Development and psychometric properties of the Social Smoking Situations (S³) Scale: An enhanced measure of social exposure to smoking during adolescence

Simon Racicot and Jennifer J. McGrath*

Pediatric Public Health Psychology Laboratory, Department of Psychology, Concordia University, 7141 Sherbrooke Street West, Montréal, Québec, H4B 1R6, Canada

Abstract

Common questions of exposure to smoking, such as number of parents, siblings, or friends who smoke, fail to capture the contexts in which the exposure occurs. This study developed the Social Smoking Situations (S³) Scale to more precisely measure contextual exposure to smoking during adolescence. Informed by the cue-reactivity literature and using informal focus groups, items of contextual exposure to smoking were generated for three categories of smokers: parents, siblings, and peers. Participants ($N = 761$; $M_{\text{age}} = 15.6$, $SD = 1.3$; 61.4% female) were recruited as part of the AdoQuest Study in Montreal, QC. Principal components analysis was used to identify the component structure of the parent, sibling, and peer versions of the S³ Scale. S³ scores were computed subsequently to test their association with smoking behavior and smoking expectancies. Further, S³ scores were compared with common questions (i.e., number of smokers) via univariate modeling to determine which would generate larger estimates of effect size when predicting smoking behavior and smoking expectancies. Overall, S³ scores generated larger estimates than common questions; this finding was consistent across the parent (OR_{avg} : 2.59 vs. 1.36), sibling (OR_{avg} : 3.44 vs. 1.59), and peer (OR_{avg} : 3.89 vs. 1.38) versions. The S³ Scale is a new psychometrically sound instrument that may provide a more robust measurement of social exposure to smoking during adolescence. Importantly, it has the potential to strengthen prevention programming and intervention efforts aimed at adolescents, as it could depict a more precise portrait of the individual and contextual sources of social exposure to smoking.

Keywords

Tobacco smoking; Social learning; Measurement; Test construction

*Corresponding author. Tel.: +1 514 848 2424 x5287. jennifer.mcgrath@concordia.ca (J.J. McGrath).

Contributors

Simon Racicot developed the research question, conducted the literature review, designed the analytical plan, undertook the statistical analyses, interpreted the results, and wrote and revised the manuscript. Jennifer J. McGrath co-developed the research question, supervised the statistical analyses, and revised the manuscript. Both authors read and approved the final manuscript for submission.

Conflict of interest

All authors declare that they have no conflicts of interest.

1. Introduction

Observing smokers in one's environment is a robust predictor of smoking during adolescence (Brandon, Herzog, Irvin, & Gwaltney, 2004; Collins & Ellickson, 2004; U.S. Department of Health and Human Services, 2012). Observing smoking by parents, siblings, and peers constitute the predominant sources of exposure to smoking, and their influence has been attributed to social modeling (cf. Avenevoli & Merikangas, 2003; Hoffman, Sussman, Unger, & Valente, 2006; Kobus, 2003; Simons-Morton & Farhat, 2010; Tyas & Pederson, 1998). Children and adolescents are 2.7 times more likely to initiate smoking if parents smoke, 2.3 times more likely if siblings smoke (Leonardi-Bee, Jere, & Britton, 2011), and 3.3 times more likely if peers smoke (O'Loughlin, Karp, Koulis, Paradis, & DiFranza, 2009).

Social Learning Theory (Bandura, 1977) posits that adolescents initiate smoking by imitating the smoking behavior of role models in their environment. Exposure to smoking constitutes a broader context of observing others and the varied circumstances under which they smoke (Van Gucht, Van den Bergh, Beckers, & Vansteenwegen, 2010). Research that examines social modeling focuses predominantly on "who" smokes, but typically fails to consider "where" and "when" smoke exposure occurs. Common questions of exposure to smoking do not adequately capture the contextual situations in which role models smoke, which may themselves contribute to the social modeling phenomenon. Another literature has considered contextual situations and how they influence smoking.

The cue-reactivity literature among smokers (cf. Carter & Tiffany, 1999) has identified several contextual situations in which adolescent and adult smokers crave or use cigarettes. Common types of smoking situations studied include: locations (e.g., home, car); activities (e.g., doing chores, watching television, eating); social contexts (e.g., at a party, with friends); and, mood states (e.g., angry, relaxed, bored; cf. Cronk & Piasecki, 2010; Dunbar, Scharf, Kirchner, & Shiffman, 2010; Shiffman et al., 2002; Tagmat, Wolff, Schumann, John, & Thyrian, 2011; Van Gucht et al., 2010). This framework underscores the pertinence of considering smoking situations. Tagmat et al. (2011) found that adolescents who experienced stronger urges to smoke in social situations, negative mood states, and routine situations (e.g., waiting for the bus) reported greater daily smoking. Among adult smokers, contextual situations including locations, activities, social contexts, and mood states have been associated with more cravings (Dunbar et al., 2010) and cigarette smoking (Cronk & Piasecki, 2010; Shiffman et al., 2002). Further, Van Gucht et al. (2010) reported that adult smokers who had greater nicotine dependence consumed cigarettes in more locations and during more varied activities. Thus, the effects of smoking situations on smokers have been established within the cue-reactivity framework. Contextual situations of smoke exposure may play a parallel role during the emergence of adolescents' smoking behavior, depending on where and when youth observe smokers. More precise measures of exposure to smoking, by whom, where, and in what context may improve our ability to predict adolescent smoking.

Social exposure to smoking encompasses both observing others smoking and the contextual situations in which others smoke. However, common questions of smoke exposure are

limited as they narrowly conceptualize exposure to only the source of exposure (“who”); they fail to capture the richer topography of social exposure to smoking via contextual situations (“where” and “when”). Thus, there is a need for development of a refined psychometric instrument to more comprehensively assess the construct of social exposure to smoking. It is posited that enhanced assessment of broader contextual situations in which adolescents observe others smoking will yield a more precise measure of social exposure to smoking.

