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Barratt, Ferris, J., & Lenton, S. (2015). Hidden Populations, Online Purposive Sampling, and External Validity: Taking off the Blindfold. Field Methods, 27(1), 3–21. https://doi.org/10.1177/1525822X14526838
Document Version: Accepted Manuscript

Published Version: https://doi.org/10.1177/1525822X14526838

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Word count including references: 5788 (limit 6000)

Word count abstract: 96 (limit 100)

Tables: 3 (Table 1 could go in online supplementary data if required).

Tables not currently included in word count (could be included as supplementary?)

Appendix: 1 (for online supplementary data)

Funding statement

The National Drug Research Institute at Curtin University is funded by the Australian Government Department of Health and Ageing under the National Drug Strategy. JF is supported by the ARC Centre of Excellence in Policy and Security.

Conflict of interest

None to declare.

Acknowledgements

We thank the survey respondents for their participation and the online communities that assisted with survey recruitment. We also acknowledge the Australian Institute of Health and Welfare, Department of Health and Ageing and the Australian Social Science Data Archive for providing access to the National Drug Strategy Household Survey dataset. We declare that those who carried out the original analysis and collection of the data bear no responsibility for the further analysis or interpretation of it. We also thank Turning Point Alcohol and Drug Centre who supported this research in its initial stages. This paper was first presented in 2010 at the 30th Australasian Professional Society on Alcohol and Other Drugs Conference, Canberra, Australia.

Hidden populations, online purposive sampling, and external validity: Taking off the blind-fold

Online purposive samples have unknown biases and may not strictly be used to make inferences about wider populations, yet such inferences continue to occur. We compared the demographic and drug use characteristics of Australian ecstasy users from a probability (National Drug Strategy Household Survey, *n* = 726) and purposive sample (online survey conducted as part of an ethnography of online drug discussion, *n* = 753) using non-parametric (bootstrap) and meta-analysis techniques. The characteristics of each sample were similar. Online purposive samples of hidden populations are useful when interpreted in conjunction with probability samples and ethnographic data.

Introduction

Due to the illegal and stigmatised nature of drug use, studying practices of drug use and harm requires accessing hidden populations. This is especially the case when studying people who use drugs like 'ecstasy' or MDMA, as most do not routinely engage with treatment services (Degenhardt et al. 2010), where they could otherwise be accessed for research purposes. Scholars have long argued that stigmatised practices are best addressed using qualitative and ethnographic approaches, where the research team participates in the cultural contexts of the target group over extended periods of time, facilitating access to hidden population as trust and rapport are built and making sense of emic cultural logics (Moore 2005; Peterson et al. 2008; Sifaneck and Neaigus 2001). While ethnographic approaches are vital in the drugs field, ethnographic methods do not lend themselves to the collection of externally valid large-scale quantitative data. For this purpose, the gold standard is the probability sample, accessed via the household survey or Random Digital Dialling (RDD) telephone survey. Using the logic and mathematical methods of inferential statistics, probability sampling methods enable estimates of population prevalence to a given degree of certainty or confidence, if the relevant assumptions are met (Dillman 2007; Kakinami and Conner 2010; Lohr 2010). If we want to describe the general demographic and drug use characteristics of a hidden population, we are interested in producing externally valid data, that is, data we can be confident represent the population of interest. Probability sampling is the benchmark for producing this kind of data.

There are a number of limitations to the use of probability sampling methods in the investigation of hidden populations. Firstly, response rates for population surveys are decreasing (Groves 2006). A response rate of less than 50% seriously decreases confidence in relying on inferential statistics to adjust for non-response bias. Voluntary bias distorts the resultant weighted data. For example, the data from young males who decide to complete the household or RDD survey will be weighted more heavily so as to make up for the lower participation rates of their fellow young males, but the young males that choose to respond may have very different drug use characteristics to the young males that choose not to respond. This kind of systematic bias cannot be adjusted for by demographic weightings (Caetano 2001; Zhao et al. 2009). Secondly, parts of hidden populations may be systematically excluded from household and RDD survey sampling frames. Lower-income, transient and young populations are systematically excluded from both methods of sampling (Zhao et al. 2009). Thirdly, probability sampling methods are expensive (Fricker 2008; Kakinami and Conner 2010). Such surveys are even more expensive when less prevalent behaviours are targeted (Gile and Handcock 2010): if only 1% of the population are regular ecstasy users, then it would be likely to require a probability sample of 20,000 people to produce a sample of 100 regular ecstasy users, assuming a 50% response rate.

