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The Feasibility of Using Cellular Phones to Collect Ecological Momentary Assessment Data: Application to Alcohol Consumption

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The limitations of paper-and-pencil self-monitoring (PM) are leading to the use of more sophisticated techniques. PM was compared with cellular phone monitoring (CM) to collect ecological momentary assessment data on alcohol use. Twenty social drinkers were randomly assigned to the 2 groups, and their drinking was monitored for 14 days. PM participants recorded data on cards. CM participants carried telephones and responded to an interactive voice response system. The authors found few significant group differences in alcohol use, compliance with the self-monitoring, and satisfaction. However, CM had useful advantages, including instantaneous entry of data into a central database, date and time stamping of data, and easy integration into daily life. Although preliminary, this study suggests that CM is a promising alternative to PM.

Paper-and-pencil self-monitoring (PM) is a common technique for gathering data on behaviors such as drinking and internal states such as mood. In PM, participants enter data on cards or diaries whenever the target behavior occurs. Although PM has the limitation of relying on self-report, it usually proves as effective, or more effective, than other traditional methods of measuring alcohol consumption (Carney, Tennen, Affleck, Del Boca, & Kranzler, 1998; Samo, Tucker, & Vuchinich, 1989; Sobell, Bogardis, Schuller, Leo, & Sobell, 1989). Studies suggest that PM is a relatively nonreactive way of measuring alcohol intake, particularly for social drinkers (Sobell et al., 1989; Vuchinich, Tucker, & Harllee, 1988). Finally, PM of alcohol intake has demonstrated construct validity in comparison with biochemical indices (Sanchez-Craig & Annis, 1982) and behavioral observations (Strickler, Bradlyn, & Maxwell, 1981).

Despite its advantages for collecting self-report information, PM has limitations that are not easily addressed, including (a) the possibility of poor compliance or faked data (e.g., no assurances of when assessments were completed); (b) deficient data (e.g., missing data, ambiguous responses); and (c) the inability to provide base-rate data as a context for understanding the target behavior being monitored (Shiffman & Stone, 1998). This last issue is important in establishing associations between potential antecedents (e.g., mood) and the target behavior. Thus, despite a long tradition of PM, its limitations have led to the development and use of more sophisticated self-report techniques.

One of the most sophisticated alternatives to PM is computerized ecological momentary assessment (EMA; Shiffman & Stone, 1998), in which participants interact with small, hand-held computers to initiate entries of the occurrence of a target behavior such as drinking and respond to random prompts that provide base-rate information (Collins et al., 1998; Shiffman et al., 1997; Shiffman & Stone, 1998). The advantages of EMA techniques are as follows: (a) Data are collected in real time in response to a standard interview; (b) compliance cannot be faked because each entry is tagged with a date and time; (c) compliance can be tracked because failures to respond to random prompts are tagged and stored; and (d) participants cannot skip items but must complete a standard interview, thereby providing quality control of data (Shiffman & Stone, 1998). EMA techniques have been applied to the self-monitoring of a variety of behaviors, clinical symptoms, and internal states. Applications to alcohol research have focused on such topics as the assessment of drinking behavior (Carney et al., 1998), behavioral training to moderate alcohol intake (Collins et al., 1998), reactivity to alcohol cues (Litt, Cooney, & Morse, 2000), and the role of mood in alcohol consumption (Swendsen et al., 2000).

Computerized EMA necessitates comprehensive training of participants, weekly in-person contact to download data and change batteries, as well as extensive data management and programming costs. Technical problems, including the loss of data, can occur if the computers are not used appropriately. Our experience with this approach to EMA (e.g., Collins et al., 1998) suggested that the benefits of EMA could be retained while lessening some of its drawbacks by