The objective of the present study was to develop the Social Smoking Situations (S^3) Scale to more accurately measure social exposure to smoking among adolescents. First, guided by classical measurement theory, the S^3 Scale and its psychometric properties were developed. Principal components analysis was used in constructing the S^3 Scale, while psychometric properties were evaluated by testing aspects of convergent and concurrent validity. Second, the S^3 Scale was compared with common questions of exposure to smoking (i.e., prevalence of others smoking) to predict smoking behavior and smoking expectancies. It was hypothesized that compared to common questions, the S^3 Scale would yield larger estimates when predicting smoking behavior and smoking expectancies.

2. Method

2.1. Development of item pool

Contextual situations of social exposure to smoking (i.e., items to be generated) were defined as “when” and “where” adolescents directly observe smokers use cigarettes, and “what” the smokers are doing at the time that adolescents are exposed. To develop the item pool, the cue-reactivity literature was first reviewed to empirically inform item development (e.g., Tagmat et al., 2011; Van Gucht et al., 2010). Next, two independent informal focus groups were conducted with adolescents ($N=8$) and young adults ($N=10$) whereby they identified situations in which they observed smoking by their parents, siblings, and peers. These groups helped in generating items; the content of items was clarified and redundant items were eliminated through discussion. Research assistants took notes; the discussions were not transcribed. Then, five independent experts in the field of tobacco control, who were convenience sampled, reviewed the items and added additional ones; consensus was reached through discussion. No formal qualitative analyses were performed. The number of unique situations identified was 35 for parents, 43 for siblings, and 40 for peers; we maintained separate versions for parents, siblings, and peers.

2.2. Procedure and participants

Adolescents ($N=1642$) were recruited in 7th, 9th, and 11th grade as part of the AdoQuest Study, an ongoing prospective investigation evaluating the natural course of smoking behavior in youth. French-language schools in the Greater Montreal were selected based on a stratified indicator of socioeconomic status (SES) to maximize adequate representation based on SES (for more detailed information about AdoQuest, please see Bélanger et al., 2008). Adolescents who received written consent from their parents completed self-report questionnaires, including the S^3 Scale. For each contextual situation item, adolescents were instructed to rate their current level of exposure to smoking using a three-point scale (0 = not

true; 2 = very true). Consistent with other child instruments (e.g., Child Behavior Checklist; Achenbach & Rescorla, 2001), a three-point scale was selected for matters of efficiency.

2.3. Study 1: Construction of the S³ Scale

2.3.1. Initial component structure and reduction of the item pool—An initial Principal Components Analysis (PCA), using varimax rotation and Kaiser's (1960) criterion (eigenvalue = 1), was applied to all items to identify separate orthogonal components. PCA assumes normality, linearity, and absence of outliers (Tabachnick & Fidell, 2013). This process yielded a four-component solution on the parent version, and five-component solutions for both the sibling and peer versions. To maximize internal consistency within each component, the item pool on each version was reduced to retain the items that would make the scale most parsimonious and practical. Sets of items on a given component displaying mean component loadings and Cronbach's alpha greater than .90 were more closely examined. Subsequently, items displaying the highest mean component loadings and Cronbach's alpha closest to 1 were retained. This led to the retention of 12 parent items, 14 sibling items, and 14 peer items, which comprise the final version of the S³ Scale.

2.3.2. S³ Scale: final version—PCA with varimax rotation was applied to the final S³ Scale to ensure that the component structure was identical to that obtained with the original, unreduced item pool. (Alternatively, factor analysis with principal axis factoring was also used; results did not differ and are not depicted). For the parent version (Table 1), components were labeled: meals (variance = 21.64%; Cronbach's α = .90), social activities (20.49%; α = .87), moods (20.29%; α = .92), and unpleasant states (19.40%; α = .85); internal consistency was excellent (α = .93). For the sibling version, components were labeled: quiet activities (20.11%; α = .92), social activities (18.68%; α = .89), meals (17.56%; α = .92), moods (17.38%; α = .95), and belongingness (14.01%; α = .90); internal consistency was excellent (α = .92). For the peer version, components were labeled: quiet activities (18.71%; α = .90), moods (18.30%; α = .93), social activities (17.22%; α = .86), at school (16.36%; α = .87), and belongingness (12.88%; α = .83); internal consistency was excellent (α = .93).

2.4. Study 2: psychometric properties of the S³ Scale

2.4.1. Measures

2.4.1.1. S³ scores: Items within each component of the parent, sibling, and peer versions were averaged to compute S³ scores. These scores represent a mean ranging from 0 to 2, whereby higher scores indicate greater contextual exposure to smoking. S³ scores were also computed using factors scores (i.e., scores created by using the items loadings generated by SPSS); results were largely identical (not depicted) and, for practical reasons, averages were preferred to factor scores.

2.4.1.2. Common questions of exposure to smoking: Number of parents who smoked and lived in the same household as the adolescents was assessed with four separate questions: "Does your biological mother/biological father/step-mother/step-father currently smoke cigarettes?" Scores range from 0 to 4 (highest number of parents who smoked). Further, participants were asked to write in the exact number of siblings, half-siblings, and

stepsiblings who smoked and lived with them. Similarly, they were asked to write in the exact number of close friends who smoked. These questions are consistent with those asked in nationally representative surveys, such as the Canadian Youth Smoking Survey (YSS; Health Canada, 2007) and the U.S. National Youth Tobacco Survey (Centers for Disease Control and Prevention, 2013).

