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Polysubstance use profiles among electronic dance music party attendees in New York City and their relation to use of new psychoactive substances

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Abstract

Background—Electronic Dance Music (EDM) party attendees are often polysubstance users and are at high risk for use of new psychoactive substances (NPS). We sought to identify patterns of use of common illegal drugs among EDM party attendees, sociodemographic correlates, and use of NPS as a function of patterns of use of more common drugs to inform prevention and harm reduction.

Method—Using time-space-sampling, 1045 individuals aged 18–40 were surveyed entering EDM parties in New York City. We queried past-year use of common illegal drugs and 98 NPS. We conducted latent class analysis to identify polysubstance use profiles of use of eight common drugs (i.e., ecstasy, ketamine, LSD, mushrooms, powder cocaine, marijuana, amphetamine, benzodiazepines). Relationships between drug classification membership and sociodemographics and use of drugs within six NPS categories were examined.

Results—We identified four profiles of use of common drugs: non-polysubstance use (61.1%), extensive poly-substance use (19.2%), moderate polysubstance use/stimulants (12.8%), and moderate polysubstance use/psychedelics (6.7%). Those in the moderate/psychedelic group were at higher odds of using NPS with psychedelic-type effects (2C, tryptamines, and other “new” psychedelics; $P_s < 0.05$). Extensive polysubstance users were at increased odds of reporting use of

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Contributors

All authors are responsible for this reported research. F. Fernández Calderón conceptualized this study and drafted the initial manuscript. F. Fernández Calderón, J. Palamar, and C. Cleland conducted the statistical analyses, interpreted results, drafted the manuscript, critically reviewed the manuscript, and reviewed and revised the manuscript. All authors edited and approved the final manuscript as submitted.

Conflict of interest

All authors declare they have no conflicts of interest to this study.

2C drugs, synthetic cathinones (“bath salts”), tryptamines, other new (non-phenethylamine) psychedelics, new dissociatives, and synthetic cannabinoids ($P_s < 0.05$).

Conclusion—NPS preference is linked to the profile of use of common drugs among individuals in the EDM scene. Most participants were identified as non-polysubstance users, but findings may help inform preventive and harm reduction interventions among those at risk in this scene.

Keywords

Latent class analysis; Polysubstance use profiles; Electronic dance music; New psychoactive substances

1. Introduction

Electronic dance music (EDM) parties at nightclubs and festivals have recently increased in popularity (Watson, 2016). Many studies have documented drug use patterns among EDM party attendees as use in this population tends to be higher than use among other populations, especially use of “club drugs” such as ecstasy (MDMA, “Molly”) (Fernández-Calderón, Lozano-Rojas, & Rojas-Tejada, 2013; Palamar, Griffin-Tomas, & Ompad, 2015a; Sañudo, Andreoni, & Sánchez, 2015; Van Havere, Vanderplasschen, Lammertyn, Broekaert, & Bellis, 2011). A recent analysis of a nationally representative study of high school seniors found that compared to non-attendees, rave attendees were much more likely to report use of each of the 18 drugs queried, with use of all drugs other than marijuana being at least twice as prevalent among attendees (Palamar et al., 2015a). Many studies targeting this population have also found high prevalence of use of various drugs (Kelly, Parsons, & Wells, 2006; Kipke et al., 2007; Mattison et al., 2001; McCambridge, Mitcheson, Winstock, & Hunt, 2005; Palamar, Acosta, Ompad, & Cleland, 2016a; Pantalone, Bimbi, Holder, Golub, & Parsons, 2010; Winstock, Griffiths, & Stewart, 2001). Alarming, poisonings and drug-related deaths are now common at EDM festivals (Centers for Disease Control and Prevention, 2010; Lund & Turris, 2015; Ridpath et al., 2014). Polysubstance use is also common among this population (Barrett, Gross, Garand, & Pihl, 2005; Fernández-Calderón et al., 2014; Halkitis, Palamar, & Mukherjee, 2007), and may increase risk of users experiencing adverse outcomes; thus, more research is needed on patterns of polysubstance use in this high-risk population.

Polysubstance use refers to the use of multiple substances within a specific time-frame (e.g., concomitant use, use within the past year) (Connor, Gullo, White, & Kelly, 2014; Halkitis et al., 2007). Many studies have examined relationships between polysubstance use, risky behaviors and adverse health consequences. While operationalization of polysubstance use in studies varies (e.g., some consider tobacco and/or alcohol while others limit analyses to illegal substances) (Karjalainen, Kuussaari, Kataja, Tigerstedt, & Hakkarainen, 2017), results typically suggest that compared to use of single substances, polysubstance use is often linked to higher likelihood of engaging in riskier behaviors and adverse health consequences (Baggio, Studer, Mohler-Kuo, Daeppen, & Gmel, 2014; Bao et al., 2015; Brookhuis, de Waard, & Samyn, 2004; Fernández-Calderón, Fernández, Ruiz-Curado, Verdejo-García, & Lozano, 2015; Morley, Lynskey, Moran, Borschmann, & Winstock, 2015; Quek et al., 2013; Salom, Betts, Williams, Najman, & Alati, 2016; Trenz et al., 2013;

Verdejo-García et al., 2010). For example, Morley et al. (2015) identified five patterns of polysubstance use according to use of eight illegal drugs (including nonmedical use of prescribed psychoactive substances) in a sample of 14,869 participants. Compared to *non-polysubstance users*, participants in all polysubstance use groups (i.e., marijuana/ecstasy, ecstasy/cocaine, marijuana/non-medical prescription drug use, all illegal drugs examined) were more likely to report risky sexual behavior or be diagnosed with a personality disorder.

Although various studies have described different patterns of poly-substance use, many have characterized these patterns according to number of substances reportedly used (Carter et al., 2013; Smith, Farrell, Bunting, Houston, & Shevlin, 2011; Tomczyk, Hanewinkel, & Isensee, 2015). However, polysubstance users are a heterogeneous group, whereby individuals tend to use different combinations of substances (Morley et al., 2015) according to desired effects. Different polysubstance use patterns are likely to have different effects on users' health, and thus may require different forms of prevention to minimize such risks.

Studies have identified polysubstance use patterns in the general population (Carter et al., 2013; Quek et al., 2013; Smith et al., 2011), in adolescents (Göbel, Scheithauer, Bräker, Jonkman, & Soellner, 2016; Tomczyk et al., 2015), and in individuals in drug treatment (Agrawal, Lynskey, Madden, Bucholz, & Heath, 2007; Fernández-Calderón et al., 2015). A few studies have examined such patterns among nightclub attendees (Morley et al., 2015; Sañudo et al., 2015); however, these studies examined polysubstance patterns in relation to musical preference and mental health. While EDM party attendees are already at high risk for use of various drugs (often in a polysubstance context), recent evidence suggests they are now at high risk for using new psychoactive substances (NPS) (Palamar, Acosta, Sherman, Ompad, & Cleland, 2016b; Palamar, Barratt, Ferris, & Winstock, 2016c). NPS can be dangerous on their own, but if included in users' current poly-substance repertoires, can potentially exacerbate risk for adverse outcomes (Law, Schier, Martin, Chang, & Wolkin, 2015; Palamar, Su, & Hoffman, 2016d; Ridpath et al., 2014).

Hundreds of NPS have emerged in recent years, and these substances often mimic effects of more common illegal drugs (European Monitoring Centre for Drugs and Drug Addiction (EMCDDA), 2013; United Nations Office on Drugs and Crime, 2016). These substances are associated with unique acute health risks (Kyriakou et al., 2015; Law et al., 2015; Miotto, Striebel, Cho, & Wang, 2013; Nugteren-van Lonkhuyzen, van Riel, Brunt, & Hondebrink, 2015; Tittarelli, Mannocchi, Pantano, & Romolo, 2015; Zawilska & Andrzejczak, 2015), in part, due to the uncertainty and unpredictability of their effects due to lack of research, varying potency, and incorrect labeling of products (Araujo et al., 2015; Patterson, Young, & Vaccarino, 2017). Thus, these substances have potential to lead to more serious health threats for users than more common substances with decades of research.