An example of the kinds of problems occurring in ‘gold standard’ probability surveys in this field can be found in the Australian National Drug Strategy Household Survey, used as data in this present paper. The NDSHS has a low response rate: 49% in 2007, which is not atypical compared to 2004 (46%) and 2001 (50%) (Australian Institute of Health and Welfare [AIHW] 2002; 2005; 2008). Although the NDSHS was weighted, this weighting cannot account for specific patterns of drug use that were not accessed using household survey methodology—that is, weighting is only based on socio-demographics, not drug use patterns (Caetano 2001; Zhao et al. 2009). It is not known whether the response rate indicates the systematic underreporting of drug use in the NDSHS; a critical point considering it is a survey on drug use. Furthermore, the young and mobile groups who are not easily accessed through the household sampling frame are also likely to report different drug use patterns.

This group of people are also becoming less ‘landline’ based for telephone based surveys (Dal Grande and Taylor 2010).

The changing context of conducting social research has combined with the limitations of probability sampling methods to necessitate new approaches to gathering externally valid data on hidden populations (Groves 2011). Purposive sampling is a method of understanding hidden populations that has a long history in the drugs field (e.g., Braunstein 1993; Peterson et al. 2008; Sifaneck and Neaigus 2001). Purposive sampling relies on the ethnographer’s situated knowledge of the field and rapport with members of targeted social networks. Purposive sampling methods of hidden populations traditionally only produced small samples and were associated only with qualitative research. However, in the last decade, purposive sampling of hidden populations through internet recruitment and survey methods has become increasingly popular among researchers who use it to gather large samples of people who are otherwise difficult to access at a relatively low cost (Fricker 2008; Miller and Sønderlund 2010). For example, a sample of 100 regular ecstasy users could be reached online for a mere fraction of the costs of employing probability sampling.

While the large samples achievable through online research methods lend themselves to quantitative analyses, the problem remains that the external validity of results arising from (online) purposive samples is unknown (Couper 2000; Lohr 2010). Focusing on illicit drug users in particular, many studies now use internet recruitment and/or survey methods with purposive sampling (Miller and Sønderlund 2010). In much of this research, inferential statistics are applied to purposive sampling with the caveat that the results cannot be inferred or generalised beyond the sample itself. Although these caveats are always present in the associated peer-reviewed articles in the limitations section, these data are indeed often used to infer information about wider populations. In the absence of any other corroborating information, the drug users recruited through purposive online sampling come to represent the general population of drug users, despite the caveats issued by researchers. This is especially the case when researching a new drug or new drug practice as online surveys are quick and easy and can therefore be administered and published more quickly than the equivalent population survey.

The Global Drug Survey (GDS) is a recent example of this phenomenon. GDS targets illicit drug users across the world annually through online purposive sampling methods. In 2011, GDS reached over 15,000 drug users making it the largest survey of its kind to date. The Guardian sponsored and promoted the survey and also used the following text to describe the results: “the survey exposes a generation of drug users willing to take significant risks with their health” (Topping 2012) and “a fifth of young drug users admit to taking ‘mystery white powders’ without any idea what they contain” (Butler et al. 2012). While academic papers published by the GDS group always mention the limitations of the sampling method and that results should not be extrapolated to a wider population (e.g., Winstock et al. 2011), inevitably media reporting will do exactly that, as can be seen from the above quotations.

We have established that inferring to a wider population from a purposive sample is problematic, yet this practice continues to occur in the drugs field given the various limitations of probability sampling for hidden populations. Rather than considering all research based on purposive sampling as fully ungeneralisable, what we wish to explore in this paper is the potential to use purposive samples as a complement to both population sampling and ethnography *in order to improve generalisability*. We wish to formalise what is already happening in the field and explore how it might be done more effectively, while being mindful of the constraints within which we operate as researchers, rather than making rigid assumptions that cannot be met outside of an ‘ideal world’.

This paper tests the extent to which an online purposive sample of ecstasy users and a household survey sample of ecstasy users differ by demographic and drug use characteristics. Unlike in previous studies (reviewed below), our samples were matched by frequency of use and location of residence. We also use a more appropriate statistical approach to comparing these samples by utilising the non-parametric bootstrap method to estimate confidence intervals around the purposive samples (also reviewed below). Furthermore, the online purposive sample was part of a larger ethnographic and mixed-methods project. In the discussion we reflect on the value of situating purposive surveys into a framework of emic knowledge to get an understanding of the sample's representativeness (see Guarte and Barrios 2006).

Representativeness of ecstasy user samples

Two comparisons between probability and purposive samples with regular ecstasy users have been undertaken (Miller et al. 2010; Topp et al. 2004) and we see our paper as adding to and extending this work, while also critiquing it. These studies are summarised below and in Table 1.

