

# Self-Administered Web-Based Timeline Followback Procedure for Drinking and Smoking Behaviors in Young Adults

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**ABSTRACT. Objective:** The goal of the current investigation was to test the psychometric properties of a self-administered web-based version of the Timeline Followback (TLFB), a retrospective calendar method of assessing daily behaviors. **Method:** The study used a within-subjects, counterbalanced design to compare estimates of daily drinking and smoking behaviors obtained by a self-administered web-based version of the TLFB with estimates obtained by a telephone interview version. The sample consisted of 120 social drinker-smoker young adults (65 men). **Results:** Correlations between the two modalities for total number of drinks, total drinking days, and heavy drinking days in a 4-week period ranged from .83 to .93; those for total cigarettes, total

smoking days, and heavy smoking days ranged from .90 to .95. The correlation between the two modalities for estimates of the number of co-use days was .90. Drinking and smoking estimates from the online TLFB also correlated significantly with scores from the Alcohol Use Disorders Identification Test and Fagerström Test of Nicotine Dependence. **Conclusions:** Overall, the results demonstrated strong support for the use of a self-administered web-based TLFB assessment tool to capture concurrent reports of social drinking and smoking behaviors in young adults. The web-based TLFB may be particularly well suited for assessment in clinical trials, longitudinal designs, and epidemiological studies. (*J. Stud. Alcohol Drugs*, 73, 829–833, 2012)

THE TIMELINE FOLLOWBACK (TLFB) is an interview-based assessment that was developed by Sobell et al. (1986) to derive subjects' retrospective daily estimates of alcohol consumption patterns. Using a calendar as a visual aid, special events, and other memory cues, subjects are guided through the process of recalling and reporting daily drinking estimates. The TLFB has been shown to be psychometrically sound across a range of populations (see Sobell and Sobell, 1992, for a review), including nonalcoholic social drinkers (Sobell et al., 1986) and persons with a diagnosis of alcohol abuse or dependence (Searles et al., 2000; Sobell et al., 1979). There is also strong psychometric support for its use in a group administration (Pedersen and LaBrie, 2006), as well as to assess a range of behaviors other than drinking, including cigarette smoking (Brown et al., 1998; Gariti et al., 1998), cigarette smoking and alcohol drinking simultaneously (Duhig et al., 2005), illicit substance use (Fals-Stewart et al., 2000; Levy et al., 2004), binge eat-

ing (Bardone et al., 2000), and sexual behavior (Schroder et al., 2007). In the majority of these studies, the TLFB has been validated when administered as an in-person interview. But some studies have used other validated versions, such as a telephone interview (Brown et al., 1998), a self-report paper-and-pencil questionnaire (Pedersen and LaBrie, 2006), or a computerized questionnaire with an administrator present (Sobell et al., 1996).

In the last decade, there has been growing interest in web-based assessments of alcohol and substance use. Although studies typically use general quantity–frequency estimation methods of consumption (Kypri et al., 2004; Miller et al., 2002), some more recent studies have used the TLFB procedure (Bingham et al., 2010; Lee et al., 2009). Two studies to our knowledge have demonstrated psychometric support for the use of a web-based TLFB. However, one used only a 7-day recall period for alcohol drinking, and psychometric evidence was limited to test–retest comparison using the same modality (Thomas and McCambridge, 2008), whereas the other focused exclusively on college students (Pedersen et al., 2012). Thus, the investigation of an online TLFB with a longer recall period and a more heterogeneous sample would add support to the use of a web-based TLFB.

The purpose of the current study was to test the psychometric properties of a self-administered, online version of the TLFB (TLFB-O) recently developed by our group and to compare them with those of a validated telephone version of the TLFB (TLFB-T; Maisto et al., 2008). Both versions

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were used to assess daily estimates of drinking and smoking behaviors for the past month in a sample of young adult co-users. It was predicted that the TLFB-O would demonstrate (a) evidence of reliability, as indexed by large, significant positive correlations of drinking and smoking quantity and frequency estimates with the TLFB-T; (b) significant, positive correlations of co-use of alcohol and cigarette estimates with the TLFB-T; and (c) evidence of concurrent validity, as measured by moderate, but significant, positive correlations with scores of related but distinct constructs using the Alcohol Use Disorders Identification Test (AUDIT; Babor et al., 1989) and the Fagerström Test of Nicotine Dependence (FTND; Heatherton et al., 1991).

