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USING THE EXPERIENCE SAMPLING METHOD IN THE CONTEXT OF CONTINGENCY MANAGEMENT FOR SUBSTANCE ABUSE TREATMENT

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Contingency management (CM) treatments have been shown to be effective in reducing substance use. This manuscript illustrates how the experience sampling method (ESM) can depict behavior and behavior change and can be used to explore CM treatment mechanisms. ESM characterizes idiosyncratic patterns of behavior and offers the potential to determine how behavioral patterns are affected by the operant conditioning principles that drive CM. It may also lead to the identification of new target behaviors for CM in the context of substance abuse treatment.

DESCRIPTORS: contingency management, experience sampling method, substance abuse treatment

Contingency management (CM) treatments for substance use disorders are based on operant conditioning principles. CM requires the frequent monitoring of the behavior targeted for change (abstinence), offers positive reinforcement when the desired behavior occurs (often the submission of drug-negative urine specimens), and withholds reinforcement when the desired behavior does not occur. Although CM is a highly effective treatment (Lussier, Heil, Mongeon, Badger, & Higgins, 2006; Prendergast, Podus, Finney, Greenwell, & Roll, 2006; Silverman et al., 2007), the specifics of how CM affects behavior are unclear. One approach that may hold potential to better understand the mechanisms of CM's actions is the application of ambulatory monitoring techniques.

The experience sampling method (ESM) is an ambulatory monitoring technique that uses electronic devices to collect repeated within-day assessments of specific events and behaviors as they occur in a person's daily life (Csikszentmihalyi & Larson, 1987; deVries, Dijkman-Caes, & Delespaul, 1990). In the early stages of development of this technique, participants wore a beeper or a wristwatch that prompted them to fill out a paper-and-pencil questionnaire. This method, however, did not allow the verification of compliance with regard to the number of responses and the exact time at which they were provided (Stone, Shiffman, Schwartz, Broderick, & Hufford, 2003). The solution to compliance verification came with the growing use of personal digital assistants and cellular phones. Even though both of these have the great advantage of generating a time-stamped data entry, personal digital assistants require the participant to be able to see, read, and handle it properly. Cellular phones are more appropriate in certain samples because they do not require vision and literacy skills and are comparatively simple to use. Collecting ESM data via personal digital assistants or cellular phones has been shown to be feasible in several populations, including nonclinical sam-

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ples (Husky, Mazure, Maciejewski, & Swendsen, 2007), psychiatric samples (Granholm, Loh, & Swendsen, 2007), and substance-abusing samples (Litt, Cooney, & Morse, 1998).

Traditionally, the associations among environments, moods, and outcome variables, such as substance use, are examined using one assessment per variable per person. ESM has several advantages over traditional assessments. First, in comparison with between-person methods, the repeated measures of ESM provide a within-person design and a more detailed characterization of the phenomenon under study, including the temporal precedence of one phenomenon over another (deVries, 1992; Stone, Shiffman, & DeVries, 1999). Second, this method allows the examination of change in a given individual over time (Affleck, Zautra, Tennen, & Armeli, 1999). Third, the use of short time intervals between two reports reduces the retrospective recall bias that hinders traditional self-reports (Bolger, Davis, & Rafaeli, 2003). Finally, ESM adds an ecological dimension to the assessments, in that it provides information on a phenomenon in the natural settings of its occurrence rather than in a laboratory or clinical setting (Reis & Gable, 2000).

The main concerns that have been raised regarding ESM include compliance with the repeated measures in samples presenting a varying level of functional impairment and the potential effect of the monitoring itself on the behavior under study. With regard to compliance, both nonclinical and clinical samples (Granholm et al., 2007; Husky et al., 2007) have shown satisfactory compliance with ESM procedures. In terms of reactivity to repeated assessments, there is little evidence showing that monitoring alters the behavior under study (Litt et al., 1998).

ESM has rarely been used in intervention research and never in the context of CM treatment. This manuscript describes how to implement ESM in the context of a CM intervention.

