



Identifying Basic Classes of Sexual Orientation with Latent Profile Analysis: Developing the Multivariate Sexual Orientation Classification System

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Received: 5 June 2017 / Revised: 19 October 2018 / Accepted: 21 October 2018 / Published online: 7 June 2019
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Abstract

Despite considerable progress, research on sexual minorities has been hindered by a lack of clarity and consistency in defining sexual minority groups. Further, despite recent recommendations to assess the three main dimensions of sexual orientation—identity, behavior, and attraction—it remains unclear how best to integrate such multivariate information to define discrete sexual orientation groups, particularly when identity and behavior fail to match. The current study used a data-driven approach to identify a parsimonious set of sexual orientation classes. Latent profile analysis (LPA) was run within a large ($N = 3182$) and sexually diverse sample, using dimensions of sexual identity, behavior, and attraction as predictors. LPAs supported four fundamental sexual orientation classes not only in the overall sample, but also when conducted separately in men ($n = 980$) and women ($n = 2175$): heterosexual, homosexual, bisexual, and heteroflexible (a class representing individuals who self-identify as heterosexual or mostly heterosexual but report moderate same-sex sexual behavior and attraction). Heterosexuals reported the highest levels of psychological functioning and lowest risk behaviors. Homosexuals showed similarly high levels of psychological functioning to heterosexuals, but higher levels of risk behaviors. Bisexuals and heteroflexibles showed similarly low levels of psychological functioning and high risk taking. To facilitate applications of this classification approach, the study developed the Multivariate Sexual Orientation Classification System, reproducing the four LPA groups with 97% accuracy ($\kappa = .95$) using just two items. Implications of this classification approach are discussed.

Keywords Sexual orientation · Gay · Lesbian · Bisexual · Mostly heterosexual · Health disparities

Introduction

Despite critical priorities as outlined by the Institute of Medicine (2011) and the US Department of Health and Human Services (2010) to reduce health disparities of sexual minorities, a more fundamental problem exists: developing a standardized method of defining and classifying sexual orientation groups. This is due, in part, to a lack of methodological consistency in operationally defining sexual orientation, as studies often assess different dimensions of sexuality (e.g., sexual identity vs. sexual attraction vs. sexual behavior) to create sexual orientation

groups (for reviews, see Beaulieu-Prevost & Fortin, 2015; Sell, 1997; Wolff, Wells, Ventura-DiPersia, Renson, & Grov, 2016). Groupings of sexual orientation have ranged from simple binary classifications (heterosexual vs. homosexual—considering sexual identification, attraction, and behavior as interchangeable) to multidimensional approaches that posit over two dozen different groups (allowing for the possibility that identification, attraction, and behavior do not always align; Wolff et al., 2016). As a result, it has been difficult to establish accurate estimates of sexual minorities in the population (Purcell et al., 2012) and compare findings across studies and literatures. Although the field is increasingly calling for multivariate assessment of sexual orientation, it remains unclear how to integrate information on sexual identity, attraction, and behavior into basic classes of sexual orientation, particularly when those different dimensions are not aligned (i.e., sexual orientation branching; van Anders, 2015).

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Unidimensional versus Multidimensional Approaches to Sexual Orientation

Although many dimensions have been proposed, the general consensus is that there are three key dimensions of sexual orientation (for reviews, see Beaulieu-Prevost & Fortin, 2015; Sell, 1997; Wolff et al., 2016). *Sexual identity* refers to how individuals classify or label their own sexuality, corresponding to categories such as heterosexual, gay, lesbian, bisexual, and queer, among others. *Sexual behavior* refers to the gender match (same gender and/or opposite gender) of individuals' sexual activity partners. Finally, *sexual attraction* refers to the degree of sexual desire toward individuals of the same sex and opposite sex.¹

Despite the widely accepted multidimensional conceptual definition of sexual orientation, most studies assess sexual orientation using a single dimension. Sexual identity is most commonly selected to measure sexual orientation, particularly in the public health and psychology literatures (e.g., Cochran, Mays, & Sullivan, 2003; Lindley, Walsemann, & Carter, 2012; Sell, 2007). Sexual behavior is the next most-frequently used method of measuring sexual orientation and is often used in research that focuses on sexually transmitted diseases and risky behaviors (e.g., Grov, Hirshfield, Remien, Humberstone, & Chiasson, 2013; for a review, see Purcell et al., 2012). Although less frequently assessed, when included, sexual attraction tends to be measured along with one or both of the other dimensions (Chung & Katayama, 1996; for exceptions, see Austin et al., 2004a, 2004b).

One of the risks of operationalizing and assessing sexual orientation with a single dimension is that researchers may miss individuals showing a different pattern across measures of sexual identity, behavior, and attraction. For example, an individual may identify as bisexual, but be predominantly attracted to and engage in sexual activity with opposite-sex partners. Recent findings suggest a sizeable minority of men who have sex with men (MSM) also identify as heterosexual (e.g., Xu, Sternberg, & Markowitz, 2010a). Termed sexual orientation branching (van Anders, 2015), these different patterns highlight the importance of assessing all three dimensions of sexual orientation. Assessing sexual orientation with a single dimension effectively ignores these individuals in datasets, and this is particularly salient as sexual branching has been found to predict higher risk of adverse health outcomes (e.g., Corliss, Austin, Roberts, & Molnar, 2009; Przedworski, McAlpine, Karaca-Mandic, & VanKim, 2014).

¹ Given its clarity of meaning and widespread use throughout the literature, we have chosen to use the term “opposite sex” when we are referring to individuals with a different gender identity. Per a reviewer's thoughtful suggestion, we considered using the term “different sex” to be more inclusive of non-binary gender identities. Unfortunately, we found that term to be confusing in a number of places (e.g., when referring to “different sex partners” in the last year), and so we decided to continue using the most common term for this construct.

Forming Sexual Orientation Groups

In response to the evolving understanding of sexual diversity and the prevalence of sexual branching (e.g., Brewster & Tillman, 2012; Copen, Chandra, & Febo-Vazquez, 2016), there have been calls for researchers to broaden their assessment of sexual orientation (Badgett, 2009; Gates, 2011, 2012; Sell, 2007; Wolff et al., 2016). The Institute of Medicine (2011) included this as the first of five most pressing areas for lesbian, gay, bisexual, and transgender (LGBT) research, and recommended measuring sexual orientation in a multidimensional, standardized way. However, even when assessed in a multidimensional way, no guidelines exist for integrating sexual identity, behavior, and attraction into distinct sexual orientation groups, particularly for individuals reporting large amounts of sexual branching.

Strategies for Forming Groups

Studies that assessed sexual orientation in a multivariate way have implemented markedly different strategies for categorizing groups. For example, Rosario et al. (2014) collected data on sexual identity, behavior, and attraction, and used that multivariate data to create just two groups: a non-sexual minority group (reporting consistent heterosexual identity, behavior, and attraction) and a sexual minority group (consisting of all other individuals in the study, including bisexuals, homosexuals, and all individuals reporting sexual branching). While this research did find higher cancer-related risk behaviors among sexual minority youth as compared to heterosexual youth, we would argue that their method of grouping the sample may have obscured meaningful and important risk differences across specific sexual orientation groups (e.g., Semlyen, King, Varney, & Hagger-Johnson, 2016). At the other extreme, Wolff et al. (2016) proposed constructing over two dozen categories of sexual orientation to capture the full diversity and branching possible across sexual identity, behavior, and attraction. Unfortunately, this approach would be logistically untenable in all but the largest of population surveys, requiring tens of thousands of participants to support analyses of so many distinct and rare groups.