[Insert Table 1 about here]

Topp et al. (2004) compared a purposive sample of regular ecstasy users interviewed face-to-face as part of the Ecstasy and related Drugs Reporting System (EDRS; n = 163) with two subsamples of the NDSHS: respondents who reported ecstasy use in the last 12 months (n = 199) and who reported using ecstasy at least monthly ('regular-using') in the last 12 months (n = 48; see Table 1). All samples had the same age range and were collected in Sydney in 2001. When demographic and drug use variables were compared, substantial concordance was found across samples especially between the purposive sample and the regular-using probability sample. Although small sample sizes and non-identical questions limited confident interpretation of the results, Topp et al. concluded that “purposive sampling that seeks to draw from a wide cross-section of users and to sample a relatively large number of individuals, can give rise to samples of ecstasy users that may be considered sufficiently representative to reasonably warrant the drawing of inferences relating to the demographic and drug use characteristics of the entire population” (p. 38). The authors also flagged the need for replication in order to validate and extend their findings across different contexts and sampling methods.

In an extension of Topp et al.’s research data from the first published online survey of Australian ecstasy users (Miller et al. 2007) was compared with both a purposive sample (EDRS) and a probability sample (NDSHS) by Miller et al. (2010, See Table 1). Miller et al. (2010) compared the representativeness of the data from the internet survey sample to data sources usually used in Australia to access ecstasy users. All participants were aged 16 years or older and all samples were collected in 2004. While the internet sample (n = 381) and EDRS sample (n = 100) comprised only of respondents who lived in the city of Melbourne the NDSHS subsample, given the small number of users from the Melbourne area, were of all ecstasy users across Australia (n = 178). The internet sample was significantly younger, less likely to report the recent use of a range of other drugs, although more likely to report recent use of GHB, and less likely to report ever injecting drugs compared with the NDSHS sample.

While Miller et al. concluded that “the data provided by these three samples of ecstasy users converged” (Miller et al. 2010, p. 444), differences in how the three samples were constructed limited confident interpretation of the results. While it could be concluded that ecstasy users recruited and surveyed online used most other drugs less intensely, methodological differences may have accounted for these results. First, a limitation of the internet sample arose from participants *not* being asked how frequently they used ecstasy, only whether they had used it in the last 6 months. It is likely that the internet sample contained ecstasy users who did not use ‘regularly’ and such occasional ecstasy users are less likely to use other ‘party drugs’ (Topp et al. 2004). Second, GHB was more commonly used in Melbourne than in other parts of Australia in 2004 (Stafford et al. 2005), so the difference in locale between the NDSHS and internet samples could explain this result. Third, although a purposive sample, the internet sample was not solely recruited using websites and online forums: hardcopy street press was also used (Miller et al. 2010; Miller et al. 2007). This additional recruitment method may have introduced more heterogeneity in the sample. Differences between the internet sample and the household sample may be attributed to sample type (probability or purposive) or survey mode (household or internet), but not solely to internet recruitment methods.

Statistical approaches with purposive samples

As purposive, non-probabilistic sample methodologies are typical in market research and studies of hidden populations (Smith and Albaum 2005) statistical approaches to account for bias have been improving. Guarte and Barrios (2006) illustrate the benefits of bootstrapping purposive sampling data to estimate population parameters. Bootstrapping is a statistical procedure that provides a way of estimating standard errors and other statistical parameters of interest drawn from the sample data available (StataCorp 2009). Bootstrap confidence intervals treat the purposive sample as the population of interest by taking random samples from that population to estimate confidence limits (Rodgers 1999). According to Adèr, Mellenbergh, and Hand (2008) bootstrap procedures are recommended when the theoretical distribution of a statistic is unknown or complicated. An advisory panel for online public opinion survey established for the Canadian government (Public Works and Government

Services Canada 2009) established that bootstrap procedures should be implemented to assess the statistical properties of non-probability data and compared to any available data drawn from probabilistic samples. In essence, bootstrapped results produce unbiased estimates from the available sample; but this does not preclude that the sample of interest is not inherently biased given the nature of the sampling.

Aim of current study

This paper aims to extend the work of Topp et al. (2004) and Miller et al. (2010) by comparing samples of both regular and occasional ecstasy users recruited from online forums and websites with randomly selected household survey samples. Our analysis differs from these previous papers in the following ways:

1. Like both Miller et al. and Topp et al. the definition of 'recent use' differs between probability and purposive samples in our analysis; however, unlikely Miller et al., our samples are otherwise matched by frequency of use and location of residence.
2. Appropriate non-parametric statistical tests are used with the purposive sample, including bootstrapping (Miller et al. used parametric statistical analysis with a purposive sample, whereas Topp et al. used descriptive statistics).
3. Our online purposive sample is grounded in multi-sited and virtual ethnography.

The authors acknowledge that the data drawn from the online forums are inherently biased due to the purposive nature of accessing this hidden population. But, more importantly, we highlight how the online forum is an effective conduit in accessing this hidden population of ecstasy users. We postulate that perhaps the data provided by this purposive sample are not dissimilar to what is considered 'flawed' data provided by national samples where the population of interest are inherently hidden within the population.