## Method

### *Participants and procedures*

The study was fully approved by the University of Chicago Institutional Review Board. Healthy young adults were recruited through local advertisements on the Internet and by word-of-mouth referrals. Inclusion criteria were age between 18 and 29 years, self-reported consumption of at least one alcoholic beverage and one cigarette on a weekly basis, and no history of treatment for alcohol use disorders. To determine initially if study candidates were eligible, they completed an online application, including the AUDIT and FTND, with estimates of typical alcohol and cigarette use; this was followed by telephone interview to further verify eligibility and to obtain verbal consent. Of the participants who consented and initially enrolled in the study, 85% (120 / 141) completed both online and telephone TLFB administrations within the allotted window of time, thereby constituting the final sample.

Participants completed the TLFB for alcohol drinking and cigarette smoking in the past month, using both online and telephone modalities. Consistent with prior studies, both administrations were completed within a 3- to 7-day interval (Levy et al., 2004; Pedersen and LaBrie, 2006). To reduce expectancy effects, participants were told that they would be completing various surveys related to their drinking and smoking behaviors, either by telephone or online, but they were not informed that they would be completing the same survey using two modalities. To reduce order effects, administration of each modality was counterbalanced.

### *Measures*

*Timeline Followback—Telephone.* The TLFB-T is an interview based on the instructions for the paper-and-pencil TLFB (Sobell and Sobell, 1996). It has demonstrated strong psychometric properties, including strong correlations with in-person interviews ( $r_s = .77-.90$ ; Sobell et al., 1996) and excellent test-retest reliability ( $\rho = .96$ ; Maisto et al., 2008)

when used to gather estimates of daily alcohol use over a 1-month followback interval. Telephone interviews were conducted by experienced research assistants trained in the administration of the TLFB as described in the user's manual (Sobell and Sobell, 1996) and previous studies using the TLFB by telephone (Maisto et al., 2008). A script was developed, based on the instructions in the user's manual, including a clear definition of the exact dates of the time frame and prompts to highlight the memory cues typically used with the TLFB. All interviews were tape recorded, and a random sampling of 20% of the interviews was used for fidelity checks conducted by the first author. Interviewers averaged 99% adherence to the script. The interviews took between 10 and 20 minutes to complete.

*Timeline Followback Interview—Online.* The TLFB-O is a web-based version of the computerized TLFB (Sobell and Sobell, 1995). With permission from the developers of the computerized TLFB (L. Sobell, personal communication, February 18, 2011) and technical assistance from the information technology department at the University of Chicago, we developed a fully automated, web-based version of the computerized TLFB for use on the Internet. Instructions for the TLFB-O were based on instructions for the paper-and-pencil version and included prompts to enter special events into the calendar and reminders to use these events as memory cues, as well as encouragement to offer best estimates. The online modality took approximately 15–25 minutes to complete.

*Alcohol Use Disorders Identification Test.* The AUDIT is a psychometrically sound, 10-item self-report scale that assesses the quantity and frequency of alcohol use and alcohol-related consequences. Scores range from 0 to 40, with scores greater than or equal to 8 indicating harmful drinking behavior (Babor et al., 1989). The internal consistency for the current sample was  $\alpha = .83$ .

*Fagerström Test of Nicotine Dependence.* The FTND is a psychometrically sound, six-item self-report scale that assesses the level of nicotine dependence. Scores range from 0 to 10, with scores of 5 or greater indicating significant nicotine dependence (Heatherton et al., 1991). The internal consistency for the current sample was  $\alpha = .79$ .

### *Plan of analysis*

Both TLFB assessments included the past 35 days to ensure four complete Sunday-to-Saturday weeks for analyses. Dependent variables were aggregate totals for 28 consecutive days and weekly totals for quantity (number of drinks and cigarettes), frequency (number of drinking and smoking days), heavy use frequency (number of days with five or more drinks for men, four or more for women [Substance Abuse and Mental Health Services Administration, 2005] and 10 or more cigarettes per day [Brown et al., 1998]), and the number of co-use days. To test the reliability of the web-based TLFB, paired-samples *t* tests and correlational

analyses were used to compare TLFB-T and TLFB-O modalities. The validity of the TLFB-O was tested by investigating the relation between drinking and smoking scores from each of the two versions of the TLFB with the total AUDIT and FTND. Analyses were conducted with both Spearman's  $\rho$  and Pearson's  $r$ , and results were very similar. Thus, we report  $r$  because it is more powerful when data are normally distributed yet robust to violations in normality (Havlicek and Peterson, 1977).