Sexual Orientation Groups Typically Analyzed

Many published studies have examined sexual orientation groups corresponding to the three most common groups: heterosexuals, bisexuals, and homosexuals. Although such a consistent conceptual strategy helps to maximize the field's ability to integrate findings across studies, even research examining these three main groups is limited by divergent operational definitions across studies. It also remains unclear how to integrate sexual orientation branching into a three-group conceptualization.

A fourth sexual orientation group has emerged from a set of studies examining one specific form of sexual branching: men

and women who identify as heterosexual yet report same-sex partners and attraction (e.g., Austin et al., 2004a, 2004b; Savin-Williams & Vrangalova, 2013; Vrangalova & Savin-Williams, 2012). Typically termed “mostly heterosexual,” these heterosexually identifying MSM and women who have sex with women (WSW) populations have been shown to be at higher risk of substance use problems (Austin et al., 2004a; Corliss, Rosario, Wypij, Fisher, & Austin, 2008) and high-risk sexual behaviors and sexually transmitted infections (STIs; Austin, Roberts, Corliss, & Molnar, 2008; Corliss et al., 2009; Xu, Sternberg, & Markowitz, 2010b) as compared to heterosexuals and, sometimes, to other sexual minority groups as well (e.g., Fish & Pasley, 2015). Although this group has been less frequently studied in the larger literature, when assessed, it tends to be a greater proportion of the sample than represented by gay men, lesbians, and bisexuals combined (e.g., Fish & Pasley, 2015; Savin-Williams & Vrangalova, 2013).

Recent Multivariate Approaches

A handful of recent studies have taken novel approaches to embrace the multivariate nature of sexual orientation. One approach avoids creating groups at all, instead treating sexual identity, sexual attraction, and sexual behavior as distinct predictors of outcomes (Brewster & Tillman, 2012; Matthews, Blossnich, Farmer, & Adams, 2014). Others have employed innovative ways to categorize sexual orientation groups using taxometric analysis (Norris, Marcus, & Green, 2015) and propensity scores (Martin-Storey, Cheadle, Skalamera, & Crosnoe, 2015) but, in these cases, only identify two groups. Closely related to the current analyses, two studies used latent class analysis with longitudinal data, finding evidence of three (Calzo, Masyn, Austin, Jun, & Corliss, 2017) and five (Fish & Pasley, 2015) sexual orientation groups. Importantly, both studies revealed a sizeable heteroflexible (also called “mostly heterosexual”) group in addition to finding one or multiple heterosexual and LGB groups.

A Need for Methodological Clarity

The lack of consistency and clarity for defining sexual orientation groups across the literature is problematic for a number of reasons. First and most fundamental, it leads to wide discrepancies in identifying rates of sexual minorities in the population (e.g., Purcell et al., 2012). For example, recent population estimates for those identifying as gay, lesbian, and bisexual vary from a low of 1.7% (National Epidemiological Survey on Alcohol and Related Conditions, 2004–2005) to a high of 5.6% (National Survey of Sexual Health and Behavior, 2009). However, estimates are substantially greater when this is assessed with sexual behavior and sexual attraction (for example: 8.8% and 11%, respectively, both assessed in the National Survey of Family Growth, 2006–2008). Thus, even the fundamental

decision of which individuals represent sexual minorities is markedly influenced by how that is assessed within specific studies, which can impact policy and funding for services targeting sexual minorities.

Related, studies may miss sexual orientation groups that are at elevated risk of STIs and adverse health outcomes (e.g., Corliss et al., 2009). For example, data from 9175 adults in the National Survey on Family Growth suggested that as many as 25% of people identifying as heterosexual reported as much, if not more, same-sex attraction than opposite-sex attraction (Copen et al., 2016), suggesting a fairly high prevalence rate of sexual branching. Importantly, these individuals face elevated risks on health outcomes when compared to heterosexuals (e.g., Zellner et al., 2009) and sometimes, elevated health risks even when compared to other sexual minorities (e.g., Xu et al., 2010a).

Finally, the methodological inconsistency across the literature limits the advancement of critical research on sexual minorities (e.g., health disparities, the effects of discrimination, risk behaviors, and relationship functioning) in that it can be difficult to compare findings across studies. This is especially puzzling when two studies assessing sexual orientation in divergent ways come to opposite conclusions. For example, Guadamuz et al. (2012) assessed sexual behavior and found a higher prevalence of obesity among sexual minority versus heterosexual men, whereas Conron, Mimiaga, and Landers (2010) assessed sexual identity and found the opposite pattern, leaving the reader wondering if part of the discrepancy was due to their different assessments of sexual orientation.

The Current Study

Operational and Temporal Approach

The current study embraced a multivariate operationalization of sexual orientation in order to have a data-driven method of integrating behavior, attraction, and identity into a holistic sexual orientation schema. We see this as critical as behavior, attraction, and identity do not always align. We conceptualize sexual orientation as a primarily stable trait, though we recognize fluidity in trajectories of sexual orientation over time, especially among women and non-heterosexual orientations (Diamond, 2008; Savin-Williams, Joyner, & Rieger, 2012). In other words, though we would expect some change across time in sexual orientation for some individuals, it is beyond the scope of this immediate work, as we assessed sexual identity, behavior and attraction at a single time-point, though we consider findings in light of temporal changes in the “Discussion” section.

Sampling Strategy

One of the challenges of previous work on sexual minority groups is their relatively low frequencies within representative national

samples, often yielding rates as low as 1 or 2% for specific sexual orientation subgroups of interest (e.g., Corliss et al., 2008; Everett, 2013; Xu et al., 2010a). This limits researchers' abilities to examine how those groups might meaningfully differ from one another, often forcing researchers to combine distinct groups together within their analyses, even in massive samples (e.g., bisexuals with homosexuals, Austin et al., 2004a; bisexuals with mostly heterosexuals, Everett, 2013). The current study therefore recruited a non-representative, sexually diverse sample, specifically oversampling sexual minorities and emerging young adults as they may show higher rates of non-heterosexual orientations as compared to older adults (Savin-Williams & Vrangalova 2013). This helped to reduce the risk that the analyses identifying a parsimonious set of sexual minority groups would inadvertently miss a major group due to a potentially small proportion of those participants.

Aim 1: Clarifying Sexual Orientation Groups with Latent Profile Analyses

Although it might be more pragmatic and straightforward in specific research contexts to focus on just one aspect of sexual orientation (e.g., examining HIV risk in MSM—focusing only on behavior), we would argue that such practices run the risk of oversimplifying sexual orientation and potentially obscuring meaningful results. We would further argue that focusing on single aspects of sexuality has led to a fragmented literature, making it harder to integrate work across laboratories and across fields. For this reason, our first aim was to conduct a latent profile analysis (LPA; McCutcheon, 1987) using a multidimensional assessment of sexual orientation to classify sexual orientation groups. In our efforts to identify a parsimonious set of classes of sexual orientation, we kept the number of items analyzed to a minimum to facilitate the broadest possible dissemination and implementation of the findings in future studies. In other words, we did not aim to capture all possible sexual orientations, but instead, only the most prevalent. Thus, we entered just five items into the LPAs: the single-item Kinsey scale (sexual identification), two items assessing attraction to those of the same-sex and opposite-sex (sexual attraction), and two items representing same-sex and opposite-sex partners in the last year (sexual behavior).

LPA is a multivariate statistical technique that can be used to identify groups of participants sharing strong similarities on a set of variables. The primary goal of LPA is to identify a parsimonious set of participant groups, helping to uncover fundamental underlying (latent) groups of people with respect to the behaviors (and/or traits & attitudes) examined, thereby clarifying how those behaviors might naturally co-occur within a population. Applying LPA to the indices of sexual orientation within a large ($N=3182$) and sexually diverse online sample allowed us to establish a data-driven, multifaceted approach to classifying sexual orientation, synthesizing work on sexual identity, attraction, and behavior and clarifying how best to integrate those constructs into a parsimonious framework.

