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Capturing illicit drug use where and when it happens: an ecological momentary assessment of the social, physical and activity environment of using versus craving illicit drugs

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Abstract

Aims—To understand the environmental and contextual influences of illicit cocaine and heroin use and craving using mobile health (mHealth) methods.

Design—Interactive mHealth methods of ecological momentary assessment (EMA) were utilized in the Exposure Assessment in Current Time (EXACT) study to assess drug use and craving among urban drug users in real time. Participants were provided with mobile devices and asked to self-report every time they either craved (without using) or used heroin or cocaine for 30 days from November 2008 through May 2013.

Setting—Baltimore, MD, USA.

Participants—A total of 109 participants from the AIDS Linked to the IntraVenous Experience (ALIVE) study.

Measurements—For each drug use or craving event, participants answered questions concerning their drug use, current mood and their social, physical and activity environments. Odds ratios (OR) of drug use versus craving were obtained from logistic regression models with generalized estimating equations of all reported events.

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Declaration of interests

None.

Supporting information

Additional Supporting information may be found in the online version of this article at the publisher's web-site:

Table S1 Number (%) of craving and use events by exposure category and drug type.

Findings—Participants were a median of 48.5 years old, 90% African American, 52% male and 59% HIV-infected. Participants were significantly more likely to report use rather than craving drugs if they were with someone who was using drugs [adjusted odds ratio (aOR) = 1.45, 95% confidence interval (CI) = 1.13, 1.86], in an abandoned space (aOR = 6.65, 95% CI = 1.78, 24.84) or walking/wandering (aOR = 1.68, 95% CI = 1.11, 2.54). Craving drugs was associated with being with a child (aOR = 0.26, 95% CI = 0.12, 0.59), eating (aOR = 0.54, 95% CI = 0.34, 0.85) or being at the doctor's office (aOR = 0.31, 95% CI = 0.12, 0.80).

Conclusions—There are distinct drug using and craving environments among urban drug users, which may provide a framework for developing real-time context-sensitive interventions.

Keywords

Ecological Momentary Assessment; EXACT study; HIV; illicit drug craving; illicit drug use; mHealth; mobile devices; urban drug users

INTRODUCTION

Substance abuse is a chronic disease often characterized by multiple attempts at abstinence with frequent relapse. It is associated with a range of morbidities as well as deleterious effects on family members and larger society [1–4].

Capturing drug use in epidemiological studies involves substantial recall bias [5,6], and often does not quantify the amount or duration of use. Drug use is often self-reported (occasionally verified through biological measures) and typically captures any drug use over long periods of recall (e.g. 6–12 months) [7–9]. This broad time-frame often misses varying periods of intense or intermittent use and further fails to capture the proximate context of an individual's drug-using experience. Drug-using behavior occurs within a specific organizational and structural environment, with out-comes fundamentally linked to both individual and situational factors [10]. Substance abuse is 'commonly associated' with a chaotic or disordered life, mental illness, financial and legal difficulties and inadequate housing or transportation [11–13]. Daily environmental cues of drug use remain largely unexamined as risk factors for drug use and barriers to care.

Drug craving has been theorized to have a critical role in drug dependence and relapse, although there have been substantial inconsistencies in data supporting this view [14,15]. There is clear recognition of the need for more detailed and novel methods for measuring craving (e.g. a virtual reality approach to examine cue-elicited tobacco cravings [16]).

Ecological momentary assessment (EMA) methods collect participant-level data in real time and facilitate responsive communication between providers and patients. EMA is a mobile health (mHealth) method that employs mobile devices (e.g. smartphones or other handheld devices) to improve health outcomes, health-care services and public health research. Real-time EMA methods have been utilized in smoking cessation studies, HIV/sexually transmitted infections (STI) research and obesity intervention studies [17–25] and employed among methadone-maintained out-patient drug users [26–30], but have yet to be utilized among non-treatment-seeking, urban drug users. EMA provides an ideal method for assessing drug

craving by capturing transient ‘states’ rather than summing craving events over time to assess ‘traits’. By collecting real-time data, a more comprehensive understanding of the drug-using environment can be generated. Knowing the proximate determinants of drug use and how they differ from drug craving and relapse can inform why some people are able to maintain cessation while others are not. The current study utilizes EMA methods to ascertain the social, physical, activity and psychosocial environment associated with drug use compared to drug craving in an urban sample of drug users in Baltimore, MD.