2.4.1.3. Smoking expectancies: The French-language version (Racicot, McGrath, Hine, O'Loughlin, & Guyon, 2008) of the Smoking Expectancy Scale for Adolescents (Hine, Honan, Marks, & Brettschneider, 2007) was used to measure the expected benefits and expected costs of smoking. Using a 10-point scale (0 = *Completely unlikely*; 9 = *Completely likely*), adolescents rated the likelihood that each cost and benefit would happen to them. Means were calculated for expected costs and benefits. This scale has excellent internal consistency (Racicot et al., 2008: costs $\alpha = .94$, benefits $\alpha = .92$; present sample: costs $\alpha = .93$, benefits $\alpha = .89$). Smoking by parents and friends has been found to predict smoking expectancies (Hine et al., 2007; Racicot, McGrath, & O'Loughlin, 2011), which in turn, have been associated with prospective smoking (Hine, McKenzie-Richer, Lewko, Tilliczek, & Perreault, 2002).

2.4.1.4. Smoking behavior: Smoking behavior included questions drawn from the YSS and the Canadian Tobacco Use Monitoring Survey (Mills, Stephens, & Wilkins, 1994). Specifically, adolescents answered six questions: ever tried a cigarette, even just a few puffs (yes/no); ever inhaled cigarette smoke into your lungs (yes/no); ever smoked one whole cigarette (yes/no); ever smoked 100 or more whole cigarettes (yes/no); smoking frequency (i.e., number of days over the last month where smoking occurred); and smoking intensity (i.e., number of cigarettes smoked per day).

2.5. Analytic plan

Data have been inspected for linearity, normality, and outliers. Missing data were replaced using the Expectation Maximization procedure in SPSS; all analyses were performed with SPSS version 20. Data analysis comprised four steps. First, the association between S^3 scores and common questions was evaluated to determine the degree of overlap between these measures. Second, S^3 scores on the parent, sibling, and peer versions were tested as predictors of smoking behavior and smoking expectancies in univariate modeling. Third, common questions (i.e., number of parents, siblings, and peers who smoked) were also tested as distinct predictors of smoking behavior and smoking expectancies in univariate modeling, for comparison with the predictability of S^3 scores. Fourth, S^3 scores were compared with common questions to determine whether our novel S^3 measure produced larger estimates of effect size when associated with smoking behavior and smoking expectancies. Linear regression was used for continuous dependent variables, whereas logistic regression was used for binary dependent variables.

3. Results

3.1. Descriptive statistics

A total of 761 adolescents were exposed to smoking and completed the S³ Scale, and constituted the analytic sample (response rate = 100%; 881 of 1642 participants reported no exposure and, thus, did not complete the S³ Scale). On average, participants were aged 15.6 years ($SD = 1.3$; range = 12–20), and the majority was female (61.4%). About half of the adolescents reported ever smoking a cigarette even just a few puffs (48.6%), and more than a third of the sample endorsed ever inhaling smoke into their lungs (37.4%). A third of the adolescents reported ever smoking a whole cigarette (33.3%), while only 15% of adolescents endorsed ever smoking more than 100 cigarettes. Participants smoked on average 3.55 days ($SD = 9.03$) over the last 30 days, and smoked 1.16 cigarettes per day ($SD = 3.38$). Adolescents were less likely to endorse benefits of smoking ($M = 2.49$, $SD = 1.86$) and expected the costs of smoking were more likely to occur to them ($M = 5.61$, $SD = 2.01$).

Descriptive statistics performed on the S³ scores indicated few adolescents identified having no exposure to parental smoking (15.4% $M = .82$, $SD = .60$), sibling smoking (20.5%, $M = .61$, $SD = .50$), or peer smoking (9.2%, $M = .83$, $SD = .51$), irrespective of the contextual situation. This indicates that the vast majority of participants endorsed exposure in at least one situation on the S³ scale. According to common questions, adolescents averaged 1.15 ($SD = .82$) smoking parents, 1.25 ($SD = .90$) smoking siblings, and 2.52 ($SD = 2.69$) smoking peers.

3.2. Convergent validity between common questions and S³ Scale

Table 2 displays zero-order correlations between S³ scores and common questions. Common questions were moderately correlated with the S³ total score on the parent version ($r = .43$, $p = .001$), sibling version ($r = .43$, $p = .001$), and peer version ($r = .40$, $p = .001$). Common questions were also significantly associated with the S³ component scores (i.e., score for each component individually) for the parent version ($r_{avg} = .36$, $p = .05$), sibling version ($r_{avg} = .31$, $p = .05$), and peer version ($r_{avg} = .29$, $p = .05$).

3.3. Concurrent validity of S³ Scale

S³ total and component scores were significantly associated with ever smoking a cigarette; ever inhaling smoke into one's lungs; ever smoking one whole cigarette; and ever smoking more than 100 cigarettes on all three versions (parent, sibling, peer), although the component "belongingness" generally was not significantly associated with smoking behavior (Table 3). Moreover, the S³ total and component scores (with the exception of "belongingness") were significantly associated with smoking frequency and smoking intensity on all three versions (Table 4). Further, with respect to smoking expectancies, the S³ scores (total and components) were significantly associated with expected benefits on the parent and peer versions, but not on the sibling version. The component "social activities" was consistently associated with expected costs.

3.4. Concurrent Validity of Common questions of Exposure to Smoking

Number of parents who smoked was significantly associated with smoking behavior, but not smoking expectancies (Tables 3–4), while number of siblings who smoked was significantly associated only with a few indicators of smoking behavior. Number of friends who smoked was significantly associated with smoking behavior and smoking expectancies.

3.5. Comparison of S³ Scale with common questions of exposure to smoking

When comparing mean coefficients of effect size obtained in univariate modeling, S³ scores generated greater effect size estimates than common questions when predicting smoking behavior on the parent version (Table 3; total S³: $OR_{avg} = 2.59$; components S³: $OR_{avg} = 1.88$; common: $OR_{avg} = 1.35$); the sibling version (total S³: $OR_{avg} = 3.44$; components S³: $OR_{avg} = 2.16$; common: $OR_{avg} = 1.59$); and the peer version (total S³: $OR_{avg} = 3.89$; components S³: $OR_{avg} = 2.98$; common: $OR_{avg} = 1.38$). The total S³ score generally exhibited larger standardized beta coefficients than common questions, except for the peer version (Table 4). However, some components on the peer version, such as “moods” or “quiet activities”, generated greater effect size estimates than common questions.