## Results

The final sample ( $n = 120$ ; 54% male) was 75% White, 13% African American, 8% Asian, and 4% other, with 15% reporting Hispanic ethnicity. The average age was 23.5 years ( $SD = 2.6$ ; range: 18–29). The sample had diverse drinking and smoking patterns:  $M_{\text{drinks per week}} = 18.74$  ( $SD = 47.57$ ; range: 3–126),  $M_{\text{cigarettes per week}} = 43.67$  ( $SD = 47.57$ ; range: 2–210),  $M_{\text{drinking days per week}} = 3.18$  ( $SD = 1.52$ ; range: 1–7), and  $M_{\text{smoking days per week}} = 5.17$  ( $SD = 2.24$ ; range: 1–7). Mean score on the AUDIT was 13.3 ( $SD = 7.2$ ; range: 2–33) and on the FTND was 2.5 ( $SD = 2.7$ ; range: 0–9). Independent-samples  $t$  tests demonstrated no significant differences in demographics or drinking- or smoking-related behaviors between participants randomized to TLFB-O versus TLFB-T as first administration ( $t_s < 1.50$ ,  $p_s > 0.14$ ).

Aggregate monthly totals for the main alcohol and smoking behaviors using the TLFB-T and TLFB-O, and

correlations between the two modalities, are presented in Table 1. Results show that participants averaged drinking on nearly half the days of the month and smoking on more than two thirds of the days. About half of those days involved heavier use of alcohol and cigarettes. Correlations between TLFB-T-derived and TLFB-O-derived monthly aggregate estimates of alcohol and smoking behaviors were large for all drinking and smoking variables, as well as the number of co-use days ( $r_s$  ranged from .83 to .95; Table 1). Table 1 also depicts weekly quantity estimates and shows that the average numbers of drinks and cigarettes were consistent across the 4 weeks. Correlations of the numbers of drinks and cigarettes assessed on a weekly basis using the two modalities were moderately large to large:  $r_s$  ranged from .75 to .95 (Table 1). Correlations for weekly frequency estimates also were moderately large to large:  $r_s$  ranged from .72 to .83 for drinking days, .63 to .76 for heavy drinking days, .77 to .90 for smoking days, and .91 to .93 for heavy smoking days. Finally, paired-samples  $t$  tests demonstrated no significant mean differences in monthly aggregate measures or weekly averages of drinking or smoking from the TLFB-O compared with the TLFB-T.

Correspondence between the two modalities also was compared by levels of use. Heavy drinkers were operationally defined as those who consumed 10 or more drinks per week with one or more heavy drinking episode (five or more standard drinks for men/four or more for women) per week ( $n = 67$ ), and heavy smokers were operationally defined as

TABLE 1. Drinking and smoking outcomes from the TLFB-T and TLFB-O

| Variable                              | TLFB-T |        | TLFB-O |        | $r$    |
|---------------------------------------|--------|--------|--------|--------|--------|
|                                       | $M$    | $SD$   | $M$    | $SD$   |        |
| Aggregate monthly totals <sup>a</sup> |        |        |        |        |        |
| Drinks consumed                       | 73.03  | 66.28  | 73.76  | 61.43  | .93*** |
| Cigarettes smoked                     | 194.00 | 225.63 | 184.90 | 196.17 | .95*** |
| Drinking days                         | 12.89  | 7.07   | 13.10  | 7.03   | .89*** |
| Smoking days                          | 20.88  | 9.25   | 21.18  | 8.78   | .90*** |
| Heavy drinking days                   | 6.89   | 5.31   | 7.03   | 5.21   | .83*** |
| Heavy smoking days                    | 8.22   | 11.21  | 8.19   | 11.41  | .95*** |
| Co-use days                           | 11.72  | 7.57   | 11.95  | 7.41   | .90*** |
| Weekly totals <sup>b</sup>            |        |        |        |        |        |
| Drinks consumed                       |        |        |        |        |        |
| Week 1                                | 17.53  | 17.20  | 18.63  | 16.98  | .75*** |
| Week 2                                | 18.72  | 17.74  | 19.35  | 17.21  | .88*** |
| Week 3                                | 18.09  | 18.22  | 17.93  | 16.04  | .88*** |
| Week 4                                | 18.70  | 20.84  | 17.86  | 17.85  | .86*** |
| Cigarettes smoked                     |        |        |        |        |        |
| Week 1                                | 57.86  | 57.61  | 45.57  | 49.00  | .92*** |
| Week 2                                | 48.64  | 56.97  | 47.04  | 50.11  | .93*** |
| Week 3                                | 49.08  | 57.25  | 46.18  | 48.58  | .92*** |
| Week 4                                | 48.41  | 56.32  | 46.11  | 50.95  | .95*** |

Notes: TLFB-T = Timeline Followback telephone interview; TLFB-O = Timeline Followback online survey; heavy drinking days = days with five or more alcoholic drinks consumed for men, four or more for women; heavy smoking days = days with 10 or more cigarettes; co-use days = days with both alcohol and cigarette use. <sup>a</sup>Aggregate monthly totals were calculated over the 28 days (4 Sunday-to-Saturday weeks) that overlapped between the two modalities; <sup>b</sup>weeks of the TLFB were calculated backwards, starting from the week closest to the TLFB administration—therefore, Week 1 = Sunday through Saturday closest to the date of TLFB administration.

