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Using the Theory of Planned Behavior to Predict Implementation of Harm Reduction Strategies Among MDMA/Ecstasy Users

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This prospective study was designed to test whether the variables proposed by the Theory of Planned Behavior (TPB) were associated with baseline intention to implement and subsequent use of 2 MDMA/ecstasy-specific harm reduction interventions: *preloading/postloading* and *pill testing/pill checking*. Using targeted Facebook advertisements, an international sample of 391 recreational ecstasy users were recruited to complete questionnaires assessing their ecstasy consumption history, and their attitudes, subjective norms, perceived behavioral control, habit strength (past strategy use), and intention to use these two strategies. Attitudes, subjective norms, and perceived behavioral control were significantly associated with baseline intention to *preload/postload* and *pill test/pill check*. Out of the 391 baseline participants, 100 completed the two-month follow-up assessment. Baseline habit strength and frequency of ecstasy consumption during the three months prior to baseline were the only significant predictors of how often participants used the *preloading/postloading* strategy during the follow-up. Baseline intention to *pill test/pill check* was the only significant predictor of how often participants used this strategy during the follow-up. These findings provide partial support for TPB variables as both correlates of baseline intention to implement and predictors of subsequent use of these two strategies. Future investigations could assess whether factors related to ecstasy consumption (e.g., subjective level of intoxication, craving, negative consequences following consumption), and environmental factors (e.g., accessibility and availability of harm reduction resources) improve the prediction of how often ecstasy users employ these and other harm reduction strategies.

Keywords: MDMA, ecstasy, harm reduction, Theory of Planned Behavior

A recent report by the United Nations Office on Drugs and Crime (UNODC, 2014) estimated the average global prevalence of ecstasy consumption to be 0.4% or 18.8 million people, with the highest prevalence of past year consumption in Oceania (e.g., Australia, New Zealand, Malaysia, etc.), North America, and Western and Central Europe. In the United States, past year prevalence of ecstasy consumption was estimated to be 3.5% among 18–25 year olds and 0.5% among individuals 26 years or older (Center for Behavioral Health Statistics and Quality, 2014). Among 15–34 year olds, the prevalence of past year ecstasy consumption in the United Kingdom was 3.2%, which was higher than the estimated prevalence of 1.4% in other European countries (European Monitoring Centre for Drugs & Drug Addiction, 2011, 2015). Because of inconsistencies and lack of reporting, it has been more difficult to estimate the prevalence of ecstasy consumption in South America, Africa, Russia, and parts of Asia, but consumption appears to be stable in most parts of the world (UNODC, 2012).

The prevalence of ecstasy consumption suggests that many people enjoy its reported effects, including enhanced mood, increased energy, sociability, self-confidence, stress reduction, sexual enhancement, and increased subjective wellbeing (Baylen & Rosenberg, 2006; Carhart-Harris & Nutt, 2010; Hunt & Evans, 2008; Morgan, Noronha, Muetzelfeldt, Fielding, & Curran, 2013; Singer & Schensul, 2011; ter Bogt & Engels, 2005; White et al., 2006). These desirable outcomes of ecstasy consumption are counterbalanced by potential acute (0–8 hours postingestion) negative effects such as dehydration, elevations in body temperature, accelerated heartbeat, nausea, teeth clenching/grinding, dizziness, muscle aches or tightness, sleeplessness, mental and/or physical fatigue, confusion, and feelings of anxiety/nervousness and fear/paranoia (Baylen & Rosenberg, 2006; Chinet, Stéphan, Zobel, & Halfon, 2007; Curran, 2000; Parrott, 2000; Parrott, Sisk, & Turner, 2000; Parrott, 2001; Singer & Schensul, 2011; White et al., 2006). Although most of these negative effects are short-lived, memory problems, anxiety, and depressed mood have been reported to occur days, weeks, months or years following heavy, persistent consumption in some users (Morgan, 2000).

Harm Reduction for MDMA/ecstasy Users

Most people who consume ecstasy do not experience problems that require medical attention. However, a recent survey (Winstock, 2015) of over 100,000 people from around the world estimated that approximately 1% of ecstasy consumers had sought emergency medical treatment related to the negative biomedical effects of intoxication in the previous year, an estimate that has tripled since 2012. Given the possible acute and longer-term consequences of consuming ecstasy, both recreational and problematic

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users could benefit from implementing harm reduction strategies designed to protect their health and well being before, during, and after intoxication. Harm reduction includes both environmental interventions and self-initiated behavioral strategies designed to minimize the injurious physiological, psychological, and/or social effects of consuming licit or illicit substances, and preserve or increase quality of life among substance users (e.g., Marlatt, Larimer, & Witkiewitz, 2012).