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using interactive voice response (IVR) systems. In IVR, a central computer is programmed to accept telephone calls and administer verbal interviews or other forms of information (Alemagno & Butts, 1995). Interviews often use a multiple-choice format, to which the participant responds by pressing a number on the telephone keypad. Compared with PM, IVR is said to have many advantages, including (a) the direct entry of data, which reduces or eliminates coding and data entry and related costs; (b) the flexible delivery of questions based on programmed skip patterns; (c) the capability to perform automated follow-ups; (d) reliability, including the tracking of when data were entered; and (e) participants' improved willingness to disclose sensitive information (Alemagno & Butts, 1995). In addition, IVR provides the opportunity to monitor participants' compliance with the research protocol on an ongoing basis so that more immediate corrective feedback can be given to them if needed. IVR has been applied successfully to the daily assessment of drinking (Mundt, Perrine, Searles, & Walter, 1995; Searles, Helzer, & Walter, 2000; Searles, Perrine, Mundt, & Helzer, 1995) and to areas ranging from the assessment and treatment of anxiety disorders (Bachofen et al., 1999; Baer & Greist, 1997) to monitoring and intervening to change eating habits (Delichatsios et al., 2001). All of these studies have used IVR paired with standard (i.e., noncellular) telephones. To our knowledge, the current study is the first to pair IVR with the use of cellular telephones (i.e., cellular monitoring [CM]), thereby coupling the advantages of IVR with those of computerized EMA to provide a mobile and flexible way to collect self-reports in a variety of contexts. If it is proved to be feasible, CM's flexibility and other data entry features could make it a useful technique for enhancing our understanding of the episode-specific precursors, correlates, and consequences of drinking. In short, the use of CM could improve on some of the limitations of PM, which currently serves as the most common approach to collecting self-monitoring data on drinking.

In the current preliminary study, we explored the feasibility of collecting EMA data using cellular telephones and IVR technology (CM) by comparing it with traditional PM. Participants were randomly assigned to CM or PM as a way to monitor drinking and related phenomena. We compared the use of these two self-monitoring procedures in a number of areas, including alcohol consumption (e.g., number of episodes, number of drinks), situational aspects of drinking (e.g., location, activities), compliance with the self-monitoring protocol (e.g., at random moments, at the start of each day, in drinking situations), as well as participants' satisfaction with the data collection procedures.

Method

Participants

Young adult social drinkers ($n = 20$; 7 men, 13 women) were recruited using print advertisements in community and college newspapers. They were screened for inclusion criteria, including minimum age of 21 years, which is the legal drinking age in the state of New York (participant age range = 21–32 years); minimum weekly drinking in the moderate range (4–11 drinks/week); no previous medical diagnosis or treatment for alcohol or other drug problems; no medical contraindications to alcohol use; and no drinking-related legal consequences. The sample (see Table 1) consisted of young adults (mean age = 24.55 years, $SD = 3.83$ years) who were predominantly single ($n = 17$, 85%) and self-identified as European American ($n = 14$, 70%). All participants had at least completed high school, and approximately 40% of the sample were college age (i.e., 22 years of age or younger). Each participant received $25 for each of the 2 weeks in the study, for a total of $50.

Questionnaires

General Information Questionnaire (GIQ). The GIQ was completed at the start of the study. It assessed demographic information (e.g., age, ethnicity, marital status), drinking-related variables (e.g., average daily quantity and frequency rates, age of first alcohol consumption), alcohol-related consequences (e.g., nausea, arrest for driving while intoxicated), and illicit drug use. The GIQ has been used in our previous research (Collins, Koutsky, & Izzo, 2000; Collins & Lapp, 1991).

Modified Alcohol Effects Questionnaire (MAEQ; Collins, Lapp, Emmons, & Isaac, 1990). The MAEQ contains eight factors: Six assess beliefs about positive effects of alcohol (e.g., social expressiveness) and two assess beliefs about negative effects (e.g., cognitive and physical impairment). Participants endorse (agree/disagree) items and indicate the strength of their beliefs on a Likert scale ranging from 1 (*mildly believe*) to 10 (*strongly believe*). Endorsements were summed to derive a score for each factor.

Consumer satisfaction. After completion of the 2 weeks of self-monitoring, participants completed a questionnaire designed to assess their experience in the study. Parallel items were listed for the CM and PM conditions. Each of the 14 items was rated on a 5-point Likert scale. The items assessed the ease of using the phone/cards (5 questions), intrusiveness of the monitoring phone/cards (4 questions), and the participant's success in adhering to the monitoring protocol (5 questions).