\*\*\* $p < .001$ .

daily smokers who smoked 10 or more cigarettes per day ( $n = 34$ ). Results demonstrated strong, statistically significant correlations (all  $ps < .001$ ) for aggregate monthly totals on alcohol consumption, drinking days, and the number of heavy drinking days for heavy drinkers ( $rs = .92, .87$ , and  $.87$ , respectively) and light drinkers ( $rs = .85, .88, .73$ , respectively). Results were similar with the number of cigarettes, smoking days, and heavy smoking days for heavy smokers ( $rs = .88, .63$ , and  $.90$ , respectively) and light smokers ( $rs = .94, .91, .86$ , respectively) (all  $ps < .001$ ). The correlation for the number of smoking days for heavy smokers became comparable to other variables ( $r = .86$ ) after removal of an extreme outlier.

Concurrent validity of the online TLFB was assessed with a comparison of TLFB drinking and smoking estimates with the total AUDIT and FTND scores. Correlations between the total AUDIT score and the estimate of total drinks using the TLFB were statistically significant for both versions ( $r = .32$  for both TLFB-O and TLFB-T,  $p < .001$ ). Similarly, the correlations between the total FTND score and the estimate of the total number of cigarettes using the TLFB were statistically significant for both versions ( $r = .69$  for both TLFB-O and TLFB-T;  $p < .001$ ). These results support our third hypothesis—that TLFB-O results would be positively correlated with scores from the AUDIT and the FTND—and the results demonstrate evidence for the validity of the TLFB-O.

## Discussion

The current study demonstrated strong psychometric properties for a self-administered, web-based version of the TLFB for concurrent assessment of alcohol and smoking behaviors. Daily estimates of drinking and smoking for the past month were assessed in a sample of young adult co-users, using a telephone interview (TLFB-T) and an online survey (TLFB-O). Results supported all hypotheses in demonstrating reliability and validity evidence, including strong, significant positive correlations of drinking and smoking quantity and frequency estimates, as well as co-use patterns, between modalities, and significant positive correlations with scores on the AUDIT and the FTND. These results add to the support for the use of a web-based TLFB (Pederson et al., 2012) and could facilitate the growing research on the co-use of alcohol and cigarettes (King et al., 2008).

There were many strengths in the current investigation, including a within-subject, counterbalanced design. This allowed for a comparison of retrospective reports of drinking and smoking across two modalities for the same individuals while controlling for expectancy effects. In addition, liberal inclusionary criteria allowed for a range of social drinking and smoking patterns in participants between ages 18 and 29 years. Thus, these results offer confidence for the use of the web-based version in young adults with variability in social drinking and smoking patterns. However, generalizability

cannot be extended to other populations, such as older participants who may not be as comfortable with the Internet. In addition, although the sample size was large enough for correlational analyses to demonstrate statistical significance, replication on a larger sample would offer more confidence in the findings. Furthermore, the 3- to 7-day interval for completing both surveys was brief, and although this is consistent with prior literature (Levy et al., 2004; Pedersen and LaBrie, 2006), confidence in the findings could be strengthened by using a longer test-retest interval.

The present findings are pertinent only to aggregate measures but do not necessarily support equivalence of modalities at the daily report level. However, previous studies have found significant differences in day-to-day correspondence rates (Carney et al., 1998; Searles et al., 2000), which suggests that the TLFB is best used with aggregate measures. Finally, the current investigation did not include monitoring of actual drinking and smoking behaviors, the use of ecological momentary assessment, or the use of a collateral to verify subjects' consumption to support the self-reported and retrospective reports on the TLFB. Although the validity of the TLFB based on comparisons with daily reports has been established for both alcohol (Searles et al., 2000; Toll et al., 2006) and cigarettes (Toll et al., 2005), future studies should continue to compare the benefits of using real-time versus retrospective estimates.

The results of this study support the use of a self-administered, web-based version of the TLFB to capture both drinking and smoking behaviors over a 1-month recall period in a young adult population with varied drinking and smoking behaviors. The online version reduces the travel burden for participants and data collection time for researchers. With the growing ubiquity of the Internet and computer availability, the use of web-based assessment tools will be an increasingly viable option in many populations. A web-based TLFB may be particularly useful in large-scale studies and in longitudinal studies that entail multiple follow-ups with subjects who are no longer in the same geographic location.

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