One harm reduction strategy that could prevent or reduce some of the short-term and long-term physiological and psychological harms associated with ecstasy consumption is *preloading/postloading*. This strategy involves consuming prescription or over-the-counter medications to reduce serotonin depletion or replace nutrients lost during an intoxication episode (Allott & Redman, 2006; Akram & Galt, 1999; De Almeida, Garcia-Mijares, & Silvca, 2009; Jacinto, Duterte, Sales, & Murphy, 2008; Kelly, 2009; Murphy, Wareing, & Fisk, 2006). Examples include consuming serotonin precursors such as 5-hydroxytryptophan (5-HTP), selective serotonin reuptake inhibitors such as citalopram (Celexa), sertraline (Zoloft), and paroxetine (Paxil), herbal supplements such as St. John's wort and Ginkgo biloba, and multivitamins or antioxidant supplements (Allott & Redman, 2006; Kelly, 2009). To date, the empirical support for the efficacy of *preloading/postloading* is based on animal studies (Malberg, Sabol, & Seiden, 1996; Shankaran, Yamamoto, & Gudelsky, 2001; Soleimani Asl, Saifi, Sakhaie, Zargooshnia, & Mehdizadeh, 2015; Sprague, Everman, & Nichols, 1998). Although research will ultimately reveal whether this strategy actually prevents harm during and following consumption, ecstasy consumers report using *preloading/postloading* to manage potential harms of intoxication (Allott & Redman, 2006; Kelly, 2009).

Another ecstasy-relevant harm reduction strategy is *pill testing/pill checking* (also referred to as drug checking). This strategy involves using a testing kit or consulting an online database to check for the presence of adulterants in one's ecstasy, whether in the form of a pill, capsule, crystals, or powder. Testing kits and content reports of ecstasy became popular following several well-publicized deaths in the 1990s that were later attributed to adulterants (Byard, Gilbert, James, & Lokan, 1998; De Letter, Coopman, Cordonnier, & Piette, 2001; Refstad, 2003). Knowing whether one's ecstasy contains seemingly innocuous adulterants (e.g., caffeine), other potentially dangerous substances (e.g., heroin, cocaine, methamphetamine), and/or MDMA analogues (e.g., para-Methoxy-N-methylamphetamine, Methylenedioxypyrovalerone, 3,4-methylenedioxy-N-ethyl-amphetamine) could help ecstasy consumers make more informed decisions about whether and how much they choose to consume, possibly decreasing the likelihood that they might experience aversive biomedical or psychological problems.

Theory of Planned Behavior

According to the Theory of Planned Behavior (TPB, Ajzen, 1985; Ajzen, 2012), intention—defined as specific plans to engage in a behavior—is associated with three factors: (a) attitudes (i.e., beliefs regarding the positive and/or negative outcomes of engaging in a target behavior), (b) subjective norms (i.e., beliefs regarding the degree to which members of one's social groups encourage or discourage the target behavior), and (c) perceived behavioral control (i.e., confidence one can successfully engage in the target behavior in specific contexts). According to the TPB, both baseline intention and perceived behavioral control predict future behavior.

McEachan, Conner, Taylor, and Lawton (2011) conducted a meta-analysis (using data from 206 published articles) summarizing the predictive validity of the TPB in several health-related domains (e.g., drinking alcohol, smoking, using and abstaining from/quitting drugs, physical activity, safer sex, dietary behaviors, speeding). The authors found that attitudes, subjective norms, and perceived behavioral control accounted for 44% of the variance in baseline intention scores across studies. In a subsequent regression analysis to predict actual behavior, baseline intention and perceived behavioral control accounted for 19% of the variance in behavior at follow-up. McEachan et al. (2011) also found that habit strength (i.e., past engagement in the health behavior) was a significant predictor of future behavior among those 86 studies that included this variable.

Understanding which TPB factors are related to baseline intention to implement and subsequent use of ecstasy-specific harm reduction strategies could suggest ways to increase the use of such strategies among consumers, thereby helping to reduce or ameliorate both acute and potential long term harms associated with intoxication. Therefore, we tested whether attitudes, subjective norms, and perceived behavioral control were associated with baseline intention to *preload/postload* and baseline intention to *pill test/pill* check. We also included frequency of ecstasy consumption during the three months prior to baseline as a possible correlate of baseline intention to use both strategies. Second, we hypothesized that baseline intention, perceived behavioral control, and habit strength would predict the proportion of drug use episodes during which ecstasy consumers implemented these two harm reduction strategies during a two-month follow-up period. We also included frequency of ecstasy consumption prior to baseline as a possible correlate of implementation of both strategies at follow-up.

