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## **An initial typology of contexts of dyadic sexual encounters between men and associations with sexual risk and pleasure: findings from an observational study**

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**Background:** Although many within-subjects comparisons conducted on samples of men who have sex with men have sought to understand the association between specific situational characteristics (e.g. drug use or location of sex) and sexual risk behaviour, none have considered the ‘clustering’ of patterns of situational characteristics. An initial typology of sexual encounters is derived and the relationship of this typology to condomless anal intercourse (CAI) and pleasure is tested. **Methods:** Data from a longitudinal survey of men who have sex with men living in England were used. Multilevel latent class analyses were estimated to determine an optimal class solution on the situational characteristics, and then pseudo-imputation was used to estimate the association between class and both CAI and pleasure. **Results:** A three-class solution fit the data best, with a scaled relative entropy of 92.4%. Classes were characterised as featuring: regular steady partners in private locations with low drug use (class 1), casual partners with increased probability of sex occurring in a sex-on-premises venue (class 2), and high levels of polydrug use together with increased probability of casual partners (class 3). Encounters were different both in pairwise comparisons and overall on probability of CAI. They were different overall but not necessarily pairwise on pleasure. **Conclusions:** These initial findings demonstrate the possibility of understanding sexual encounters in terms of the contexts, or classes, within which they occur. This may have implications for tailoring HIV prevention to specific encounter types. Future research should seek to extend encounter-level typologies to specific drug use variables.

**Additional keywords:** HIV risk behaviour, latent variable modelling, men who have sex with men, observational epidemiology.

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TOC summary?

An initial typology of situational characteristics in dyadic sexual encounters between men was derived using longitudinal data from a survey of men who have sex with men living in England. This typology suggested three classes: encounters with regular steady partners in private locations with low drug use, encounters with casual partners with increased probability of sex occurring in a sex-on-premises venue, and encounters with high levels of polydrug use together with increased probability of casual partners. Classes were associated with differential probability of condomless anal intercourse.

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Typology of dyadic sexual encounters in MSM

## Introduction

To understand associations between situational characteristics and sexual risk behaviour, it is most effective to compare multiple encounters within the same subjects.<sup>1</sup> Within-subjects comparisons can be made in case-crossover analyses or in multilevel models. Both address confounding by partitioning out variance due to person-level characteristics.<sup>2</sup>

There have been several within-subjects comparisons of the situational characteristics associated with condomless anal intercourse (CAI) among men who have sex with men (MSM), including consideration of drug use,<sup>3–6</sup> venue of sex,<sup>7–10</sup> partner seroconcordance<sup>11–13</sup> and the relationship between partners.<sup>6,10,11</sup> Findings on drug use<sup>14</sup> and venue of sex<sup>15</sup> are inconsistent, but partner seroconcordance and increased partner familiarity appear to be associated with increased likelihood of CAI.

However, situational characteristics do not occur in isolation and may ‘cluster’ together; that is, groups of characteristics may be more likely to appear together. These ‘clusters’ could be meaningfully interpreted as the contexts within which sex occurs. Contexts of sexual encounters are critical in understanding how sexual risk occurs in that they provide both the opportunity and sometimes the motivation for the behaviour. Contexts may serve to frame and structure what is possible and what is anticipated in a sexual encounter, possibly dissuading condom use and enabling ‘slip-ups’<sup>16</sup>. In their germinal work on cognitive escape as a motivation for CAI occurrences, McKirnan *et al.*<sup>17</sup> point to the role of ‘highly stimulating sexual contexts’ in facilitating CAI. It follows, then, that contexts of sex may be differentially associated with CAI. The cognitive escape theory of CAI suggests that CAI arises when the avoidance of sexual risk is a weaker motivation than the cognitive escape anticipated by engagement in CAI – participants place greater value on the immediate, probable and multifaceted pleasures arising from sex than the more doubtful and difficult to imagine harms of HIV/sexually transmissible infections (STIs). This suggests that pleasure should also be considered as a possible sexual

outcome alongside sexual risk behaviour. It also suggests that pleasure may be a strong motivation in considering self-justifications for CAI.<sup>16</sup>