Procedures

Those who met screening criteria were randomly assigned to either the CM or PM condition. Each participant received 20–30 min of individualized training in the self-monitoring of drinking and related activities on either a cellular phone or special cards. They were provided with monitoring materials (cell phone or cards) and instructed to use them as they engaged in their typical daily activities.

CM. Participants carried the cellular phones at all times and, when appropriate, used them to call the IVR software on a central computer. The IVR system provided a verbal menu of recorded options/interviews to which the participant responded when randomly prompted or upon initiating an interview. The IVR system consisted of programmable software (SpeechMaster; Speechsoft) and a computer telephony voice board (Dialogic). The software was programmed to administer four types of interviews patterned on those used in our previous EMA research (Collins et al., 1998): a morning interview (20 questions), a before-drinking interview (32 questions), an after-drinking interview (26 questions), and a random telephone prompt interview (28 questions). The typical phone interview took less than 10 min to complete. Each question included a multiple-choice response set ranging from two to nine choices, which corresponded to the numbers on the telephone keypad. In addition, error-trapping loops were built into the inter-

Table 1
Demographic and Substance Use Variables

Variable	Cellular phone (n = 10)	Paper-and-pencil (n = 10)	Group comparisons
Demographics			
Age (mean years)	24.90	24.20	$t(18) = 0.40$
Gender			$\chi^2(1, N = 20) = 0.22$
Male	4	3	
Female	6	7	
Marital status			$\chi^2(1, N = 20) = 0.39$
Single	8	9	
Married	2	1	
Ethnicity			$\chi^2(3, N = 20) = 3.33$
European American	7	7	
African American	1	2	
Asian American	2	0	
Hispanic American	0	1	
Average drinking and substance use in past month			
Alcohol	3.40	3.90	$t(18) = -2.61$*
Marijuana	2.10	1.80	$t(18) = 0.70$
Caffeine	3.10	3.40	$t(18) = -0.59$
Cigarettes	3.00	1.50	$t(18) = 3.00$**
Alcohol consumption during 14-day monitoring period			
Total no. of episodes	46	47	
Drinks per episode (M)	4.00	4.15	$t(87) = 0.29$
Total drinks	184	195	
Binge drinking episodes	16/38 (42%)	17/45 (38%)	$\chi^2(1, N = 83) = 0.16$

Note. Total number of drinking episodes is based on predrinking interviews. Average number of drinks per episode is based on postdrinking interviews. Binge drinking episodes are defined as five or more drinks in a single episode. Past month average drinking and substance use is based on ratings (1 = *never used*, 2 = *rarely used*, 3 = *occasionally used*, 4 = *regularly used*) from the General Information Questionnaire.
* $p < .05$. ** $p < .01$.

view, such that if participants were to press a key outside the possible range of responses for a particular question, the system would issue an alert and readminister the question. Participants were instructed to call the IVR system at the start of each day. After entering a three-digit identification number, they completed the morning interview. This and the other interviews were initiated at the discretion of the participants, with the exception of the random telephone prompt interview.

Using a separate phone-dialing program, participants received four separate telephone prompts (rings) randomly distributed throughout each day. The program dialed the cell phone number, rang once, and hung up. This signal required participants to call the IVR system and respond to the telephone prompt interview. If they were unable to respond immediately, they were required to do so at the earliest opportunity. Random prompts were programmed to occur no earlier than 1 hr after the morning interview and no later than 11:00 p.m. No two prompts were initiated within 2 hr of each other. All calls to the IVR system were date and time stamped and, together with the interview responses, were recorded and collected in a database file. To ensure that cellular phones were used only for the purposes of the study, we blocked all dial-out numbers other than to the IVR system and the research project, and participants were not provided with the number for their phones.