METHODS

EXACT study participants

Exposure Assessment in Current Time (EXACT) study participants were recruited from the AIDS Linked to the IntraVenous Experience (ALIVE) study, an ongoing, community-recruited, observational cohort of people with a history of injecting drugs in Baltimore, MD [31]. The ALIVE cohort is community- rather than clinic-based, thereby avoiding selection bias towards people seeking or accessing care. While the ALIVE study examines the association between drug use and HIV at semi-annual clinic visits, the EXACT study was conceived as an implementation and feasibility study designed for near real-time characterization of illicit drug use in users’ natural environments. Details of the EXACT study have been previously described [32], and included four successive trials conducted from November 2008 to May 2013. Each trial was planned to follow approximately 30 participants each for 30 days.

Eligibility criteria for the EXACT study included current enrollment in ALIVE and the ability to understand and follow directions on a personal digital assistant (PDA) or mobile phone. Convenience sampling was utilized to identify individuals for participation in EXACT. In each trial, the specific inclusion criteria regarding drug use and HIV status were varied slightly to ensure a diverse sample; both injection and non-injection drug users were included. Individuals were excluded if they had any medical conditions that would prevent them from operating the hand-held device (e.g. vision or hearing impairment) or failed to attend the screening appointment where they were trained on device use.

The Johns Hopkins School of Public Health Institutional Review Board approved the study protocol. All participants provided written informed consent. Participants were informed that involvement (or non-involvement) in EXACT would in no way affect their participation in ALIVE.

Data collection

On the provided hand-held devices, participants were asked to self-initiate a survey and self-report each time they either craved (but refrained from using) or used heroin or cocaine (or both) in any manner (smoked, snorted or injected); these responses represent event-contingent entries. All data used in the present analyses are from the self-reported event-contingent entries. Heroin-only and cocaine-only reports incorporated all reports of heroin or cocaine use (including those jointly with another drug).

For each event, participants answered questions concerning their drug use, current mood, social, physical and activity environment, using survey instruments adapted from previous EMA studies [26–30]. Participants had 30 minutes to complete an event-contingent survey to ensure that responses were recorded in near real-time.

Participants were provided initially with PDA (Palm Z22, Palm, Inc., Sunnyvale, CA, USA) running applications developed using Satellite Forms software (<http://www.satelliteforms.net/>) to complete data collection. When this PDA model became obsolete, data collection transitioned to Android Smartphones (Motorola Droid X2), running an application developed using the Electronic Mobile Open-source Comprehensive Health Application (*eMOCHA*) platform, created at Johns Hopkins School of Medicine [33].

Baseline characteristics were obtained from audio computer-assisted self-interviews (ACASI) completed at enrollment into EXACT and/or from the prior ALIVE study visit and represent behaviors within the previous 6 months. In addition to socio-demographic variables (e.g. age, sex, race, education, marital status, employment, income, homelessness and health insurance status), baseline data collection included self-reported alcohol, tobacco and illicit drug use [Drug Abuse Screening Test (DAST)] and depressive symptoms [Center for Epidemiologic Studies—Depression Scale (CES-D)] in the prior 6 months [34].

To reduce participant burden while using the handheld device, event-contingent time-varying questions required only a ‘yes/no’ response. These EMA variables included:

- *Social environment*: who the participant was with during an event: friend, acquaintance, family member, a stranger, a spouse and a child, alone, someone currently using drugs or an ‘out-the-door partner’ (someone a drug user visits for the purpose of using or buying drugs).
- *Activity environment*: what activity was the participant engaged in when they reported an event: socializing, sleeping, eating, shopping, planning/thinking, engaging in recreational activities, drinking alcohol, using tobacco, offered drugs, saw someone using drugs, saw drug paraphernalia, handling \$10 in cash, engaging in illegal activity or ‘copping’ (exchanging small goods or services for obtaining drugs).
- *Physical environment*: the participant’s physical location when reporting an event: home, another’s home, car, bus or train, outdoors, church, job/working, restaurant, abandoned space, doctor’s office, store, shelter, bar or ‘cop’ spot (where someone goes to buy drugs).
- *Psychosocial environment*: the participant’s mood or motivation when reporting an event. Responses to the question: ‘How do you feel right now?’ included happy, stressed, tired, relaxed, bored, irritated and none of the above. Responses were not mutually exclusive, allowing participants to mark all that applied. Motivational variables included responses to whether participants ‘wanted to see what would happen if you took just one hit’ or ‘wanted to use out of the blue’.