Most NPS use occurs among individuals already experienced with more common illegal drugs (Bruno et al., 2012; French Monitoring Centre for Drugs and Drug Addiction, 2016; Palamar & Acosta, 2015; Winstock & Barratt, 2013). Research suggests that between 83% and 99% of people who use NPS also use more common illegal drugs (Palamar & Acosta, 2015; Palamar, Barratt, Coney, & Martins, 2017a; Stephenson & Richardson, 2014). To our knowledge, no studies have examined the risk of using different types of NPS as a function

of patterns of use of more common illegal drugs. Sutherland et al. (2016) examined NPS use in a sample of regular psychostimulant users and found that users sought NPS with similar properties to more common drugs they had already used. The authors also found that NPS use was related to use of a larger number of more common illegal drugs.

Many EDM party attendees (who are often polysubstance users) carry out harm reduction strategies to minimize drug-related harms (Fernández-Calderón et al., 2014; Van Havere, Tutenges, De Maeyer, Broekaert, & Vanderplasschen, 2015). Harm reduction messages have been shown to be effective (Doumas, Miller, & Esp, 2017; Pedersen, Hummer, Rinker, Traylor, & Neighbors, 2016; Vidal-Giné, Fernández-Calderón, & López-Guerrero, 2016) and appear to be accepted among EDM party attendees (Branigan & Wellings, 1999). Thus, identifying profiles of polysubstance use, associated characteristics of users, and their relation to NPS use, can contribute to the designing of harm reduction interventions tailored to EDM party attendees.

Thus, in this study we aimed to: 1) identify patterns of use of common illegal drugs in a sample of EDM party attendees in New York City (NYC), 2) identify sociodemographic correlates of use, and 3) determine whether specific patterns relate to use of various NPS. Based on previous research (Palamar et al., 2016b; Palamar et al., 2016c; Sutherland et al., 2016), we believe polysubstance use is associated with increased odds for NPS use, and specifically, we hypothesize that polysubstance profiles indicating desired effects of particular more common illegal drugs will be related to use of NPS known to have similar effects.

2. Methods

2.1. Participants and procedure

1087 individuals entering EDM parties in NYC were surveyed from May through September of 2016. We targeted individuals entering these parties as this method is most ideal for reaching “hidden populations” (Watters & Biernacki, 1989), although to overcome limitations of targeted or venue-based sampling, we specifically utilized time-space sampling (Jenness et al., 2011; MacKellar et al., 2007; Palamar et al., 2016b). Parties were randomly selected (in order to maintain an element of randomness), and individuals entering those parties were approached. Individuals (or groups) appearing to be eligible were approached (as feasible); we did not also randomize at the individual level as studies have shown that eliminating this allows fuller utilization of resources and does not resort in different characteristics of those sampled (Parsons, Grov, & Kelly, 2008). Individuals were eligible if they were ages 18–40 and were about to attend the selected party. Participants provided informed consent and completed the survey on tablets. Surveys were conducted in areas recruiters deemed safe and recruiters were present to help ensure privacy and safety. The response rate of those believed to be eligible was 77% (of 1412 approached). However, these analyses only focus on the 1045 participants with complete drug use data who were not flagged for overreporting [defined as reporting use of nadropax, a fictitious drug] (Aldridge, Measham, & Parker, 1998). Procedures were approved by the New York University Langone Medical Center institutional review board.

2.2. Measures

Participants were first asked about sociodemographic characteristics (e.g., sex, age, race/ethnicity, education, sexual orientation, parent education, weekly income) and frequency of nightclub/festival attendance. They were then asked about drug use in the past 12 months, which was queried in a binary (yes/no) manner. We first queried use of 98 NPS, which were grouped by NPS category. Participants were asked about NPS grouped in categories including 2C series (e.g., 2C-E), “bath salts” (synthetic cathinones; e.g., methylone), tryptamines (e.g., 5-MeO-DiPT), other new (non-phenethylamine) psychedelics (e.g., AL-LAD), new dissociatives (e.g., methoxetamine), and synthetic cannabinoids (“synthetic marijuana”). We then asked about use of 8 common illegal drugs: marijuana, ecstasy/MDMA (“Molly”), ketamine, mushrooms, powder cocaine, LSD, and nonmedical use of amphetamines and benzodiazepines.

2.3. Analyses

Latent Class Analyses (LCA) were conducted to determine poly-substance use profiles using Mplus 6.12 software. The classification variables were the 8 common illegal drugs explored. We extracted distinct subgroups based on the similarity of their response profiles (Reboussin, Song, Shrestha, Lohman, & Wolfson, 2006). LCA produces probabilities of class membership for each participant, reflecting each class size, and the probability of response for use of each drug in each class (Uebersax, 1994). To determine the number of classes that have the best fit, we considered Bayesian Information Criterion (BIC) in which lower values indicate better fit and more parsimonious models (Vermunt & Magidson, 2005).

After conducting descriptive analyses, we conducted Rao-Scott chi-square tests (Rao & Scott, 1984) to analyze associations between LCA-membership and demographic characteristics and NPS use. Multi-variable multinomial logistic regressions were also conducted to determine relationships between each covariate and latent classes to examine associations with all else being equal. In order to determine how class membership related to self-reported NPS use, we entered latent classes as an independent variable (with no polydrug use as the reference category) into six separate logistic regression models with self-reported use of each category of NPS as the outcome. We then repeated these six models, controlling for all demographic characteristics. These statistics were computed using Stata SE 13.

Sample weights were created which incorporated frequency of party attendance and proportion of eligible participants approached each night. We calculated participant's selection probability (MacKellar et al., 2007) and weighted prevalence estimates by the inverse of that probability (Jenness et al., 2011). Thus, analyses accounted for clustering of participants by party and differential selection probability using Taylor series estimation (Heeringa, West, & Berglund, 2010). We specified party as the primary sampling unit and utilized probability weights for each participant. Weights were utilized for all analyses.

3. Results

Over half of the sample identified as male (54.5%), or age 18–24 years old (56.8%); half (51.7%) reported having a college degree or higher, and the majority (61.0%) identified as white. The most prevalent NPS used were new psychedelics (4.7%), and synthetic cannabinoids (3.6%), followed by 2C (1.8%), tryptamines (1.8%) and new dissociatives (1.7%). “Bath salt” (synthetic cathinone) use was self-reported by 1.2% of participants.

3.1. LCA drug use profiles for common illegal drugs

We explored 7 possible solutions to find the best classification. Solutions with 4–7 latent classes demonstrated good fit ($p > 0.05$) (Table 1). The best-fitting model was determined based on BIC with $p > 0.10$, with the 4-class model identified as the most parsimonious model with best fit.

Each participant was assigned to the class with the highest posterior probability. The average probability of classification varied from 0.858 to 0.946. The likelihood of endorsement of each drug in the 4 classes is presented in Fig. 1 and estimated weighted prevalence of drug use in each class is presented in Table 2.

Class 1 consisted of 61.1% of the sample. Those in this class had a low conditional probability (< 0.13) of reporting use of any substances other than marijuana, which was moderate (0.29). Almost a third (31.2%) reported marijuana use; 14.6% reported ecstasy use, and 2.1% reported use of any other substance. The mean number of substances used was 1.1 ($SE = 0.1$). This group was labeled *non-polysubstance use*.