PM. After individualized training, each participant was provided with 14 sets of monitoring cards and 14 stamped, self-addressed envelopes (one set of cards and one envelope for each day of participation in the study) with which to mail her or his daily reports. The PM cards contained written versions of the CM interviews and were color coded (e.g., blue for before and after drinking, yellow for morning interview) so that they could easily be identified. Participants were instructed to (a) begin each day with a new card and complete the morning interview; (b) complete four other reports at random during the day, recording what was going on in their lives at that moment; (c) complete a report just before and just after each episode of drinking; (d) each morning mail all the cards completed during the previous day.

To analyze and present our data, we generated descriptive statistics (means and percentages) of the variables of interest. To compare the two groups, we used the appropriate test of comparison based on whether the variable was continuous (t tests) or dichotomous (chi-square).

Results

Equivalence of Groups

We conducted t tests in salient domains to determine whether random assignment to the CM (n = 10) and PM (n = 10) conditions had resulted in similar groups. Group comparisons were conducted on demographic variables (e.g., age, ethnicity, marital status, education) and typical drinking and substance use practices (see Table 1). There were no significant group differences on demographic vari-

ables. We found only two group differences on use of substances: Compared with the PM group, the CM group reported significantly greater cigarette use in the past month, $t(18) = 3.00$, $p < .01$, and significantly less alcohol use in the past month, $t(18) = 2.61$, $p < .05$. We also examined group differences in alcohol expectancies (MAEQ) and found no significant group differences on any of the subscales. After Bonferroni adjustments, none of the group differences was significant.

Alcohol Consumption

We sought to accommodate the variations in how people drink and instructed participants to define a drinking episode by considering such factors as changes in the time of day, their location, and activity (cf. Collins et al., 1998). During the 2-week monitoring period, the CM and PM groups reported similar numbers of drinking episodes and a comparable number of total drinks consumed (see Table 1). The number of episodes per CM participant ranged from 0 to 15, and per PM participant, from 2 to 13. Participants consumed an average of four drinks per episode; however, almost 40% of the drinking episodes involved binge drinking (i.e., ≥five drinks/episode). There were no significant group differences in number of drinks consumed per episode or in rate of binge drinking (see Table 1).

Situational Aspects of Drinking

For each episode of drinking, participants were instructed to identify the locations where they drank (e.g., bar, home) and their primary reasons for drinking (e.g., social pressure, feeling good). Most of the participants in the CM group indicated that they were socializing when drinking (84.1%) and that they were drinking in someone else's home (31.8%). They primarily drank either "just because" (34.9%) or "to feel good" (23.3%). Most of the participants in the PM group indicated that they were socializing when drinking (83%) and that they were drinking at home (40.4%). They also drank either "just because" (40.4%) or "to feel good" (14.9%).

Compliance With the Self-Monitoring Protocol

Compliance with the EMA procedures was measured differently based on whether the interview was prompted by the IVR system (possible for the CM group only) or initiated by the participant. All participants were instructed to initiate a morning interview as well as matched before- and after-drinking interviews. The time between the occurrence of the target behavior and the interview served as an indicator of compliance with the self-monitoring protocol. For example, initiating an after-drinking interview within 1 min of completing a drinking episode was seen as better compliance than initiating that interview 15 min after completing the episode. Group descriptive data on each type of interview are presented in Table 2.

Table 2
Descriptive Data on Compliance of Cellular Telephone and Paper-and-Pencil Monitoring Groups

Assessment	Cellular phone ($n = 10$)	Paper-and-pencil ($n = 10$)
Random prompts (total)	517	522
No missing data	5	6
Missed <10	1	3
Missed 10–20	1	0
Missed 20–30	1	1
Missed >30	2	0
Morning interviews (total)	113	131
No missing data	2	7
Missed 1–4 days	4	2
Missed 5–8 days	3	1
Missed 9 or more days	1	0
Before-drinking interviews (total)	47	47
No missing data	8	10
Missed 1	1	0
Missed 2	1	0
Missed 3	0	0
After-drinking interviews (total)	44	45
No missing data	7	9
Missed 1	2	0
Missed 2	0	1
Missed 3	1	0

Note. Based on the reported times of interview completions, pre- and postdrinking interviews were matched for 80 drinking episodes.