The current analysis uses sexual encounter-level data from a longitudinal survey of MSM living in England. Situational characteristics include the relationship between partners, perceptions of HIV status seroconcordance, location of sex and concurrent use of substances. We apply an innovative methodology, multilevel latent class analysis, to derive empirically for the first time an initial typology of sexual encounters and to test the relationship of this typology to CAI and pleasure. Latent class analysis is a statistical method used to describe underlying typologies in data based on ‘clusters’ of variables. That is, it describes how specific characteristics co-occur and separates observations into classes on that basis.

## Methods

Data are from a year-long longitudinal study using monthly Internet surveys, conducted in 2011–2012 among MSM living in England aged 16 years and over. Detailed survey methods are published elsewhere.<sup>18</sup> The survey was approved by the London School of Hygiene and Tropical Medicine ethics committee (approval number 5834). This analysis was approved by the Department of Social Policy and Intervention research ethics committee at the University of Oxford.

‘Sex’ was defined for participants as ‘physical contact to orgasm (or close to orgasm) for one or both partners’. ‘Sex with men’ was defined as including, but not limited to, anal intercourse. In five waves of the study (in surveys sent on 1 March 2011, 1 June 2011, 1 August 2011, 1 November 2011 and 1 February 2012), men were asked: ‘Please think about the **most recent occasion you had any kind of sex with a man**, whether that was with a new partner or someone you had sex with before’. They were then asked a series of questions about that encounter.

### *Situational characteristics*

We chose several situational characteristics that have been shown in previous encounter-level analyses to be associated with sexual risk behaviour in MSM. To describe the extent and variety of drug use, we included a manifest indicator for number of drugs (including alcohol and poppers) that the respondent reported consuming before sex. We measured partner relationship as a three-category variable including ‘regular steady’ (partners the respondent regarded as a primary sexual partner such as a boyfriend or husband); ‘regular but non-steady’ (partners with whom the respondent reported some familiarity, but not as a primary sex partner); and ‘one-off’ (characterised by no expectation of repeat sexual contact, such as a one-night stand or partner

met anonymously). We classified encounters by the respondent's views as to whether he and his partner were of the same HIV serostatus (HIV seroconcordant), of different HIV serostatus (HIV serodiscordant) or of unclear HIV serostatus match (e.g. where the respondent reported not knowing his partner's HIV serostatus). Finally, we classified encounters by where they occurred: in a private location (at home or a hotel), in a sex-on-premises venue (e.g. a sex club or sauna) or in an outdoor cruising location.

### *Outcomes*

Another goal of this analysis was to examine how the typology of situational characteristics was associated with key sexual outcomes. We used two sexual outcomes: CAI, defined as any sexual encounter in which the respondent reported both anal intercourse and inconsistent or no condom use, and pleasure, measured on a scale of 1 to 10 with 10 being 'the best sex ever' and 1 being 'the worst sex ever' (intermediate ratings were not labelled).

### *Analytic strategy*

Latent class analysis aims to describe exhaustive and probabilistic unmeasured classes to which individual observations in empirical data belong,<sup>19,20</sup> using categorical and/or continuous observed variables.<sup>21</sup> Multilevel latent class models account for the nested structure of the data by placing random means for each latent class at the second level of the analysis. These random means allowed for the probability of an encounter's assignment to a latent class to vary over persons.