Analysis

This analysis examined all event-contingent entries of all participants ($n = 109$), using logistic regression models with generalized estimating equations (GEE) and autoregressive covariance structures to model the outcome of drug use versus drug craving. GEE adjusts for the correlation of repeated measures within each subject, thereby allowing for examination of population average effects. Drug craving was the reference category in all logistic regression models (SAS Proc Genmod). Variables selected for the final models of drug use versus drug craving and those stratified by drug type (heroin use versus heroin craving and cocaine use versus cocaine craving) were chosen through stepwise regression.

Variables from separate univariate analyses within baseline and EMA variable categories (social, activity, physical and psychosocial environmental variables) with P -values <0.1 were carried forward to separate adjusted models. Next, baseline and EMA variables with P -values <0.1 in the adjusted models were combined in the fully adjusted models. Final models were generated to achieve parsimony and included statistically significant (P -value <0.05) variables from the fully adjusted models. All models included a control term for the number of records that each participant contributed to the data set. An analysis restricted to HIV-infected ($n = 64$) individuals was repeated using the same methods. All analyses were conducted using SAS version 9.2 (SAS Institute, Cary, NC, USA).

RESULTS

Table 1 describes baseline characteristics for the 109 EXACT participants. The median age was 48.5 years [interquartile range (IQR) 43–53 years], 90% were African American, 52% male and 59% were HIV-infected. At baseline, 23% of participants reported recent methadone treatment and 83% reported smoking cigarettes daily in the 6 months prior to baseline assessment. The 109 participants reported a total of 2798 event-contingent responses; 1954 (69.8%) were drug craving and 844 (30.2%) were drug use events. Of the drug use events, 351 events were exclusively heroin (41.6%), 289 events were exclusively cocaine (34.2%) and 201 events were reports of using both heroin and cocaine (23.8%). During the 30 days, the median number of self-reported craving events was 8 (IQR 5–14) and the median number of self-reported drug-using events was 4 (IQR 1–10). Table S1 (see Supporting information) describes the proportion of craving and use events by drug type and demographic, social, physical and activity environments.

Table 2 presents univariate models A–E for the three outcomes of: drug use ($n = 844$) versus craving ($n = 1954$), heroin use ($n = 552$) versus heroin craving ($n = 1284$) and cocaine use ($n = 490$) versus cocaine craving ($n = 926$). Each model provides unadjusted odds ratios (OR) for baseline characteristics or the social, physical, activity and psychosocial environment variables.

Among baseline factors (Table 2, model A), participants with recent methadone treatment reported 27% of events as drug-using and 73% as drug-craving events. Older age and recent methadone use were associated significantly with craving rather than using drugs (Table 2, model A), while baseline reports of substance use, including cigarette, heroin and cocaine use, increased the odds of drug by three- to fourfold.

Social environment factors (Table 2, model B), including children being present, reduced the odds of using drugs while being around someone else using drugs increased the risk for using. Children were present at 4% of drug use events and 15% of craving events. Specifically, cocaine use increased significantly if participants reported being with an out-the-door partner or if their spouse was present at the time of the event.

With respect to the activity environment (Table 2, model C), reports of eating around the time of the event were associated with reduced drug use. The likelihood of drug use increased with reports of using tobacco, handling \$10 in cash and seeing drug paraphernalia. Tobacco use was reported at 95% of drug-using events. Events where seeing drug paraphernalia was reported 48% were drug-using events and 52% were drug-craving events.

Physical environments (Table 2, model D) that were associated with a reduced likelihood of using drugs included reports of being in a car, bus or train, at the doctor's office or at work. Reports of being at home, walking or wandering and being in an abandoned space at the time of the reported event were associated with increased odds of drug use. More drug use than drug craving events occurred in abandoned spaces (81% were drug use events, 19% were drug craving events).

Regarding participants' psychosocial state around the time of the event (Table 2, model E), reports of anger were associated with reduced drug use, while people reporting being in pain because they needed a hit were more than five times as likely to use rather than crave drugs, especially with heroin use.