Random prompts. Although computer-generated random prompting only could take place for the CM group, we instructed PM participants to randomly choose 4 times each day to report on their current experiences. During the 14-day self-monitoring period, the 10 CM participants received an average of 4 random prompts per day, resulting in a potential of 560 prompts. We collected data for 544 (97%) random prompts. However, because of a system error, 27 random prompts had to be dropped, resulting in 517 (92%) viable CM random-prompt interviews. The PM group could generate a potential of 560 self-selected random prompts outside of drinking episodes. They completed a total of 522 (93%) viable random interviews.

Morning interviews. During the 14-day monitoring period, a potential 140 morning interviews could be collected per group. Compared with the PM group (131 interviews, 94%), the CM group (113 interviews, 81%) reported significantly fewer morning interviews, $t(287) = 3.26$, $p < .001$, indicating that they were less compliant with instructions to initiate a morning interview. In addition, there were a few significant group differences in reporting drinking episodes from the previous day. Compared with the PM group, the CM group indicated a greater number of reported drinking episodes the previous day, $\chi^2(2, N = 232) = 27.53$, $p < .001$, and a greater failure to report drinking episodes the previous day, $\chi^2(2, N = 230) = 146.47$, $p < .001$. The CM group also indicated a greater number of unreported drinks the previous day, $t(40) = 2.51$, $p < .05$.

Drinking episodes. Participants were instructed to initiate an interview immediately before and after each episode of drinking. Eight of the 10 CM participants completed 47 before-drinking interviews and 44 after-drinking interviews.

The IVR date and time stamping of data indicated that 75% ($n = 35$) of these before- and after-drinking interviews corresponded to the same episode. The 10 PM participants completed 47 before-drinking interviews and 45 after-drinking interviews, resulting in a match for 96% ($n = 45$) of the drinking interviews. Compared with the PM group, the CM group was significantly less compliant in reporting drinking episodes, $t(92) = 3.00$, $p < .01$.

A few group differences emerged for the reported time drinking interviews were completed. For before-drinking interviews, the CM group reported consuming more drinks before completing the interview than the PM group (CM, $M = 1.24$ drinks; PM, $M = 0.42$ drinks), $t(64) = 3.07$, $p < .005$. For after-drinking interviews, the PM group reported a longer time lapse before completing interviews than the CM group, $\chi^2(2, N = 89) = 10.49$, $p < .05$. For the CM group, 24% of drinking episodes were reported within 1 min of finishing drinking, 33% within 2–5 min, 7% within 6–15 min, and 14% within 16–30 min; 21% were completed 30 min or longer more after a drinking episode. For the PM group, 6% of drinking episodes were reported within 1 min of finishing drinking, 21% within 2–5 min, 23% within 6–15 min, and 21% within 16–30 min; 28% were completed 30 min or longer after a drinking episode.

Ease of Self-Monitoring

At the end of the 14-day self-monitoring period, all participants completed a 14-item consumer satisfaction questionnaire assessing their reactions to the self-monitoring technique to which they were assigned. Generally, both groups reported high satisfaction with their experience. Only two group differences emerged. Compared with the CM group, the PM group reported greater difficulty remembering to complete morning interviews, $t(18) = 2.31$, $p < .05$. However, they saw themselves as more successful overall, $t(18) = 2.32$, $p < .05$.

Discussion

We have demonstrated that cellular telephones can be used to collect EMA data effectively. During a 14-day period, social drinkers who were randomly assigned to use cellular phones and IVR versus paper-and-pencil techniques to self-monitor drinking reported similar numbers of drinking episodes and levels of alcohol intake. They also reported drinking in similar situations (e.g., socializing in homes) and for similar reasons (e.g., "to feel good").

Overall, the CM and PM participants reported high and somewhat comparable levels of compliance with responding to random prompts, initiating morning interviews, and reporting on drinking episodes (cf. Collins et al., 1998; Shiffman et al., 1997). Although in some cases the PM group seemed to perform better, their seemingly better performance must be considered in the context of a major limitation of PM: the lack of date and time stamping of data with which to verify data entry. For example, the CM group failed to initiate an after-drinking interview in 25% of cases compared with the PM group's relatively low (4%) level of failure rate. Even so, it is our view that having some information to verify the data entry for 75% of the CM cases represents an improvement over having unverifiable data entry for 96% of the PM cases.

