

# Development and Psychometric Properties of the Smoking Restraint Questionnaire

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Restraint is a component of self-control that focuses on the deliberate reduction of an undesired behavior and is theorized to play a role in smoking reduction and cessation. However, there exists no instrument to assess smoking restraint. This research aimed to develop the Smoking Restraint Questionnaire (SRQ) to meet this need. Participants were 406 smokers (48% female; 52.2% nondaily) with a mean age of 38.83 years ( $SD = 12.05$ ). They completed a baseline questionnaire designed to assess smoking restraint. They also completed 21 days of ecological momentary assessment (EMA), during which they recorded each cigarette smoked and answered questions related to planned restraint every morning, and restraint attempts every evening. The 4-item questionnaire of smoking restraint was found to fit a single factor (root mean square error of approximation = .038, comparative fit index = .99, Tucker-Lewis index = .99), and the resulting composite was reliable (composite reliability = 0.74). The questionnaire contains items that assess the setting of weekly restraint goals and attempts at not lighting up when tempted to smoke. Participant SRQ scores positively correlated with EMA data on plans to restrain ( $p < .001$ ) and frequency of restraint attempts ( $p < .001$ ). These correlations suggest that the SRQ has good predictive validity in relation to the intention and behaviors of smoking reduction. The SRQ is promising as a measure of smoking restraint and may enable further research and insights into smoking reduction and cessation.

*Keywords:* restraint, smoking, dependence, smoking cessation, reduction

As the leading cause of preventable death and disease in the developed world (Lim et al., 2012), cigarette smoking has become a global health concern. Smoking can cause serious illness, such as cancer, and heart and lung disease (Bellomi et al., 2010; Rachtan, 2002; Stellman et al., 2001). In general, smoking increases morbidity while decreasing life-expectancy (Brønnum-Hansen & Juel, 2001). In light of the adverse health outcomes there is considerable

interest in understanding the correlates of smoking, including those related to reduced consumption.

Many mechanisms are theorized to enable smoking reduction and cessation, including self-control. *Self-control* can be defined as the ability to increase the occurrence of desirable behaviors or decrease the occurrence of undesirable behaviors (de Ridder, Lensvelt-Muuders, Kinkenauer, Stok, & Baumeister, 2012). It is a broad construct that involves self-regulating thoughts, feelings, and behaviors. Similarly broad is the related concept of self-regulation, which is theorized to be a personality construct for which dispositional self-control is a prerequisite (Baumeister, Gailliot, DeWall, & Oaten, 2006). These concepts propose that behavior can be modified in line with a person's wishes. It is theorized that self-regulation is a distinctively human characteristic that evolved to suppress survival instincts that run counter to cultural longevity and morality (Baumeister, 2014).

Self-regulation that focuses solely on decreasing the occurrence of an undesired behavior is typically referred to as restraint. Similar to self-regulation, *restraint* has been defined as the conscious, chronic restriction of a target behavior based on personally set limits (Keller & Siegrist, 2014). Restraint has mostly been studied in the eating literature (e.g., binge-eating) where it can be accomplished through a variety of behavior strategies, such as setting limits on daily and weekly caloric intake, avoiding places where eating is expected (planned restraint), or providing excuses when food is presented (situational restraint; Moreno, Warren, Rodríguez, Fernández, & Cepeda-Benito, 2009). Moreno et al. (2009) described the strategies as strict and self-imposed, with some behavior demonstrating temporal effectiveness. For exam-

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ple, refusal skills are essential to achieving restraint when it is momentarily required (Vandereycken & Van Humbeeck, 2008), whereas planning skills are essential to setting caloric intake restraint goals (Segura-García, De Fazio, Sinopoli, De Masi, & Brambilla, 2014).