Class 2 comprised 19.2% of the sample. The conditional probabilities in this class were very high for powder cocaine (1.0), marijuana (0.98), ecstasy (0.94) and mushrooms (0.74). In addition, these participants were likely to have used ketamine (0.57), LSD (0.56), and amphetamine (0.54), and also relatively likely to have use benzodiazepines (0.29). All participants reported cocaine use while almost all reported using marijuana and ecstasy. The mean number of drugs used in this class was 6.4 ($SE = 0.1$). This class was labeled *extensive polysubstance use*.

Class 3 contained over a tenth (12.8%) of the sample. Participants in this class were very likely to have used marijuana (0.86) and likely to have used powder cocaine (0.53) and amphetamine (0.42). Also, they were relatively likely to have used benzodiazepines (0.24). Those in this class reported high prevalence of marijuana, amphetamine, and powder cocaine use. The mean number of drugs used by participants in this class was 4.0 ($SE = 0.2$). Neither ketamine nor LSD were reported by participants in this class. This class was labeled *moderate polysubstance use/stimulants*.

Class 4 consisted of participants (6.7%) who were very likely to have used LSD (0.83), ecstasy (0.76), and marijuana (0.69), and likely to have used mushrooms (0.48). Most participants (92.4%) reported LSD use; around 3 out of 4 participants reported ecstasy use and marijuana, while about half of those reported use of mushrooms. Similar to *Class 3*, the mean number of substances used by participants in this group was 4.5 ($SE = 0.2$). In contrast

to *Class 3*, participants in *Class 4* were more likely to have used ecstasy, mushrooms, and/or LSD, and less likely to have used cocaine and amphetamine. This class was labeled *moderate polysubstance use/psychedelics*.

3.2. Comparison of demographic characteristics and NPS use by latent classes

As shown in Table 3, the majority of those identifying as white were categorized into polysubstance classes, with *Class no polysubstance use* including the lowest percentage of white participants (56.1%) ($p = 0.005$). Ad hoc analysis further determined that race/ethnicity differences were limited to those identifying as White ($p = 0.003$) and Hispanic ($p < 0.001$) with more Hispanics and fewer White participants in the no polysubstance use class. Those in the no polysubstance use group were less likely to report college education or higher compared to other levels of education ($p = 0.049$). With regard to NPS use, differences were found between classes for all NPS other than synthetic cannabinoids. *Class extensive polysubstance use* had the highest prevalence of NPS use—often with prevalence more than double that of other categories, with a third (33.7%) reporting use of other new psychedelics, 13.4% reporting use of new dissociatives, 11.7% reporting tryptamine use, and one out of ten (10.1%) reporting synthetic cannabinoid use. *Class moderate/psychedelic polysubstance use* had a relatively high percentage of individuals who used tryptamines (5.7%) and other new psychedelics (12.9%) compared to classes other than *extensive polysubstance users*.

Table 4 presents the results of the multivariable multinomial logistic regressions. In comparison to those identifying as heterosexual, gay/bisexual/other participants were more likely to be in the *moderate/psychedelic use group* vs. the *non-polysubstance use group* ($p = 0.011$). Compared to white participants, those identifying as black ($p = 0.001$), Asian ($p = 0.001$) or other race ($p = 0.010$) were at lower odds of being in *class extensive polysubstance use*. Also, Hispanic participants were at lower odds of being in *moderate/stimulant use group*. Those identifying as gay/bisexual/other ($p = 0.029$), or reporting medium ($p = 0.026$) or high ($p = 0.035$) parent education were also at increased odds of being in this category. Compared to participants with a weekly income of \$199 or less, those reporting earning \$200–500 per week were at higher odds of being in *class extensive polysubstance use* ($p < 0.001$). Participants aged 25–40 years ($p = 0.042$) or reporting any college education ($p = 0.029$) were at higher odds of being in *class moderate/stimulant use* compared to participants who were 18–24 years old and participants reporting high school education or less, respectively.

Associations between classes and NPS use are presented in Table 5. Compared to those in the no polysubstance use group, those in the *moderate/psychedelic use group* were at consistently increased odds using 2C, tryptamines, and/or other new psychedelics. This group was also at increased odds for reporting “bath salt” use until controlling for demographic characteristics. Compared to *non-polysubstance users*, *extensive polysubstance users* were at increased odds of reporting use of each NPS (most with robust associations).

4. Discussion

This study aimed to identify patterns of use of common illegal drugs and their relation to user sociodemographics and NPS use in a sample of EDM party attendees in NYC. We determined four polysubstance use profiles which were related to user characteristics and to use of various NPS. While six out of ten participants were not classified as poly-substance users, consistent with previous research (Palamar, Martins, Su, & Ompad, 2015b; Sutherland et al., 2016), we found that users of multiple common illegal substances were at risk for NPS use. Results also support our hypothesis that polysubstance profiles relate to use of NPS known to have similar effects as drugs in that class (e.g., stimulants, psychedelics).

The *non-polysubstance use* class, which comprised the most of sample, contained mostly participants who used marijuana and no other substances. This result is consistent with previous studies of party attendees classifying 55% (Sañudo et al., 2015) and 49.1% (Morley et al., 2015) of participants as *non-polysubstance users*. Our *extensive polysubstance user class* comprised a fifth (19.2%) of the sample, which is somewhat higher than the 10% in a similar classification (containing “all substances” or “all illicit substances” found by Sañudo et al. (2015) and 13.2% found by Morley et al. (2015). This is important information when attempting to intervene with EDM party attendees who use drugs as while we determined that the majority of attendees largely limit their recent use to a single substance, and a minority will use a more extensive number of substances. Thus, when harm reduction messages are delivered to EDM party attendees, it is likely that not all will be equally receptive to messages related to minimize polysubstance related harm (e.g., avoiding the combination of stimulants).

Our findings suggest two classes were similar according to the number of substances used. Nonetheless, these classes are nuanced with regard to drug preferences. In *class moderate polysubstance use/psychedelics*, a higher percentage reported use of “psychedelic” drugs such as LSD, mushrooms, and ecstasy. On the contrary, users of these substances was much less likely in the *class moderate polysubstance use/stimulants*, characterized by more prevalent use of amphetamine and powder cocaine, along with marijuana. As other authors have pointed out (Fernández-Calderón et al., 2011), preference for “psychedelics” (including ecstasy; e.g., as in the *moderate/psychedelic use* group) may reflect drug popularity within EDM culture while *moderate/stimulant users* could be identified as more of a mainstream drug user group. The use of marijuana and benzodiazepines to counteract effects of stimulants is common (Groß, Kelly, & Parsons, 2009; Hunt, Evans, Moloney, & Bailey, 2009), and may reflect the larger percentage of marijuana and benzodiazepine use in *extensive polysubstance users* and *moderate/stimulant users* groups, which include participants with a high prevalence of use of stimulants. In light of these results, polysubstance users who fit these profiles may benefit from harm reduction messages aimed at reducing risks of combining stimulants and/or depressants.

Our results are consistent with some sociodemographic correlates found in prior research that identify profiles of polysubstance use in the general population. Kecojovic, Jun, Reisner, and Corliss (2017), for example, found that identifying as heterosexual was associated with a lower likelihood of polysubstance use. We believe we corroborate these findings as we

found that participants in *class moderate polysubstance use/psychedelics* and *extensive polysubstance use* were more likely to identify as non-heterosexual. Previous research focusing on the general population has also shown that racial/ethnic minorities are less likely to report polysubstance use (McCabe, Cranford, Morales, & Young, 2006), and this is the case in our study as well, where identifying as black, Asian or other race was associated with lower odds of being classified in the *extensive polysubstance use class*. With regard to associations between polysubstance use and gender, our results are consistent with other studies of nightclub attendees which did not find differences between genders (Fernández-Calderón et al., 2012; Grov et al., 2009). The sociodemographic correlates identified in our study may help inform intervention with substance users in the EDM scene, contributing to more tailored and effective interventions that take into account which subjects are at higher risk of maintaining different polysubstance use patterns.