The date and time stamping of CM data, particularly responses to random prompts, increases our confidence in verifying compliance with certain aspects of the self-monitoring protocol. However, we have no way to verify that PM data were entered within the context or specific time frame reported by the participants. Even if participants mailed their cards on a daily basis, in accordance with procedure, there were many opportunities for them to misrepresent their self-monitoring and report behavior so as to seem to comply with the research protocol. This is an issue particularly when collecting base-rate data from random prompts, but it also can (and likely does) occur in other aspects of collecting PM data. The lack of date and time verification lessens our confidence in the PM results. Other benefits of CM compared with PM are (a) instantaneous entry of data into a central database, which reduces data entry errors and costs; (b) the potential to monitor compliance with the data entry protocol on an ongoing basis; and (c) early identification and correction of data entry problems, which may be particularly important for longer monitoring periods. These benefits occurred in a context in which CM participants easily learned the self-monitoring protocol, integrated it into their daily lives, were compliant in their entry of CM data, and reported satisfaction with their experiences.

This is a preliminary feasibility study and so several limitations need to be addressed in future research. Research involving larger samples of CM users is needed to replicate and extend our findings. In addition, research designed to examine various aspects of the validity of CM data would move the field beyond the face validity that is inherent in the use of CM and PM. Future research might include assessment of the validity of reports of alcohol use, such as collecting collateral reports and biochemical measures of alcohol intake. Behavioral observations could be used to validate the situational aspects of drinking (e.g., location, presence of others). Some of the compliance issues identified in the current study can be addressed in future versions of CM. For example, we can enhance compliance with initiating the after-drinking interview by programming the IVR system to remind participants who are currently drinking that they need to complete an after-drinking interview. Thus, even this initial version of CM seems a promising alternative to PM. It joins a growing number of different technologies that are being used to enhance the quality of self-monitoring data (cf. Carney et al., 1998; Litt et al., 2000; Searles et al., 2000; Shiffman & Stone, 1998; Swendsen et al., 2000).

Although we did not directly compare use of cellular phones with hand-held computers, we now have experience with both technologies (cf. Collins et al., 1998) and see cellular phones as a viable alternative to this approach as well. CM incorporates many of the advantages of computerized EMA while lessening some of its disadvantages. We concur with Shiffman and Stone's (1998) description of the

"significant burdens" (p. 4) that EMA imposes on researchers and participants, and we believe that cellular phone use can ease some of them. For example, cellular telephones are now so ubiquitous that, relative to hand-held computers, it may be easier to train participants in CM procedures and to integrate cellular monitoring into their daily lives. Also, compared with EMA on hand-held computers, CM software and hardware are relatively inexpensive and easy to program. Future research should directly compare the costs and benefits of using CM versus hand-held computers to collect EMA data. In the meantime, the results of this study suggest that researchers may want to explore the use of cellular telephones and IVR as a cost-effective way to collect in-depth self-monitoring data.

References

Alemagno, S. A., & Butts, J. M. (1995, November). *HIV prevention: A telecommunications outreach model.* Paper presented at the annual meeting of the American Society of Criminology, Boston, MA.

Bachofen, M., Nakagawa, A., Marks, I. M., Park, J. M., Greist, J. H., Baer, L., et al. (1999). Home self-assessment and self-treatment of obsessive-compulsive disorder using a manual and a computer-conducted telephone interview: Replication of a UK–US study. *Journal of Clinical Psychiatry, 60,* 545–549.

Baer, L., & Greist, J. H. (1997). An interactive computer-administered self-assessment and self-help program for behavior therapy. *Journal of Clinical Psychiatry, 58*(Suppl. 12), 23–28.

Carney, M. A., Tennen, H., Affleck, G., Del Boca, F., & Kranzler, H. R. (1998). Levels and patterns of alcohol consumption using timeline follow-back, daily diaries and real-time "electronic interviews." *Journal of Studies on Alcohol, 59,* 447–454.