Expected Results

We hypothesized that, at a minimum, three classes of sexual orientation would emerge from the LPA analyses corresponding to the heterosexual, bisexual, and homosexual classifications seen in the previous literature. However, given the exploratory nature of these analyses and recent conceptual work positing over two dozen possible categories of sexual orientation (Wolff et al., 2016), it was likely that more than just three classes of sexual orientation might be uncovered. As such, we were not able to hypothesize a specific number of classes, nor did we anticipate *a priori* differences across classes on our outcome measures.

Aim 2: Characterizing the Latent Groups

Next, we sought to better understand the latent groups that emerged from the LPA by examining differences across those groups on demographic background factors and outcomes representing psychological functioning and risk behaviors. We purposefully chose a diverse array of measures of psychological functioning and risk behaviors commonly examined in prior work in order to situate our findings within the larger psychology and public health literatures on sexuality. Thus, we sought to characterize the upstream and downstream correlates of these latent sexual orientation groups, developing preliminary profiles of the groups across a broad array of factors.

Aim 3: Developing and Validating a Classification Algorithm

Finally, to facilitate the dissemination of these latent sexual orientation groups to analyze in future studies, we aimed to develop and validate the Multidimensional Sexual Orientation Classification System (M-SOCS), a simple algorithm based on two items (the Kinsey scale and an item assessing attraction to same-sex individuals) that would reproduce the latent classes with a high level of accuracy. The M-SOCS is intended to provide researchers with a straightforward method of creating the sexual orientation groups characterized in this study without the need for running LPAs.

Method

Participants

We conducted the survey from March to July 2016. Participants had to be a minimum of 18 years of age to participate in the survey (hosted on SurveyGizmo.com). They were recruited online with the study title, "The Finding Partners in the 21st Century Survey," a brief description explaining the purpose ("to examine the predictors and correlates of different methods of finding romantic and sexual partners"), and key aspects of the study (e.g., voluntary, completed online, 25–30 min), with a link to the survey website. Participants

were recruited from various sources: MechanicalTurk (MTurk; 33.4%; targeting a slightly lower socioeconomic population), ResearchMatch (32.9%; targeting a slightly higher socioeconomic population), a psychology undergraduate subject pool (24.6%; targeting emerging adults as they tend to be highly sexually active), psychology research websites (e.g., socialpsych.org, University of Hanover, 3.3%), social websites (e.g., Facebook, eHarmony, 2.7%), and a variety of other methods with lower yields (3.1%). Multiple recruitment methods were used to defray the sociodemographic impact that any one recruitment source might have had. Although participation was open to all adults in the U.S., we oversampled sexual minorities and emerging adults to yield a sample with sufficient sexual diversity to support the planned LPA analyses. Individualized feedback on a number of background and individual difference factors within the larger survey served as the primary recruitment incentive. Additionally, students from the undergraduate subject pool were given extra credit toward their psychology courses and participants recruited via MTurk were given \$0.40 of amazon.com store credit as incentives. All study materials were evaluated and approved by an institutional review board.

A total of 4468 individuals accessed a preliminary survey presenting informed consent, of whom 4212 clicked through to the main survey (which collected no identifying information; 94% participation rate). The main survey presented subjects with 228–423 questions—using screener questions at key points to minimize burden on subjects. Of the 4212 individuals starting the main survey, 918 (22%) completed fewer than 165 questions (<70% of the minimum number of survey questions and <39% of the maximum number of survey questions). Another 114 (3%) completed the survey excessively rapidly (either completing the survey > 3 × faster than the median time or completing questions > 2 × faster than the median rate), thereby demonstrating poor attention and effort.² Those participants were dropped, yielding a final sample of 3180 participants (75% completion

rate): 68% female, 31% male, and 0.8% neither male nor female (most in this latter group identified as transgender). As seen in Table 1, participants were predominantly white, in their 20s and 30s ($M = 29.3$ years, $SD = 10.6$), and college educated, with average incomes of \$55,826 ($SD = \$33,699$).

Measures

LPA Predictors of Sexual Orientation

Consistent with our conceptual definition, we separately assessed sexual identity, sexual attraction, and sexual behavior.

Sexual Identification Participants completed the single-item Kinsey scale (Kinsey, Pomeroy, & Martin, 1948): “Please indicate the sexual orientation with which you identify” using the original 0 (“*Exclusively heterosexual*”) to 6 (“*Exclusively homosexual*”) response options (see Fig. 2).

Sexual Attraction Participants were asked to indicate their level of sexual attraction to men and women separately, “How much are you sexually attracted to: Men? Women?” on a 1 to 6 scale from “*Not at all*” to “*Extremely*”. From these questions and participant’s self-reported gender, we created two variables representing attraction to the opposite-sex and attraction to the same sex.

Sexual Behavior Participants were also given two open-ended text boxes and were asked to report their number of sexual activity partners, “In the last year: With how many men have you engaged in sexual activity? With how many women have you engaged in sexual activity?” To focus the LPA on the gender(s) of sexual partners rather than on numbers of sexual partners, we created dichotomous variables coding opposite-sex and same-sex sexual activity within the last year for use in the LPAs (i.e., participants received a “1” on same-sex sexual activity if they reported one or more same-sex partners).

Constructs Proximal to Sexual Orientation A number of measures were included to assess constructs strongly linked to sexual orientation yet conceptually distinct.

Outness To assess the degree to which participants were open to the people in their lives about their non-exclusively heterosexual sexual identities, we drew upon three items from the Self-Identified Lesbian Internalized Homophobia Scale (Weibley & Hindin, 2011), modifying their content to be more broadly applicable to a range of sexual identities and adding three additional targets: “How aware are the people in your life of your sexual interests/orientation beyond exclusive heterosexuality? Close friends, Casual friends, Immediate family, Extended family, Coworkers, Boss/employer.” Thus, participants identifying as anything other than “*Exclusively Heterosexual*” on the Kinsey

² A common concern with survey research is inattentive responding. Thankfully, rates of excessively inattentive responding for online surveys (similar in content, format, and length to the current study) tend to be fairly low (roughly 3–5%; see Maniaci & Rogge, 2014a). Despite such low rates, removing inattentive participants can lead to slight increases in power for correlational analyses (Maniaci & Rogge, 2014a). Identifying incomplete participants and participants completing the survey too rapidly are accepted methods of identifying such individuals (see Maniaci & Rogge, 2014b for a review as well as Maniaci & Rogge, 2014a for a review and supporting results). The cutscores used in the current article were developed by the second author across over 30 online surveys collecting data from over 40,000 participants. On average, participants answer an average of 11 questions per minute on surveys like the one presented in this manuscript. Thus, we used a cutscore of 26 questions per minute or more to identify participants rushing through the survey too quickly (at a pace more than double the average, strongly suggesting that they cannot be reading each item carefully). We also used a cutscore of completing at least 70% of the baseline survey as that helps to quickly separate out individuals who drop out of the survey after the first couple pages and to retain those with truly usable multivariate data.