The association among use of specific common illicit drugs and use of NPS has been understudied. Sutherland et al. (2016), however, examined a sample of regular users of psychostimulants and found that those who use ecstasy and LSD were more likely to report use of new phenethylamines. Our study builds upon these findings by identifying a typology of multiple common drugs used among a high-risk population for NPS use (Palamar et al., 2016b; Palamar et al., 2016c). Research suggests users of common illegal drugs sometimes seek NPS with similar effects as their preferred common drugs (Sutherland et al., 2016). Since availability of various NPS changes frequently (although their effects are often similar) (European Monitoring Centre for Drugs and Drug Addiction [EMCDDA], 2013; Hohmann, Mikus, & Czock, 2014), it seems appropriate to explore categories of NPS rather than specific substances, as we did in this study. Another strength of our study is that we explored a broad range of NPS ($n = 98$) which we classified into distinct NPS categories.

Relevant to our first hypothesis, it is noteworthy that among our two classes identified as moderate polysubstance users, the class characterized as psychedelic users (with higher use of ecstasy, LSD, and mushrooms) was the class associated with higher odds of using NPS with psychedelic-type effects such as 2C, tryptamines, and other new psychedelics. This suggests use of these new psychedelics not only may be associated with use of specific common psychedelics (e.g., LSD), but use could also possibly be predicted according to which types of drugs are preferred—or are at risk to be tried—regarding more common psychedelic drugs. Also, in agreement with our second hypothesis, our study suggests that the probability of trying an NPS is also related to the number of common substances used. This strengthens the idea that there is a link between the types of preferred common drugs and preference of specific types of NPS.

4.1. Limitations

Our results may not be representative of the EDM community beyond NYC. We did use a probability-based approach for recruiting our sample (time-space sampling), but we could not utilize a traditional random sampling approach as this is not feasible for reaching this population. The cross-sectional design of our study limits the possibility to determine whether use of NPS occurred after using more common drugs. Our data are based on self-report, which may affect validity by means of recall bias and social desirability.

We operationalized polysubstance use as the use of multiple drugs in the past year; however, we cannot affirm that substances were combined on the same occasions. Nevertheless, Quek et al. (2013) found that a large percentage of “last year” polysubstance users also used substances simultaneously. Another possible limitation was the eligibility age range of 18–40 as this can affect prevalence estimates of drug use. Alcohol was not included in our LCA as we sought to focus on illegal drug use in this sample. We did conduct a specificity test including alcohol in our LCA models; however, categories were less interpretable and the best-fitting models were less parsimonious with its inclusion. In addition, a potential limitation is that we only considered past-year use as a dichotomous variable. Examining frequency of use may provide more in-depth information about use patterns. NPS are commonly consumed unintentionally as adulterants in drugs such as ecstasy (Palamar et al., 2017b; Palamar, Salomone, Vincenti, & Cleland, 2016e) so this survey only focuses on known use.

4.2. Conclusions and future research

This is the first study identifying polysubstance use profiles and their relation to use of NPS in a sample focusing solely on EDM attendees—a high-risk population for polysubstance use and NPS use. Our results contribute information for designing preventive measures with EDM attendees. Profiles were also related to sociodemographic characteristics, which emphasizes the need to target adjusted interventions within this population. Findings also highlight that using NPS may be linked to profiles of use of common illegal substances more than to the use of substances considered independently.

Future research should analyze what protective strategies are used when EDM party attendees take drugs (including NPS) and how these strategies contribute in reducing potential harm. Moreover, unintentional NPS use should be considered (Energy Control, 2015; Palamar et al., 2016e), where harm reduction strategies like drug-checking may play an important role in reducing risks. Taking into account our limitations, longitudinal studies could better address the predictability of profiles of use of common drugs with regard to NPS use.

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References

- Agrawal A, Lynskey MT, Madden PF, Bucholz KK, Heath AC. A latent class analysis of illicit drug abuse/dependence: Results from the National Epidemiological Survey on Alcohol and Related Conditions. *Addiction*. 2007; 102:94–104. <http://dx.doi.org/10.1111/j.1360-0443.2006.01630.x>. [PubMed: 17207127]
- Aldridge, J., Measham, F., Parker, H. *Illegal Leisure: Normalization of Adolescent Recreational Drug Use*. Routledge; 1998.
- Araujo AM, Valente MJ, Carvalho M, Da Silva DD, Gaspar H, Carvalho F, De Pinho PG. Raising awareness of new psychoactive substances: Chemical analysis and in vitro toxicity screening of

- 'legal high' packages containing synthetic cathinones. *Archives of Toxicology*. 2015; 89:757–771. <http://dx.doi.org/10.1007/s00204-014-1278-7>. [PubMed: 24903018]
- Baggio S, Studer J, Mohler-Kuo M, Daeppen JB, Gmel G. Concurrent and simultaneous polydrug use among young Swiss males: Use patterns and associations of number of substances used with health issues. *International Journal of Adolescent Medicine and Health*. 2014; 26:217–224. <http://dx.doi.org/10.1515/ijamh-2013-0305>. [PubMed: 24030025]
- Bao YP, Liu ZM, Li JH, Zhang RM, Hao W, Zhao M, Lu L. Club drug use and associated high-risk sexual behaviour in six provinces in China. *Addiction*. 2015; 110:11–19. <http://dx.doi.org/10.1111/add.12770>.
- Barrett SP, Gross SR, Garand I, Pihl RO. Patterns of simultaneous polysubstance use in Canadian rave attendees. *Substance Use & Misuse*. 2005; 40:1525–1537. <http://dx.doi.org/10.1081/JA-200066866>. [PubMed: 16048831]
- Branigan P, Wellings K. Acceptance of the harm minimization message in London clubs and underground system. *Drug Education Prevention Policy*. 1999; 6:389–398. <http://dx.doi.org/10.1080/09687639997061>.
- Brookhuis KA, de Waard D, Samyn N. Effects of MDMA (ecstasy), and multiple drugs use on (simulated) driving performance and traffic safety. *Psychopharmacology*. 2004; 173:440–445. <http://dx.doi.org/10.1007/s00213-003-1714-5>. [PubMed: 14714102]
- Bruno R, Matthews AJ, Dunn M, Alati R, McIlwraith F, Hickey S, Sindicich N. Emerging psychoactive substance use among regular ecstasy users in Australia. *Drug and Alcohol Dependence*. 2012; 124:19–25. <http://dx.doi.org/10.1016/j.drugalcdep.2011.11.020>. [PubMed: 22209387]
- Carter JL, Strang J, Frissa S, Hayes RD, Hatch SL, Hotopf M, Study Team, S. E. L. C. H. Comparisons of polydrug use at national and inner city levels in England: Associations with demographic and socioeconomic factors. *Annals of Epidemiology*. 2013; 23:636–645. <http://dx.doi.org/10.1016/j.annepidem.2013.07.012>. [PubMed: 23953948]
- Centers for Disease Control and Prevention. Ecstasy Overdoses at a New Year's Eve Rave—Los Angeles, California, 2010. *Morbidity and Mortality Weekly Report*. 2010; 59(22):677–681. [PubMed: 20535091]
- Connor JP, Gullo MJ, White A, Kelly AB. Polysubstance use: Diagnostic challenges, patterns of use and health. *Current Opinion in Psychiatry*. 2014; 27:269–275. <http://dx.doi.org/10.1097/YCO.0000000000000069>. [PubMed: 24852056]
- Doumas DM, Miller R, Esp S. Impulsive sensation seeking, binge drinking, and alcohol-related consequences: Do protective behavioral strategies help high risk adolescents? *Addictive Behaviors*. 2017; 64:6–12. <http://dx.doi.org/10.1016/j.addbeh.2016.08.003>. [PubMed: 27533076]
- Energy Control. Informe sobre las sustancias analizadas en España en 2015 por Energy Control [Report on substances analyzed in Spain during 2015 by Energy Control]. 2015. https://energycontrol.org/files/analisis/Informe_Analisis_Estatal_EC_2015.pdf (Accessed 01.02.2017)
- European Monitoring Centre for Drugs and Drug Addiction [EMCDDA]. European Drug Report 2013: Trends and developments. Luxembourg: Publications Office of the European Union; 2013. <http://www.emcdda.europa.eu/publications/edr/trends-developments/2016> (Accessed 01.25.17)
- Fernández-Calderón F, Lozano OM, Vidal C, Gutiérrez J, Vergara E, González-Saiz F, Bilbao I. Polysubstance use patterns in underground rave attendees: A cluster analysis. *Journal of Drug Education*. 2011; 41:183–202. <http://dx.doi.org/10.2190/DE.41.2.d>. [PubMed: 21888000]
- Fernández-Calderón F, Rojas OM, Bilbao I, Rojas AJ, Vidal C, Vergara E, González-Saiz F. Polysubstance use and associated effects at raves parties Health. *Drugs*. 2012; 12:37–59.
- Fernández-Calderón F, Lozano-Rojas OM, Rojas-Tejada AJ. Raves and drug use from an epidemiologic and psychosocial approach: A bibliographic systematic review. *Adicciones*. 2013; 25:269–279. [PubMed: 23880840]
- Fernández-Calderón F, Lozano OM, Rojas-Tejada AJ, Bilbao I, Vidal C, Vergara E, González-Saiz F. Harm reduction behaviors among young poly-substance users at raves. *Substance Abuse*. 2014; 35:45–50. <http://dx.doi.org/10.1080/08897077.2013.792760>. [PubMed: 24588292]