Post-hoc analyses were conducted to determine whether the S³ Scale accounts for additional variance over and above that of common questions. The S³ score (total) and common questions were entered simultaneously into multivariable regression models for the parent, sibling, and peer versions. Results indicated that, for all three versions, the S³ Scale contributed variance above and beyond that of common questions (findings not shown).

4. Discussion

Researchers are learning increasingly about the importance of considering contextual situations when measuring social exposure to smoking and predicting smoking initiation among adolescents. Common questions fail to capture the contextual situations in which adolescents are exposed to smoking in their social environment.

Consistent with findings from the cue-reactivity framework, several of the components identified on the S³ Scale were largely similar to the situations in which smokers report cravings or using cigarettes. Examples of such situations include social activities, mood states, meals, or quiet activities, suggesting that our scale has the ability to capture the situations in which smokers themselves reported smoking in previous studies. Further, analyses of convergent validity showed that the strength of association between S³ scores and common questions was moderately high. This implies that S³ scores and number of smokers both measure a theoretically related construct, namely, social exposure to smoking. The fact that their strength of association was not excessively high, however, suggests that S³ scores and common questions provide unique, non-overlapping information. Relatedly, post-hoc analyses indicated that S³ scores provide variance above and beyond that of common questions. As such, present findings provide support for our conceptualization such that common questions are mostly smoker-centric (i.e., “who is smoking”), whereas the S³ Scale broadens the construct to include contextual situations of exposure (i.e., “where” and “when” adolescents observe smokers).

Analyses of concurrent validity showed that globally, adolescents exposed to smoking in more situations were more likely to be smokers, smoked more frequently and with greater intensity, and held more positive beliefs about smoking. Most importantly, S^3 scores were generally more strongly associated with smoking behavior and smoking expectancies than common questions on all three versions of the S^3 Scale, which suggests the latter represents a potent alternative when measuring social exposure to smoking. This study corroborates and extends previous findings that situations of smoke exposure are associated with greater smoking susceptibility in adolescent never-smokers (Racicot et al., 2011).

Present findings provide support to the hypothesis that the S^3 Scale is a novel, psychometrically sound instrument designed to more precisely assess contextual exposure to smoking. Okoli, Browning, Rayens, Ellen, and Hahn (2008) contend that the relation between social exposure to smoking and smoking behavior can be explained by two theoretical frameworks: social modeling (e.g., Krohn, Skinner, Massey, & Akers, 1985) and cue-reactivity (e.g., Caggiula et al., 2001). Given that adolescents complete the S^3 Scale for targeted role models, the scale encompasses elements of social modeling, such as observational learning of said role models. Moreover, the S^3 Scale captures elements of the cue-reactivity framework, given that contexts are environmental cues (Conklin, 2006). For example, observing one's father smoke after he has eaten a meal provides different cues than when he is smoking while he is stressed, which may have different repercussions on the observing adolescent. In fact, this study highlighted that not all types of situations were equal. As such, "social activities" emerged as a much stronger component than "belongingness".

4.1. Study limitations

First, the cross-sectional nature of this study does not permit assessment of temporality. Second, S^3 items do not measure the intensity or duration of exposure. Nicotine monitors (Hammond & Leaderer, 1987) could be used in future studies to objectively obtain these data. Third, the S^3 measures contextual situations in which adolescents are exposed to cigarette smoking only. Although enquiring about other tobacco products would have been informative, cigarettes remain by far the most popular (Health Canada, 2007). Fourth, this study used a full-sample design to validate the S^3 Scale; future studies should replicate the current findings with a larger sample, including a holdout sample. With larger samples, current findings could also be replicated with factor analysis (e.g., principal axis factoring). Fifth, the S^3 Scale is limited to social exposure to parental, sibling, and peer smoking. Additional versions could be developed to more comprehensively assess contextual exposure to smoking, including other family members, strangers in public places, or social media.

4.2. Implications and recommendations for future research

From a methodological perspective, the S^3 Scale may be used as an alternative to common questions to more precisely capture contextual exposure to smoking. Researchers may opt to examine the effects of the total S^3 scores or look at the effects of each component individually on smoking behavior during adolescence. Longitudinal research should test whether S^3 scores predict key smoking behavior milestones. Moreover, momentary ecological assessment (Shiffman, 2009) could be used to explore the degree of concordance

between situations in which adolescents report exposure to smoking and situations in which parents, siblings, and friends report smoking. Finally, future studies should test for measurement invariance across socio-demographics and settings.

From a public health perspective, this new, enhanced scale has the potential to strengthen prevention efforts targeting youth, as it could depict a more precise portrait of social exposure to smoking. Specifically, situations of smoke exposure known to be strongly associated with smoking (i.e., high-risk situations) could be depicted more purposefully in media campaigns to reduce exposure in such contexts. Classroom interventions could address the situations in which adolescents observe smokers and emphasize the negative consequences of smoke exposure on smoking-related beliefs and eventual smoking. Relatedly, future research should examine the situations in which adolescents initiate cigarette smoking themselves. If these situations are consistent with the ones in which they previously observed smokers, prevention programs could target specific situations of smoke exposure for better prevention of smoking uptake.