METHOD

ESM in the Context of CM Treatment

To illustrate the use of ESM, we recruited a small sample of participants in a randomized clinical trial examining CM for cocaine-dependent methadone patients. As part of the trial, participants were randomly assigned to one of four groups: standard methadone treatment or standard treatment plus one of three variants of CM (offering vouchers or prize draws for submission of cocaine-negative urine specimens). Two to three times per week, participants submitted breath samples tested for blood alcohol content and urine specimens tested for cocaine and opioids. Participants who were compliant with attendance and submission of urine specimens were invited to participate in the supplemental ESM study. Five agreed to participate. One participant dropped out of treatment after the first ESM phase and could not be contacted to complete Phase 2. Participant 1 was assigned to the standard treatment condition and received a small compensation for submitting urine specimens, regardless of results. Participants 2 and 5 were assigned to a CM voucher condition. Participants 3 and 4 were assigned to a CM prize condition.

ESM Procedure

ESM was applied during two assessment periods: Phase 1, during baseline, prior to randomization; and Phase 2, 4 weeks into treatment when the benefits of CM were expected to be optimal. Each ESM phase was conducted over a 5-day period to sample a variety of daily life circumstances and cover at least 1 weekend day. This was possible because participants started ESM the morning after they were given the phones. Cellular phones were selected instead of personal digital assistants because of their relative ease of operation in a population that may have literacy problems.

Following provision of written informed consent, a 10-min ESM training session was provided, during which participants were instructed in the use of the phone and each answered a test phone call. Participants were informed that self-reports of drug use were not shared with CM staff, so there were no consequences for accurate reporting of substance use. After the training session, participants were given a phone and its charger. During each ESM phase, participants were contacted five times a day at random times within each of the following time periods: 8:00 a.m. to 11:00 a.m., 11:00 a.m. to 2:00 p.m., 2:00 p.m. to 5:00 p.m., 5:00 p.m. to 8:00 p.m., and 8:00 p.m. to 10:00 p.m. Each phone call was intended to provide a brief assessment of current events and behaviors. Each call lasted approximately 4 min. All answers were simultaneously rated on an ESM form (Appendix). If a participant did not answer the phone, no message was left. Participants were asked to let the research team call them back, rather than calling back themselves. Participants were called up to two times in the 30 min following the missed call. At the end of each ESM phase, phones and chargers were collected.

ESM Repeated Measures

The Appendix presents a sample of the questions used in the pilot study. This form was used to record the participant's answers while on the phone with him or her. Participants were asked where they were, who was with them, and what they were doing at the time of each call. These responses were classified into predefined categories adapted from procedures typically used in ESM studies (Husky et al., 2007; Swendsen, 1997). Participants rated their mood states on the mood circumplex (Larsen & Diener, 1992), using a seven-point Likert scale. Participants were asked about their contact with individuals whom they know use drugs, whether someone had used drugs in front of them, and what they did when it happened. Participants were asked whether they had used drugs or alcohol themselves since the previous call. If the answer was "yes," they were asked to specify. This pilot study did not assess how long ago the most recent drug use or contact with an individual using drugs occurred, but such information would have been useful to refine the timing of these events, especially for the first assessment of the day, when the period covered the night preceding the call. Additional questions can be added to address other areas of interest, such as coping skills used to resist drug use, self-efficacy in refraining from use, or to monitor behaviors such as tobacco use, which is very common in drug users (Lasser et al., 2000).

Cellular Phones

Cellular phones were provided with a prepaid air time of $50.00. Prepaid phones were used in order for the research staff to have control over the amount spent on the phone. Fifty dollars was the smallest increment of money that would allow the phone to be activated for making and receiving calls during each ESM phase. Using internal calling, participants could receive study calls with no deduction in the available prepaid minutes during the 5-day assessment period. Participants were compensated at the rate of $2.00 per call answered. Because 25 phone calls were scheduled, a maximum compensation of $50.00 for each ESM period was available. Participants could elect to receive compensation in the form of gift cards or as minutes used on the phone to make personal calls. That is, for every dollar in minutes used, a dollar of compensation was deducted from the earnings. To provide an incentive to return the phone after each ESM period, participants received an additional $25.00 if the phone was returned in working order. Thus, for each ESM phase, participants could receive up to $75.00. There were no technical or coverage problems with the phones, and all were returned. It is possible that the compensation need not have been so high, because recent ambulatory monitoring studies have obtained satisfactory compliance with lower dollar amounts (Collins, Todd, & Gollnisch, 2003; Granholm et al., 2007).