Figures 1–3 depict the final multivariable models with adjusted odds ratios (aOR) combining significant variables of the fully adjusted models (not shown): any drug use (Fig. 1), heroin only (Fig. 2) and cocaine only (Fig. 3). Any drug use (Fig. 1) was reduced significantly with reports of being with a child [aOR = 0.26, 95% confidence interval (CI) = 0.12, 0.59], at the doctor's office (aOR = 0.31, 95% CI = 0.12, 0.80) or eating (aOR = 0.54, 95% CI = 0.34, 0.85) at the time of the event. Recent methadone treatment was associated marginally with reduced drug use (aOR = 0.57, 95% CI = 0.30, 1.07). Factors associated with an increased likelihood of drug use included recent heroin use (aOR = 2.49, 95% CI = 1.34, 4.61), seeing drug paraphernalia (aOR = 3.07, 96% CI = 1.97, 4.80) and being in an abandoned space at the time of the event (aOR = 6.65, 95% CI = 1.78, 24.84). Additional predictors of any drug use in the final adjusted model included: using tobacco at the time of the reported event (aOR = 2.27, 95% CI = 1.37, 3.78), handling \$10 in cash (aOR = 1.70, 95% CI = 1.11, 2.59), being with someone who was using drugs (aOR = 1.45, 95% CI = 1.13, 1.86), being with your spouse (aOR = 2.09, 95% CI = 1.22, 3.59), being at home (aOR = 1.68, 95% CI = 1.00, 2.82) and walking/wandering (aOR = 1.68, 95% CI = 1.11, 2.54) at the time of the event.

While there was some overlap between the overall final models for any drug use, heroin only and cocaine only (e.g. protective associations with being around children or doctor's office, increased risk with seeing drug paraphernalia; Figs 1–3), there were several factors associated uniquely with the type of drug used. For heroin use events, as might be expected, reports of heroin use in the period just before study entry increased use in real-time (aOR =

3.56, 95% CI = 1.90, 6.69), while recent methadone treatment reduced risk (aOR = 0.43, 95% CI = 0.19, 0.97). There were also specific demographic differences. African Americans were less likely than Caucasians to use heroin (aOR = 0.47, 95% CI = 0.19, 0.15), while older adults (≥ 50 years of age) were less likely to use cocaine (aOR = 0.39, 95% CI = 0.22, 0.68). Tobacco use was associated strongly with heroin use, including both recent intensity of smoking prior to study entry and cigarette smoking concurrent with the event. In contrast, social context appeared associated uniquely with increased likelihood of cocaine use, including being in the presence of others using drugs, a spouse or an 'out-the-door' partner (aOR = 7.90, 95% CI = 1.45, 43.01). After accounting for other socio-demographic and environmental factors, psychosocial factors were not associated significantly with drug use overall or with using heroin or cocaine only.

An analysis restricted to people who were HIV-infected revealed that being with a child and recent methadone treatment were predictors of drug craving, whereas using tobacco, seeing someone use and past heroin use were predictors of drug use. The point estimates (not shown) were similar to those in the final drug use versus craving model in Fig. 1, suggesting that there were no significant differences in behaviors by serostatus. Additional sensitivity analyses restricting heroin and cocaine use to exclusively heroin or cocaine (excluding reports of mixed heroin/cocaine use events) resulted in similar estimates to the heroin and cocaine analyses in Figs 2 and 3.

DISCUSSION

This EMA study provides real-time data on drug-using and drug-craving events among urban drug users in their natural environments. For the 109 participants followed for 30 days, distinct drug-using and drug-craving environments were uncovered. Our data suggest that drug use is facilitated over craving in less structured social and physical environments. Further, the presence of drug-related activity often appears to serve as a catalyst for illicit drug use. Our study provides novel data that individual, social and physical environmental factors encountered during craving events may mitigate against drug use. These findings implicate the need to strongly consider proximate environmental factors in designing individualized interventions to reduce drug use.

Less structured social and physical environments, including reports of walking and wandering or being in an abandoned space at the time of an event, were highly associated with drug use rather than drug craving. Physical environments where drug use may readily occur have been theorized to represent environments impacted by disadvantage and deprivation, lack structure and present drug exposure opportunities [35–37]. Practically, informal physical environments may give rise to drug use because individuals can wander without difficulty where drug sales are common, locate and access abandoned spaces readily and evade law enforcement more easily [38–40]. Abandoned buildings may help to protect from police intrusion but, importantly, will lack facilities to ensure clean injection equipment [41].