Methods

Data

A one-off internet survey was conducted between October 2007 and April 2008 to explore the use of online forums by people who use psychostimulants and hallucinogens ('party drugs'). The survey was part of a mixed-methods project guided by virtual and multi-sited ethnographic methods, involving participation and observation of internet forums where drugs were discussed (Barratt and Lenton 2010). Multi-sited ethnography is spatially decentred, tracing networks of people rather than constructing place-based boundaries around fieldwork sites (Falzon 2009). Virtual ethnography occurs in online spaces and is, by the nature of online spaces and networks, also multi-sited (Hine 2008). Respondents were recruited to the internet survey primarily through discussions hosted at online forums where drugs were discussed by Australians. Forty such forums were identified: 32 were electronic dance music (EDM) forums, four were overtly about drugs and the remaining four discussed music, lifestyle and technology. After negotiations with forum moderators, 26 recruitment threads were posted, and the project was advertised by a feature article at an EDM website and through email lists and social networking websites (see Barratt and Lenton 2010). Most respondents (74%) reported finding out about the study through a 'thread in online forum', 19% reported being 'referred via email/through internet', 6% 'saw the link on a social networking site', and 2% were 'referred by word-of-mouth (offline)'. The sample consisted of 837 Australian residents aged 16 and over who reported recent (last 12 month) use of party drugs and recent (last 6 month) participation in online drug discussion. For the purpose of this paper, two subsamples were drawn: occasional ecstasy users (n = 328) who reported ecstasy use from 1 to 5 times in the last 6 months, and regular ecstasy users (n = 425) who reported ecstasy use monthly or more often in the last 6 months.

The 2007 NDSHS was the ninth iteration of a series of surveys asking Australians about their knowledge of and attitudes towards drugs and their history of drug consumption and related behaviours (AIHW 2008). This NDSHS was conducted between July and November 2007. It used a multistage, stratified area random sample design with households selected from within each geographic region of Australia. Two survey modes were used: 'Drop and Collect' and 'Computer Assisted Telephone Interviewing (CATI)'. A total of 23,356 people successfully completed the survey, mostly via the Drop and Collect mode (n = 19,818; 85%). The overall response rate was 49%: the Drop and Collect mode achieved a higher response rate (52%) compared to the CATI mode (39%). Design weights provided by the AIHW were used to adjust for imbalances arising in the design and execution of the sampling. For comparative analysis with the online sample data two subsamples were drawn from those aged between 16 and 60 years: occasional ecstasy users (n = 546) who reported ecstasy use 'every few months' or 'once or twice a year' in the last 12 months, and regular ecstasy users (n = 180) who reported ecstasy use 'about once a month', 'once a week or more' or 'every day' in the last 12 months.

Measures

Most survey items were comparable between the two samples; however, there were some notable differences. Recent use in the NDSHS referred to the last 12 months, whereas the online survey measured use in the last 6 months. We acknowledge that this difference biases our comparisons towards underreporting drug use prevalence in the online sample due to the shorter duration defined as recent use; however, as this was counter to the likely difference between the two samples, this was less of a concern than if the bias was in the other direction. There were also some differences in the way drug types were described: the online survey asked specifically about three different types of hallucinogens, a category that was aggregated in the NDSHS, and frequency of drinking alcohol had additional response categories in the NDSHS which were collapsed into 'weekly or more often' to match the online survey item. The items used to derive recent and regular illicit drug use were sufficiently similar to be considered comparable (see Appendix) and any differences have been taken into consideration in our interpretation of the results. Readers can view the NDSHS questionnaire in the *First Results* report (AIHW 2008) and the online survey is available by contacting the first author.

Analysis

Means for continuous variables or percentages for categorical variables are presented for each sample. STATA 11.1 was used to estimate confidence intervals. Design weights, and weighted numbers and percentages were reported for the NDSHS data. Non-parametric bootstrap confidence intervals were estimated around comparable estimates and proportions from the purposive sample. Subsampling was repeated 250 times to generate each estimate. While bootstrap confidence intervals are better suited to estimating confidence intervals using the convenience sample as the population, standard linearised confidence intervals (not shown) also produced very similar results. Further analysis was undertaken using meta-analysis techniques to compare the results from the two samples directly (Sterne 2009) using an alpha level of .05. This study was approved by the Curtin University and Turning Point Alcohol and Drug Centre ethics committees.