Protection of Confidentiality

Collecting information on the use of illegal substances requires special attention to the risks in possible breach of confidentiality. To minimize these risks, names or identifying personal information were not included in the study phone's contact list or memory. Instead, the phone numbers were associated with anonymous labels. Should a phone be lost, there would be no identifying information on the phone to enable anyone to identify a participant or his or her participation. A related concern is the potential stigma associated with participating in a research study in the community. The use of cellular phones as opposed to personal digital assistants was not likely to suggest to others that a participant was enrolled in a study, because cellular phones are common in all socioeconomic strata of the population. Finally, ESM studies relying on computer-automated telephone interviews have encountered technical difficulties such as loss of data (Freedman, Lester, McNamara, Milby, & Schumacher, 2006). Our use of live interaction makes it possible to avoid missing data within an assessment and to specify, correct, or repeat unclear responses. Furthermore, live interaction offers more safeguards for the participant should he or she report a situation of immediate danger. Even though live interaction presents several advantages over computerized assessments, it does require some organization and time on the part of the research staff to call participants several times per day for several consecutive days.

RESULTS

Acceptability of and Compliance with ESM Procedures

During the period of enrollment for this study, 13 participants began the main CM trial and were offered to participate. Six refused, and 2 verbally agreed but did not show up for appointments to review the consent form. Of those who began the study, compliance with ESM procedures was high. On average, participants missed one of the 25 possible calls during Phase 1 and less than one during Phase 2. In total, they provided 121 observations for Phase 1 and 97 observations for Phase 2. Although our sample does not permit us to draw conclusions about the acceptability and compliance of cocaine-dependent participants in methadone maintenance treatment in general, the compliance reported in previous ESM studies in substance-using populations is encouraging (Collins et al., 2003).

Reliability of Self-Reported Drug Use

Across participants and throughout both ESM phases, 29 instances of substance use were reported. Six different substances were used, including alcohol, cannabis, cocaine, benzodiazepines, heroin, and other opioids. Only two of these related to cocaine, the drug targeted by CM. As part of the CM trial, 15 urine and breath specimens were tested. As illustrated in Figure 1, all breath samples were consistent with ESM self-reports, as were opioid self-reports with opioid toxicology results. Two participants admitted to cocaine use during the first ESM phase, which was consistent with toxicology testing. However, Participant 4 denied cocaine use during both ESM phases yet tested cocaine positive during both. Our results are consistent with the 73% concordance rate between self-reported drug use in ESM and drugs detected in urine specimens in a previous study (Freedman et al., 2006). Even though we emphasized to participants that self-reports would not affect reinforcement procedures, the concordance was not optimal. These results highlight the need to obtain objective confirmation of self-reports when it is possible to do so.

Effect of Monitoring on Substance Use

Participant 1 indicated that he felt he had avoided going to certain places in which he was more likely to be in contact with drugs because he knew he would be asked about his