- Fernández-Calderón D, Fernández F, Ruiz-Curado S, Verdejo-García A, Lozano OM. Profiles of substance use disorders in patients of Therapeutic Communities: Link to social, medical and psychiatric characteristics. *Drug and Alcohol Dependence*. 2015; 149:31–39. [PubMed: 25682479]
- French Monitoring Centre for Drugs and Drug Addiction. New psychoactive substances: user profiles and practices. 2016. <http://en.ofdt.fr/publications/tendances/new-psychoactive-substances-user-profiles-and-practices-tendances-108-april-2016/> (Accessed 03.02.2017)
- Göbel K, Scheithauer H, Bräker AB, Jonkman H, Soellner R. Substance use patterns among adolescents in Europe: A latent class analysis. *Substance Use & Misuse*. 2016; 51:1130–1138. <http://dx.doi.org/10.3109/10826084.2016.1160120>. [PubMed: 27192400]
- Grov C, Kelly BC, Parsons JT. Polydrug use among club-going young adults recruited through time-space sampling. *Substance Use & Misuse*. 2009; 44:848–864. <http://dx.doi.org/10.1080/10826080802484702>. [PubMed: 19444726]
- Halkitis PN, Palamar JJ, Mukherjee PP. Poly-club-drug use among gay and bisexual men: A longitudinal analysis. *Drug and Alcohol Dependence*. 2007; 89:153–160. <http://dx.doi.org/10.1016/j.drugalcdep.2006.12.028>. [PubMed: 17267140]
- Heeringa, SG., West, BT., Berglund, PA. Applied survey data analysis. CRC Press; 2010.
- Hohmann N, Mikus G, Czock D. Effects and risks associated with novel psychoactive substances. *Deutsches Ärzteblatt International*. 2014; 111:139–147. <http://dx.doi.org/10.3238/arztebl.2014.0139>. [PubMed: 24661585]
- Hunt G, Evans K, Moloney M, Bailey N. Combining different substances in the dance scene: Enhancing pleasure, managing risk and timing effects. *Journal of Drug Issues*. 2009; 39:495–522. [PubMed: 20686669]
- Jenness SM, Neaigus A, Murrill CS, Gelpi-Acosta C, Wendel T, Hagan H. Recruitment-adjusted estimates of HIV prevalence and risk among men who have sex with men: Effects of weighting venue-based sampling data. *Public Health Reports*. 2011; 126:635–642. <http://dx.doi.org/10.1177/003335491112600505>. [PubMed: 21886323]
- Karjalainen K, Kuussaari K, Kataja K, Tigerstedt C, Hakkarainen P. Measuring concurrent Polydrug use in general populations: A critical assessment. *European Addiction Research*. 2017; 23(3):163–169. <http://dx.doi.org/10.1159/000477802>. [PubMed: 28641293]
- Kecojevic A, Jun HJ, Reisner SL, Corliss HL. Concurrent polysubstance use in a longitudinal study of US youth: Associations with sexual orientation. *Addiction*. 2017; 112:614–624. <http://dx.doi.org/10.1111/add.13681>. [PubMed: 27790758]
- Kelly BC, Parsons JT, Wells BE. Prevalence and predictors of Club drug use among club-going young adults in New York City. *Journal of Urban Health*. 2006; 83(5):884–895. <http://dx.doi.org/10.1007/s11524-006-9057-2>. [PubMed: 16937088]
- Kipke MD, Weiss G, Ramirez M, Dorey F, Ritt-Olson A, Iverson E, Ford W. Club drug use in Los Angeles among young men who have sex with men. *Substance Use & Misuse*. 2007; 42(11):1723–1743. <http://dx.doi.org/10.1080/10826080701212261>. [PubMed: 17934992]
- Kyriakou C, Marinelli E, Frati P, Santurro A, Afxentioud M, Zaami S, Susardo FP. NBOMe: New potent hallucinogens—pharmacology, analytical methods, toxicities, fatalities: A review. *European Review for Medical and Pharmacological Sciences*. 2015; 19(17):3270–3281. [PubMed: 26400534]
- Law R, Schier J, Martin C, Chang A, Wolkin A. Notes from the field: Increase in reported adverse health effects related to synthetic cannabinoid use - United States, January–may 2015. *Morbidity and Mortality Weekly Report*. 2015; 64(22):618–619. [PubMed: 26068566]
- Lund A, Turris SA. Mass-gathering medicine: Risks and patient presentations at a 2-day electronic dance music event. *Prehospital and Disaster Medicine*. 2015; 30:271–278. <http://dx.doi.org/10.1017/S1049023X15004598>. [PubMed: 25868489]
- MacKellar DA, Gallagher KM, Finlayson T, Sánchez T, Lansky A, Sullivan PS. Surveillance of HIV risk and prevention behaviors of men who have sex with men—a national application of venue-based, time-space sampling. *Public Health Reports*. 2007; 122:39–47. <http://dx.doi.org/10.1177/003335490712208107>. [PubMed: 17354526]