Results

[Insert Table 2 about here]

Occasional ecstasy users recruited online were significantly younger than occasional users in the household survey (mean of 24 vs. 28 years of age), and regular ecstasy users recruited online were significantly younger than regular users in the household survey (mean of 23 vs. 25 years of age; see Table 2). Occasional ecstasy users recruited online were more likely to live in capital cities than their household recruited counterparts (82% vs. 72%). Both samples were well distributed across Australian states and territories, although there were significantly less regular ecstasy users recruited online from Queensland (15% vs. 28%). Occasional ecstasy users recruited online who had completed secondary school were more likely to have completed secondary school compared to occasional ecstasy users in the household sample (86% vs. 69%). No other differences in demographic characteristics were noted.

[Insert Table 3 about here]

With respect to ‘other’ drugs there were a number of differences between the occasional ecstasy users recruited online and the equivalent household survey samples (see Table 3). Hallucinogens, ketamine, GHB and benzodiazepines for non-medical use were all more likely to be self-reported to have been used ‘recently’ (6 months for online survey and 12 months for household survey) and ‘monthly or more often’ by the occasional ecstasy users recruited online. The online-recruited occasional ecstasy users were also more likely to report use of meth/amphetamine in the past 6 months (57%) compared with the equivalent household sample (37%). Across both occasional and regular ecstasy user samples, the household samples were more likely to report monthly and weekly alcohol use than the online-recruited samples. Greater alcohol use by the household sample was the only significant difference between the regular ecstasy user samples’ recent and monthly drug use patterns.

Discussion

Purposive sampling of drug users through online methods is here to stay. Even though we make caveats that the findings should not be generalised, findings are often generalised regardless, perhaps due to a lack of alternative ‘better’ evidence. One way to test the representativeness of purposive samples is to compare their characteristics with carefully matched probability samples, where such samples exist. We have performed this comparison here. While there are some differences, we find that ecstasy users recruited and surveyed online are not significantly different from ecstasy users accessed through probability sampling methods. Both occasional and regular ecstasy user samples recruited online were younger than their equivalent household survey samples, but were otherwise not significantly different in terms of gender, rurality and highest education qualification, although occasional ecstasy users recruited online were more likely to have completed secondary school than their household survey counterparts. Recent and monthly use of other drugs was similar between samples of regular ecstasy users recruited online and accessed through households; however, compared to occasional ecstasy users from the household survey those recruited online were more likely to report more frequent use of meth/amphetamine, hallucinogens, ketamine, GHB, and benzodiazepines. By contrast, both regular and occasional ecstasy users from households were more likely to report monthly and weekly alcohol use compared with the online-recruited samples.

While our findings regarding demographics were similar, our results regarding drug use estimates deviate from those reported by Miller et al. (2010): their online sample reported less recent drug use than their household sample. Our results challenge Miller et al.’s suggestion that the internet “may be an effective way to recruit more dedicated, less polydrug-using ERD [ecstasy] users than other methods” (2010, p. 444). As previously mentioned, Miller et al.'s results may be explained by the household and internet samples being mismatched on frequency of ecstasy use and locale. In the present study, online recruitment, specifically through online forums where drugs are discussed, provided access to samples of occasional ecstasy users who were *more* likely to report the use of other 'party drugs' and regular ecstasy users who were *just as likely* to report other 'party drug' use.

Value of ethnographic grounding

The online purposive sample reported in this paper formed part of a larger project that also included online interviews and online participant observation (see Barratt 2012; Barratt and Lenton 2010). The lead author engaged in a virtual and multi-sited ethnography of internet forums where psychostimulant and hallucinogenic drugs were discussed by Australians. We identify three reasons why an ethnographic grounding is useful for online purposive surveys. First, developing an understanding of the sites and networks within which participants interact and interacting with them to gain their trust and respect is a vital part of the online recruitment process (Barratt and Lenton 2010; Potter and Chatwin 2011). While this step is critical for traditional 'face-to-face' ethnography, it is particularly important in virtual ethnographies where trust can only be built through online interaction. Second, participant observation of online sites generates additional research sites. In this case 40% of 40 forums were found through observing already-known forums. Thus, participant observation enabled the inclusion of a wider variety of online communities in the study. Third, we are better able to interpret the survey findings. For example, we know that the forums that were most successful in recruiting participants to the online survey hosted online discussions about the non-medical use of prescription drugs and the use of novel hallucinogens. Thus, it is not surprising that our purposive sample reported significantly more use of these substances than the matched household survey sample.

Limitations

This study has some limitations. Like Miller et al. (2010) and Topp et al. (2004), survey items between samples were not identical. Specifically, the alcohol question differences were likely to have biased the results towards more recent and regular alcohol use in the household survey given the more acute time frame, and the composite item measuring three different types of hallucinogens was likely to have biased the results towards more recent and regular hallucinogen use in the online survey. Even so, differences in question wording cannot explain the other estimates that differed significantly (meth/amphetamine, ketamine, GHB and benzodiazepines) which were assessed using single comparable items in both surveys. Wider windows of recall are likely to increase measurement error (Dillman 2007) and this fact informed the use of a 6-month window in the online survey; however, the difference in time frames between samples is a limitation of this study. This difference would have biased the results towards 'recent use' of drugs being greater among household survey respondents who have a 12-month window to reflect upon for drug use compared to the 6-month drug use window in the online survey, which is contrary to what was found in this analysis. Thus, no drugs except alcohol were recently used more often by the household survey. Identical questions and increased sample sizes—more specifically greater observations in population studies—would strengthen future studies of this type.