The eating definition of restraint is equivalent to that provided in the smoking literature, in that smoking restraint has been defined as a conscious, cognitive, and behavioral ability to refrain from consumption (Nordgren, van Harreveld, & van der Pligt, 2009). Craving often prompts smoking, so deliberately resisting smoking may require the application of immediate, situational restraint. Among smokers who have quit, temptations to smoke, characterized by strong craving, frequently present challenges to the individual's commitment to abstinence (Ferguson & Shiffman, 2009) and analysis shows that whether the person actually succumbs can be influenced by whether they implement restraint strategies (i.e., coping; Shiffman, 1982, 1984; Shiffman et al., 1996; van Osch, Lechner, Reubsæet, Wigger, & de Vries, 2008). More strategic—or planned—restraint strategies that are not enacted at the moment of temptation, but distal to such critical moments, have also been described (i.e., “anticipatory coping”; van Osch, et al., 2008; Wills & Shiffman, 1985).

Less has been studied about the role of restraint in smoking reduction, rather than complete cessation, but there has been increased interest in reduction, either as a harm-reduction strategy (Hamilton, Cross, Resnicow, & Hall, 2005) or as a path to cessation (Shiffman, Ferguson, & Strahs, 2009). Studies show that smokers who are better able to reduce their smoking are also more likely to quit completely (Klemperer & Hughes, 2015; Moore et al., 2009) suggesting a link or continuity between restraint for reduction and for cessation.

Despite interest in the area, there is currently no smoking restraint assessment tool. This is disappointing given that restraint assessments have benefitted health outcomes and research in other areas (Jacobi, Völker, Trockel, & Taylor, 2012). It is also surprising given that the construct was theorized decades ago to account for smoking reduction (Herman, 1974). Furthermore, the existence of assessments for eating restraint and alcohol restraint indicate that the construct can be operationalized with good effect. For example, the Temptation and Restraint Inventory (Collins & Lapp, 1992), which is a brief self-report questionnaire that measures restraint from consuming alcohol, is predictive of weekly drinking and problematic drinking (Collins, Koutsky, & Izzo, 2000). Similarly, the Eating Disorder Examination—Questionnaire (Fairburn & Beglin, 1994), which was designed to assess one's ability to restrain oneself from exceeding caloric intake goals, among other constructs, has been used extensively in the literature to assess dietary restraint (Brewin, Baggott, Dugard, & Arcelus, 2014). Both tools have simple designs, in that restraint is represented as a single factor, and are used in clinical research to assess postintervention outcomes and improve scientific understanding of behavior reduction (Jacobi et al., 2012; Jones et al., 2014). Thus, it is probable that a smoking restraint assessment tool will be similarly useful to study smoking reduction and cessation. In addition, the absence of a tool has hindered interpretability and comparability of smoking restraint interventions given that the construct has not been operationalized (Kelly, Zuroff, Foa, & Gilbert, 2010; Muraven, 2010).

The present research aims to develop a brief Smoking Restraint Questionnaire (SRQ). The goal was for the SRQ to have good

psychometric properties; emphasis was placed on achieving good content validity through literature review and systematic item selection processes. To test the SRQ's predictive capacity, a simple scoring procedure was developed that allowed correlational analysis with data collected via Ecological Momentary Assessment (EMA) of actual smoking. It was hypothesized that scores on the SRQ would relate positively to self-report restraint plans, and to frequency of restraint attempts.

## Method

### Overview

The present data were drawn from a larger study examining smoking behavior in daily and nondaily smokers who were not interested in quitting smoking. Comprehensive descriptions of the sample, measures, and procedures have been provided elsewhere (Shiffman et al., 2013; Shiffman et al., 2014; Shiffman, Ferguson, Dunbar, & Scholl, 2012; Shiffman et al., 2012). Briefly, participants completed a baseline questionnaire, six cue reactivity sessions (see Shiffman et al., 2013) and monitored their smoking and activities for up to 21 days using a handheld electronic diary to implement EMA monitoring procedures. The University of Pittsburgh's Institutional Review Board approved the study.