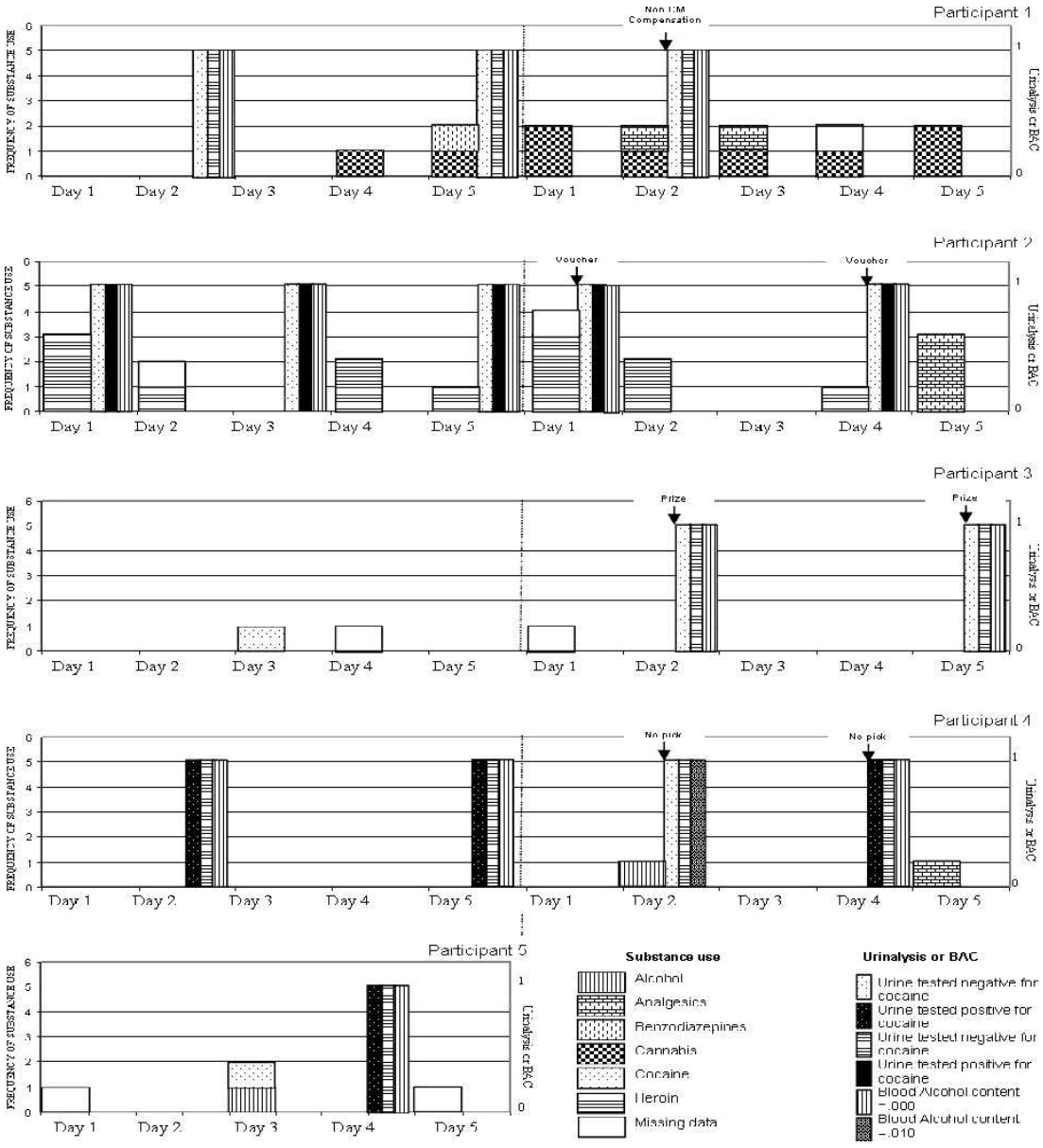

Figure 1. Urine toxicology results, non-CM compensation, CM reinforcers, and ESM-reported substance use for each participant.

whereabouts several hours later. Participant 2 reported that it was comforting to receive multiple phone calls a day and to be asked questions about how she was feeling. The other 3 participants did not volunteer any feedback on their participation and on how it may have affected their behavior. Even though some participants spontaneously report that their behavior may have been influenced by monitoring, there is little evidence that the repeated completion of self-reports actually alters substance use (Litt et al., 1998). In our illustrative sample, drug use did not change substantially from Phase 1 to Phase 2, suggesting that

Table 1
Frequency and Percentage of Observations (in Parentheses) Each Participant Spent in Specific Physical Environment, Social Environment, and Activity During Phases 1 and 2