- Mattison AM, Ross MW, Wolfson T, Franklin D, Group SDHNR. Circuit party attendance, club drug use, and unsafe sex in gay men. *Journal of Substance Abuse*. 2001; 13(1–2):119–126. [PubMed: 11547613]
- McCabe SE, Cranford JA, Morales M, Young A. Simultaneous and concurrent polydrug use of alcohol and prescription drugs: Prevalence, correlates, and consequences. *Journal of Studies on Alcohol and Drugs*. 2006; 67:529–537.
- McCambridge J, Mitcheson L, Winstock A, Hunt N. Five-year trends in patterns of drug use among people who use stimulants in dance contexts in the United Kingdom. *Addiction*. 2005; 100(8): 1140–1149. <http://dx.doi.org/10.1111/j.1360-0443.2005.001127.x>. [PubMed: 16042644]
- Miotto K, Striebel J, Cho AK, Wang C. Clinical and pharmacological aspects of bath salt use: A review of the literature and case reports. *Drug and Alcohol Dependence*. 2013; 132(1–2):1–12. <http://dx.doi.org/10.1016/j.drugalcdep.2013.06.016>. [PubMed: 23916320]
- Morley KI, Lynskey MT, Moran P, Borschmann R, Winstock AR. Polysubstance use, mental health and high-risk behaviours: Results from the 2012 Global Drug Survey. *Drug and Alcohol Review*. 2015; 34:427–437. <http://dx.doi.org/10.1111/dar.12263>. [PubMed: 25867685]
- Nugteren-van Lonkhuyzen JJ, van Riel AJ, Brunt TM, Hondebrink L. Pharmacokinetics, Pharmacodynamics and toxicology of New Psychoactive Substances (NPS): 2C-B, 4-Fluoroamphetamine and Benzofurans. *Drug and Alcohol Dependence*. 2015; 157:18–27. <http://dx.doi.org/10.1016/j.drugalcdep.2015.10.011>. [PubMed: 26530501]
- Palamar JJ, Acosta P. Synthetic cannabinoid use in a nationally representative sample of US high school seniors. *Drug and Alcohol Dependence*. 2015; 1:194–202. <http://dx.doi.org/10.1016/j.drugalcdep.2015.01.044>.
- Palamar JJ, Griffin-Tomas M, Ompad DC. Illicit drug use among rave attendees in a nationally representative sample of US high school seniors. *Drug and Alcohol Dependence*. 2015a; 152:24–31. <http://dx.doi.org/10.1016/j.drugalcdep.2015.05.002>. [PubMed: 26005041]
- Palamar JJ, Martins SS, Su MK, Ompad DC. Self-reported use of novel psychoactive substances in a US nationally representative survey: Prevalence, correlates, and a call for new survey methods to prevent underreporting. *Drug and Alcohol Dependence*. 2015b; 156:112–119. <http://dx.doi.org/10.1016/j.drugalcdep.2015.08.028>. [PubMed: 26377051]
- Palamar JJ, Acosta P, Ompad DC, Cleland CM. Self-reported ecstasy/MDMA/“Molly” use in a sample of nightclub and dance festival attendees in New York City. *Substance Use & Misuse*. 2016a; 52(1):82–91. <http://dx.doi.org/10.1080/10826084.2016.1219373>. [PubMed: 27661470]
- Palamar JJ, Acosta P, Sherman S, Ompad DC, Cleland CM. Self-reported use of novel psychoactive substances among attendees of electronic dance music venues. *The American Journal of Drug and Alcohol Abuse*. 2016b; 42:624–632. <http://dx.doi.org/10.1080/00952990.2016.1181179>. [PubMed: 27315522]
- Palamar JJ, Barratt MJ, Ferris JA, Winstock AR. Correlates of new psychoactive substance use among a self-selected sample of nightclub attendees in the United States. *The American Journal on Addictions*. 2016c; 25:400–407. <http://dx.doi.org/10.1111/ajad.12403>. [PubMed: 27419383]
- Palamar JJ, Su MK, Hoffman RS. Characteristics of novel psychoactive substance exposures reported to New York City poison center, 2011–2014. *The American Journal of Drug and Alcohol Abuse*. 2016d; 42(1):39–47. <http://dx.doi.org/10.3109/00952990.2015.1106551>. [PubMed: 26678258]
- Palamar JJ, Salomone A, Vincenti M, Cleland CM. Detection of “bath salts” and other novel psychoactive substances in hair samples of ecstasy/MDMA/“Molly” users. *Drug and Alcohol Dependence*. 2016e; 161:200–205. <http://dx.doi.org/10.1016/j.drugalcdep.2016.02.001>. [PubMed: 26883685]
- Palamar JJ, Barratt MJ, Coney L, Martins SS. Synthetic cannabinoid use among high school seniors. *Pediatrics*. 2017a; 140(4) <http://dx.doi.org/10.1542/peds.2017-1330>.
- Palamar JJ, Salomone A, Gerace E, Di Corcia D, Vincenti M, Cleland CM. Hair testing to assess both known and unknown use of drugs among ecstasy users in the electronic dance music scene. *The International Journal on Drug Policy*. 2017b; 48:91–98. [PubMed: 28810159]
- Pantalone DW, Bimbi DS, Holder CA, Golub SA, Parsons JT. Consistency and change in club drug use by sexual minority men in New York City, 2002 to 2007. *American Journal of Public Health*. 2010; 100(10):1892–1895. <http://dx.doi.org/10.2105/AJPH.2009.175232>. [PubMed: 20724693]

- Parsons JT, Grov C, Kelly BC. Comparing the effectiveness of two forms of time-space sampling to identify club drug-using young adults. *Journal of Drug Issues*. 2008; 38(4):1061–1081. [PubMed: 20686625]
- Patterson ZR, Young MM, Vaccarino FJ. Novel psychoactive substances: What educators need to know. *Clinical Pharmacology and Therapeutics*. 2017; 101:173–175. <http://dx.doi.org/10.1002/cpt.538>. [PubMed: 27756105]
- Pedersen ER, Hummer JF, Rinker DV, Traylor ZK, Neighbors C. Measuring protective behavioral strategies for marijuana use among young adults. *Journal of Studies on Alcohol and Drugs*. 2016; 77(3):441–450. [PubMed: 27172576]
- Quek LH, Chan GC, White A, Connor JP, Baker P, Saunders JB, Kelly AB. Concurrent and simultaneous polydrug use: Latent class analysis of an Australian nationally representative sample of young adults. *Frontiers in Public Health*. 2013; 1:61. <http://dx.doi.org/10.3389/fpubh.2013.00061>. [PubMed: 24350230]
- Rao JNK, Scott AJ. On chi-squared tests for multiway contingency tables with cell proportions estimated from survey data. *The Annals of Statistics*. 1984; 12(1):46–60.
- Reboussin BA, Song E, Shrestha A, Lohman KK, Wolfson M. A latent class analysis of underage problem drinking: Evidence from a community sample of 16–20 year olds. *Drug and Alcohol Dependence*. 2006; 83:199–209. <http://dx.doi.org/10.1016/j.drugalcdep.2005.11.013>. [PubMed: 16359829]
- Ridpath A, Driver CR, Nolan ML, Karpati A, Kass D, Paone D, Centers for Disease Control and Prevention (CDC). Illnesses and deaths among persons attending an electronic dance-music festival - New York City, 2013. *MMWR Morbidity and Mortality Weekly Report*. 2014; 19(63): 1195–1198.
- Salom CL, Betts KS, Williams GM, Najman JM, Alati R. Predictors of comorbid polysubstance use and mental health disorders in young adults—A latent class analysis. *Addiction*. 2016; 111:156–164. <http://dx.doi.org/10.1111/add.13058>. [PubMed: 26190689]
- Sañudo A, Andreoni S, Sánchez ZM. Polydrug use among nightclub patrons in a megacity: A latent class analysis. *The International Journal on Drug Policy*. 2015; 26:1207–1214. <http://dx.doi.org/10.1016/j.drugpo.2015.07.012>. [PubMed: 26297562]
- Smith GW, Farrell M, Bunting BP, Houston JE, Shevlin M. Patterns of polydrug use in Great Britain: Findings from a national household population survey. *Drug and Alcohol Dependence*. 2011; 113:222–228. <http://dx.doi.org/10.1016/j.drugalcdep.2010.08.010>. [PubMed: 20863629]
- Stephenson, G., Richardson, A. New psychoactive substances in England: a review of the evidence. 2014. https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/368587/NPSevidenceReview.pdf (Accessed 02.18.2017)
- Sutherland R, Peacock A, Whittaker E, Roxburgh A, Lenton S, Matthews A, Bruno R. New psychoactive substance use among regular psychostimulant users in Australia, 2010–2015. *Drug and Alcohol Dependence*. 2016; 161:110–118. <http://dx.doi.org/10.1016/j.drugalcdep.2016.01.024>. [PubMed: 26880592]
- Tittarelli R, Mannocchi G, Pantano F, Romolo FS. Recreational use, analysis and toxicity of tryptamines. *Current Neuropharmacology*. 2015; 13(1):26–46. <http://dx.doi.org/10.2174/1570159X13666141210222409>. [PubMed: 26074742]
- Tomczyk S, Hanewinkel R, Isensee B. Multiple substance use patterns in adolescents—A multilevel latent class analysis. *Drug and Alcohol Dependence*. 2015; 155:208–214. <http://dx.doi.org/10.1016/j.drugalcdep.2015.07.016>. [PubMed: 26233485]
- Trenz RC, Scherer M, Duncan A, Harrell PT, Moleko AG, Latimer WW. Latent class analysis of polysubstance use, sexual risk behaviors, and infectious disease among South African drug users. *Drug and Alcohol Dependence*. 2013; 132:441–448. <http://dx.doi.org/10.1016/j.drugalcdep.2013.03.004>. [PubMed: 23562370]
- Uebersax, J. Latent class analysis of substance use patterns. In: Collins, LM., Seitz, LA., editors. *NIDA Research Monograph*, no 142. Rockville, MD: National Institute on Drug Abuse; 1994.
- United Nations Office on Drugs and Crime. *World Drug Report 2016*. 2016. http://www.unodc.org/doc/wdr2016/WORLD_DRUG_REPORT_2016_web.pdf (Accessed 01.11.2017)