5. Conclusions

The development of the S³ Scale and its psychometric properties was conducted to gain greater insight about the nature and repercussions of contextual situations of youth's exposure to smoking. The parental, sibling, and peer versions displayed excellent internal consistency and were significantly associated with smoking behavior and expected benefits. Compared with common questions, S³ scores yielded larger estimates of effect size when associated with smoking behavior and expected benefits. Present findings suggest that the S³ Scale is a brief, psychometrically sound instrument that could be used as an alternative to common questions when assessing contextual exposure to smoking and statistically modeling adolescent smoking behavior. Thus, prevention programming should not only target who is smoking around adolescents, but also in which situations.

Acknowledgments

Role of funding sources

This work was partly supported by the Canadian Institutes of Health Research (S. Racicot #87864; J. McGrath #MOP-97879, #MSH-95353), the Canadian Tobacco Control Research Initiative, and the Institut national de santé publique du Québec. The authors declare that the funding sources had no role in the study design, collection, analysis or interpretation of the data, writing the manuscript, or the decision to submit the paper for publication.

The authors would like to thank Drs. Jennifer O'Loughlin, Roisin O'Connor, Nadia Chaudhri, Sylvia Kairouz, and Scott Leatherdale for their insightful comments on the conceptualization of this article. Sincere thanks to Dr. Jennifer O'Loughlin for her contribution to the protocol development of the AdoQuest II cohort and her leadership on the Interdisciplinary Capacity Enhancement Team: Advancing the Science to Reduce Tobacco Use. Finally, the authors are grateful to all families and schools that participated in AdoQuest.

References

- Achenbach, T.M., Rescorla, L.A. Manual for the ASEBA school-age forms and profiles. Burlington, VT: University of Vermont, Research Center for Children, Youth, and Families; 2001.
- Avenevoli S, Merikangas KR. Familial influences on adolescent smoking. *Addiction*. 2003; 98(Suppl 1):1–20. <http://dx.doi.org/10.1046/j.1360-0443.98.s1.2.x>.
- Bandura, A. Social learning theory. Englewood Cliffs, NJ: Prentice Hall; 1977.

- Bélanger M, O'Loughlin J, Okoli CTC, McGrath J, Setia M, Guyon L, et al. Nicotine dependence symptoms among young never-smokers exposed to secondhand tobacco smoke. *Addictive Behaviors*. 2008; 33:1557–1563. <http://dx.doi.org/10.1016/j.addbeh.2008.07.011>. [PubMed: 18760878]
- Brandon TH, Herzog TA, Irvin JE, Gwaltney CJ. Cognitive and social learning models of drug dependence: Implications for the assessment of tobacco dependence in adolescents. *Addiction*. 2004; 99(Suppl 1):51–77. <http://dx.doi.org/10.1111/j.1360-0443.2004.00737.x>. [PubMed: 15128380]
- Caggiula AR, Donny EC, White AR, Chaudhri N, Booth S, Gharib MA, et al. Cue dependency of nicotine self-administration and smoking. *Pharmacology Biochemistry and Behavior*. 2001; 70:515–530. [http://dx.doi.org/10.1016/S0091-3057\(01\)00676-1](http://dx.doi.org/10.1016/S0091-3057(01)00676-1).
- Carter BL, Tiffany ST. Meta-analysis of cue-reactivity in addiction research. *Addiction*. 1999; 94:327–340. <http://dx.doi.org/10.1046/j.1360-0443.1999.9433273.x>. [PubMed: 10605857]
- Centers for Disease Control and Prevention. National Youth Tobacco Survey (NYTS). 2013. Retrieved from. http://www.cdc.gov/tobacco/data_statistics/surveys/nyts/
- Collins RL, Ellickson PL. Integrating four theories of adolescent smoking. *Substance Use & Misuse*. 2004; 39:179–209. <http://dx.doi.org/10.1081/JA-120028487>. [PubMed: 15061558]
- Conklin CA. Environments as cues to smoke: Implications for human extinction-based research and treatment. *Experimental and Clinical Psychopharmacology*. 2006; 14:12–19. <http://dx.doi.org/10.1037/1064-1297.14.1.12>. [PubMed: 16503701]
- Cronk NJ, Piasecki TM. Contextual and subjective antecedents of smoking in a college student sample. *Nicotine & Tobacco Research*. 2010; 12:997–1004. <http://dx.doi.org/10.1093/ntr/ntq136>. [PubMed: 20739458]
- Dunbar MS, Scharf D, Kirchner T, Shiffman S. Do smokers crave cigarettes in some situations more than others? Situational correlates of craving when smoking. *Nicotine & Tobacco Research*. 2010; 12:226–234. <http://dx.doi.org/10.1093/ntr/ntp198>. [PubMed: 20133379]
- Hammond SK, Leaderer BP. A diffusion monitor to measure exposure to passive smoking. *Environmental Science and Technology*. 1987; 21:494–497. 0013-936X/107/0921-0494\$01.50/0. [PubMed: 22296139]
- Health Canada. Youth smoking survey (YSS) 2004–05. 2007. Retrieved from. http://www.hc-sc.gc.ca/hc-ps/tobac-tabac/research-recherche/stat/survey-sondage_2004-2005-eng.php
- Hine DW, Honan CA, Marks AD, Brettschneider K. Development and validation of the Smoking Expectancy Scale for Adolescents. *Psychological Assessment*. 2007; 19:347–355. <http://dx.doi.org/10.1037/1040-3590.19.3.347>. [PubMed: 17845126]
- Hine DW, McKenzie-Richer A, Lewko J, Tilleczek K, Perreault L. A comparison of the mediational properties of four adolescent smoking expectancy measures. *Psychology of Addictive Behaviors*. 2002; 16:187–195. <http://dx.doi.org/10.1037/0893164X.16.3.187187>. [PubMed: 12236453]
- Hoffman BR, Sussman S, Unger JB, Valente TW. Peer influences on adolescent cigarette smoking: A theoretical review of the literature. *Substance Use & Misuse*. 2006; 41:103–155. <http://dx.doi.org/10.1080/10826080500368892>. [PubMed: 16393739]
- Kaiser HF. The application of electronic computers to factor analysis. *Educational and Psychological Measurement*. 1960; 20:141–151. <http://dx.doi.org/10.1177/001316446002000116>.
- Kobus K. Peers and adolescent smoking. *Addiction*. 2003; 98(Suppl 1):37–55. <http://dx.doi.org/10.1046/j.1360-0443.98.s1.4.x>. [PubMed: 12752361]
- Krohn MD, Skinner WF, Massey JL, Akers RL. Social learning theory and adolescent cigarette smoking: A longitudinal study. *Social Problems*. 1985; 32:455–473. <http://dx.doi.org/10.1525/sp.1985.32.5.03a00050>.
- Leonardi-Bee J, Jere ML, Britton J. Exposure to parental and sibling smoking and the risk of smoking uptake in childhood and adolescence: A systematic review and meta-analysis. *Thorax*. 2011; 66:847–855. <http://dx.doi.org/10.1136/thx.2010.153379>. [PubMed: 21325144]
- Mills C, Stephens T, Wilkins K. Summary report of the workshop on data for monitoring tobacco use. *Health Reports*. 1994; 6:377–387. (Retrieved from <http://www.statcan.gc.ca/pub/82-003-x/4060784-eng.htm>). [PubMed: 7756574]