### Participants

There were 406 participants who were either daily (47.8%) or nondaily (52.2%) smokers with a mean age of 38.83 years ( $SD = 12.05$ ). Gender was approximately equal with 48% being female. Most participants identified as either Caucasian (62.6%) or African American (34.5%), and had never married (57.9%). Approximately 69% of the sample had posthigh school education. On average, daily smokers had smoked for 25.69 years ( $SD = 11.83$ ) and smoked 15.01 cigarettes per day ( $SD = 5.86$ ). Nondaily smokers had smoked for an average of 19.25 years ( $SD = 12.71$ ), 4.51 days per week ( $SD = 1.64$ ), and smoked 4.45 cigarettes ( $SD = 2.92$ ) on smoking days. Additional demographic and smoking history characteristics have been reported previously (see Shiffman et al., 2014).

Inclusion criteria were being at least 21 years old, smoking for at least 3 years, smoking at a consistent rate for at least 3 months, and having no plan to quit within the next month. Inclusion as a daily smoker required smoking between 5 and 30 cigarettes per day; inclusion as a nondaily smoker required smoking between 4 and 27 days per month with no limit on number of cigarettes smoked. African Americans were oversampled because they are more likely to be nondaily smokers than Caucasian Americans (Trinidad et al., 2009).

### Materials and Procedure

After providing written informed consent, participants completed a baseline questionnaire addressing personal characteristics and smoking history. Within the questionnaire were eight items related to smoking restraint, defined as the ability to restrict cigarette intake based on personally determined limits (see Table 1). The items were created specifically for the measurement of

Table 1  
Final Item Pool

Code	Item (response)	Outcome
0a	When you are tempted to smoke, but want not to, what sorts of things do you THINK in order to keep from smoking? Put a limit on how much you're allowed to smoke. (Yes, no)	Failed inter-item correlation assumption
0b	Considering only the occasions when you feel you shouldn't smoke, what percent of the time do you go ahead and smoke the cigarette anyhow? (0–100)	Failed inter-item correlation assumption
0c	How often do you smoke your cigarette halfway or limit how many puffs you take in an effort to limit your smoking? (1 = never, 2 = less than once per day, 3 = 1–2 times per day, 4 = 3–10 times per day, 5 = more than 10 times per day)	Poor factor loading
0d	Do you have a limit or target that you set for yourself of how many cigarettes to smoke in a day? (Yes, no)	Omitted during respecification
1	Do you ever try to limit the number of cigarettes you smoke? (Yes, no)	Included in final model
2	Do you have a limit or target that you set for yourself of how many cigarettes to smoke in a week? (Yes, no)	Included in final model
3	Do you plan out or ration your cigarettes for each day or week? (1 = never to 5 = always)	Included in final model
4	How often do you deliberately refrain from lighting up a cigarette to keep your smoking rate down? (1 = never, 2 = less than once per day, 3 = 1–2 times per day, 4 = 3–10 times per day, 5 = more than 10 times per day)	Included in final model

restraint based on theory and a review of existing restraint scales in other areas.

Participants also completed 21 days of EMA monitoring during which they were asked to record every cigarette smoked and respond to randomly timed assessments of mood, activities and social setting throughout the day. At the beginning of each day, participants completed a brief morning report where, among other items, they were asked to indicate whether they planned to limit the amount they smoked that day scored on a 0 (no) to 100 (yes) scale. Similarly, at the end of each day, subjects were asked to complete an evening report designed to summarize their experiences over the day. Of relevance to the present study, participants were asked, "How many times did you feel like smoking but tried to resist?" scored on a 0 to 10 scale then dichotomized (0 [*no restraint*] to 1 [*any restraint*]).

### Analytic Plan

We used a split-half validation method to assess the factor structure of the SRQ. A split-half variable stratified by smoker type (daily or nondaily smoker) was randomly assigned to participants to divide the sample. One half was analyzed with an exploratory factor analysis and the other half was analyzed with a confirmatory factor analysis; the latter tested stability of the factor structure identified via the exploratory analysis. The exploratory and confirmatory factor analyses were conducted according to Costello and Osborne (2005) and Brown (2006) guidelines.