- Author Manuscript
- Author Manuscript
- Author Manuscript
- Author Manuscript
- Van Havere T, Vanderplasschen W, Lammertyn J, Broekaert E, Bellis M. Drug use and nightlife: More than just dance music. *Substance Abuse Treatment, Prevention, and Policy*. 2011; 6:18. <http://dx.doi.org/10.1186/1747-597X-6-18>.
- Van Havere T, Tutenges S, De Maeyer J, Broekaert E, Vanderplasschen W. 'Keep an eye on your friends, even when you don't know them': Drug use and harm reduction in the Goa trance scene in Belgium. *Drugs: Education, Prevention, and Policy*. 2015; 22(3):239–247. <https://doi.org/10.3109/09687637.2014.899985>.
- Verdejo-García A, Sánchez-Fernández MM, Alonso-Maroto LM, Fernández-Calderón F, Perales JC, Lozano O, Pérez-García M. Impulsivity and executive functions in polysubstance-using rave attenders. *Psychopharmacology*. 2010; 210:377–392. <http://dx.doi.org/10.1007/s00213-010-1833-8>. [PubMed: 20386885]
- Vermunt, JK., Magidson, J. Technical guide for Latent GOLD 4.0: Basic and advanced. Massachusetts: Statistical Innovations Inc.; 2005.
- Vidal-Giné C, Fernández-Calderón F, López-Guerrero J. Patterns of use, harm reduction strategies, and their relation to risk behavior and harm in recreational ketamine users. *The American Journal of Drug and Alcohol Abuse*. 2016; 42(3):358–369. <http://dx.doi.org/10.3109/00952990.2016.1141211>. [PubMed: 27052358]
- Watson, K. IMS Business Report. An Annual Study of the Electronic Music Industry. 2016. Ibiza International Music Summit <http://www.internationalmusicsummit.com/wp-content/uploads/2016/05/IMS-Business-Report-2016.pdf> (Accessed 01.04.2017)
- Watters JK, Biernacki P. Targeted sampling: Options for the study of hidden populations. *Social Problems*. 1989; 36(4):416–430. <http://dx.doi.org/10.2307/800824>.
- Winstock AR, Barratt MJ. Synthetic cannabis: A comparison of patterns of use and effect profile with natural cannabis in a large global sample. *Drug and Alcohol Dependence*. 2013; 131:106–111. [PubMed: 23291209]
- Winstock AR, Griffiths P, Stewart D. Drugs and the dance music scene: A survey of current drug use patterns among a sample of dance music enthusiasts in the UK. *Drug and Alcohol Dependence*. 2001; 64(1):9–17. [PubMed: 11470336]
- Zawilska JB, Andrzejczak D. Next generation of novel psychoactive substances on the horizon - a complex problem to face. *Drug and Alcohol Dependence*. 2015; 157:1–17. <http://dx.doi.org/10.1016/j.drugalcdep.2015.09.030>. [PubMed: 26482089]

HIGHLIGHTS

- We determined four polydrug use profiles and their relation to novel drug use in NYC.
- Most electronic dance music attendees were categorized in the non-polydrug use class.
- Preference for new psychoactive substances (NPS) was related to polydrug profiles.
- Moderate/psychedelic polysubstance users were more likely to use NPS.
- Extensive polysubstance users were more likely to use all NPS examined.

Fig. 1.
Probability of participants in each cluster endorsing drugs.

Table 1

Summary of fit measures for estimated Latent Class Analysis models.

	Npar	DF	p	BIC	Entropy
2-Model	17	238	< 0.001	5582.233	0.872
3-Model	26	229	0.022	5509.826	0.801
4-Model	35	220	0.455	5503.456	0.866
5-Model	44	211	0.857	5524.120	0.864
6-Model	53	202	0.981	5554.449	0.861
7-Model	62	193	0.998	5589.274	0.853

Note. Npar: number of parameters; df: degrees of freedom; BIC: Bayesian Information Criteria.

Table 2

Prevalence of past-year drug use according to drug classification.

	Total	Class 1 61.1% (n = 640) No polysubstance use	Class 2 19.2% (n = 201) Extensive polysubstance use	Class 3 12.8% (n = 134) Moderate polysubstance use-stimulants	Class 4 6.7% (n = 70) Moderate polysubstance use-psychedelics
Ecstasy	25.1	14.6	95.4	27.2	76.0
Ketamine	5.4	0.4	57.6	0.0	14.1
LSD	8.1	0.0	56.6	0.0	92.4
Mushrooms	10.4	0.1	78.5	16.1	49.5
Powder cocaine	17.8	2.1	100	60.8	1.6
Marijuana	46.9	31.2	97.8	97.9	67.9
Amphetamines (nonmedical)	12.9	1.0	52.2	52.5	23.5
Benzodiazepines (nonmedical)	6.8	0.0	27.5	29.5	18.1
Number of drugs used (<i>M, SE</i>)	2.0 (0.2)	1.1 (0.1)	6.4 (0.1)	4.0 (0.2)	4.5 (0.2)

Note. All χ^2 for chi-square comparisons were $p < 0.0001$. M = mean, SE = standard error.

Table 3
Drug classification according to sociodemographic characteristics and self-reported past-year use of new psychoactive substances.