Table 1 Sample demographics split by gender and M-SOCS agreement with the LPA classes by demographic group

Demographic dimension	N	% in full sample	% in men	% in women	M-SOCS agreement with LPA classes	Demographic dimension		N	% in full sample	% in men	% in women	M-SOCS agreement with LPA classes
						Kappa	Overall accuracy (%)					
Subsamples												Kappa Overall accuracy (%)
Full sample	3180				.953	.97						
Gender												
Male	980	31			.952	.97		328	10	13	9	.943
								1229	39	39	38	.947
Female	2175	68			.951	.97		1029	32	32	33	.957
Transgender/non-binary/gender-fluid	25	0.8			–	–		590	19	17	20	.964
Race												
White	2368	74	73	75	.952	.97		519	16	16	16	.943
Asian	341	11	13	10	.971	.99		716	23	26	21	.951
Black	242	8	8	7	.962	.98		601	19	19	19	.972
Other	229	7	7	7	.935	.96		436	14	13	14	.954
Ethnicity								267	8	7	9	.956
Non-Latino/Hispanic	2911	92	90	92	.951	.97		625	20	20	20	.940
Latino/Hispanic	269	8	10	8	.965	.98						.97
Age												
18–20 year	628	20	16	21	.928	.97		1776	56	60	54	.945
21–24 year	772	24	23	25	.964	.98		1404	44	40	46	.962
25–29 year	584	18	19	18	.952	.97		2806	88	88	88	.952
30–39 year	626	20	23	18	.958	.97		374	12	12	12	.955
40+ year	561	18	19	17	.947	.97						.97

M-SOCS = multidimensional sexual orientation system, LPA = latent profile analysis

scale answered these items on a 6-point scale (“*Not at all*” to “*Extremely*”). Responses were averaged ($\alpha = .92$) such that higher scores reflected higher levels of outness.

Internalized Stigma To assess participants’ internal conflict, guilt, and rejection of an LGBT identity, we modified a 4-item Self-Homophobia Scale (Flores, Mansergh, Marks, Guzman, & Colfax, 2009) to be more broadly applicable to various LGBT identities: “Sometimes I dislike myself for being LGBT,” “Sometimes I wish I were not LGBT,” “I sometimes feel guilty about having sex with people of my same sex,” “I feel stress or conflict within myself over having sex with people of my same sex.” Participants self-identifying as a 3 (*equally heterosexual and homosexual*) or higher on the Kinsey scale answered these questions on a 6-point scale (“*Strongly Disagree*” to “*Strongly Agree*”). Those answering a 0, 1, or 2 on the Kinsey scale (identifying as heterosexual or predominantly heterosexual) did not see these questions as they assessed experiences of identifying as LGBT. Responses were averaged such that higher scores reflected higher internalized stigma ($\alpha = .92$).

Background Factors

A number of items were included to assess individual differences on background constructs. *Sociosexual Orientation*: Responses to the nine items of the SOI-R (Penke & Asendorpf, 2008) were presented on the original 9-point response scales to assess casual sex behavior (e.g., “With how many different partners have you had sexual intercourse on one and only one occasion?”), casual sex desire (e.g., “How often do you have fantasies about having sex with someone you are not in a committed romantic relationship with?”), and pro-casual sex attitudes (e.g., “Sex without love is ok”). Responses were averaged ($\alpha = .87$) so that higher scores indicated sociosexual orientations more embracing of causal sex. *Sex Drive*: Five items commonly used in the literature (e.g., Lippa, 2006, 2007; “I have a strong sex drive”) assessed sex drive on a scale of 1 (*not at all true*) to 6 (*extremely true*). Responses were averaged such that higher scores indicated a higher sex drive ($\alpha = .91$). *Sexual Sensation Seeking*: Nine items from the Revised Sexual Sensation Seeking Scale (R-SSSS; Kalichman & Rompa, 1995) were used to assess sexual sensation seeking (e.g., “I like wild ‘uninhibited’ sexual encounters”) on a 6-point scale (“*Not at all like me*” to “*Extremely like me*”). Responses were averaged ($\alpha = .88$) such that higher scores reflected a tendency for more sexual sensation seeking.

Outcomes: Psychological Functioning

We assessed a number of outcomes examining individuals’ psychological functioning. Self-esteem was assessed with the 10-item Rosenberg Self-Esteem Scale (Rosenberg, 1979).

Items (e.g., “I feel I have a number of good qualities”) were rated on a scale of “*1 = Strongly Disagree*” to “*6 = Strongly Agree*” and responses were averaged such that higher scores reflected higher self-esteem ($\alpha = .92$). *Psychological Distress*: Eight items from the General Distress subscale of the Mood and Anxiety Symptom Questionnaire (MASQ; Watson et al., 1995) assessed depressive symptoms: “Thinking of the last two weeks, I felt depressed” rated on a 6-point scale “*Not at all*” to “*Extremely*.” Responses were averaged ($\alpha = .97$) so that higher scores indicated greater psychological distress. *Self-Control*: Thirteen items from the Brief Self-Control Scale (Tangney, Baumeister, & Boone, 2004) assessed participants’ abilities to focus on long-term goals rather than immediate gratification (e.g., “I am good at resisting temptation,” rated on a 6-point scale from “*Not at all*” to “*Extremely*”). Responses were averaged ($\alpha = .85$) so that higher scores indicated higher self-control. *Psychological Needs*: The 21-item Basic Psychological Needs Satisfaction Scale (Gagne, Ryan, & Bargmann, 2003) assessed the satisfaction of participants’ needs for autonomy (seven items; e.g., “I feel like I am free to decide for myself how to live my life”), relatedness (eight items; e.g., “People in my life care about me”), and competence (six items; e.g., “People I know tell me I am good at what I do”) on a 6-point scale (“*Not at all true*” to “*Extremely true*”). Responses were averaged ($\alpha = .89$) so that higher scores reflected higher need satisfaction.

Outcomes: Risky Behavior

We also assessed a number of risk-taking behaviors. *Problematic Drinking*: Responses to the three-item Alcohol Use Disorders Identification Test–Consumption screener (AUDIT-C; Bush, Kivlahan, McDonell, Fihn, & Bradley, 1998) focused on the last two months, were summed using the original response options and scoring algorithm ($\alpha = .75$), and a threshold of five points or higher (see Rumpf, Hapke, Meyer, & John, 2002) was used to identify potentially problematic levels of drinking. *Hookups in Last 2 Months*: Participants were asked if they had engaged in any of the following activities in the last 2 months: using geosocial networking apps (i.e., Tinder, Grindr), using dating websites (i.e., OkCupid, Match.com, PlentyOfFish), or engaging in offline social activities (group activities, going to bars, clubs, or parties). Participants recently engaging in any of those activities ($n = 2152$) indicated the number of hookups (defined as “having a no-strings attached sexual encounter with someone”) arranged with people from each type of social activity. Responses were summed across all activity types. *Risky Sexual Behavior in Last 2 Months*: A subset of participants engaging in at least one of the social activities assessed ($n = 1229$) were asked if they had had condomless oral, anal or vaginal intercourse with people met via each of the venues. These responses were converted into a dichotomous variable coding any risky sexual activity in the last two months. *Sexually Transmitted Infections–Lifetime*: Participants were provided a

list of 10 common STIs and were asked to check all that they had contracted. We used this to create a dichotomous variable identifying participants who reported having had an STI.