Given that the broader aim of the study was to generate a better understanding of restraint, a maximum-likelihood factor analysis was used. This method explores latent structures with the purpose of deriving a causal model (O'Rourke, Hatcher, & Stepanski, 2005). To prevent factor overextraction, scree plots were examined for a point of inflection (Costello & Osborne, 2005). Items with loadings less than .32 were omitted (Tabachnick & Fidell, 2007). To be consistent with existing restraint scales in other domains, the analyses were run with specification of a single factor.

Findings from the exploratory factor analysis were used as a priori hypotheses in the confirmatory factor analysis with the

second split half. The analyses employed delta parameterisation due to its better management of categorical data than theta parameterization (Muthén & Asparouhov, 2002), and weighted least squares estimation was specified to compensate for the non-normal distributions of categorical data (Muthén & Muthén, 1998–2012). To evaluate model fit, the root mean square of error approximation (RMSEA), comparative fit index (CFI), and Tucker-Lewis index (TLI) were assessed according to Hu and Bentler (1999) guidelines. As per the two-step procedure (Anderson & Gerbing, 1988), composite reliability and average variance extracted (AVE) were calculated with the Fornell and Larcker (1981) formulae. Composite reliability indicates the reliability with which a construct is measured and reportedly overcomes several limitations imposed by Cronbach's alpha (Hair, Anderson, Tatham, & Black, 1998).

Predictive validity was assessed with Pearson bivariate correlations between SRQ scores and EMA planned restraint and attempted restraint. Planned restraint was calculated as each participant's mean response to the morning report item asking about intentions to limit smoking during the coming day. Actual restraint was calculated as the percentage of days that participants reported any attempt to restrain their smoking (assessed in the evening report). As these variables were measured using the EMA methodology following completion of the baseline questionnaire, the data are likely to be an accurate reflection of actual behavior and is therefore especially useful in determining predictive validity (Ferguson & Shiffman, 2011; Shiffman & Waters, 2004).

The restraint items (see Table 1) had between zero and five cases missing (0–1.5%) with all considered missing completely at random. Multiple imputation replaced the missing data as per recommendations for factor analysis (Cabrera-Nguyen, 2010). Normality was violated for Item 0b, the only continuous variable ( $p < .001$ ). The data were subjected to square root, cubed root, and logarithmic transformations but no improvement in distribution shape was evident. The variable was retained as entered. Analyses were conducted in SPSS (version 21) and Mplus (Muthén & Muthén, 1998–2012).

## Results

### Psychometric Properties

**Exploratory factor analysis.** The first split-half had a person-to-item ratio of 40.6:1, which is sufficient for statistical power (Pallant, 2011). Of the eight items (see Table 1), three were omitted following Tabachnick and Fidell (2007) guidelines. Two had unacceptable interitem correlations and one item had a loading  $< .32$ . Upon removal of these items, the data met factorability requirements ( $KMO = .73$ ;  $\chi^2$  for Bartlett's test of Sphericity = 304.42,  $p < .001$ ; at least one significant interitem correlation for all variables).

The one-factor model had post extraction communalities ranging from .11 to .72; therefore, no redundancies were indicated. The model explained 51% of the variance and factor loadings ranged from .32 to .85 (see Table 2). Two loadings were meaningful yet poor, and three were excellent (Comrey & Lee, 1992).

**Confirmatory factor analysis and reliability.** The assumption of model overidentification was met as the single factor included more than the required minimum of four items (Brown, 2006). The hypothesized model was a poor fit to the data ( $RMSEA = .17$ ,  $CFI = .96$ ,  $TLI = .92$ ), so the model was respecified by alternatively removing Items 0d and 2. These items were chosen given their conceptual overlap. The best model fit included Item 2, which assessed setting weekly restraint goals ( $RMSEA = .038$ ,  $CFI = .99$ ,  $TLI = .99$ ). This was better than including the item that assessed setting daily restraint goals ( $RMSEA = .13$ ,  $CFI = .98$ ,  $TLI = .93$ ), which is unsurprising given that daily restraint goals may not apply to nondaily smokers. Table 3 reports the standardized and unstandardized model estimates, which were good and supported convergent validity (Brown, 2006). Using the two-step approach (Anderson & Gerbing, 1988), acceptable convergent validity and internal consistency was demonstrated (composite reliability = .74,  $AVE = .42$ ; Malhotra & Dash, 2011).