Future directions

In future, it may be worth designing online versions of household drug use prevalence surveys aimed at improving access to younger subgroups of recreational drug users. The online prevalence survey could be used within a probability sampling frame where chosen households are informed that an online option is available for survey completion, as done by the Australian Bureau of Statistics during the 2006 Australian census (Williams 2007). The online prevalence survey could also be used with an internet-recruited purposive sample using similar methods used to recruit the online sample described here. Using identical items, order of presentation and context would allow for comparisons between the internet purposive, internet probability and standard probability modes. Teasing out how these samples differ will further our understanding of how best to interpret both bias in purposive samples and prevalence estimates of probability samples. Such work is also important because it informs interpretations of results arising from internet research methods that are increasingly utilised for drug research.

Conclusion

Hidden populations cannot be effectively and meaningfully analysed in generalised population-based surveys as they are often out-of-scope or hard to reach. Obtaining generalisable results from such methods would be financially unviable. So, what is the alternative? Convenience samples. But if these are so readily rejected by the research community, we are stuck between a rock and a hard place. What this paper illustrates is that with the right focus (and adjusted statistical analysis) perhaps the black and white distinction between convenience samples and population samples can become more greyed, especially in contemporary society where the response rate for population studies is dropping and the ability to ‘generalise’ to the population of interest is becoming more fraught.

The time has come for researchers to embrace the opportunities of the internet, now that networked digital technologies are embedded into the everyday lives of a growing majority, including people who use drugs. Probability samples can be enhanced by purposive online samples gathered and informed through participant observation of online discussions. Non-parametric methods of estimation are also available. We hope this paper will prompt readers to take off the blind-fold, admit that (online) purposive sampling of hidden populations happens and will continue to happen, and focus on developing better ways of harnessing these data in order to make more accurate inferences about hidden and stigmatised practices in the wider population.

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Table 1: Selected methodological, demographic and drug use characteristics of ecstasy user samples described in Topp et al. and Miller et al.

(Table 1 could be placed in online supplementary material if space is a problem)

Sample characteristics	Topp et al. 2004			Miller et al. 2010		
	NDSHS recent [a]	NDSHS regular	Purposive	Probability	Face-to-face non-probability	Internet non-probability
	N = 199	N = 48	N = 163	N = 178	N = 100	N = 381
Methodological characteristics						
Sample type	Probability	Probability	Purposive	Probability	Purposive	Purposive
Survey mode	Household	Household	Face-to-face	Household	Face-to-face	Internet
Recruitment	Random selection	Random selection	Street press [b]	Random selection	Websites/forums Street press [b]	Websites/forums Street press [b]
Frequency of ecstasy use	Last 12 months	At least monthly	At least monthly	At least monthly	At least monthly	Last 6 months
Age range in years	17–45	17–45 [c]	17–45 [d]	16–52	16–44	16–54
Locale	Sydney	Sydney	Sydney	Australia	Melbourne	Melbourne
Year of data collection	2001	2001	2001	2004	2004	2004
Demographic characteristics						
Mean Age (SD)	25.5 (6.1)	24.4 (5.4)	24.7 (6.2)	25.0 (0.5) [e]	23.5 (5.2)	23.4 (5.4)
Male (%)	59	62	58	63.5	58.0	66.1
Completed qualifications (%)	57	56	53	57.9	53.0	NA
Drugs recently used (%)						
Alcohol	99	97	98	96.4	94.0	71.1
Cannabis	84	89	82	87.3	78.0	61.7
Meth/amphetamine	64	89	87	87.1	75.0	76.9
Cocaine	39	59	57	46.2	48.0	26.2
Hallucinogens	18	35	23	27.8	39.0	18.4

Ketamine	NA	NA	NA	23.1	45.0	35.4
GHB	NA	NA	NA	7.8	27.0	19.2
Heroin	2	5	6	3.9	9.0	2.6
Ever injected	NA	NA	NA	24.0	15.0	10.6

[a] Sample names as given by study authors. [b] Also radio, flyers/posters, interviewer contacts, snowballing. [c] Not stated but sample is a subset of larger household sample. [d] From Topp et al. 2002. [e] Standard error.