Analytic Strategy

Latent Profile Analyses

LPA is a form of mixture modeling—a set of analytic approaches that can be used to identify homogenous subgroups within a diverse and heterogeneous sample. Couched within a structural equation modeling (SEM) framework, LPA represents a form of latent modeling, with the distinction that the analysis extracts categorical latent variables (identifying homogenous groups of people) rather than continuous variables. The researcher specifies the predictor variables to be used in an LPA and the number of latent groups to extract. After extracting the requested number of latent groups in a specific analysis, LPA estimates the probability of each subject belonging to each group, assigning each subject to the group to which he or she most likely belongs. Thus, the goal of exploratory LPA is to identify a parsimonious set of participant classes on a set of variables (McCutcheon, 1987). This is achieved by running a series of LPAs, starting by specifying the extraction of just two classes and then increasing the number of specified classes on each subsequent run. A parsimonious number of classes is then identified by optimizing: (1) model fit indices (i.e., lower AIC and BIC indices, significant Lo–Mendel–Ruben and Bootstrapping Likelihood Ratio Tests), (2) the entropy of each resulting model (the average probability of each participant belonging to the class to which he or she was ultimately assigned, with high values—preferably above .9—representing clarity of classification), and (3) the interpretability and relevance of each solution (favoring solutions lacking exceedingly small classes that would be less likely to replicate; see Calzo, 2014 for a discussion of balancing these criteria). Thus, a series of LPA models on the five indicators of sexual orientation were run in the current data using MPlus, version 7.11 (Muthen & Muthen, 2012) specifying from two to five classes. To ensure that the LPA solution developed in the full sample did not mask meaningful gender differences, secondary LPAs were run in men and women separately, allowing us to directly examine the stability of the solution across the two main gender groups.

Characterizing Latent Groups

To examine differences among the final LPA groups (Tables 3 and 4), we ran a series of univariate ANCOVA³ and χ^2 analyses

³ The ANCOVAs controlled for the six demographic variables showing significant differences across the latent groups—thereby helping to defray the impact of those demographic differences when examining group means on the remaining variables.

to test for omnibus differences across the groups on: (1) the five variables that we used to create those groups, (2) a set of four variables representing proximal constructs to sexual orientations, (3) a set of seven demographic variables, (4) a set of five background factors linked to sexuality, (5) a set of four outcomes associated with psychological functioning, and (6) a set of five outcomes reflecting risky behavior. Given the planned number of contrasts across all of the analyses presented, we used a threshold of $p < .001$ to identify significant differences and a threshold of $p < .01$ to identify marginal differences on all of the omnibus tests presented. This served to both constrain the experiment-wide alpha error levels and to focus the results on the more robust differences that emerged. Toward that same end, we present Cohen's d effect sizes for the largest pairwise difference on each variable, thereby placing the findings on a common metric and providing readers with a concrete sense of the relative magnitude of the effects presented. All omnibus tests revealing significant differences were then followed up with post hoc pairwise comparisons using Tukey HSD (for the ANOVAs) or Bonferroni corrections (for the χ^2 tests) to further constrain experiment-wide alpha levels.

Results

Aim 1: Identifying Latent Classes of Sexual Orientation

Latent Profile Analyses

To identify the most parsimonious number of groups that would represent the diversity of sexual orientations in the current sample, a series of LPA models specifying one to five classes were estimated. As shown in Table 2, in the LPA analyses on the five indicators of sexual orientation converged to suggest a four-class solution regardless of whether those analyses were run in the full sample or in men and women separately. Specifically, the primary indicator of model fit (the adjusted Lo–Mendel–Ruben Likelihood Ratio Test; LMR-LRT) suggested that a four-class solution fit significantly better than a three-class solution (LMR-LRT = 874, $p = .002$), whereas a five-class solution failed to represent better fit than a four-class solution (LMR-LRT = 687, $p = .466$). Consistent with this, solutions including five or more classes yielded exceedingly small classes of respondents suggesting lower levels of interpretability/generalizability in those solutions. As all of the solutions demonstrated exceptionally high levels of entropy (representing the clarity of classification), these results would suggest that a four-class solution was the most parsimonious. Further supporting the stability of the four-class solution, the same four fundamental classes (described below) emerged across the analyses in the full sample and in men and women separately.

Table 2 Model fit across latent profile analyses specifying from 2 to 5 latent classes

Classes Specified	No. of free parameters	Log-likelihood	AIC	BIC	BIC <i>N</i> -adj.	LMR-LRT <i>p</i>	BLRT <i>p</i>	Entropy	No. classes with <i>n</i> < 5% sample
Full sample									
2	14	−18,101	36,230	36,315	36,271	<.0001	<.0001	.973	0
3	20	−15,955	31,950	32,071	32,007	<.0001	<.0001	.971	0
4	26	−15,509	31,069	31,227	31,144	.0018	<.0001	.953	0
5	32	−15,158	30,381	30,575	30,473	.4661	<.0001	.955	1
In 980 men									
2	14	−5400	10,827	10,896	10,851	<.0001	<.0001	.979	0
3	20	−4617	9275	9372	9309	<.0001	<.0001	.987	0
4	26	−4403	8857	8984	8902	.0009	<.0001	.985	0
5	32	−4241	8547	8703	8601	.2005	<.0001	.985	1
In 2175 women									
2	14	−12,220	24,468	24,548	24,504	<.0001	<.0001	.943	0
3	20	−10,983	22,006	22,120	22,056	<.0001	<.0001	.969	0
4	26	−10,690	21,431	21,579	21,496	.0001	<.0001	.942	0
5	32	−10,473	21,009	21,191	21,089	.0739	<.0001	.940	1

The table presents the fit statistics from LPAs run in the full sample (top section), in men only (middle section), and in women only (bottom section), demonstrating that the fit indices continued to suggest a four-class solution in both major gender groups. The solution selected to have the most parsimonious fit has been bolded to ease interpretation

AIC = Akaike's information criterion, BIC = Bayesian information criterion, *N*-adj. = BIC adjusted for sample size (lower numbers on the AIC and BIC indices suggest better fit), LMR-LRT *p* = Lo-Mendel-Rubin likelihood ratio test significance level, BLRT *p* = Bootstrap Likelihood Ratio Test significance level (a significant LMR-LRT or BLRT suggests that the current solution accounts for significantly greater amounts of between-person differences than the solution with one fewer classes specified). Entropy = the average probability of each participant belonging to the class to which they were ultimately assigned, thereby representing clarity of classification for each solution (higher numbers suggest a better fit with numbers above .9 suggesting excellent fit)

Describing Latent Sexual Orientation Groups

As shown in the top section of Table 3, the latent groups demonstrated marked differences on the five sexual orientation variables from which they were created, yielding Cohen's *d*s ranging from 2.33 to 15.96 across the largest pairwise group differences. As seen in Fig. 1a and Table 3, the pairwise comparisons revealed that the largest group (*n* = 1956, 65% of the sample) represented heterosexuals: a class made up of individuals reporting the lowest (0—exclusively heterosexual, 87%) or the second lowest (1—predominantly heterosexual, only incidentally homosexual, 13%) responses on the Kinsey scale, with high rates of attraction to and recent experience with opposite-sex partners (78%), and the lowest rates of attraction to and recent experience with same-sex partners (1.9%). Consistent with expectations, the analyses further revealed a clear class of homosexuals (*n* = 374, 12%): a class made up of individuals selecting either the highest (6—exclusively homosexual, 76%) or the second highest (5—predominantly homosexual, only incidentally heterosexual, 24%) responses on the Kinsey scale, with the highest rates of attraction to and recent experience with same-sex partners (87%), and the lowest rates of

attraction to and recent experience with opposite-sex partners (14%). The analyses also revealed a class of bisexuals (*n* = 369, 12%): a class made up of individuals primarily selecting the middle (3—equally heterosexual and homosexual, 69%) or next highest (4—predominantly homosexual, more than incidentally heterosexual) responses on the Kinsey scale, with moderately high levels of attraction to both opposite-sex and same-sex individuals as well as high levels of reporting opposite-sex (73%) and same-sex (57%) partners in the last year. Finally, the analyses revealed a class of sexual orientation representing individuals who self-identify as predominantly heterosexual but also report a fair amount of same-sex attraction and behavior. We named this class heteroflexibles to capture that particular multivariate combination (*n* = 481, 15%): a class made up of individuals primarily selecting response options 2 (predominantly heterosexual, more than incidentally homosexual, 54%) or 1 (predominantly heterosexual, only incidentally homosexual, 39%) on the Kinsey scale, with high levels of attraction to and recent experience with opposite-sex partners (89%) and moderate levels of attraction to and recent experience with same-sex partners (39%).