Method

Procedure and Participants

Following approval from our institutional Human Subjects Review Board, we recruited ecstasy consumers using targeted advertisements on www.facebook.com (May and June 2014). Creating a targeted advertisement (ad) on this website enabled us to target recruitment efforts in multiple geographic regions where ecstasy consumption is prevalent and where English is the primary language (e.g., United States, United Kingdom, Canada, New Zealand, Australia). We were also able to specify the demographic (i.e., aged 18–65, English-speaking) and online user characteristics (e.g., "liked" Facebook pages related to MDMA, ecstasy, club drugs, electronic dance communities/events) of individuals to whom the ads should be presented.

We created four ads on Facebook, each with the same heading and recruitment script (i.e., "Participate in MDMA/Ecstasy Harm Reduction Research") and each ad included one of four similar images of an assortment of MDMA/ecstasy pills. Although the exact algorithm used by Facebook to deliver these ads is proprietary, it appears that after people saw the ad they had the opportunity to invite other people in their Facebook network to view the ad by "liking," "sharing," or "commenting" on the ad. Viewers

"liked" one or more of the ads 683 times and "shared" one or more of the ads 112 times. We also recorded 513 comments (e.g., to "tag" a friend in their network), although some who made comments did so multiple times and some "tagged" multiple friends.

After individuals clicked on one of the ads, they were directed to a web-based study site hosted by Survey Gizmo (www.surveygizmo.com). Once at the study site, and prior to giving consent, potential participants were informed that they had to be at least 18 years old and no older than 65, had to read and understand English, and that we would provide a $10 electronic Starbucks gift card to each of the first 160 participants who participated in the two-month follow-up. Although not an initial requirement, to be included in the data analysis, a participant had to report at baseline consuming ecstasy at least once during the previous three months and had to be planning to consume ecstasy at least once during the two-month follow-up (all potential participants met these criteria). To contact participants regarding their use of harm reduction strategies two months after baseline assessment, we asked them to provide an email address—which was not stored with their questionnaire answers—to which we would later send a web-link to the follow-up questions.

After providing their contact information, participants were asked to complete all of the study measures (described below). To reduce consistency bias, items within each measure of the TPB variables were presented in random order, and the TPB-intention items were interspersed among the other measures. Because of an oversight, we did not counterbalance the order of the harm reduction strategies, and always administered the items regarding *pill testing/pill checking* prior to items regarding *preloading/postloading*. Finally, participants answered a series of questions to create an anonymous identification code number for matching baseline and follow-up data.

During the recruitment period (May and June, 2014), 3,982 people clicked one of the ads and were presented with information about the study. Of these individuals, 1,950 were presented with the informed consent document and 858 consented to participate and provided an email address for the two-month follow-up assessment. Of these potential participants, 383 did not complete study questionnaires and 84 did not provide a usable identification code number. Demographics and drug use history variables for the sample of 391 baseline participants are reported in Table 1 and Table 2.

Approximately two months after participants enrolled in the study and completed baseline measures, we sent an email asking them to participate in the follow-up assessment. After participants clicked the link to the study website, they were again provided with the informed consent document and asked to agree to participate in the follow-up. Next, participants were asked the same questions used at baseline to produce an anonymous identification number to match their follow-up data with their baseline data. Finally, participants completed a questionnaire that assessed the frequency with which they had used each of 19 harm reduction strategies, including our two target strategies, since baseline.

Because the email addresses we collected at baseline were not connected to individual responses (to preserve anonymity), we sent out the email invitation for the follow-up assessment (during July and August, 2014) to the entire group of 858 people who had provided a usable email address at baseline. We sent the email overture three times over the course of three weeks to give participants several opportunities to participate. During that time period, 335 people clicked the link to the web-based study site. However, 118 of these people provided either a duplicate identification code with another participant at follow-up or a code that could not be matched to any code provided at baseline (perhaps because they did not complete the baseline assessment). Of the remaining 217 participants, 100 had completed the ecstasy harm reduction strategy questionnaire and reported having used ecstasy at least once since baseline, and thus comprised our final follow-up subsample.