We estimated multilevel latent class models in *Mplus* (Muthén & Muthén, Los Angeles, CA, USA) using maximum likelihood estimation and robust standard errors, with missing data handled via full information maximum likelihood. We estimated models with two, three and four latent classes on the encounter-level situational characteristics and a factor on the person-level means, and compared these models using a variety of model fit indices, including scaled relative entropy and the Akaike information criterion. Additionally, the Vuong–Lo–Mendell–Rubin likelihood ratio test was used to compare the explanatory power of each latent class solution against the solution with one fewer latent class.<sup>22</sup> When we selected a model based on these initial tests, the model was re-run with random effects correlated instead of modelled on a factor variable to reap any benefits in terms of fit.

Once we identified the optimal latent class model, we distinguished between the latent classes and named them based on the differences between the classes on the average values of the situational characteristics in each class. For situational characteristics measured using categorical variables, these average values are called conditional probabilities, whereas for

continuously measured characteristics, the mean is used. For example, we compared how likely it was in each class that an encounter was with a partner believed to be serodiscordant, or with a regular steady partner; similarly, we examined the average number of drugs used in each class.

We then tested whether the latent classes of situational characteristics predicted the outcomes using the pseudo-class draws method.<sup>23,24</sup> The underlying logic of this approach is that classification probabilities for each observation themselves form a distribution from which can be drawn a series of estimates of ‘most likely classes’, with pseudo-imputation used to relate the series of estimates to the outcome.<sup>25</sup>

## Results

Overall, 2142 MSM reported at least one dyadic sexual encounter. Between them, they contributed 6742 encounters to the analytic sample. Participants had an average age of 42.5 (s.d. = 11.9) years. Almost half (49.6%) had a university degree. In ethnic composition, 81.5% were White British, 13.0% were White other, 1.7% were Black and 2.5% were Asian, while 1.2% described themselves as of another racial category. At time of enrolment, 52.0% described themselves as being single and 85.5% identified as gay or homosexual, whereas 14.5% identified as straight, bisexual or other. Concerning HIV testing history, 15.8% had never received a HIV test result, 17.5% had received a positive HIV test result and 66.7% had last received a negative test result.

### *Model selection and fit*

Compared with a two-class model with factors on the random means, a three-class model with factors on the random means had lower scores on the Akaike information criterion, higher scaled relative entropy, and a statistically significant improvement in fit (Table 1). A four-class model did not replicate log-likelihood, despite several attempts at model estimation with increased numbers of random starts, and did not offer better fit as compared with a three-class model. When we re-estimated the three-class model without the factor on the random means, we saw a marginal improvement in model fit and thus chose this model.

Examination of both the scaled relative entropy for the chosen model (92.4%) and the mean probabilities for most likely class membership by most likely latent class (Table 2) revealed well-separated latent classes. That is, the three latent classes identified in this model distinguish strongly between different encounters. For example, among encounters with most likely class 1, the mean probability of assignment to class 1 was 97.1%. This means that for encounters where the highest class probability was for class 1, the average of those probabilities was 97.1%. Mean probability of assignment for each class matched closely with the appropriate latent class.

### *Class descriptions*

Based on examination of conditional probabilities, class 1 was identified as ‘familiar encounters’, class 2 was identified as ‘casual partners’ and class 3 was identified as ‘polydrug use’.

#### *Class 1: familiar encounters*

Of the included encounters in this model, 31.5% were most likely to be assigned to class 1 (Table 3). Encounters in this class were characteristically those with regular steady partners (conditional probability 94.1%). Encounters were almost always at home (99.1%). Nearly three-quarters (71.6%) of encounters in this class were with partners believed to be HIV seroconcordant. Encounters in this class had a low average number of substances used by respondents at 0.41 (SE = 0.02), although the distribution of this mean was right-skewed and bounded at zero. Thus, this class likely encompassed encounters with zero, one or two substances used.