	Participant 1 No CM		Participant 2 CM with vouchers		Participant 3 CM with prizes		Participant 4 CM with prizes	
	Phase 1 $n = 25$	Phase 2 $n = 24$	Phase 1 $n = 24$	Phase 2 $n = 24$	Phase 1 $n = 24$	Phase 2 $n = 24$	Phase 1 $n = 25$	Phase 2 $n = 25$
Location								
Home	15 (60)	18 (75)	23 (95.8)	21 (87.5)	13 (54.2)	14 (58.)	20 (80)	17 (68)
In a vehicle	2 (8)	2 (8.3)	1 (4.2)	3 (12.5)	3 (12.5)	6 (25.0)	2 (8)	4 (16)
In a store or office	1 (4)	2 (8.3)			5 (20.8)			1 (4)
At family member's home	6 (24)	1 (4.2)				1 (4.2)		
At significant other's home								1 (4)
At friend's home					1 (4.2)			
On the street		1 (4.2)					2 (8)	
In a health care facility					2 (8.3)	3 (12.5)	1 (4)	2 (8)
Other	1 (4)							
Social context								
With using significant other	15 (60)	18 (75)	12 (50)	19 (79.2)				
With family member	5 (20)	1 (4.2)	2 (8.3)		13 (54.2)	16 (66.7)	11 (44)	10 (4)
Alone	2 (8)	5 (20.8)	8 (33.3)	5 (20.8)	10 (41.7)	6 (25)	4 (16)	5 (20)
With significant other							8 (32)	9 (36)
With using friends	1 (4)		1 (4.2)					
With friends					1 (4.2)		1 (4)	1 (4)
With strangers	1 (4)		1 (4.2)					
With animals	1 (4)						1 (4)	
Other						2 (8.3)		
Activity								
Watching TV	7 (28)	11 (45.8)	3 (12.5)	6 (25)	6 (25)	6 (25)	18 (72)	12 (48)
Eating, bathing, sleeping	3 (12)	6 (25)	11 (45.8)	7 (29.2)	5 (20.8)	6 (25)	2 (8)	
Transportation	2 (8)	3 (12.5)	1 (4.2)	2 (8.3)	3 (12.5)	6 (25)	4 (16)	4 (16)
Nothing	8 (32)	1 (4.2)	1 (4.2)	6 (25)	3 (12.5)	1 (4.2)		1 (4)
Housekeeping chores			7 (29.2)		3 (12.5)	2 (8.3)		4 (16)
Shopping	2 (8)	3 (12.5)			2 (8.3)			1 (4)
Childcare					1 (4.2)			1 (4)
Exercise or sports								
Social interaction	2 (8)		1 (4.2)	2 (8.3)				
Waiting						1 (4.2)	1 (4)	2 (8)
Work	1 (4)				1 (4.2)			
Other						2 (8.3)		

repeated reporting did not affect the response patterns with regard to drug use. The nature and amplitude of the effect of monitoring on substance use remain to be fully investigated, and future ESM studies would benefit from examining this important question.

Examining Daily Life Behavior

With ESM, it is possible (a) to characterize behavioral patterns associated with drug use, (b) to determine whether CM has main effects on daily life variables (e.g., behavior, drug use, craving), and (c) to determine whether the behavioral patterns associated with drug use are altered by CM treatment.

A detailed pattern of behavior can be obtained for each individual both pre- and posttreatment. Table 1 provides the summary of the location, social context, and activities of each participant who completed Phases 1 and 2. These descriptive results underline the richness of the behavioral profile obtained for each

person and the potential for studying the within-person change from baseline to active treatment. In addition, it is possible to determine whether specific behaviors (activity, physical and social environment, contact with others using drugs) and psychological states (affect, craving) are associated with increases in subsequent drug use. This may lead to the identification of high-risk social and physical contexts in which a person is more likely to use drugs. For example, in the case of Participant 2, the use of opiates was more often than not associated with the presence of her significant other (who was also addicted to opiates) and with being at home.

In the same way that ESM can identify proximal predictors of drug use, it may be helpful in identifying behaviors that are incompatible with drug use. In choosing a target behavior, CM focuses on behaviors that occur frequently and can be measured objectively (Petry, 2000). However, community settings use toxicology screens at a much lower frequency than CM interventions, which hinders widespread implementation of CM treatment (Prendergast et al., 2006). Extending CM procedures to reinforce alternate behaviors is highly compatible with operant behavioral principles (Petry, Tedford, & Martin, 2001) and may be more productive than the current CM technique of reinforcing the absence of a behavior (drug use). In the case of Participant 2, engaging in behaviors that would be outside of home and without her significant other could represent a target behavior on which CM treatment could focus. However, reinforcing behaviors that cannot easily be objectively verified pose significant problems to the implementation of CM. One potential solution is to develop the use of a global positioning system, which is available on an increasing number of cellular phones and electronic bracelets used to monitor the whereabouts of sex offenders or individuals on probation or house arrest. Although this technology has not yet been used to monitor target behaviors in the context of CM, it may represent a future application of ESM.