Prior to conducting the main analyses, we conducted a series of chi-square and *t* test analyses to evaluate whether there were any differences in baseline demographic history, ecstasy consumption, other substance consumption, and mean scores of TPB variables between those participants in the follow-up subsample ($n = 100$) and those who participated only at baseline ($n = 291$). Baseline and follow up samples differed on only one of 23 variables. Specifically, the mean score on the perceived behavioral control subscale related to the *preloading/postloading* harm reduction strategy was higher in the final subsample ($M = 0.77$, $SD = 1.83$) than it was in the baseline subsample ($M = 0.17$, $SD = 2.02$), $t(389) = 2.64$, $p = .009$.

Table 1
Demographic Characteristics of Participants by Study Sample

Characteristics	Baseline sample % ($n = 391$)	Follow-up subsample % ($n = 100$)
Gender		
Female	14	14
Male	85	85
Age		
18–24	81	78
25–34	17	21
35–54	2	1
Sexual orientation		
Heterosexual	83	83
Homosexual/bisexual	13	13
Other	1	2
Decline to respond	3	2
Ethnicity		
White/Caucasian	80	86
Hispanic/Latino/a	4	2
Other (Asian, African, Native)	12	8
Decline to respond	4	4
Country of Residence		
United Kingdom	54	48
United States	26	27
Canada	13	17
New Zealand	7	8
Education level		
12th grade or less	3	1
High school graduate or equivalent	24	20
Some college, no degree	38	41
Associates degree	9	11
Bachelor's degree	20	23
Graduate degree	6	4
Relationship status		
Single	73	77
Married/partnered	27	23

Note. Numbers of participants varied by characteristic because some participants did not answer every question. Totals may not sum to 100% due to rounding.

Table 2
Ecstasy and Other Drug Use History for Baseline and Follow-Up Samples

Variable	Baseline sample *M* (*SD*) or % (*n* = 391)	Follow-up subsample *M* (*SD*) or % (*n* = 100)
Ecstasy use history		
General frequency of use		
Less than monthly	43	43
Once per month	31	25
Every other week	17	21
Weekly	8	8
Two times per week	1	1
More than two times per week	1	1
Past 3 month frequency of use at Time 1[a]	4.7 (4.6)	4.9 (5.2)
One time	24	30
Two times	18	13
Three times	13	17
Four times or more	45	40
Frequency of use since Time 1		
1–2	—	40
3–4	—	29
5 or more	—	31
Number of times used during lifetime		
1–20	37	35
21–50	30	30
51–100	15	14
100 or more	17	21
Typical consumption environment		
Home	9	7
Rave	34	38
Club	27	26
Festival	19	17
Other (e.g., friend's house)	12	11
Last time consumed ecstasy		
More than one week ago	54	51
Approximately one week ago	20	19
A few days ago	20	22
Yesterday	5	7
Earlier today/currently intoxicated	2	1
Number of pills/capsules consumed per occasion		
One	17	19
Two	42	39
Three	22	24
Four or more	20	17
Number of pills/capsules purchased per transaction		
1–3	45	54
4–9	31	20
10 or more	25	26
Use of other drugs during previous 3 months		
Alcohol	96	96
Cannabis	85	85
LSD	27	25
Mushrooms	25	28
Benzodiazepines	25	20
Spice/K2	1	1
Research chemicals	13	9
Ketamine	29	26
Prescription Amphetamines	15	15
Cocaine	62	62
Prescription Opioids	27	19
Inhalants	10	6
DMT	9	11
Methamphetamine	10	9
Synthetic Cathinones	6	3
GHB	5	5
Salvia	6	8
Synthetic Cannabinoids	9	6
Barbiturates	3	1
Ayahuasca	0	0
Heroin	2	0
Other[b]	57	16

(*table continues*)

Note. Numbers of participants by characteristic varied because some participants did not answer every question. Totals may not sum to 100% due to rounding.
[a] Response options were continuous (1–24) and we capped responses with "25 or more" to avoid having outliers distort the mean. [b] Types of "other drugs" included research chemicals (2C-x family), modafinil, DMT-family, designer steroids, kratom, san pedro cactus, mescaline, tobacco, Suboxone, and 25b/c-NBOME.

Measures

Prior to filling out study measures, participants were presented with the following definitions of *pill testing/pill checking*: "What I mean is, using a pill testing kit to check for the presence of MDMA or other common 'ecstasy' substances; or checking the contents of your ecstasy by looking at an online pill testing database (e.g., pill reports)," and the following description of *preloading/postloading*: "What I mean is, trying to lower the possible negative effects of using MDMA/ecstasy by taking 5-HTP (5-Hydroxytryptophan) or other vitamins/herbal supplements."