#### *Class 2: casual partners*

Of the included encounters in this model, 61.8% were mostly likely to be assigned to class 2. Encounters in this class were characteristically those with casual partners, that is either regular but non-steady partners (conditional probability 35.9%) or one-off partners (conditional probability 62.8%). Encounters with regular steady partners only had a conditional probability of 1.2% in this class. Most encounters in this class were with partners of unclear HIV serostatus match (68.3%). Class 2 encounters were less likely to occur in private settings (conditional probability 80.7% vs 87.2% in the whole sample). Finally, like class 1 encounters, class 2 encounters involved low levels of respondent substance use (M = 0.50, SE = 0.02), although as mentioned above, some polysubstance use was likely included in this class as well.

#### *Class 3: polydrug use*

Of the included encounters, 6.7% were most likely to be assigned to class 3. Encounters in this class were characterised by high polysubstance use. Encounters in this class also included an average of 3.52 substances used by respondents (SE = 0.13). These encounters were less likely to include regular steady partners (conditional probability 22.3%) and more likely to include regular but non-steady partners (conditional probability 37.7%) than all encounters, although the conditional probability of encounters including one-off partners (40.1%) was not substantially different from all encounters. Conditional probabilities for location of sex were not absolutely different from the general sample of encounters, although encounters in cruising or outdoor locations were less likely to occur in class 3 (conditional probability 1.6%) than in the

population of encounters generally (5.5%). Encounters in this class had a conditional probability of serodiscordant encounters twice as high as that compared with the probability of serodiscordant encounters in the entire sample (14.9% vs 7.0%).

#### *Relationship between latent classes and outcomes*

On average, encounter assignment to class 2 was associated with a 23.0% probability of CAI, whereas encounter assignment to class 1 was associated with a 41.5% probability of CAI, and assignment to class 3 was associated with a probability of 52.9%. An overall test for differences between classes was statistically significant ( $\chi^2(2) = 312.58, P < 0.001$ ), as were all pairwise tests between classes (Table 4). This indicated that each class was statistically associated with a different probability of CAI. In contrast, while both class 1 and class 3 had higher average reported pleasure than class 2, class 1 and class 3 were not statistically distinguishable ( $\chi^2(1) = 0.5, P = 0.50$ ) and an overall test of differences was significant ( $\chi^2(2) = 159.11, P < 0.001$ ).

#### **Discussion**

In the first analysis of its kind, we used multilevel latent class analysis to construct a working typology of contexts of sexual encounters between men. The three classes that arose were readily distinguishable with clear separation between them. Classes were characterised as featuring regular steady partners in private locations with low drug use (class 1), casual (regular but not steady and one-off) partners with increased probability of sex occurring in a sex-on-premises venue (class 2) and high levels of polydrug use together increased probability of partners that were regular but not steady and one-off (class 3). Encounters were different both in pairwise comparisons and overall on probability of CAI. They were different overall but not necessarily pairwise on pleasure.

Encounters in class 1, marked by regular steady partners, were associated with a higher likelihood of CAI compared with encounters in class 2, which was defined by encounters with casual partners and higher odds of sex-on-premises venues. This could suggest that explanations for sexual risk behaviour in the face of risk of HIV transmission possibly ignore planned CAI, a finding that is reflected in qualitative research on the subject.<sup>26,27</sup>

Moreover, CAI in the context of steady partnerships where partners are assumed to be seroconcordant—as in most of the encounters in class 1 – carry a much lower risk for HIV transmission. This is especially important because not all CAI is the same in terms of risk. That is, CAI with a regular and steady partner, even when that relationship is not monogamous, may occur in the context of negotiated safety.<sup>26,27</sup> Negotiated safety and strategic positioning have, in cohort studies, not been associated with an increase in HIV transmission.<sup>28</sup> Moreover, the higher



rate of CAI in the context of regular and steady partnerships has long been established.<sup>29</sup> Thus, while encounters in class 1 have a higher rate of CAI than encounters in class 2, it may be that on the whole, class 2 encounters present a greater risk for HIV transmission.