Drug-related activities provided the strongest cues for drug use in this analysis. Activities including handling small amounts of cash, seeing drug paraphernalia or being around others

using drugs were strongly associated with participants reporting drug use. These associations suggest that use is intensely influenced by situational drug triggers, which may be difficult to avoid in some heavily impacted communities. These real-time EMA data are consistent with our prior reports from the ALIVE cohort that moving from a highly deprived neighborhood to a less deprived one is among the strongest predictors of maintaining long-term cessation [35]. Exposure to drug use through individuals or paraphernalia not only indicates drug availability, but also provides the opportunity to maintain using habits. Reports of handling \$10 in cash reflect the nature of our participants' cash-based financial lives; however, the strong association with using drugs suggests that it may also be a trigger for drug use. It has been reported previously that the likelihood of handling cash increases in the hours preceding cocaine use, and although this may reflect transactions needed to buy cocaine it could also indicate that handling cash triggers the temptation to use drugs [28].

We also found that being at home or with a spouse was an environment in which drug use is easily facilitated. Although different from an abandoned space, a home is controlled by an owner or renter and is accessible only to acquaintances of the home. Using drugs at home with or without a spouse may represent a shared drug addiction where drug use is enabled [42]. These associations are likely to be bidirectional, with individuals seeking certain settings when they plan to use and certain environmental factors facilitating use.

Recent methadone treatment was associated with drug craving. An expected finding as methadone is an effective treatment for opioid addiction and is a proven strategy in supporting heroin abstinence as well as in reducing injection-related risk behaviors and other undesired social behaviors, such as criminal activity [43]. Conversely, self-reports of heroin use and cigarette smoking within the 6 months prior to the start of EXACT were predictors of using drugs and heroin. The prevalence of cigarette smoking among illicit drug users is among the highest reported from any population [44], and illicit drug users may experience stronger physiological dependence to nicotine as a result of their addiction [44–46]. Understanding the dynamics of tobacco and illicit drug use warrants further investigation; however, our analysis suggests a considerable need for combination therapy targeting both illicit drug use and smoking [47–49].

Our analysis showed that drug craving without using occurred more frequently in structured physical and social environments. These situations included being with a child, at the doctor's office, at work, eating or in formal transport such as a car, bus or train. Structured activities such as these are probable indicators of a more stable life-style, and suggest a more controlled environment with responsibilities for self-care and care for others.

It has been suggested that craving and relapse may represent independent phenomena and that reports of craving may not predict relapse [50,51]. However, it is possible that craving represents episodes where individuals have motivation to use but other environmental factors impeded use. Building on this premise, our findings suggest that EMA may be utilized to tailor drug treatment interventions. By identifying social, physical and activity environments associated with craving and drug use, drug users could be counseled and supported to cope with or avoid such settings and to facilitate time in environments that reduce the probability of drug use.

Although we demonstrate a clear distinction between the drug-using and drug-craving environments, this analysis is limited to event monitoring, and therefore we cannot demonstrate predictors or triggers of drug use. It is also not possible to distinguish between subjects who spend regular amounts of time with other drug users from subjects who are only around drug users when they choose to use.

As reported previously, the EXACT study demonstrated the ability to collect high-quality, real-time EMA data efficiently and effectively in a challenging study population of drug users [32]. Although prior EMA studies in Baltimore have examined the role of stress, tobacco and other moods on combined craving or use among methadone-maintained out-patient populations, to our knowledge this is the first EMA study to examine these environments among non-treatment-seeking urban drug users and to assess how HIV impacts these associations. In this study, we provide evidence that EMA methods represent a novel interactive mHealth strategy for capturing the drug-using experience in natural settings. The next step for these methods is to move beyond real-time data collection towards tailored interventions in response to these environmental cues. As our understanding of the drug-using environment improves, ecological momentary interventions (EMI), such as those that utilize GPS to alert and divert drug users when they approach a location that was previously a spot for drug use, or the delivery of motivational or cognitive behavioral therapies in real-time as personalized, context-sensitive interventions, hold great promise to improve drug treatment and prevent drug relapse.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Odds ratio of Drug Use vs. Drug Craving

Figure 1.

Drug use refers to any drug use reported in real time and is defined as the use of heroin or cocaine in any manner over the 30-day Exposure Assessment in Current Time (EXACT) study period. Odds ratios are adjusted for all variables listed

Odds Ratio of Heroin Use vs. Heroin Craving

Figure 2.

Heroin use refers to all uses of heroin reported in real time, including those jointly with another drug, in any manner, over the 30-day Exposure Assessment in Current Time (EXACT) study period. Cigarette packs/day was assessed at baseline represents use within the 6 months prior to the start of EXACT. Odds ratios are adjusted for all variables listed

Odds Ratio of Cocaine Use vs. Cocaine Craving

Figure 3.