Collins, R. L., Koutsky, J. R., & Izzo, C. V. (2000). Temptation, restriction, and the regulation of alcohol intake: Validity and utility of the Temptation and Restraint Inventory. *Journal of Studies on Alcohol, 61,* 766–773.

Collins, R. L., & Lapp, W. M. (1991). Restraint and attributions: Evidence of the abstinence violation effect in alcohol consumption. *Cognitive Therapy and Research, 15,* 69–84.

Collins, R. L., Lapp, W. M., Emmons, K. M., & Isaac, L. M. (1990). Endorsement and strength of alcohol expectancies. *Journal of Studies on Alcohol, 51,* 336–342.

Collins, R. L., Morsheimer, E. T., Shiffman, S., Paty, J. A., Gnys, M., & Papandonatos, G. D. (1998). Ecological momentary assessment in a behavioral drinking moderation training program. *Experimental and Clinical Psychopharmacology, 6,* 306–315.

Delichatsios, H. K., Friedman, R. H., Glanz, K., Tennstedt, S., Smigelski, C., Pinto, B. M., et al. (2001). Randomized trial of a "talking computer" to improve adults' eating habits. *American Journal of Health Promotion, 15,* 215–224.

Litt, M. D., Cooney, N. L., & Morse, P. (2000). Reactivity to alcohol-related stimuli in the laboratory and in the field: Predictors of craving in treated alcoholics. *Addiction, 95,* 889–900.

Mundt, J. C., Perrine, M. W., Searles, J. S., & Walter, D. (1995). An application of interactive voice response (IVR) technology to longitudinal studies of daily behavior. *Behavior Research Methods, Instruments, & Computers, 27,* 351–357.

Samo, J. A., Tucker, J. A., & Vuchinich, R. D. (1989). Agreement between self-monitoring, recall, and collateral observation measures of alcohol consumption in older adults. *Behavioral Assessment, 11,* 391–409.

Sanchez-Craig, M., & Annis, H. M. (1982). "Self-monitoring" and "recall" measures of alcohol consumption: Convergent validity with biochemical indices of liver function. *British Journal of Alcohol and Alcoholism, 17,* 117–121.

Searles, J. S., Helzer, J. E., & Walter, D. E. (2000). Comparison of drinking patterns measured by daily reports and timeline follow back. *Psychology of Addictive Behaviors, 14,* 277–286.

Searles, J. S., Perrine, M. W., Mundt, J. C., & Helzer, J. E. (1995). Self-report of drinking by touch-tone telephone: Extending the limits of daily contact. *Journal of Studies on Alcohol, 56,* 375–382.

Shiffman, S., Hufford, M., Hickcox, M., Paty, J. A., Gnys, M., & Kassel, J. D. (1997). Remember that? A comparison of real-time versus retrospective recall of smoking lapses. *Journal of Consulting and Clinical Psychology, 65,* 292–300.

Shiffman, S., & Stone, A. A. (1998). Introduction to the special section: Ecological momentary assessment in health psychology. *Health Psychology, 17,* 3–5.

Sobell, M. B., Bogardis, J., Schuller, R., Leo, G. I., & Sobell, L. C. (1989). Is self-monitoring of alcohol consumption reactive? *Behavioral Assessment, 11,* 447–458.

Strickler, D. P., Bradlyn, A. S., & Maxwell, W. A. (1981). Teaching moderated drinking behaviors to young adult heavy drinkers: The effects of three training procedures. *Addictive Behaviors, 6,* 355–364.

Swendsen, J. D., Tennen, H., Carney, M. A., Affleck, G., Willard, A., & Hromi, A. (2000). Mood and alcohol consumption: An experience sampling test of the self-medication hypothesis. *Journal of Abnormal Psychology, 109,* 198–204.

Vuchinich, R. E., Tucker, J. A., & Harllee, L. M. (1988). Behavioral assessment. In D. M. Donovan & G. A. Marlatt (Eds.), *Assessment of addictive behaviors* (pp. 51–83). New York: Guilford Press.

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