What is notable, especially with regards to highly stimulating sexual contexts,<sup>17,30</sup> is our finding that the encounters with the highest risk of CAI were in the presence of polydrug use, with roughly three-quarters of the encounters in class 3 occurring with casual partners. That is to say, this model indicates that polydrug use in the presence of unfamiliar partners may be enough to create a highly stimulating sexual context where risk of CAI exceeds even that of encounters at home with regular and steady partners, especially given that pleasure, on average, was equal between both classes of encounters. This specific conclusion matches with the statistically similar levels of reported pleasure between both classes. It also matched with recent encounter-level evidence, indicating that drug use moderates the relationship between venue of sex and CAI in encounters reported by MSM with new partners; that is, whereas sex-on-premises venues are associated with decreased sexual risk as compared with encounters at home, in the presence of drug use, sexual risk is elevated and roughly equal across all settings.<sup>31</sup> Of course, these findings cannot be used to assert a causal link between polydrug use, pleasure and CAI. However, it does raise interesting questions about whether the primary goal of polydrug use is an intensely pleasurable experience, in which considerations of sexual risk are secondary, or whether polydrug use is a device used both for intense pleasure and removal of inhibitions.<sup>32</sup> Another possibility is that a person-level mechanism drives this situational relationship between polydrug use, pleasure and sexual risk, although we were unable to examine this specific relationship.

Finally, it is worth noting that although we used a three-category variable to describe partner relationships, we did not find that encounters with regular and non-steady partners and encounters with one-off partners were statistically separated in our model. That is, class 1 was defined by encounters with partners who were both regular *and* steady (e.g. a boyfriend or a husband), but classes 2 and 3 were defined by non-steady partners. Thus, some ambiguity remains about how to understand the level of sexual risk embedded in contexts of sex involving encounters with regular, non-steady partners, who are neither long-term primary partners nor one-off, anonymous or opportunity partners.<sup>33</sup>

Our analysis has several limitations. Survey participants were drawn from a convenience sample rather than a random sample of MSM living in England. They are thus more likely to be gay-identified and to report higher levels of sexual risk than probabilistic samples.<sup>34</sup> All retrospective surveys are subject to recall error, recall bias based on length of time from the

sexual encounter, and reactivity bias over multiple waves of data collection. Because our analysis was restricted to dyadic encounters, our findings may not be generalisable to multipartner encounters, although this does reduce the risk of confounding by number of partners. Finally, we had initially hoped to construct a typology of encounters that also included specific drug use variables, rather than the overall exposure variable we used here. However, these analyses did not converge and thus we were unable to pursue this line of inquiry.

There are also several limitations with our specific analytic approach. First, given the advent of pre-exposure prophylaxis and treatment as prevention, CAI is by now a blunt measure for sexual risk. Future analyses may collect data that allows sexual risk to be more clearly understood at the encounter level. While our study had an exceptionally large number of encounters and participants relative to other similar within-subjects comparisons – to our the best of knowledge, only one within-subjects comparison<sup>3</sup> has recruited more than 1000 MSM – we were limited by the number of encounters we had per respondent, which was not more than five. It is possible that a model including more encounters per respondent would have been able to meaningfully compare a four-class model with a three-class model. In this regard, our findings should be considered tentative. Because of the limitations of what is possible in statistical software programs, we were unable to examine person-level classes (i.e. is there a typology of persons with respect to their probability of engaging in the different types of sexual encounters we identified?) and the relationship of person-level classes to the outcomes.

Although these findings are tentative, they offer several important directions for epidemiological and intervention research. First, our demonstration of the use of this method in the context of within-subjects comparisons creates the possibility that other relevant typologies of sexual encounters could be derived; for example, in typologies of polydrug use, as has been done with person-level data.<sup>35</sup> Second, the construction of typologies of sexual encounters can help guide future HIV prevention efforts, including the development of interventions such as personalised cognitive counselling<sup>36</sup> and other interventions that seek to develop sexual negotiation skills that consider contextual factors specific to particular sexual encounters, that is, ‘in the heat of the moment’. This can help move interventions from their focus on either person-level characteristics or individual situational characteristics to a perspective that examines the whole of the context within which sex occurs, and that aims to target specific types of encounters rather than overall sexual behaviour. In particular, it may be of use to target encounters characterised by polydrug use, and those characterised by encounters in sex-on-premises venues with regular and non-steady or one-off partners; in the first instance, because these encounters carry the highest risk of CAI and in the second instance because these encounters, though lowest in risk for CAI, may have *riskier* CAI than encounters in class 1.