Cocaine use refers to all uses of cocaine reported in real time including, those jointly with another drug, in any manner, over the 30-day Exposure Assessment in Current Time (EXACT) study period. Odds ratios are adjusted for all variables listed

Table 1

Baseline characteristics of Exposure Assessment in Current Time (EXACT) participants*.

Characteristic	n (%)
Median age, IQR	48.5 (43–53)
Male	58 (52)
African American	98 (90)
Ever married	43 (39)
High school education	44 (40)
CES-D >23	26 (23)
Alcohol use	71 (65)
Cigarette use	91 (83)
<1/2 pack cigarettes per day	20 (18)
>1/2 pack cigarettes per day	71 (65)
Income <\$5000	83 (77)
Homeless	9 (8)
Medical insurance	93 (85)
Have a primary care doctor	97 (89)
Drug abuse, DAST >16	6 (18)
Methadone treatment	26 (23)
Marijuana use	27 (24)
Speedball use	25 (24)
Heroin use (any route) ^a	49 (46)
Cocaine use (any route) ^a	50 (46)
Hepatitis C-positive	94 (86)
HIV-positive	64 (59)
Median CD4 (IQR) ^b	360.5 (239–529)
Viral load >500 ^b	37 (55)

* All baseline characteristics represent behavior within the 6 months prior to the start of EXACT.

^a Drug use included any route of administration (smoking, snorting, and injecting).

^b CD4 and viral load based on HIV-infected participants only.

IQR = interquartile range; CES-D = Center for Epidemiologic Studies—Depression scale; DAST = Drug Abuse Screening Test.

Table 2

Univariate odds ratios of drug, heroin and cocaine use versus craving*.

Model A: Baseline demographics	Drug use versus drug craving				Heroin use versus heroin craving				Cocaine use versus cocaine craving			
	OR	95% CI	P-value		OR	95% CI	P-value		OR	95% CI	P-value	
Age 50 years	0.42	0.20	0.88	0.02	0.49	0.18	1.33	0.16	0.40	0.21	0.76	0.01
Female	1.51	0.75	3.04	0.25	2.16	0.91	5.15	0.08	1.53	0.78	2.98	0.21
African American	0.33	0.10	1.05	0.06	0.26	0.10	0.64	<0.01	0.53	0.12	2.37	0.41
Ever married	0.60	0.30	1.21	0.15	0.44	0.20	0.98	0.04	0.54	0.28	1.06	0.07
High school education	0.47	0.25	0.90	0.02	0.49	0.23	1.04	0.06	0.51	0.24	1.09	0.08
CES-D >23	1.88	0.76	4.62	0.17	2.90	1.11	7.59	0.03	1.42	0.61	3.31	0.42
Alcohol use	1.15	0.56	2.36	0.70	1.07	0.50	2.28	0.86	0.99	0.48	2.02	0.97
Cigarette use	3.28	1.43	7.51	<0.01	3.96	1.92	8.16	<0.01	1.30	0.73	2.30	0.38
<1/2 pack cigarettes per day	3.80	1.60	9.05	<0.01	4.81	2.21	10.46	<0.01	1.43	0.75	2.70	0.28
>1/2 pack cigarettes per day	2.22	0.85	5.81	0.10	2.25	1.02	4.97	0.04	1.04	0.47	2.32	0.92
Income <\$5000	2.02	0.79	5.12	0.14	0.68	0.20	2.25	0.52	1.08	0.38	3.04	0.89
Homeless	0.70	0.21	2.29	0.55	1.29	0.46	3.63	0.63	0.34	0.08	1.45	0.15
Medical insurance	0.67	0.32	1.40	0.29	0.93	0.39	2.21	0.87	0.59	0.24	1.42	0.24
Have a primary care doctor	0.74	0.31	1.74	0.49	1.32	0.51	3.40	0.56	0.53	0.20	1.37	0.19
Drug abuse, DAST >16	0.74	0.19	2.91	0.67	0.85	0.40	1.82	0.68	0.35	0.06	1.92	0.23
Methadone treatment	0.50	0.26	0.99	0.05	0.53	0.27	1.04	0.07	0.86	0.35	2.10	0.73
Marijuana use	0.93	0.48	1.79	0.82	0.65	0.30	1.39	0.26	0.87	0.40	1.90	0.74
Speedball use	1.83	0.97	3.46	0.06	1.18	0.52	2.67	0.69	2.18	1.08	4.40	0.03
Any heroin use (any route)	4.69	2.16	10.16	<0.01	5.55	2.57	11.98	<0.01	3.70	1.60	8.59	<0.01
Any cocaine use (any route)	3.10	1.56	6.18	<0.01	2.60	1.18	5.73	0.02	3.07	1.56	6.03	<0.01
Hepatitis C-positive	0.44	0.15	1.24	0.12	0.40	0.13	1.23	0.11	0.68	0.24	1.93	0.47
HIV-positive	0.64	0.34	1.22	0.18	0.81	0.36	1.81	0.60	0.81	0.42	1.56	0.52
Model B: Social environment	Drug use versus drug craving				Heroin use versus heroin craving				Cocaine use versus cocaine craving			
	OR	95% CI	P-value		OR	95% CI	P-value		OR	95% CI	P-value	
With a friend	1.74	1.17	2.58	0.01	1.71	1.10	2.65	0.02	1.42	0.90	2.23	0.13
With acquaintance	1.20	0.73	1.95	0.47	1.28	0.80	2.04	0.30	1.18	0.66	2.12	0.58