- O'Loughlin J, Karp I, Koulis T, Paradis G, DiFranza J. Determinants of first puff and daily cigarette smoking in adolescents. *American Journal of Epidemiology*. 2009; 170:585–597. <http://dx.doi.org/10.1093/aje/kwp179>. [PubMed: 19635735]
- Okoli CTC, Browning S, Rayens MK, Ellen J, Hahn EJ. Secondhand tobacco smoke exposure, nicotine dependence, and smoking cessation. *Public Health Nursing*. 2008; 25:46–56. <http://dx.doi.org/10.1111/j.1525-1446.2008.00679.x>. [PubMed: 18173585]
- Racicot S, McGrath JJ, Hine DW, O'Loughlin J, Guyon L. Replicability of the smoking expectancy scale for adolescents: French-Canadian version. *Annals of Behavioral Medicine*. 2008; 35:S186. (Abstract, Retrieved from <http://www.springerlink.com/content/0883-6612/35/s1/>).
- Racicot S, McGrath JJ, O'Loughlin J. An investigation of social and pharmacological exposure to secondhand tobacco smoke as possible predictors of perceived nicotine dependence, smoking susceptibility, and smoking expectancies among never-smoking youth. *Nicotine & Tobacco Research*. 2011; 13:926–933. <http://dx.doi.org/10.1093/ntr/ntr100>. [PubMed: 21622492]
- Shiffman S. Ecological momentary assessment (EMA) in studies of substance use. *Psychological Assessment*. 2009; 21:486–497. <http://dx.doi.org/10.1037/a0017074>. [PubMed: 19947783]
- Shiffman S, Gwaltney CJ, Balabanis MH, Liu KS, Paty JA, Kassel JD, et al. Immediate antecedents of cigarette smoking: An analysis from ecological momentary assessment. *Journal of Abnormal Psychology*. 2002; 111:531–545. <http://dx.doi.org/10.1037/0021-843X.111.4.531>. [PubMed: 12428767]
- Simons-Morton BG, Farhat T. Recent findings on peer group influences on adolescent smoking. *Journal of Primary Prevention*. 2010; 31:191–208. <http://dx.doi.org/10.1007/s10935-010-0220-x>. [PubMed: 20614184]
- Tabachnick, BG., Fidell, LS. *Using multivariate statistics*. 6. Boston: Pearson; 2013.
- Tagmat D, Wolff J, Schumann A, John U, Thyrian JR. Development and psychometric properties of a short situational urge to smoke scale (SUS) for smoking adolescents. *Substance Use & Misuse*. 2011; 46:959–968. <http://dx.doi.org/10.3109/10826084.2010.540288>. [PubMed: 21222519]
- Tyas SL, Pederson LL. Psychosocial factors related to adolescent smoking: A critical review of the literature. *Tobacco Control*. 1998; 7:409–420. <http://dx.doi.org/10.1136/tc.7.4.409>. [PubMed: 10093176]
- U.S. Department of Health and Human Services. Preventing tobacco use among youth and young adults: A report of the Surgeon General. Atlanta, GA: Centers for Disease Control and Prevention, Office on Smoking and Health; 2012. (Retrieved from <http://www.surgeongeneral.gov/library/index.html>)
- Van Gucht D, Van den Bergh O, Beckers T, Vansteenwegen D. Smoking behavior in context: Where and when do people smoke? *Journal of Behavior Therapy and Experimental Psychiatry*. 2010; 41:172–177. <http://dx.doi.org/10.1016/j.jbtep.2009.12.004>. [PubMed: 20060515]

HIGHLIGHTS

- The S³ Scale permits an enhanced assessment of social smoke exposure.
- Compared to commonly used questions, it more strongly predicts adolescent smoking.
- Researchers may opt to rely on this new scale to better measure social modeling.
- Prevention efforts could more easily target high-risk situations of exposure.
- Understanding situations of exposure may help understand situations of initiation.

Table 1Component loadings on the parent, sibling, and peer versions of the S³ scale.