## Conflicts of interest

The authors do not have any conflicts of interest to report.

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**Table 1. Diagnostic statistics for latent class models tested**

LL, log-likelihood; VLMR-LRT, Vuong-Lo-Mendell-Rubin likelihood ratio test

Model specification	–2 LL	Scaled relative entropy (%)	Akaike information criterion	VLMR-LRT ( <i>P</i> -value)
2 classes, factor on means	47712.4	90.2	47754.4	0.0004
3 classes, factor on means	44886.1	92.1	44954.1	<0.0001
3 classes, no factor on means	44662.1	92.4	44732.1	<0.0001
4 classes, factor on means	43709.3	86.7	43803.3	0.25

**Table 2. Mean probabilities for most likely class membership by latent class**

Most likely class	Class 1 (%)	Class 2 (%)	Class 3 (%)
Class 1	97.1	2.6	0.3
Class 2	2.0	97.3	0.6
Class 3	1.1	4.0	94.9

**Table 3. Model specifications and conditional probabilities**

SE, standard error; CAI, condomless anal intercourse

Manifest indicators <i>n</i> = 6742 in 2142 groups	All encounters	Class 1		Class 2		Class 3
	Probability (%) Mean (SE)	Probability (%) Mean (SE)	<i>P</i> -value	Probability (%) Mean (SE)	<i>P</i> -value	Probability (%) Mean (SE)
Most likely class probability (count)		31.5 (2124)		61.8 (4167)		6.7 (45)
Number of substances used	0.68 (0.01)	0.41 (0.02)		0.50 (0.02)		3.52 (0)
Relationship status with partner(s)						
Regular steady	32.3	94.1	0.001	1.2	<0.001	22.3
Regular non-steady	26.3	5.3	0.097	35.9	<0.001	37.7
Opportunity/anonymous	41.4	0.6		62.8		40.1
Seroconcordance						
Both partners believed HIV+ or HIV–	43.0	71.6	<0.001	27.9	<0.001	45.3
Didn't care, didn't notice, didn't remember	50.0	17.1	<0.001	68.3	0.06	39.8
One partner HIV+ and one HIV–	7.0	11.3		3.8		14.9
Location of sex						
Private (residence, hotel)	87.2	99.1	<0.001	80.7	<0.001	89.8
Sex-on-premises venue	7.3	0.0	<0.001	11.0	0.007	8.6
Cruising or outdoors location	5.5	0.9		8.4		1.6
Mean level of CAI	30.9	41.5 (1.1)		23.0 (0.7)		52.9 (2)
Mean level of pleasure	6.5 (0.02)	6.9 (0.04)		6.2 (0.03)		6.8 (0.0)

**Table 4.  $\chi^2$  tests for equality of means on outcomes between classes**

CAI, condomless anal intercourse

Comparison	Wald test ( $\chi^2$ , df, <i>P</i> -value)
CAI	
Class 1 vs Class 2	202.26, 1, <0.001
Class 1 vs Class 3	18.21, 1, <0.001
Class 2 vs Class 3	138.49, 1, <0.001
Overall test	312.58, 2, <0.001
Pleasure	
Class 1 vs Class 2	157.11, 1, <0.001
Class 1 vs Class 3	0.50, 1, 0.48
Class 2 vs Class 3	32.73, 1, <0.001
Overall test	159.11, 2, <0.001