	Total n (%)	Class 1 No polysubstance use %	Class 2 Extensive polysubstance use %	Class 3 Moderate polysubstance use-stimulants %	Class 4 Moderate polysubstance use- psychedelics %	P
Sex						0.183
Male	600 (54.5)	53.0	66.1	52.5	65.7	
Female	445 (45.5)	47.0	33.9	47.5	34.3	
Age						0.109
18–24	599 (56.8)	60.9	45.2	41.4	55.1	
25–40	446 (43.2)	39.1	54.8	58.6	44.9	
Race/ethnicity						0.005
White	624 (61.0)	56.1	82.1	76.3	58.5	
Black	76 (6.8)	7.3	2.4	4.5	13.5	
Hispanic	146 (12.7)	15.3	9.4	1.1	8.8	
Asian	108 (13.2)	14.4	3.4	11.4	15.5	
Other/mixed	91 (6.3)	6.8	2.7	6.6	3.7	
Education						0.049
High School Or less	195 (22.3)	25.2	18.0	8.7	21.9	
Some college	307 (26.0)	27.4	20.7	24.2	16.6	
College or higher	543 (51.7)	47.4	61.3	67.1	61.5	
Parent education						0.428
Low	313 (29.2)	31.7	18.3	25.7	16.0	
Medium	481 (47.1)	45.5	51.5	51.8	51.8	
High	251 (23.7)	22.8	30.1	22.5	32.2	
Weekly income						0.079
\$199 or less	268 (30.3)	33.9	14.5	25.2	11.4	
\$200–500	333 (29.4)	29.1	41.7	25.0	26.5	
\$500 or more	444 (40.2)	37	43.8	49.9	62.2	
Sexual orientation						0.162
Heterosexual	823 (81.2)	83.2	71.7	80.3	66.3	
Gay/bisexual/other	222 (18.8)	16.8	28.3	19.7	33.7	

	Total n (%)	Class 1 No polysubstance use %	Class 2 Extensive polysubstance use %	Class 3 Moderate polysubstance use-stimulants %	Class 4 Moderate polysubstance use- psychedelics %	P
Past-year NPS use						
2C series	53 (1.8)	1.1	9.9	0.1	5.6	< 0.001
„Bath salts”	39 (1.2)	0.7	5.3	1.3	2.8	< 0.001
Tryptamines	38 (1.8)	0.3	11.7	2.7	5.7	< 0.001
New other psychedelics	89 (4.7)	2.0	33.7	0.6	12.9	< 0.001
New dissociatives	69 (1.7)	0.5	13.4	0.3	3.7	< 0.001
Synthetic cannabinoids	45 (3.6)	2.8	10.1	4.8	3.7	0.125

Note. NPS = new psychoactive substance.

Table 4

Multivariable multinomial logistic regression examining associations between sociodemographic characteristics and drug classification.

	Class 2 Extensive polysubstance use AOR (95% CI)	Class 3 Moderate polysubstance use- stimulants AOR (95% CI)	Class 4 Moderate polysubstance use- psychedelics AOR (95% CI)
Sex			
Male	1.00	1.00	1.00
Female	0.55 (0.27, 1.11)	0.97 (0.53, 1.79)	0.60 (0.24, 1.52)
Age			
18–24	1.00	1.00	1.00
25–40	1.56 (0.82, 2.96)	1.93 * (1.03, 3.63)	0.67 (0.18, 2.43)
Race/ethnicity			
White	1.00	1.00	1.00
Black	0.18 ** (0.07, 0.46)	0.46 (0.10, 2.13)	1.68 (0.35, 8.03)
Hispanic	0.46 (0.18, 1.14)	0.06 *** (0.02, 0.22)	0.63 (0.18, 2.26)
Asian	0.14 ** (0.05, 0.43)	0.50 (0.17, 1.52)	1.12 (0.20, 6.37)
Other/mixed	0.34 * (0.15, 0.76)	0.68 (0.28, 1.70)	0.62 (0.14, 2.72)
Education			
High school or Less	1.00	1.00	1.00
Some college	0.88 (0.34, 2.27)	2.35 (0.85, 6.52)	1.59 (0.18, 1.88)
College or higher	1.42 (0.42, 4.75)	2.80 * (1.12, 6.99)	1.00 (0.26, 3.83)
Sexual			
Heterosexual	1.00	1.00	1.00
Gay/bisexual/other	2.14 * (1.09, 4.21)	1.11 (0.40, 3.12)	3.12 * (1.32, 7.35)
Parent education			
Low	1.00	1.00	1.00
Medium	2.15 * (1.10, 4.21)	1.24 (0.65, 2.37)	2.37 (0.78, 7.19)
High	2.35 * (1.06, 5.18)	0.96 (0.38, 2.43)	2.46 (0.87, 6.91)
Weekly income			
\$199 or less	1.00	1.00	1.00
\$200–500	3.43 *** (1.89, 6.23)	1.03 (0.52, 2.02)	2.83 (0.63, 12.62)
\$500 or more	1.63 (0.63, 4.18)	1.03 (0.46, 2.27)	4.83 (0.99, 23.68)

Note. Comparison category = Class 1 (No polysubstance use). AOR: adjusted odds ratio; CI: confidence interval.

* $p < 0.05$.

** $p < 0.01$.

*** $p < 0.001$.

Table 5

Participant drug classification in relation to past 12-month use of new psychoactive substances.

	OR	(95% CI)	AOR	(95% CI)
2C Series				
No polydrug use	1.00		1.00	
Extensive polydrug use	10.30 ^{***}	(5.26, 20.14)	15.13 ^{***}	(3.93, 58.31)
Moderate/stimulant use	0.11 [*]	(0.02, 0.82)	0.17	(0.02, 1.38)
Moderate/psychedelic use	5.59 [*]	(1.48, 21.05)	6.35 [*]	(1.44, 28.02)
"Bath salts"				
No polydrug use	1.00		1.00	
Extensive polydrug use	8.00 ^{**}	(2.55, 25.15)	7.91 ^{**}	(2.56, 24.49)
Moderate/stimulant use	1.84	(0.37, 9.15)	2.32	(0.37, 14.38)
Moderate/psychedelic use	4.21 [*]	(1.12, 15.85)	1.68	(0.22, 12.75)
Tryptamines				
No polydrug use	1.00		1.00	
Extensive polydrug use	38.35 ^{***}	(6.99, 210.34)	37.65 ^{***}	(7.30, 194.09)
Moderate/stimulant use	8.07 [*]	(1.26, 51.57)	9.64 [*]	(1.58, 58.87)
Moderate/psychedelic use	17.34 ^{***}	(4.38, 68.64)	24.15 ^{***}	(7.01, 83.15)
Other new psychedelics				
No polydrug use	1.00		1.00	
Extensive polydrug use	25.52 ^{***}	(10.04, 65.82)	24.95 ^{***}	(6.98, 89.15)
Moderate/stimulant use	0.32	(0.04, 2.29)	0.28	(0.39, 2.03)
Moderate/psychedelic use	7.40 ^{**}	(2.07, 26.41)	8.40 ^{**}	(1.97, 35.82)
New dissociatives				
No polydrug use	1.00		1.00	
Extensive polydrug use	27.72 ^{***}	(7.81, 98.39)	22.71 ^{***}	(4.46, 115.61)
Moderate/stimulant use	0.60	(0.14, 2.48)	0.52	(0.11, 2.55)
Moderate/psychedelic use	6.93 ^{**}	(1.67, 28.72)	5.69	(0.96, 33.65)
Synthetic cannabinoids				
No polydrug use	1.00		1.00	
Extensive polydrug use	3.95	(0.94, 16.62)	6.04 [*]	(1.18, 30.99)
Moderate/stimulant use	1.76	(0.38, 8.13)	1.72	(0.36, 8.16)
Moderate/psychedelic use	1.37	(0.32, 5.79)	1.74	(0.34, 8.83)

Note. OR = (unadjusted) odds ratio, AOR = adjusted OR (controlling for all demographic covariates), CI = confidence interval.

^{*}
 $p < 0.05$.^{**}
 $p < 0.01$.^{***}
 $p < 0.001$.