Parent items: They smoke (when)...	Component loadings				
	Social activities	Moods	Meals	Unpleasant states	–
at a party	.85	.24	.18	.15	–
in a group	.79	.33	.19	.22	–
having guests	.74	.28	.15	.35	–
in a calm situation	.31	.81	.24	.30	–
in a happy situation	.35	.76	.21	.32	–
in a boring situation	.35	.76	.22	.31	–
eating dinner	.17	.18	.89	.10	–
eating lunch	.20	.14	.87	.19	–
eating breakfast	.10	.19	.84	.20	–
doing housework	.29	.13	.20	.77	–
sick	.17	.38	.17	.77	–
having physical pain	.21	.39	.20	.75	–
Sibling items: They smoke (when)...	Social activities	Moods	Meals	Quiet activities	Belongingness
at a party	.91	.17	.16	.10	.09
drinking alcohol	.82	.25	.19	.20	.06
in a group	.78	.30	.13	.06	.29
in a calm situation	.26	.82	.28	.30	.10
in a happy situation	.33	.78	.29	.28	.16
in a boring situation	.37	.77	.31	.21	.16
eating lunch	.22	.24	.84	.21	.20
eating dinner	.21	.35	.82	.24	.04
eating breakfast	.14	.21	.74	.44	.21
studying	.10	.18	.16	.87	.18
reading	.13	.17	.26	.86	.05
doing homework	.14	.25	.25	.84	.15
wanting to be part of a group	.13	.10	.14	.15	.92
wanting to impress others	.17	.14	.13	.13	.91
Peer items: They smoke (when)...	Social activities	Moods	At school	Quiet activities	Belongingness
in a group	.78	.19	.32	.14	.27
using drugs	.77	.23	.15	.14	.26
at a party	.77	.27	.30	.10	.14
in a sad situation	.19	.84	.26	.28	.12
in a stressful situation	.32	.81	.25	.26	.08
in an infuriating situation	.25	.79	.30	.29	.07
during recess	.24	.24	.79	.21	.09
after school	.44	.26	.75	.17	.06
before going to school	.20	.32	.74	.31	.06

Parent items: They smoke (when)...	Component loadings				
	Social activities	Moods	Meals	Unpleasant states	–
on the computer	.12	.20	.14	.90	.12
watching TV	.10	.19	.20	.87	.06
talking on the phone	.14	.33	.23	.78	.13
wanting to impress others	.22	.07	.04	.08	.89
wanting to be part of a group	.20	.08	.09	.14	.88

Note. Bold loadings represent items for corresponding factor.

Table 2

Zero-order correlations of S³ scores and common questions of exposure to smoking.

Parent version	1	2	3	4	5	6	
1. Smokers (parents) ^a	–						
2. S ³ Score (total)	.43 ^{**}	–					
3. Social activities	.43 ^{**}	.84 ^{**}	–				
4. Moods	.39 ^{**}	.89 ^{**}	.71 ^{**}	–			
5. Meals	.21 ^{**}	.73 ^{**}	.44 ^{**}	.50 ^{**}	–		
6. Unpleasant activities	.39 ^{**}	.84 ^{**}	.61 ^{**}	.72 ^{**}	.47 ^{**}	–	
Sibling version	1	2	3	4	5	6	7
1. Smokers (sibling) ^a	–						
2. S ³ Score (total)	.43 ^{**}	–					
3. Social activities	.40 ^{**}	.78 ^{**}	–				
4. Moods	.39 ^{**}	.88 ^{**}	.64 ^{**}	–			
5. Meals	.30 ^{**}	.84 ^{**}	.48 ^{**}	.68 ^{**}	–		
6. Belongingness	.25 ^{**}	.59 ^{**}	.37 ^{**}	.38 ^{**}	.38 ^{**}	–	
7. Quiet activities	.22 [*]	.74 ^{**}	.36 ^{**}	.57 ^{**}	.61 ^{**}	.35 ^{**}	–
Peer version	1	2	3	4	5	6	7
1. Smokers (friends) ^a	–						
2. S ³ Score (total)	.40 ^{**}	–					
3. Social activities	.32 ^{**}	.82 ^{**}	–				
4. Moods	.32 ^{**}	.80 ^{**}	.60 ^{**}	–			
5. At school	.30 ^{**}	.78 ^{**}	.65 ^{**}	.68 ^{**}	–		
6. Belongingness	.15 ^{**}	.57 ^{**}	.51 ^{**}	.28 ^{**}	.26 ^{**}	–	
7. Quiet activities	.34 ^{**}	.72 ^{**}	.41 ^{**}	.60 ^{**}	.54 ^{**}	.29 ^{**}	–

Note

^a = Common questions of exposure to smoking.

* $p < .05$;

** $p < .01$.

Table 3

Binary logistic regression estimates for smoking behavior.