Model A: Baseline demographics												
Drug use versus drug craving				Heroin use versus heroin craving				Cocaine use versus cocaine craving				
	OR	95% CI	P-value	OR	95% CI	P-value	OR	95% CI	P-value	OR	95% CI	P-value
Alone	0.98	0.69	1.38	0.90	0.92	0.59	1.42	0.69	0.82	0.56	1.21	0.32
With family	0.88	0.39	1.99	0.75	0.94	0.32	2.79	0.91	0.49	0.29	0.80	<0.01
With your spouse	2.22	1.39	3.55	<0.01	1.02	0.57	1.82	0.96	2.29	1.38	3.81	<0.01
With a child	0.29	0.16	0.53	<0.01	0.19	0.08	0.43	<0.01	0.34	0.19	0.63	<0.01
With an out-the-door partner	2.59	0.99	6.79	0.05	2.43	0.67	8.78	0.18	4.14	1.18	14.60	0.03
With someone who is using	3.21	2.23	4.62	<0.01	2.95	1.74	4.98	<0.01	3.66	2.51	5.33	<0.01
With a stranger	0.75	0.34	1.66	0.48	1.14	0.61	2.13	0.68	0.62	0.25	1.55	0.31
Model C: Activity environment												
	OR	95% CI	P-value	OR	95% CI	P-value	OR	95% CI	P-value	OR	95% CI	P-value
Eating	0.68	0.49	0.94	0.02	0.78	0.54	1.13	0.18	0.68	0.44	1.07	0.10
Socializing	1.48	1.06	2.07	0.02	1.42	0.94	2.12	0.09	1.44	1.01	2.07	0.04
Shopping	1.07	0.72	1.59	0.74	1.16	0.634	2.11	0.62	1.04	0.63	1.71	0.87
Planning	1.75	1.00	3.05	0.05	1.93	1.06	3.49	0.03	1.62	0.94	2.77	0.08
Recreation	1.25	0.91	1.71	0.16	1.13	0.75	1.70	0.56	1.06	0.68	1.64	0.81
Sleeping	0.71	0.48	1.07	0.10	0.85	0.55	1.33	0.48	0.62	0.36	1.08	0.09
Using tobacco	4.82	2.78	8.36	<0.01	6.43	2.88	14.37	<0.01	3.45	1.92	6.21	<0.01
Using alcohol	1.19	0.64	2.23	0.58	0.81	0.37	1.77	0.60	1.32	0.72	2.42	0.36
Were offered drugs	2.67	1.59	4.46	<0.01	2.07	1.14	3.76	0.02	2.87	1.66	4.98	<0.01
Saw someone use	4.22	2.87	6.22	<0.01	3.69	2.49	5.48	<0.01	4.80	2.92	7.87	<0.01
Saw drug paraphernalia	6.39	3.71	11.03	<0.01	6.77	3.54	12.94	<0.01	4.99	3.04	8.17	<0.01
Handled \$10 in cash	2.97	1.89	4.68	<0.01	3.00	1.62	5.54	<0.01	2.81	1.74	4.54	<0.01
Doing illegal activities	2.30	1.21	4.38	0.01	1.66	0.89	3.09	0.11	2.30	1.19	4.44	0.01
Copping	3.42	1.88	6.23	<0.01	3.01	1.54	5.90	<0.01	3.29	1.33	8.12	0.01
Model D: Physical environment												
	OR	95% CI	P-value	OR	95% CI	P-value	OR	95% CI	P-value	OR	95% CI	P-value
At your home	1.88	1.29	2.74	<0.01	1.53	0.87	2.70	0.14	1.82	1.14	2.88	0.01
In another's home	0.90	0.54	1.50	0.69	0.73	0.37	1.43	0.36	0.98	0.55	1.77	0.96
In a car/bus/train	0.36	0.17	0.75	0.01	0.54	0.25	1.14	0.11	0.23	0.09	0.57	<0.01