TPB Questionnaires (Baseline). We devised two questionnaires, one for *preloading/postloading* and one for *pill testing/pill checking*, based in part on Orbell, Blair, Sherlock, and Conner (2001) questionnaire assessing the relations of TPB variables and ecstasy consumption. Specifically, we wrote four items to measure attitudes regarding each harm reduction strategy (e.g., "Pill testing/checking is important to me," "Preloading/post-loading is beneficial for me"), three items to measure subjective norms (e.g., "Most of my ecstasy-using friends tell me that I should test/check the content of my pill before I use ecstasy," "Most of my ecstasy-using friends pre-load/post-load when they use ecstasy"), five items to measure perceived behavioral control (e.g., "I can pre-load/post-load when I use ecstasy if I choose to," "I am confident that I could test/check the content of my pill before I use ecstasy over the next 2 months"), and three items to measure intention (e.g., "It is likely that I will pre-load/post-load when I use ecstasy over the next 2 months," "I intend to test/check the content of my pill before I use ecstasy in the next 2 months").

Participants responded to each item on the two 15-item questionnaires (copy available upon request) using a 7-point scale ranging from −3 (*strongly disagree*) to 3 (*strongly agree*). Cronbach's alpha for the subscales of the *preloading/postloading* questionnaire in the baseline sample (*n* = 391) was .92 for the attitudes subscale, .93 for the subjective norms subscale, .95

for the perceived behavioral control subscale, and .98 for the intention subscale. Cronbach's alpha for the subscales of the *pill testing/pill checking* questionnaire in the baseline sample (n = 391) was .88 for the attitudes subscale, .89 for the subjective norms subscale, .93 for the perceived behavioral control subscale, and .97 for the intention subscale.

Index of Habit Strength Questionnaires (Baseline). We devised two questionnaires, one for *preloading/postloading* and one for *pill testing/pill checking*, by eliminating those seven of the original 12 items on the Index of Habit Strength (Verplanken & Orbell, 2003) that we considered ambiguous or confusing. The remaining five items on each questionnaire asked how frequently and automatically an individual had implemented each specific harm reduction strategy in the past (e.g., "Pill testing/checking is something I do frequently," "Pre/post-loading is something I do automatically"). Participants were asked to rate each item using a 7-point scale ranging from −3 (*strongly disagree*) to 3 (*strongly agree*). Cronbach's alpha for the *preloading/postloading* questionnaire in the baseline sample (n = 391) was .96. Cronbach's alpha for the *pill testing/pill checking* questionnaire in the baseline sample (n = 391) was .98.

Ecstasy and Substance Use History Questionnaire (Baseline). We created a questionnaire to assess both ecstasy and other drug use history variables. At baseline, we asked participants about their frequency of MDMA/ecstasy use, how many times they had used MDMA/ecstasy in the previous three months, the number of times they had used in their lifetime, where they typically consumed MDMA/ecstasy, the last time they used, average number of pills or capsules consumed per occasion, and the average number of pills or capsules they purchased per transaction. We also asked participants to indicate whether they had consumed other drugs (e.g., alcohol, nicotine, cannabis/marijuana, synthetic cannabinoids) during the three months prior to baseline. At the two-month follow-up, we asked participants how many times they had consumed MDMA/ecstasy since baseline.

Demographic Questionnaire (Baseline). We created this questionnaire to assess participants' gender, age, sexual orientation, ethnicity, country of residence, education level, and relationship status.

Ecstasy Harm Reduction Strategies Questionnaire (Follow-up). We devised this questionnaire (copy available upon request) to assess the proportion of occasions (from "0%/None of the times" to "100%/All of the time" in increments of 10%) that they had used each of 19 ecstasy-specific harm reduction strategies when they consumed MDMA/ecstasy during the two-month follow-up period. These 19 strategies included our two dependent variables: (a) "I used a test kit to test for the presence of MDMA and adulterants or checked an online database or MDMA testing service," and (b) "I pre-loaded/post-loaded (by consuming herbal and/or pharmacological products) in an attempt to decrease physiological, psychological, or neurological effects of MDMA/ecstasy intoxication." A Pearson product–moment correlation revealed no significant relationship between the proportion of times participants *preloaded/post-loaded* and *pill tested/pill checked* during follow up, $r(98)$ = .16, p = .105.