Table 3 ANOVA, χ^2 , and ANCOVA analyses examining the latent classes of sexuality emerging from the LPA in the full sample

Class of constructs Specific constructs examined	Full sample	Latent classes				Omnibus test of differ- ences across classes	Effect size of largest pairwise difference (Cohen's <i>d</i>)
		Heterosexual	Heteroflexible	Bisexual	Homosexual		
Number of partici- pants	3180	1956	481	369	374		
LPA Predictor Vari- ables	<i>M</i> or %	<i>M</i> or % within each group					
Self-identification (Kinsey)	2	0.1 ^D	1.5 ^C	3.3 ^B	5.8^A	$F(3, 3176) = 19,009.0^*$	15.96
(SD)	(1.96)	(0.33)	(0.61)	(0.68)	(0.43)		
Attraction to opposite-sex	4.9	5.7^A	5.0 ^B	4.3 ^C	1.5 ^D	$F(3, 3127) = 2452.1^*$	6.46
(SD)	(1.59)	(0.64)	(1.2)	(1.41)	(0.69)		
Attraction to same- sex	2.6	1.4 ^D	3.6 ^C	4.5 ^B	5.6^A	$F(3, 3136) = 4166.4^*$	7.57
(SD)	(1.81)	(0.52)	(1.18)	(1.34)	(0.75)		
Opposite-sex partner in last year	72%	78% ^B	90%^A	74% ^B	14% ^C	$\chi^2(3) = 721.4^*$	2.33
(<i>n</i>)	(2257)	(1521)	(429)	(258)	(49)		
Same-sex partner in last year	24%	1.9% ^D	42% ^C	56% ^B	87%^A	$\chi^2(3) = 1639.6^*$	3.56
(<i>n</i>)	(744)	(28)	(198)	(195)	(323)		
Demographics	<i>M</i> or %	<i>M</i> or % within each group					
Female	69%	70% ^B	80%^A	73% ^{AB}	43% ^C	$\chi^2(3) = 145.7^*$	0.80
(<i>n</i>)	(2175)	(1373)	(380)	(261)	(161)		
Age	29.3	29.3 ^B	28.5 ^{BC}	27.5 ^C	32.5^A	$F(3, 3167) = 16.5^*$	0.49
(SD)	(10.55)	(10.89)	(9.05)	(8.36)	(11.74)		
White	75%	71% ^B	80%^A	79%^A	81%^A	$\chi^2(3) = 34.2^*$	0.17
(<i>n</i>)	(2368)	(1387)	(384)	(293)	(304)		
Black	7.6%	7.9%	5.6%	8.4%	7.8%	$\chi^2(3) = 3.3$	0.11
(<i>n</i>)	(242)	(155)	(27)	(31)	(29)		
Latino	8.5%	7.4%	8.5%	11.7%	11.0%	$\chi^2(3) = 10.9$	0.12
(<i>n</i>)	(269)	(144)	(41)	(43)	(41)		
Asian	10.7%	14.5%^A	5.8% ^B	3.5% ^B	4.5% ^B	$\chi^2(3) = 75.6^*$	0.24
(<i>n</i>)	(341)	(283)	(28)	(13)	(17)		
Education	15.0	15.0^A	14.9 ^{AB}	14.6 ^B	15.2^A	$F(3, 3172) = 4.6^\dagger$	0.27
(SD)	(2.39)	(2.49)	(2.16)	(2.03)	(2.49)		
Income	\$55,826	\$59,055^A	\$53,255 ^B	\$45,000 ^C	\$52,823 ^B	$F(3, 3130) = 20.6^*$	0.42
(SD)	(\$33,699)	(\$33,933)	(\$33,271)	(\$32,041)	(\$31,917)		
In a committed rela- tionship	44%	43%	50%	44%	40%	$\chi^2(3) = 9.1$	0.19
(<i>n</i>)	(1404)	(849)	(240)	(164)	(151)		
Married	11.8%	13.3%^A	12.1%^A	7.9% ^B	7.0% ^B	$\chi^2(3) = 18.5^*$	0.14
(<i>n</i>)	(374)	(261)	(58)	(29)	(26)		
Constructs proximal to sexual orientation	<i>M</i>	<i>M</i> within each group					
Outness	2.8	1.7 ^D	2.1 ^C	3.1 ^B	4.0^A	$F(3, 1386) = 218.1^*$	1.83
(SD)	(1.48)	(0.86)	(1)	(1.3)	(1.46)		
Internalized shame	2.1	—	—	2.3^A	1.9 ^B	$F(1, 681) = 12.0^*$	0.22
(SD)	(1.29)	—	—	(1.36)	(1.19)		
# same-sex partners	0.8	0.0 ^D	0.9 ^C	1.6 ^B	4.0^A	$F(3, 3098) = 340.2^*$	1.95
(SD)	(2.45)	(0.19)	(1.82)	(2.72)	(5.04)		

Table 3 (continued)

Class of constructs	Full sample	Latent classes				Omnibus test of differences across classes	Effect size of largest pairwise difference (Cohen's <i>d</i>)
		Heterosexual	Heteroflexible	Bisexual	Homosexual		
Specific constructs examined							
# opposite-sex partners	2.1	2.1 ^B	3.3^A	2.3 ^B	0.3 ^C	$F(3, 3122) = 66.1^*$	0.97
(SD)	(3.26)	(3.12)	(3.77)	(3.73)	(1.61)		

The highest values among the four groups have been bolded to facilitate interpretation

Different superscripted letters indicate significant differences between classes emerging from the pairwise comparisons. To give a sense of the range of the differences observed for each variable, we present the Cohen's *d* for the largest pairwise difference observed for each variable (in the case of dichotomous variables, these were obtained by converting the χ^2 values of relevant pairwise comparisons to d-scores to place them on a common metric). To control for the slight demographic differences that emerged across the classes of sexual orientation, the final section presents ANCOVA results controlling for the 6 demographic variables demonstrating significant differences