Predictor variable	Ever tried a cigarette		Ever inhaled smoke into your lungs		Ever smoked one whole cigarette		Ever smoked 100 or more cigarettes	
	OR	(95%, CI)	OR	(95%, CI)	OR	(95%, CI)	OR	(95%, CI)
Parent version								
S ³ score (total)	2.35	(1.77, 3.12) ***	2.37	(1.76, 3.18) ***	2.32	(1.71, 3.14) ***	3.32	(2.13, 5.17) ***
Social activities	1.82	(1.46, 2.29) ***	1.76	(1.39, 2.23) ***	1.83	(1.43, 2.35) ***	2.45	(1.66, 3.61) ***
Moods	1.84	(1.48, 2.30) ***	1.85	(1.47, 2.33) ***	1.86	(1.46, 2.37) ***	2.42	(1.70, 3.46) ***
Meals	1.72	(1.37, 2.17) ***	1.83	(1.45, 2.31) ***	1.76	(1.39, 2.23) ***	2.11	(1.53, 2.91) ***
Unpleasant activities	1.69	(1.33, 2.15) ***	1.69	(1.32, 2.14) ***	1.57	(1.23, 2.01) ***	1.90	(1.35, 2.66) ***
Smokers (parents) ^a	1.23	(1.01, 1.50) *	1.28	(1.04, 1.57) *	1.36	(1.09, 1.68) **	1.54	(1.16, 2.06) **
Sibling version								
S ³ score (total)	3.31	(1.91, 5.72) ***	4.10	(2.37, 7.09) ***	2.64	(1.57, 4.44) ***	3.69	(1.95, 6.97) ***
Social activities	2.07	(1.48, 2.90) ***	2.20	(1.54, 3.13) ***	1.82	(1.28, 2.59) ***	2.80	(1.63, 4.81) ***
Moods	2.29	(1.59, 3.29) ***	2.72	(1.88, 3.93) ***	2.02	(1.41, 2.88) ***	2.54	(1.61, 4.01) ***
Meals	1.73	(1.20, 2.50) **	2.13	(1.48, 3.06) ***	1.59	(1.12, 2.26) **	1.83	(1.20, 2.80) **
Quiet activities	2.44	(1.42, 4.20) ***	2.65	(1.62, 4.35) ***	1.85	(1.18, 2.90) **	1.93	(1.17, 3.18) **
Belongingness	1.06	(.63, 1.79)	1.01	(.58, 1.76)	1.37	(.79, 2.38)	2.15	(1.11, 4.19) *
Smokers (siblings) ^a	1.68	(1.07, 2.62) *	1.53	(1.00, 2.33) *	1.55	(1.00, 2.39) *	1.47	(.88, 2.47)
Peer version								
S ³ score (total)	3.18	(2.23, 4.54) ***	3.71	(2.60, 5.29) ***	3.29	(2.32, 4.66) ***	5.37	(3.47, 8.30) ***
Social activities	2.12	(1.53, 2.94) ***	2.29	(1.62, 3.26) ***	2.39	(1.66, 3.43) ***	3.79	(2.01, 7.13) ***
Moods	2.19	(1.75, 2.74) ***	2.49	(1.99, 3.13) ***	2.26	(1.81, 2.83) ***	3.84	(2.80, 5.28) ***
At school	2.42	(1.90, 3.08) ***	2.81	(2.19, 3.61) ***	2.47	(1.93, 3.16) ***	5.65	(3.72, 8.59) ***
Quiet activities	3.10	(2.24, 4.29) ***	3.34	(2.48, 4.50) ***	2.75	(2.09, 3.62) ***	3.68	(2.77, 4.89) ***
Belongingness	.94	(.74, 1.18)	.92	(.73, 1.16)	1.04	(.82, 1.31)	.97	(.74, 1.28)
Smokers (friends) ^a	1.39	(1.27, 1.53) ***	1.41	(1.29, 1.54) ***	1.39	(1.28, 1.51) ***	1.31	(1.22, 1.41) ***

Note

^a = Common questions of exposure to smoking.

OR = Odds ratio; CI = Confidence interval.

* *p* .05;** *p* .01;*** *p* .001.

Table 4

Linear regression estimates for smoking behavior and smoking expectancies.

Predictor variable	Measures of smoking behavior						Smoking expectancies					
	Smoking frequency			Smoking intensity			Expected benefits			Expected costs		
	β	<i>t</i>	η^2	β	<i>t</i>	η^2	β	<i>t</i>	η^2	β	<i>t</i>	η^2
Parent version												
S ³ score (total)	.20	5.02 ***	.04	.19	4.64 ***	.04	.13	3.08 **	.02	.06	1.50	.00
Social activities	.18	4.55 ***	.03	.17	4.27 ***	.03	.12	3.04 **	.02	.14	3.47 ***	.02
Moods	.21	5.15 ***	.04	.19	4.77 ***	.04	.11	2.81 **	.01	.04	.91	.00
Meals	.11	2.62 **	.01	.11	2.73 **	.01	.09	2.25 *	.01	-.01	-.23	.00
Unpleasant activities	.17	4.19 ***	.03	.14	3.49 ***	.02	.08	2.01 *	.01	.03	.73	.00
Smokers (parents) ^a	.18	4.30 ***	.03	.16	23.87 ***	.03	-.01	-.20	.00	.00	.05	.00
Sibling version												
S ³ score (total)	.19	3.21 ***	.04	.21	3.42 ***	.04	.10	1.64	.01	.09	1.43	.01
Social activities	.13	2.14 *	.02	.13	2.20 *	.02	.05	.73	.00	.14	2.28 *	.02
Moods	.27	4.53 ***	.07	.27	4.63 ***	.08	.09	1.47	.01	.10	1.54	.01
Meals	.14	2.26 *	.02	.16	2.55 **	.02	.08	1.25	.01	.07	1.08	.00
Quiet act	.12	2.01 *	.02	.12	1.99 *	.02	.11	1.71	.01	.02	.25	.00
Belongingness	.02	.25	.00	.06	.72	.00	.16	1.95	.02	-.01	-.08	.00
Smokers (siblings) ^a	.11	1.20	.01	.07	.73	.01	.10	1.06	.01	.11	1.18	.01
Peer version												
S ³ score (total)	.31	7.85 ***	.10	.31	7.86 ***	.10	.21	5.27 ***	.05	.06	1.40	.00
Social activities	.20	3.67 ***	.04	.19	3.59 ***	.04	.22	4.04 ***	.05	.21	4.01 ***	.05
Moods	.36	9.23 ***	.13	.35	8.91 ***	.12	.23	5.67 ***	.05	.06	1.34	.00
At school	.36	9.22 ***	.13	.33	8.45 ***	.11	.22	5.49 ***	.05	.07	1.74	.01
Quiet activities	.41	10.86 ***	.17	.41	10.82 ***	.17	.20	4.98 ***	.04	-.03	-.71	.00
Belongingness	-.08	-1.88	.01	-.05	-1.18	.00	.05	1.14	.00	.08	2.02 *	.01
Smokers (friends) ^a	.32	8.04 ***	.10	.34	8.41 ***	.11	.20	4.75 ***	.04	-.08	-1.99 *	.01

Note

^a = Common questions of exposure to smoking. β = standardized beta coefficient; η^2 = eta squared, estimate of effect size.*
p .05;**
p .01;***
p .001.