Results

Baseline: Associations of TPB Subscales and Frequency of Ecstasy Consumption With Intention

First, we calculated Pearson product–moment correlations among the attitudes, subjective norms, and perceived behavioral control subscales and frequency of ecstasy consumption during the three months prior to baseline for both *preloading/postloading* and *pill testing/pill checking*. As Table 3 reveals, none of the individual coefficients were over the threshold ($r > .90$) considered indicative of multicollinearity (Berry, 1993). We then tested the assumption of normally distributed standardized residuals using the Shapiro-Wilk's test for each of our dependent measures (i.e., intention to *preload/postload* and intention to *pill test/pill check*). Because of the large sample size, we used a more conservative ($p < .01$) threshold for statistical significance. Results indicated that the distribution of standardized residuals for each dependent measure was not significantly different from a normal distribution (W's ranged from 0.991 to 0.997). Therefore, we concluded that a multiple linear regression was an appropriate test for each group of variables in our baseline analyses.

Second, we calculated a multiple linear regression to examine whether scores on baseline TPB subscales (i.e., attitudes, subjective norms, perceived behavioral control), and frequency of ecstasy consumption during the three months prior to baseline, were associated with baseline intention to *preload/postload*. We began by examining Variance Inflation Factor (VIF) estimates, which ranged from 1.02 to 2.55, again suggesting that there was not meaningful multicollinearity (all VIFs <10; Stevens, 1992) among study variables. Inspection of histograms and Q-Q plots of standardized residuals revealed a normal distribution. The overall regression model was significant, $F(4, 379) = 160.82$, $p < .001$, $R^2 = .63$, and attitudes ($\beta = .67$, $p < .001$), subjective norms ($\beta = .18$, $p = .001$), and perceived behavioral control ($\beta = .17$, $p = .002$) were significantly positively associated with baseline intention to implement this strategy (see Table 4).

Third, we calculated a multiple linear regression to examine whether scores of baseline TPB subscales and frequency of ecstasy

Table 3
Correlations Among Theory of Planned Behavior Subscales and Frequency of Ecstasy Use at Baseline for Each Strategy

Variables	1	2	3	4
Preloading/Postloading				
1. TPB: Attitudes	—			
2. TPB: Subjective norms	.67***	—		
3. TPB: Perceived behavioral control	.74***	.64***	—	
4. Frequency of ecstasy use during previous 3 months	.08	.12*	.08	—
Pill testing/pill checking				
1. TPB: Attitudes	—			
2. TPB: Subjective norms	.63***	—		
3. TPB: Perceived behavioral control	.62***	.67***	—	
4. Frequency of ecstasy use during previous 3 months	.03	.11*	.15**	—

Note. Number of participants ranged from 380 to 391 due to missing data.
* $p < .05$. ** $p < .01$. *** $p < .001$.

consumption during the three months before baseline were associated with baseline intention to *pill test/pill check*. We began by examining VIF estimates, which ranged from 1.03 to 2.09, again suggesting that there was not meaningful multicollinearity among study variables. Inspection of histograms and Q-Q plots of standardized residuals revealed a normal distribution. The overall regression model was significant, $F(4, 379) = 233.45$, $p < .001$, $R^2 = .71$, and attitudes ($\beta = .47$, $p < .001$), subjective norms ($\beta = .29$, $p < .001$), and perceived behavioral control ($\beta = .37$, $p < .001$) were significantly positively associated with baseline intention to implement this strategy (see Table 4).

Follow-Up: Predicting Implementation of Each Harm Reduction Strategy

We began by calculating the proportion of time participants *preloaded/postloaded* and *pill tested/pill checked* during the two-month follow-up. Frequency counts revealed a negative binomial distribution. In addition, the conditional variance was greater than the conditional mean for both dependent variables. Therefore, we conducted a negative binomial with log-link regression for each of the Time 2 analyses.

The first of these regressions examined whether baseline intention, perceived behavioral control, habit strength, and frequency of ecstasy consumption during the three months prior to baseline predicted the proportion of drug use episodes during which participants *preloaded/postloaded* during the two-month follow-up ($M = 27\%$, $SD = 39\%$). As Table 5 reveals, the omnibus test was significant, $\chi^2(4) = 59.44$, $p < .001$. Baseline habit strength ($\beta = .47$, $p = .046$) was positively associated, and frequency of ecstasy consumption prior to baseline was negatively associated ($\beta = -0.12$, $p = .012$), with the proportion of time participants used this harm reduction strategy.

The second regression examined whether baseline intention, perceived behavioral control, habit strength, and frequency of ecstasy consumption during the three months prior to baseline predicted the proportion of episodes during which participants *pill tested/pill checked* when they consumed ecstasy during the two-month follow-up ($M = 16\%$, $SD = 33\%$). As Table 5 reveals, the omnibus test was significant, $\chi^2(4) = 32.44$, $p < .001$. Only baseline intention ($\beta = .46$, $p = .018$) was a significant predictor of the proportion of time participants used this harm reduction strategy during the follow-up.