Table 2: Demographic characteristics of occasional and regular ecstasy users for the online purposive sample matched with the 2007 NDSHS probability samples

Demographic variables	Occasional ecstasy users (less than monthly)				Regular ecstasy users (monthly or more often)			
	Online (N = 328)		Household (N = 546) [a]		Online (N = 425)		Household (N = 180) [a]	
	n	% (95% CI Boot)	n	% (95% CI Linear)	n	% (95% CI Boot)	n	% (95% CI Linear)
Age (valid n)	328		546		425		180	
mean	24.2	(23.6–24.8)	28.0	(27.2–28.9)***	22.9	(22.3–23.5)	24.8	(23.6–26.0)**
SD (range)	5.72	(16–51)	7.69	(16–55)	6.25	(16–51)	5.76	(16–55)
Sex (valid n)	326		546		423		180	
Male	221	67.8 (62.3–73.3)	330	60.3 (55.3–65.4)*	313	74.0 (69.9–78.0)	120	66.5 (57.5–75.5)
State of residence (valid n)	324		546		421		180	
NSW & ACT	87	26.9 (21.8–31.9)	183	33.5 (28.5–38.5)	129	30.6 (26.3–35.0)	61	33.9 (24.2–43.5)
Vic & Tas	103	31.8 (26.7–36.9)	154	28.2 (23.3–33.2)	136	32.3 (28.0–36.6)	41	23.0 (12.4–33.7)
Qld	45	13.9 (10.4–17.4)	98	17.9 (13.8–22.0)	62	14.7 (11.2–18.3)	50	27.9 (18.8–37.0)**
SA & NT	24	7.4 (4.6–10.2)	44	8.1 (5.4–10.7)	30	7.1 (4.6–9.7)	11	5.8 (2.1–9.6)
WA	65	20.1 (15.5–24.6)	67	12.3 (9.0–15.5)**	64	15.2 (12.1–18.3)	17	9.4 (4.1–14.7)
Rurality classification (valid n)	326		546		415		180	
Capital city	266	81.6 (77.3–85.8)	393	71.9 (67.1–76.7)**	327	78.8 (75.1–82.5)	119	66.1 (55.5–76.7)*
Year of school completed [b] (valid n)	306		498		386		166	
Year 12 (secondary school)	264	86.3 (82.6–89.9)	345	69.3 (64.4–74.2)***	307	79.5 (75.6–83.5)	112	67.8 (57.9–77.7)*
Highest qualification [b] (valid n)	283		504		360		167	
Any qualification [c]	186	65.7 (60.3–71.1)	305	60.6 (55.3–66.0)	215	59.7 (54.8–64.6)	102	60.9 (50.7–71.1)
University qualification [d]	98	34.6 (29.2–40.1)	142	28.1 (23.2–33.1)	93	25.8 (21.3–30.4)	33	19.5 (10.9–28.1)
Postgraduate qualification	32	11.3 (7.6–15.0)	28	5.5 (3.3–7.7)*	30	8.3 (5.5–11.2)	6	3.9 (0.0–9.0)

[a] All household survey estimates are weighted. [b] Excludes those 'still at school'. [c] Includes trade or technical certificate or diploma, undergraduate and postgraduate qualifications. [d] Includes undergraduate and postgraduate qualifications. * p<0.05; ** p<0.01; *** p<0.001

Table 3: Drug use characteristics of occasional and regular ecstasy users for the online purposive sample matched with the 2007 NDSHS probability samples