### Predictive Validity

As good reliability and factor structure was achieved, the predictive capacity of the SRQ was investigated. The predictive validity data were collected each morning and evening over a 3-week period following administration of the baseline questionnaire. As the ecological validity of self-reported EMA data is very good (Serre, Fatseas, Swendsen, & Auriacombe, 2015), correlating

Table 3  
Standardized and Unstandardized Model Parameters From  
Confirmatory Factor Analysis

Item	Standardized model			Unstandardized model		
	Factor loading	Standard error	<i>p</i>	Factor loading	Standard error	<i>p</i>
1	.75	.10	<.001	1	0	.999
2	.53	.08	<.001	.70	.16	<.001
3	.64	.06	<.001	.85	.13	<.001
4	.66	.07	<.001	.88	.17	<.001

daily restraint plans and attempts with SRQ scores was deemed an effective analytical strategy to assessing predictive validity.

To run the correlations, each participant's SRQ score was calculated as the sum of the questionnaire items, where binary items were converted to 1 = no and 5 = yes (final scores could range from 4 to 20; see Appendix). The mean SRQ score was 9.65 ( $SD = 3.80$ ; range = 4–19). As expected, there was a significant positive correlation between SRQ scores and both plans to restrain ( $r^2 = .15$ ,  $p < .001$ ) and percentage of days restrained ( $r^2 = .10$ ,  $p < .001$ ). This means that participants with higher SRQ scores were more likely to plan and attempt to reduce their cigarette intake than participants with lower SRQ scores.

## Discussion

This study developed the SRQ, which is the first known smoking restraint questionnaire. Content validity was achieved via a structured item evaluation procedure that involved a literature review of restraint and examining existing restraint assessment tools. A single factor model was derived in exploratory factor analysis and, following respecification, was supported in confirmatory factor analysis. The final questionnaire was reliable and the hypothesis that SRQ scores would predict plans to restrain over 21-days of EMA was supported. The hypothesis that SRQ scores would relate to attempted restraint over this period was also supported. As a whole, the findings indicate that the SRQ has good predictive validity and psychometric properties.

The SRQ items reflect definitional and operational aspects of restraint in the existing literature. The eating and alcohol literature define *restraint* as a conscious, chronic restriction of intake based on personally set limits (Collins et al., 2000; Keller & Siegrist,

Table 2  
Correlations, Communalities, and Factor Loadings From Exploratory Factor Analysis

Variable	0a	0b	0c	0d	1	2	3	4	Communalities	Factor loadings
0a	—								—	—
0b	-.10	—							—	—
0c	.04	.06	—						—	—
0d	.15	-.03	.18	—					.51	.71
1	.23	-.10	.26		—				.10	.33
2	.10	-.02	.11	.32	.11	—			.72	.85
3	.16	.03	.15	.51	.25	.36	—		.64	.80
4	.16	.001	.45	.34	.37	.17	.30	—	.13	.36

Note. Results are from participants in the first stratified split half. Loadings greater than .30 are considered statistically significant (Brown, 2006).

2014) and repeatedly makes note of individuals both setting plans of allowed intake, and also enacting situationally based behaviors to achieve these goals (Collins & Lapp, 1992; Moreno et al., 2009; Vandereycken & Van Humbeeck, 2008). Similarly, the SRQ includes items related to both planning and situational smoking restraint behaviors. The temporally relevant factor structure of proximal and distal restraint behaviors may inform clinical practice as quitters could be encouraged to set weekly limits on their cigarette intake. For example, a smoker may set a plan to ration or limit smoking, but then fail to resist smoking on any particular occasion. They could still achieve their weekly smoking reduction goal by reattempting restraint later that week. Further, the single factor structure is consistent with existing restraint scales (Fairburn & Beglin, 1994; Ruderman & McKirnan, 1984), suggesting that this new measure is compatible with the literature and may enable further investigation into the restraint construct as it relates to addictive behavior and smoking reduction.