Discussion

Because it could help us understand ways to increase the use of strategies intended to reduce injurious outcomes, we designed this study to evaluate the strength with which TPB variables were associated with baseline intention to implement and subsequent use of two ecstasy-specific harm reduction strategies (i.e., *pill testing/pill checking* and *preloading/postloading*). Our results are similar to the meta-analytic findings by McEachan et al. (2011), who concluded that baseline TPB variables were associated with intention to implement, and intention and perceived behavioral control were predictors of actual use of, a variety of health-related behaviors. Specifically, in our study, attitudes, subjective norms, and perceived behavioral control were significantly associated with baseline intention to implement both *preloading/postloading* and *pill testing/pill checking*. Furthermore, intention to *pill test/pill check* at baseline significantly predicted how often participants used this strategy during the follow-up. These findings provide partial support for the TPB when applied to the use of harm reduction strategies among ecstasy users.

However, contrary to our prediction based on McEachan et al. (2011), baseline intention did *not* predict use of *preloading/postloading* during the follow-up period. One explanation for this finding is that the availability and accessibility of harm reduction-related products or services might limit one's ability to *preload/postload* regardless of their intention to do so. To employ the *preloading/postloading* strategy, ecstasy consumers must have access to and financial resources to purchase vitamins and/or other supplements. Not being able to afford or locate these products shortly before or after consumption could also interfere with use of this strategy. In addition, both *preloading/postloading* and *pill testing/pill checking* are less likely to be available and employed in states or countries with laws prohibiting provision of harm reduction.

Another explanation is that we combined *preloading* with *postloading* into one strategy, and intention might predict *preloading*

Table 4
Multiple Linear Regression Analyses Assessing Associations of Theory of Planned Behavior Subscales and Intention to Implement Specific Ecstasy Harm Reduction Strategies at Baseline

Dependent variable	Independent variable	β	Standard error	*t*-value
Intention to preload/postload[a]				
	Attitudes	.67	.06	11.21***
	Subjective norms	.18	.05	3.46**
	Perceived behavioral control	.17	.05	3.14**
	Previous 3-month frequency of ecstasy use	.01	.02	.75
Intention to pill test/pill check[b]				
	Attitudes	.47	.05	10.07***
	Subjective norms	.29	.05	5.80***
	Perceived behavioral control	.37	.04	8.78***
	Previous 3-month frequency of ecstasy use	.02	.01	1.19

[a] Overall model, $F(4, 379) = 160.82$, $p < .001$, $R^2 = .63$. [b] Overall model, $F(4, 379) = 233.45$, $p < .001$, $R^2 = .71$.
** $p < .01$. *** $p < .001$.

Table 5
Negative Binomial Regression Assessing Associations of Baseline Theory of Planned Behavior Subscales, Habit Strength, and Previous 3-Month Frequency of Ecstasy Use With Actual Use of Each Ecstasy Harm Reduction Strategy During Follow-Up

Dependent variable	Independent variable	β	Se	(confidence interval)	Wald χ^2
Percent of occasions during which participants Preloaded/postloaded[a]					
	Intention	.11	.10	(−.09, .31)	1.10
	Perceived behavioral control	.06	.11	(−.15, .26)	.30
	Habit strength	.47	.21	(.06, .87)	5.14*
	Previous 3-month frequency of ecstasy use	−.12	.03	(−.19, −.05)	11.86**
Percent of occasions during which participants Pill tested/pill checked[b]					
	Intention	.46	.13	(.21, .72)	12.46***
	Perceived behavioral control	−.21	.12	(−.46, .03)	2.97
	Habit strength	.04	.23	(−.41, .48)	.03
	Previous 3-month frequency of ecstasy use	.03	.03	(−.02, .08)	1.29

[a] Omnibus test, $\chi^2(4) = 59.44$, $p < .001$; $N = 97$. [b] Omnibus test, $\chi^2(4) = 32.44$, $p < .001$; $N = 97$.
* $p < .05$. ** $p < .01$. *** $p < .001$.

but not *postloading*. Specifically, intoxication may interfere with one's intention to implement harm reduction strategies that are employed during or immediately following intoxication, such as *postloading*. For example, Ramaekers, Kuypers, Wingen, Heinecke, and Formisano (2009) reported that ecstasy intoxication impaired prospective memory (i.e., remembering that one wants to do something). In short, intention may be a significant predictor of only those strategies that are employed prior to ecstasy consumption (e.g., *pill testing/pill checking*; *preloading*) and before such intentions are disrupted by intoxication.