M = Mean, Opposite-sex = Individuals of a different gender identity

* $p < .001$; † $p < .01$

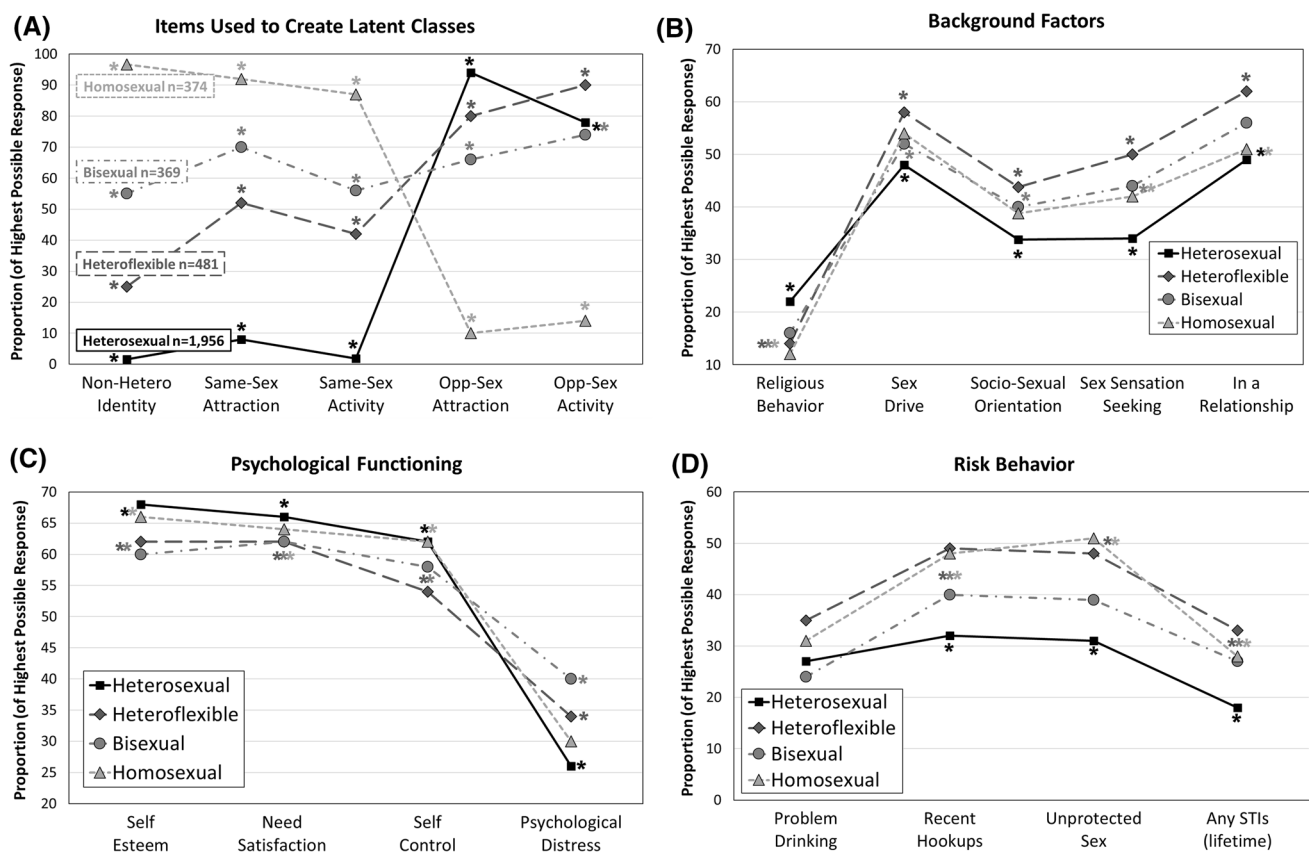


Fig. 1 Latent sexual orientation classes extracted by LPA. *Note.* Item responses and scale scores were placed onto a common 0 to 100 scale for the purposes of this graph. Vertically separated asterisks indicate

significant differences between latent sexual orientation groups on the indices, whereas adjacent asterisks indicate homogenous sets of groups on the indices. Non-Hetero = non-heterosexual; Opp-Sex = opposite sex

Aim 2: Characterizing the Latent Groups

Heterosexuals

As seen in Tables 3 and 4, participants classified as heterosexual reported an average of 2.1 opposite-sex partners in the last

year and an average of 0.0 same-sex partners. Compared to the other groups, heterosexual participants had a higher proportion of Asians (14.5%), higher incomes, higher levels of religious behavior (Fig. 1b), and lower levels of sexual openness (Fig. 1b). This group also reported the highest psychological functioning (Fig. 1c) and lowest levels of risk behaviors across indices (Fig. 1d).

Homosexuals

As seen in Tables 3 and 4, participants in the homosexual group reported the highest number of same-sex partners in the last year ($M=4.0$) and the lowest numbers of opposite-sex partners ($M=0.3$). Participants in the homosexual group also reported the highest levels of sharing their non-heterosexual orientation with various groups of people in their lives as compared to other non-heterosexual groups. The mean response in this group suggested that the various people in their lives were “mostly” aware of their sexual orientation. Participants classified as homosexual also reported fairly low levels of internalized stigma, with the average suggesting the typical response was “disagree” when questioned about internal conflict, guilt, and rejection of their sexual orientations. Demographically, homosexual participants were older and had the lowest rates of females (43%) compared to other groups. Turning to the outcome variables, homosexual participants reported high levels of psychological functioning, comparable to those seen in heterosexuals (Fig. 1c). In contrast, homosexual participants reported significantly higher levels of dysregulated and risk-taking behaviors than heterosexuals (Fig. 1d).

Bisexuals

As seen in Tables 3 and 4, participants classified as bisexual reported an average of 2.3 opposite-sex partners in the last year and an average of 1.6 same-sex partners. On average, bisexual participants suggested that people in their lives were only “somewhat” aware of their non-heterosexual orientation and reported higher levels of internalized stigma than homosexual participants. Demographically, bisexual participants reported the lowest incomes. Finally, bisexual participants showed lower levels of psychological functioning (Fig. 1c) and higher rates of risk taking across some, but not all, indices (Fig. 1d).

Heteroflexibles

As seen in Tables 3 and 4, participants classified as heteroflexible reported the highest average number of opposite-sex partners in the last year ($M=3.3$) and an average of about one same-sex partner ($M=0.9$). On average, the heteroflexible participants indicated that people in their lives were only “a little” aware of their non-heterosexual orientation, suggesting that they generally withheld that information from friends, family members, and coworkers. Demographically, participants classified as heteroflexible were more likely to be female, and currently in relationships as compared to the other groups. As seen in Table 4 and Fig. 1b, heteroflexible participants reported the highest degree of sexual openness. Consistent with this, heteroflexible participants reported some of the highest levels of recent hookups, high-risk sexual behavior, and lifetime STIs (Fig. 1d), comparable to the rates seen in the homosexual participants. Heteroflexible participants also reported slightly lower levels

of self-esteem and psychological need satisfaction, highlighting some possible adverse correlates of their notably sexualized orientation.

Aim 3: Developing and Validating a Parsimonious Classification Algorithm

To facilitate the identification of the classes of sexual orientation in future studies and to obviate the need for running LPAs in each new sample, we created the Multidimensional Sexual Orientation Classification System (M-SOCS), a parsimonious scoring algorithm that could recreate the latent classes using as few items as possible. Toward that end, we started by using the single-item Kinsey scale as it was the single indicator of sexual orientation that yielded the strongest group differences (Cohen's $d=15.96$ for the largest pairwise difference). We then augmented that classification algorithm using the single-item assessment of attraction to same-sex individuals as that gave the second strongest group differences (Cohen's $d=7.57$).

Single-Item Algorithm

To develop our first classification algorithm, we based our cutscores on the most frequent responses given on the Kinsey scale within each orientation group. Following this strategy, individuals reporting a 0 on that scale were identified as heterosexual, individuals reporting a 1 or a 2 were identified as heteroflexible, individuals reporting a 3 or 4 were identified as bisexual, and individuals reporting a 5 or 6 were identified as homosexual. This algorithm accurately classified 90.1% of the individuals, yielding a kappa of .83 when compared to the latent sexual orientation classes from the LPA. The agreement was highest for the homosexual and bisexual classes, as most of the errors occurred between the heterosexual and heteroflexible classes.

Two-Item Algorithm

To improve the accuracy of our classification algorithm, we used the item assessing same-sex attraction to help distinguish between heterosexuals and heteroflexibles. As shown in Fig. 2, in the M-SOCS, individuals selecting the two lowest responses on the Kinsey scale could end up in either the heterosexual or heteroflexible groups depending upon the level of interest in same-sex partners. Thus, individuals selecting the lowest answer on the Kinsey (exclusively heterosexual) were classified as heterosexual unless they reported one of the two highest answers for same-sex attraction (in which case, they were classified as heteroflexible). Similarly, individuals selecting the second to lowest answer on the Kinsey scale (predominantly heterosexual, only incidentally homosexual) were classified as heteroflexible unless they reported one of the two lowest answers for same-sex attraction (in which case they were classified as heterosexual).