Although smoking restraint is a relatively new concept, the alcohol restraint research identifies the construct to be of clinical importance in drinking reduction and as a potential target for treatment (Jones, Cole, Goudie, & Field, 2011; Tahaney, Kantner, & Palfai, 2014). Indeed, smoking reduction and cessation interventions have found that teaching coping skills improves success rates (van Osch, et al., 2008). This is consistent with observational studies that found that the use of cognitive and behavioral coping strategies is related to successful restraint during cigarette craving (Shiffman, 1982, 1984; Shiffman et al., 1996). Because of the development of the SRQ, research into smoking reduction and cessation may be furthered, as the restraint construct has been successfully operationalized. Major strengths to the SRQ are its brevity, simple scoring procedure, and that it was developed using a large sample of both daily and nondaily smokers. The latter is important given the recent interest in nondaily smoking patterns and the multitude of differences observed between daily and nondaily smokers (Coggins, Murrelle, Carchman, & Heidbreder, 2009; Reitzel, Buchanan, Nguyen, & Ahluwalia, 2014; Shiffman et al., 2014; Shiffman, Tindle, et al., 2012; Sutfin et al., 2012; Tindle & Shiffman, 2011). In addition, the use of 3-week EMA data to analyze predictive validity is a significant strength to this study, as it was demonstrated that SRQ scores relate day-to-day intentions and behaviors.

The correlational strength of SRQ scores and EMA data, however, were relatively modest. This suggests that global questionnaire self-reports of restraint and observed instances of restraint are not strongly related, which is unsurprising given the many influences in smoking behavior, meaning that restraint intentions and behavior are likely to be influenced by the smokers environment among other things. Indeed, global questionnaire measures of smoking motivations and patterns and EMA data were correlated poorly or not at all (Shiffman, 1993), and widely used laboratory measures of cue reactivity were similarly uncorrelated with EMA observations (Shiffman et al., 2015). Thus, the correlations observed here, though limited, were actually stronger than those observed for other measures.

However, this study is not without limitations. The use of split-halves within a single sample in this study provides promising evidence of the utility of the SRQ, but a stronger evidence would come from a study that yielded converging results with a larger, more diverse sample. In addition, the absence of data on

actual smoking reduction or cessation leads to interpretive limitations: Future studies will be necessary to determine whether restraint as measured by the SRQ is predictive of reduction and cessation outcomes.

In conclusion, this study reports the development of the SRQ, a brief self-report questionnaire of smoking restraint for which preliminary evidence suggests there is good psychometric properties and predictive validity. Future researchers may wish to investigate the SRQ's test-retest reliability to determine its capacity to monitor change. In addition, the relationship between smoking restraint and cigarette consumption should be examined as to enhance our understanding of successful cessation and therefore enable improved health outcomes. It is recommended that this be done alongside smoking reduction and cessation programs so that claims regarding the manipulation of restraint may be empirically evaluated.

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### Appendix

#### The Smoking Restraint Questionnaire and Scoring Procedure

	Assigned numerical value				
	1	2	3	4	5
1. Do you ever try to limit the number of cigarettes you smoke?	No				Yes
3. Do you have a limit or target that you set for yourself of how many cigarettes to smoke in a week?	No				Yes
4. Do you plan out or ration your cigarettes for each day or week?	Never	Almost never	Sometimes	Often	Always
5. How often do you deliberately refrain from lighting up a cigarette to keep your smoking rate down?	Never	Less than once per day	1–2 times per day	3–10 times per day	More than 10 times per day

The two binary questions of the Smoking Restraint Questionnaire are scored 1 (*no*) and 5 (*yes*). The two multiple-choice items are scored from 1 to 5.

Total smoking restraint is calculated as the sum of the four items. The minimum possible score is 4 and the maximum possible score is 20.

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