Also contrary to what we expected, perceived behavioral control was unrelated to actual use of both harm reduction strategies at follow-up. Several factors may attenuate the relation between self-confidence to implement a harm reduction strategy at baseline and future use of that strategy. In addition to the factors noted above (i.e., availability and accessibility of resources, acute intoxication), craving for the drug (Davis & Rosenberg, 2014; Hopper et al., 2006) could also attenuate the relation between one's confidence to implement and how often one actually uses a harm reduction strategy, perhaps especially when such craving contributes to impulsive drug consumption.

Our findings also revealed that lower frequency of ecstasy consumption in the *3* months before baseline predicted the proportion of time participants *preloaded/postloaded* during the follow-up but did not predict use of *pill testing/pill checking*. One explanation for this finding is based on the assumption that ecstasy consumers believe that *preloading/postloading* will reduce both short- and long-term mood and memory problems. Concern about these possible negative outcomes could result in both less frequent consumption of ecstasy and more frequent use of this strategy. However, to the degree that *pill testing/pill checking* is viewed as a means of avoiding consumption of an unwanted adulterant, this strategy could be used regardless of how frequently or infrequently one chooses to consume ecstasy.

Several methodological considerations may limit the generalizability of our findings. For example, ecstasy consumers who do not access Facebook, or who will not participate in online research about illegal drug consumption, might have more or less favorable beliefs about the use of ecstasy harm reduction strategies. However, there are many practical and methodological advantages of web-based studies (King, O'Rourke, & DeLongis, 2014), and evidence supports the reliability and validity of anonymous reports of drug consumption and consumption-related consequences provided via the Internet (Ramo, Liu, & Prochaska, 2012). In addition, our recruitment ads included the term *harm reduction*, and participants could inform other people in their Facebook network about the study, which could have increased the likelihood we recruited participants who had favorable and similar attitudes regarding harm reduction practices. Those who did not learn about the study on Facebook, and those who reside in countries from which we did not recruit participants, may have different attitudes about the use of harm reduction and be more or less likely to implement these strategies.

Another potential limitation was our within-subjects design. Although an efficient means of assessing attitudes and beliefs regarding two different harm reduction strategies, answering the questionnaires about one strategy could have created carryover effects when completing the measures for the other strategy. Also, we combined *preloading* with *postloading*, and *pill testing* with *pill checking*, to describe each of these two harm reduction strategies. Although both elements in each of these strategies address the same underlying harm, participants could have different views regarding, and abilities to implement, the separate elements in each of the compound strategies.

In addition, we asked participants if they used a "test kit to test for the presence of MDMA and adulterants or checked an online database or MDMA testing service" during the two-month follow-up, but we used the term *pill testing/checking* in the TPB questionnaires at baseline as a shorthand description of this strategy. This could have led some participants who consume only crystal or powder forms of the substance to think that part of the study did not apply to them, either because they do not consume "pills" or

because these items asked about a strategy they might instead refer to as drug checking. This discrepancy could also have attenuated the relation between TPB variables at baseline and measurement of strategy use at follow-up. Another potential limitation is that we did not use the popular term *Molly* in our questionnaires nor did we explicitly describe crystal or powder forms of MDMA (when not pressed or put into capsules) in our description of *pill testing/pill checking*. However, we think most participants understood that we meant MDMA/ecstasy in all of its forms and preparations, and testing the chemical composition of one's ecstasy is relevant whether one consumes a pill, tablet, crystal, or powder form of the drug.

Acknowledging that more research is needed to evaluate the relation of TPB variables with use of harm reduction strategies by MDMA/ecstasy consumers, our findings have potential clinical, educational, and research applications. For example, our results indicated that attitudes, subjective norms, and perceived behavioral control significantly predicted concurrent intention to implement, and intention significantly predicted actual use of, the *pill testing/pill checking* strategy. Therefore, we suggest that clinicians, harm reduction workers, and public health officials evaluate whether education and prevention materials noting the importance, benefits, and necessity of using *pill testing/pill checking* (i.e., drug checking) increases use of this strategy and, more importantly, if such testing/checking decreases the potential psychological and biomedical harms among those who consume ecstasy. In addition, although harm reduction strategies could be of benefit to infrequent and novice users, individuals who abuse ecstasy are probably more likely to experience harms associated with increased consumption. Therefore, researchers might find stronger relations between TPB variables and use of harm reduction strategies among problematic users than among the recreational users we recruited for the present study.

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