To examine main effects of CM treatment, one can determine whether the mean frequency of specific behaviors (drug use, specific locations, activities, social environment, or contact with others using drugs) has been altered by CM. As illustrated in Figure 1, Participant 3 reported using cocaine once during the first ESM phase, but did not use cocaine during Phase 2, which is corroborated by urine toxicology results. One can also determine whether a person's mean level of craving and affect has been altered by treatment. The level of intensity of craving reported by Participant 3 during Phase 2 was very different from that observed in Phase 1 (Figure 2). Although there were important within-day fluctuations in his level of craving in the first ESM phase, Participant 3 consistently reported not experiencing craving during Phase 2. Comparing changes observed between Phase 1 and Phase 2 in those who received CM treatment to changes observed in those who did not receive CM can elucidate proportions of change attributable to CM.

Further, it is possible to determine whether the behavioral patterns associated with drug use identified in Phase 1 changed in Phase 2 as a function of CM. One can identify temporal relations between specific behaviors and receipt of CM reinforcers. For example, Figure 2 shows the fluctuations in the level of reported craving and discrete instances of reinforcement for participants who completed both ESM phases. The effect of a reinforcer at one point in time on a person's subsequent behavior can thus be detected in a way similar to that used for drug use and holds potential for reaching a better understanding of how reinforcement affects behavior.

Summary

This paper provides instructions on how to apply ESM to the study of behavior and changes in behavior as a function of CM