Drug use variables	Occasional ecstasy users (less than monthly)				Regular ecstasy users (monthly or more often)			
	Online (N = 328)		Household (N = 546) [a]		Online (N = 425)		Household (N = 180) [a]	
	n	% (95% CI Boot)	n	% (95% CI Linear)	n	% (95% CI Boot)	n	% (95% CI Linear)
Meth/amphetamine [b, c] (valid n)	321		541		422		179	
Used in the last 6/12 months	183	57.0 (51.6–62.4)	198	36.6 (31.5–41.6)***	290	68.7 (64.1–73.3)	123	68.5 (59.0–78.0)
Monthly or more often	45	14.0 (10.2–17.8)	49	9.0 (6.0–12.1)	164	38.9 (34.1–43.6)	69	38.5 (28.4–48.5)
Cannabis (valid n)	323		546		420		180	
Used in the last 6/12 months	212	65.6 (60.6–70.7)	371	68.0 (63.0–73.0)	327	77.9 (74.0–81.7)	149	83.0 (75.3–90.7)
Monthly or more often	103	31.9 (26.6–37.2)	195	35.8 (30.7–40.9)	197	46.9 (42.0–51.8)	103	57.3 (46.5–68.1)
Heroin (valid n)	309		545		403		180	
Used in the last 6/12 months	8	2.6 (0.8–4.4)	11	2.1 (0.6–3.6)	4	1.0 (0.0–1.9)	10	5.5 (1.4–9.6)*
Monthly or more often	5	1.6 (0.3–3.0)	5	1.0 (0.0–2.2)	1	0.2 (0.0–0.6)	6	3.1 (0.1–6.2)
Cocaine (valid n)	316		546		412		180	
Used in the last 6/12 months	76	24.1 (19.5–28.6)	152	27.8 (23.1–32.5)	148	35.9 (31.3–40.6)	86	47.6 (37.1–58.1)*
Monthly or more often	11	3.5 (1.5–5.5)	16	3.0 (1.2–4.8)	44	10.7 (7.8–13.6)	27	15.3 (8.0–22.5)
Hallucinogens [d] (valid n)	312		546		414		180	
Used in the last 6/12 months	102	32.7 (27.3–38.1)	43	7.9 (5.1–10.7)***	154	37.2 (32.6–41.8)	47	26.2 (17.3–35.1)*
Monthly or more often	21	6.7 (4.1–9.4)	2	0.4 (0.0–0.8)***	52	12.6 (9.3–15.8)	18	10.0 (3.6–16.3)
Ketamine (valid n)	314		543		412		179	
Used in the last 6/12 months	44	14.0 (10.3–17.7)	12	2.2 (0.8–3.6)***	81	19.7 (16.0–23.3)	21	11.8 (4.8–18.9)
Monthly or more often	8	2.5 (0.7–4.4)	0	0	25	6.1 (3.9–8.3)	7	3.9 (0.0–8.1)
GHB (valid n)	313		542		410		178	
Used in the last 6/12 months	20	6.4 (3.8–9.0)	4	0.7 (0.0–1.3)***	42	10.2 (7.4–13.0)	16	9.1 (2.3–15.9)
Monthly or more often	10	3.2 (1.3–5.1)	0	0	18	4.4 (2.3–6.4)	8	4.5 (0.0–10.0)

Benzodiazepines [c] (valid n)	314		544		412		180	
Used in the last 6/12 months	90	28.7 (23.7–33.7)	60	11.0 (7.8–14.2)***	96	23.3 (19.3–27.3)	46	25.4 (16.1–34.7)
Monthly or more often	42	13.4 (9.7–17.1)	23	4.2 (2.0–6.3)***	46	11.2 (8.3–14.1)	21	11.4 (4.5–18.4)
Alcohol [e] (valid n)	327		544		425		180	
Monthly or more often [f]	284	86.9 (83.1–90.6)	510	93.6 (90.9–96.4)*	371	87.3 (84.0–90.6)	173	95.8 (92.5–99.1)**
Weekly or more often	206	63.0 (58.3–67.7)	421	77.5 (72.9–82.0)**	296	69.6 (65.1–74.2)	158	87.7 (81.7–93.7)***
Injecting (valid n)	325		546		416		180	
Ever injected	42	12.9 (9.5–16.4)	79	14.5 (11.0–18.0)	30	7.2 (4.9–9.5)	26	14.4 (7.8–21.0)*
Injected in the last 6/12 months	19	5.8 (3.3–8.4)	34	6.2 (3.8–8.7)	14	3.4 (1.7–5.1)	12	6.7 (2.4–11.0)

Note. See Appendix for survey items from which estimates of drug use were derived.

[a] Household survey estimates are weighted.

[b] Defined as meth/amphetamine in the household survey; non-medical use of pharmaceutical stimulants were explicitly included in the online survey.

[c] For non-medical reasons only.

[d] Defined as hallucinogens in the household survey; LSD, mushrooms and other psychoactive plants were measured separately in the online survey and then combined into a composite hallucinogens variable.

[e] Four alcohol response categories from the household data were collapsed into ‘weekly or more often’ to match the online forum data.

[f] Includes weekly or more often.

* $p<0.05$; ** $p<0.01$; *** $p<0.001$

Appendix: Survey items from which estimates of recent and regular drug use were derived

(To be published as an online ancillary file)

Online survey

Have you ever used *[drug name]* for non-medical reasons? If yes, how often in the past 6 months?

(a) no, never

(b) yes, but not in the past 6 months

(c) 1 to 5 times in the past 6 months

(d) 1 to 3 times per month in the past 6 months

(e) weekly or more often in the past 6 months

Ever used = b–e

Used in the last 6 months = c–e

Used monthly or more often = d–e

Used weekly or more often = e

Household survey

1. Have you ever used *[drug name]*? Yes/No

2. *If yes to 1*, Have you used *[drug name]* in the last 12 months? Yes/No

3. *If yes to 2*, In the last 12 months, how often did you use *[drug name]*?

(a) Every day

(b) Once a week or more

(c) About once a month

(d) Every few months

(e) Once or twice a year

Ever used = Yes to 1, no missing data on subsequent questions

Used in the last 12 months = Yes to 2, no missing data on subsequent question

Used monthly or more often = 3a–c

Used weekly or more often = 3a–b