Model A: Baseline demographics	Drug use versus drug craving			Heroin use versus heroin craving			Cocaine use versus cocaine craving					
	OR	95% CI	P-value	OR	95% CI	P-value	OR	95% CI	P-value			
Outdoors	1.19	0.74	1.90	0.47	1.12	0.65	1.91	0.69	1.82	0.98		
At your work place	0.24	0.12	0.47	<0.01	0.45	0.19	1.09	0.08	0.39	0.15	1.00	0.05
At a store	0.36	0.18	0.72	<0.01	0.30	0.12	0.74	0.01	0.21	0.06	0.83	0.03
At a restaurant	5.04	1.12	22.66	0.03	17.28	5.94	50.27	<0.01	2.03	0.32	12.84	0.45
At a bar	0.79	0.36	1.73	0.56	0.74	0.20	2.66	0.64	0.89	0.36	2.24	0.81
At the doctors office	0.19	0.07	0.57	<0.01	0.17	0.03	0.87	0.03	0.15	0.05	0.43	<0.01
In an abandoned space	6.34	2.91	13.80	<0.01	4.04	1.68	9.75	<0.01	5.86	2.65	12.94	<0.01
Walking/wandering	2.31	1.65	3.24	<0.01	3.21	2.22	4.66	<0.01	1.59	1.07	2.35	0.02
Cop spot	2.17	0.47	9.92	0.32	1.82	0.16	20.94	0.63	2.53	0.45	14.23	0.29
At a shelter	2.98	0.74	11.99	0.13	3.39	0.58	19.80	0.18	0.70	0.08	6.55	0.76
In church	0.26	0.03	2.00	0.20	0.38	0.04	3.25	0.38	0.00	0.00	0.00	0.00
Model E: Psychosocial environment	Drug use versus drug craving			Heroin use versus heroin craving			Cocaine use versus cocaine craving					
	OR	95% CI	P-value	OR	95% CI	P-value	OR	95% CI	P-value			
You were angry	1.44	0.98	2.13	0.07	1.60	0.99	2.59	0.05	1.33	0.83	2.13	0.24
You were angry at someone	0.93	0.51	1.69	0.81	1.14	0.50	2.59	0.75	0.72	0.39	1.32	0.29
You were bored	1.41	0.81	2.45	0.22	1.50	0.77	2.91	0.23	1.05	0.63	1.76	0.84
You were celebrating	1.03	0.61	1.74	0.90	0.93	0.45	1.91	0.84	1.02	0.62	1.68	0.93
You were sad	1.07	0.64	1.79	0.79	0.95	0.49	1.83	0.87	1.02	0.60	1.72	0.95
You were tense	1.28	0.80	2.05	0.30	1.49	0.88	2.52	0.14	1.02	0.58	1.78	0.94
You were tense about something	0.84	0.41	1.75	0.64	0.92	0.39	2.19	0.85	0.86	0.43	1.71	0.66
You were in pain	1.47	0.80	2.72	0.22	1.49	0.73	3.03	0.27	1.19	0.58	2.41	0.64
You were in pain because you needed a hit	5.26	2.06	13.46	<0.01	8.11	3.59	18.33	<0.01	3.89	1.27	11.96	0.02
Wanted use out of the blue	3.07	1.74	5.41	<0.01	2.44	1.17	5.10	0.02	2.95	1.70	5.10	<0.01
Wanted to see what would happen if you took one hit	1.65	1.02	2.67	0.04	1.35	0.76	2.40	0.31	1.51	0.89	2.57	0.13

* All baseline characteristics represent behavior within the 6 months prior to the start of EXACT. Bold values represent associations with *P*-values <0.1. OR = odds ratio; CES-D = Center for Epidemiologic Studies-Depression scale; CI = confidence interval; DAST = Drug Abuse Screening Test.