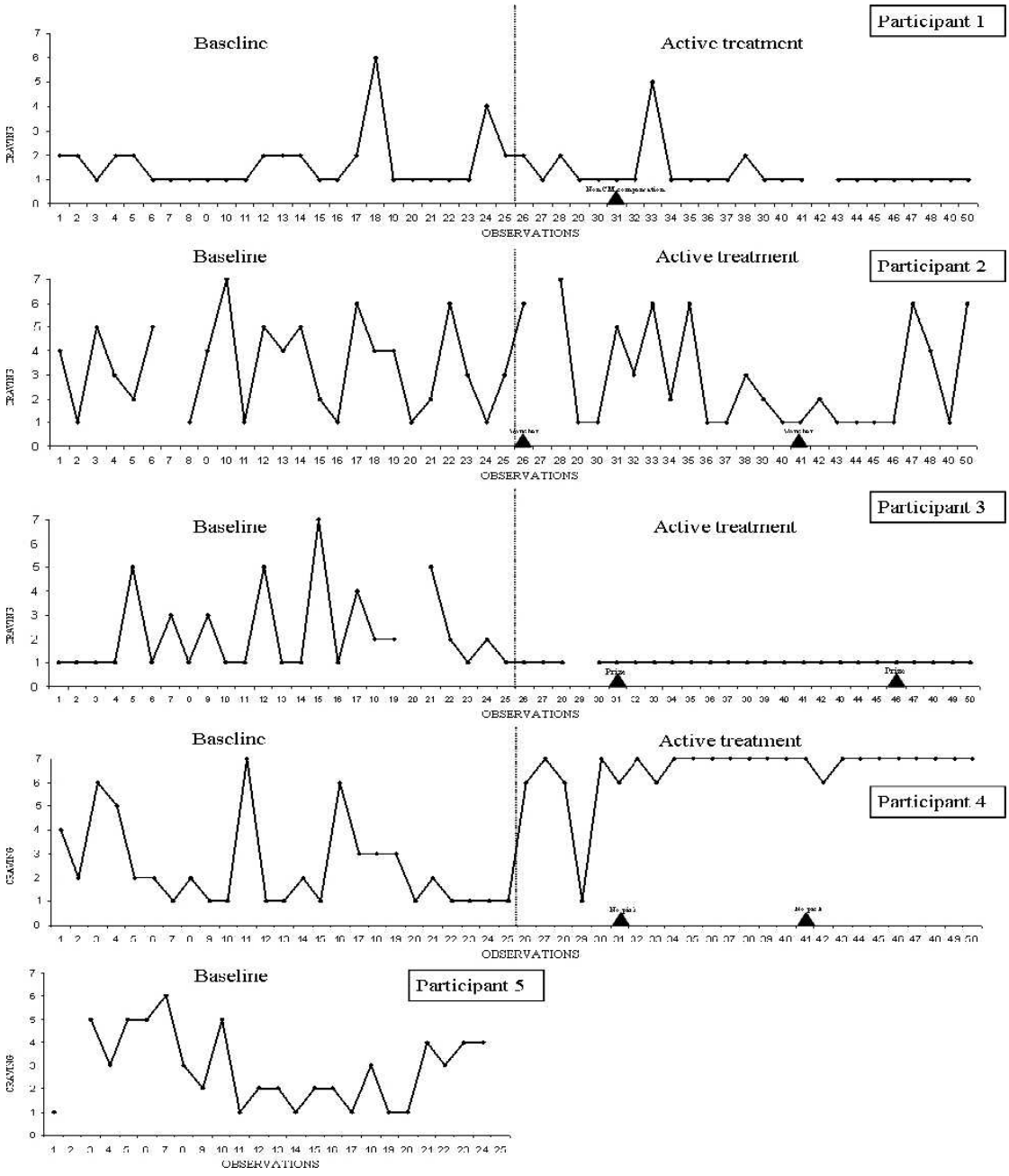

Figure 2. Craving and reinforcers during baseline and active treatment for each participant.

treatment for substance abuse. Our pilot study also highlights the potential weaknesses of ESM, notably the questions of compliance, acceptability to participants, the use of self-reports to document illegal substance use, and the possibility of reactivity to monitoring. The limitations of this study lie in the very small population that was used to illustrate the technique. The small sample and the low frequency of the target drug use precluded

statistical analyses. A full-scale study is needed to substantiate the suggested benefits of applying ESM to further our understanding of various reinforcers and to identify new targets for CM treatment. However, our study describes the potential of ESM in its ability to characterize behavioral patterns by identifying behavioral and psychological variables associated with discrete instances of drug use or with discrete CM reinforcers. The intrinsic characteristics of ESM make it a remarkable tool for intervention research, including but not limited to the study of CM treatment.

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APPENDIX

ESM Rating Form
Session # 1 2
Date:_____/_____/_____ Call #: 1 2 3 4 5 Time:_____:_____

1. Where are you? _____
1. Home
2. At family member's home
3. At significant other's home
4. At friend's home
5. At work
6. At school
7. In a restaurant
8. In a bar
9. In a store/office
10. In a vehicle
11. In a health care facility
12. In a sports/exercise facility
13. At an entertainment center
14. On the street
15. Outdoors
16. Other_____

2. Who are you with? _____
1. Alone
2. With family member(s)
3. With significant other
4. With friends
5. With using family member(s)
6. With using significant other
7. With using friends
8. With colleagues/coworkers/employer
9. With strangers
10. With animals
11. Other_____

3. What are you doing? _____
1. Nothing
2. Waiting
3. Personal care
4. Work
5. Housekeeping chores
6. Shopping
7. Childcare
8. Exercise/Sports
9. Entertainment
10. Social interaction
11. Transportation
12. Other_____

4. Right now, on a scale from 1 to 7, how active do you feel? 1 2 3 4 5 6 7
5. How nervous do you feel? 1 2 3 4 5 6 7
6. How bored do you feel? 1 2 3 4 5 6 7
7. How peppy do you feel? 1 2 3 4 5 6 7
8. How relaxed do you feel? 1 2 3 4 5 6 7
9. How quiet do you feel? 1 2 3 4 5 6 7
10. How sad do you feel? 1 2 3 4 5 6 7
11. How happy do you feel? 1 2 3 4 5 6 7
12. How many people that you know use drugs have you been in contact with since I last called you? _____
13. Have you been in contact with someone using in front of you? 1-Yes 2- No
14. If 13=Yes, how long ago was that? _____
15. If 13=Yes, which substances were they using? _____
16. If 13=Yes, what did you do when it occurred? _____
1. Nothing and ended up using drugs
2. Left to avoid the situation, did not use
3. Tried not to think about it, but stayed and did not use
4. Engaged in thoughts that are pleasurable and non drug-related, and stayed and did not use
5. Asked for them not to use in front of you, expressed your feelings, and stayed and did not use
6. Other_____

17. Since my last call, did you use any drugs or alcohol? 1. Yes 2. No
18. If 17=Yes, which one(s) and how much of it (them)? _____
19. If 17=Yes, how long ago did you use? _____
20. Since my last call, how many cigarettes did you smoke? _____
21. On a scale from 1 to 7, how would you rate the intensity of your craving for cocaine right now? 1 2 3 4 5 6 7