results of the current study provide evidence for a two-factor structure for a shortened version of the QSU (i.e., Model 2). Although the correlation between the factors showed a high degree of shared variation (i.e., 45%), the factors do appear to represent two distinct constructs, as the one-factor model (i.e., Model 3) did not represent a good fit for the data. The factor loadings for the second model tested in the current study showed that individual items of the QSU are relatively good indicators of each factor. This supports the idea that the QSU is composed of two distinct factors characterized by (a) intention and desire to smoke and (b) relief from withdrawal or negative affect.

It should be noted that a shorter version of the QSU, the QSU-brief, was recently developed, and a two-factor structure was reported for this 10-item instrument (Cox et al., 2001). Unfortunately, because the wording of several items in the QSU was changed for the QSU-brief, it was not possible to conduct a confirmatory factor analysis of the items used in this new scale. Similar to the wording changes made by Kozłowski et al. (1996), Cox et al. (2001) replaced negatively worded items with identical positively worded items to reduce the amount of method variance associated with reverse scoring. This is a common trade-off that must be considered when creating a questionnaire. Research devoted to scale construction offers diverging views with regard to this dilemma. Spector (1992) suggested that negatively worded items should always be used to avoid acquiescence (i.e., the tendency to agree with items irrespective of content). On the other hand, whereas DeVellis (1991) acknowledged that acquiescence can be avoided by including negatively worded items, he also asserted that reversals in item polarity could confuse individuals completing a questionnaire. In the present study, it was decided to use both negatively and positively worded items in the confirmatory factor analysis for two reasons. First, the original factor analyses of the QSU used such items. Second, data had not been gathered for positively worded items like that collected by Kozłowski et al. (1996). Whether negatively worded items should be used is an issue that deserves further investigation. Future studies should compare the positively keyed QSU-brief

to the positively and negatively keyed shortened version of the QSU described in this study to ascertain whether one version is superior.

The findings in the current study provide further evidence for the use of a short, multifactorial measure of smoking urges. The results of this study suggest that a short form of the QSU is more psychometrically sound than the longer version. In addition, its brief nature allows for easy administration, without compromising the ability to adequately assess multiple aspects of craving. A shortened form of the QSU in craving research provides an efficient and reliable method to measure the dual nature of smoking urges, distinguishing desire to smoke from relief of withdrawal or negative affect. In light of these findings, it will be important for future studies to confirm the two-factor structure of the QSU-brief and to compare this scale to both the longer version of the QSU and the shortened version described in this study.

Appendix

Questionnaire on Smoking Urges

Items included in the questionnaire are as follows:

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- 1 Smoking would make me feel very good right now.
 - 2 I would be less irritable now if I could smoke.
 - 3 Nothing would be better than smoking a cigarette right now.
 - 4 I am not missing smoking right now.
 - 5 I will smoke as soon as I get the chance.
 - 6 I don't want to smoke now.
 - 7 Smoking would make me less depressed.
 - 8 Smoking would not help me calm down now.
 - 9 If I were offered a cigarette, I would smoke it immediately.
 - 10 Starting now, I could go without smoking for a long time.
 - 11 Smoking a cigarette would not be pleasant.
 - 12 If I were smoking this minute, I would feel less bored.
 - 13 All I want right now is a cigarette.
 - 14 Smoking right now would make me feel less tired.
 - 15 Smoking would make me happier now.
 - 16 Even if it were possible, I probably wouldn't smoke now.
 - 17 I have no desire for a cigarette right now.
 - 18 My desire to smoke seems overpowering.
 - 19 Smoking now would make things seem just perfect.
 - 20 I crave a cigarette right now.
 - 21 I would not enjoy a cigarette right now.
 - 22 A cigarette would not taste good right now.
 - 23 I have an urge for a cigarette.
 - 24 I could control things better right now if I could smoke.
 - 25 I am going to smoke as soon as possible.
 - 26 I would not feel better physically if I were smoking.
 - 27 A cigarette would not be very satisfying right now.
 - 28 If I had a lit cigarette in my hand I probably wouldn't smoke it.
 - 29 If I were smoking now I could think more clearly.

- 30 I would do almost anything for a cigarette now.
- 31 I need to smoke now.
- 32 Right now, I am not making plans to smoke.

Note. Questionnaire on Smoking Urges items from “The Development and Initial Validation of a Questionnaire on Smoking Urges,” by S. T. Tiffany and D. J. Drobes, 1991, *British Journal of Addiction*, 86, p. 1469. Copyright 1991 by Blackwell Publishing (available electronically at www.blackwell-synergy.com). Reprinted with permission.

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Table 1
Fit Indices for the Confirmatory Factor Models of the Questionnaire on Smoking Urges

Model	χ^2	df	p	GFI	NNFI	CFI	RMSR	RMSEA
1	1784.55	298	<.05	.80	.78	.79	.08	.09
2	314.77	53	<.05	.92	.88	.90	.06	.09
3	597.43	54	<.05	.83	.75	.80	.09	.09

Note. N = 649 for chi-squares. GFI = goodness-of-fit index; NNFI = nonnormed fit index; CFI = comparative fit index; RMSR = root-mean-square residual; RMSEA = root-mean-square error of approximation.

Table 2

Factors, Items, Item Factor Loadings, and *t* Values for Confirmatory Factor Analysis of the Questionnaire on Smoking Urges (Model 2)

Factor and item	Loading	<i>t</i>
Factor 1—Intention/Desire to Smoke		
Smoking a cigarette would not be pleasant. ^a	.39	17.32
Even if it were possible, I probably wouldn't smoke now. ^a	.67	14.83
I have no desire for a cigarette right now. ^a	.74	13.48
A cigarette would not taste good right now. ^a	.58	16.03
I have an urge for a cigarette.	.71	14.12
I am going to smoke as soon as possible.	.57	16.16
Factor 2—Relief of Negative Affect or Withdrawal		
Nothing would be better than smoking a cigarette right now.	.68	15.35
Smoking would make me less depressed.	.50	17.00
All I want right now is a cigarette.	.76	13.82
Smoking now would make things seem just perfect.	.72	14.75
I could control things better right now if I could smoke.	.72	14.75
I would do almost anything for a cigarette now.	.66	15.70

Note. Questionnaire on Smoking Urges items from “The Development and Initial Validation of a Questionnaire on Smoking Urges,” by S. T. Tiffany and D. J. Drobes, 1991, *British Journal of Addiction*, 86, p. 1469. Copyright 1991 by Blackwell Publishing. Reprinted with permission.

^aIndicates reverse scored items (negatively worded).