Table 4 ANCOVA and χ^2 analyses characterizing the latent classes of sexuality emerging from the LPA in the full sample

Class of constructs	Full sample	Latent classes				Omnibus test of differences across classes	Effect size of largest pairwise difference (Cohen's <i>d</i>)
		Heterosexual	Heteroflexible	Bisexual	Homosexual		
Specific constructs examined							
Background factors	<i>M</i> or %	<i>M</i> or % within each group					
Sex drive	3.5	3.4 ^C	3.9^A	3.6 ^B	3.4 ^{BC}	$F(3, 3133) = 21.3^*$	0.37
(SD)	(3.49)	(3.35)	(3.87)	(3.6)	(3.68)		
Sociosexual orientation	3.0	2.7 ^C	3.8^A	3.5 ^B	3.6 ^B	$F(3, 3136) = 89.9^*$	0.69
(SD)	(3.04)	(2.66)	(3.78)	(3.49)	(3.6)		
Sexual sensation seeking	2.9	2.7 ^C	3.4^A	3.2 ^B	3.1 ^B	$F(3, 3103) = 83.4^*$	0.67
(SD)	(2.92)	(2.7)	(3.44)	(3.23)	(3.12)		
Religious behavior	0.9	1.1^A	0.7 ^B	0.8 ^B	0.6 ^B	$F(3, 3137) = 22.7^*$	0.37
(SD)	(0.91)	(1.05)	(0.69)	(0.78)	(0.59)		
Outcomes—psychological functioning	<i>M</i>	<i>Ms</i> within each group					
Self-esteem	4.3	4.4^A	4.1 ^B	4.0 ^B	4.3^A	$F(3, 3052) = 15.7^*$	0.37
(SD)	(4.26)	(4.36)	(4.06)	(3.98)	(4.27)		
Basic psychological need satisfaction	4.3	4.3^A	4.1 ^B	4.1 ^B	4.2 ^{AB}	$F(3, 2982) = 13.7^*$	0.29
(SD)	(4.26)	(4.33)	(4.13)	(4.11)	(4.19)		
Self-control	4.0	4.1^A	3.7 ^B	3.9 ^B	4.1^A	$F(3, 3112) = 33.1^*$	0.47
(SD)	(4.03)	(4.13)	(3.73)	(3.86)	(4.06)		
Psychological distress	2.5	2.3 ^C	2.7 ^{AB}	2.9^A	2.5 ^{BC}	$F(3, 2997) = 19.7^*$	0.47
(SD)	(2.47)	(2.32)	(2.7)	(2.95)	(2.52)		
Outcomes—risk behavior	<i>M</i>	<i>M</i> or % within each group					
Problematic drinking in last 2 months	28%	27% ^B	35%^A	24% ^{AB}	31%^A	$\chi^2(3) = 15.3^\dagger$	0.23
(<i>n</i>)	(870)	(514)	(161)	(86)	(109)		
Hookup in last 2 months	38%	32% ^B	49%^A	40%^A	48%^A	$\chi^2(3, 2152) = 50.8^*$	0.30
(<i>n</i> out of 2152)	(808)	(393)	(174)	(108)	(133)		
# of hookups among people reporting them	4.0	3.6 ^B	4.8^A	4.5 ^{AB}	4.0 ^B	$F(3, 792) = 6.4^*$	0.31
(SD)	(4.04)	(3.56)	(4.78)	(4.61)	(4.01)		
Condomless Sex in last 2 months	39%	31% ^B	48%^A	39% ^{AB}	51%^A	$\chi^2(3) = 39.9^*$	0.32
(<i>n</i> out of 1229)	(473)	(191)	(102)	(69)	(111)		
Sexually transmitted infections—lifetime	22%	18% ^B	33%^A	27%^A	28%^A	$\chi^2(3) = 63.1^*$	0.30
(<i>n</i>)	(692)	(343)	(154)	(95)	(100)		

The highest values among the four groups have been bolded to facilitate interpretation

The table presents ANCOVA omnibus tests on continuous measures controlling for the six demographic variables demonstrating differences across the four classes (gender, age, white, Asian, income, and marital status), defraying the impact that any demographic differences might have had on the variables examined. Different superscripted letters indicate significant differences between classes emerging from the pairwise comparisons. To give a sense of the range of the differences observed for each variable, we present the Cohen's *d* for the largest pairwise difference observed for each variable (in the case of dichotomous variables, these were obtained by converting the χ^2 values of relevant pairwise comparisons to *d*-scores to place them on a common metric)

M = Mean

* $p < .001$; $^\dagger p < .01$

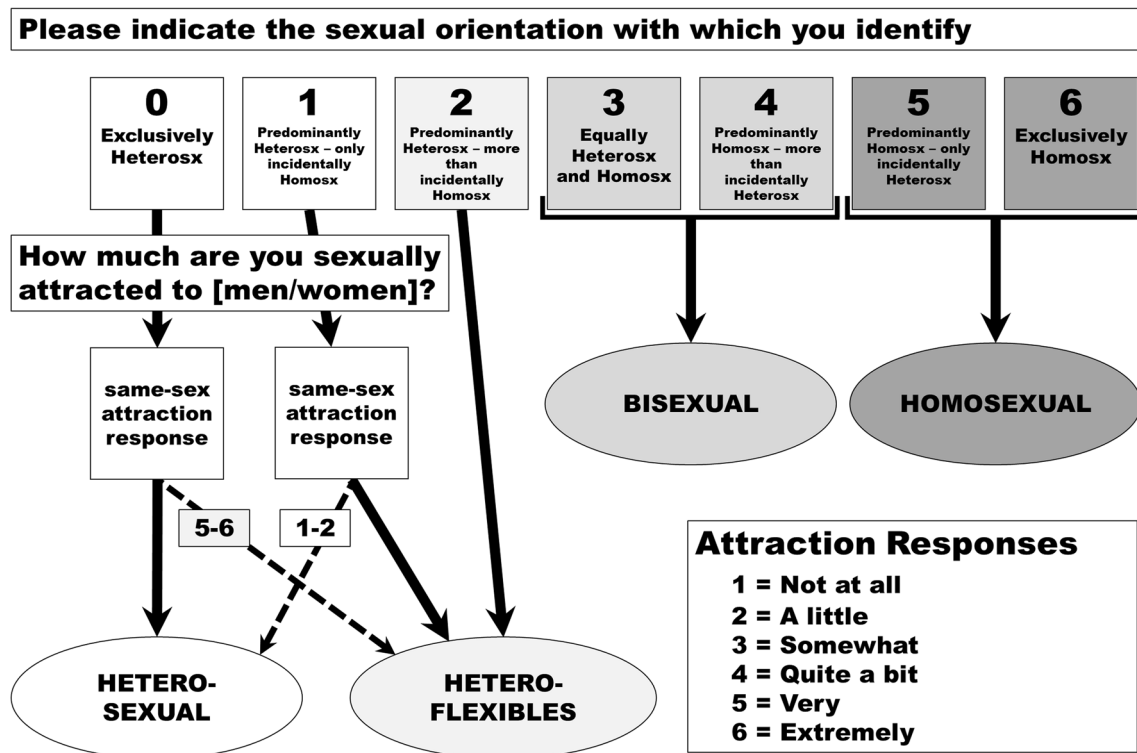


Fig. 2 The Multidimensional Sexual Orientation Classification System (M-SOCS) algorithm for creating 4 sexual orientation classes. *Note* The arrows indicate how individuals are classified based on their responses. The same-sex attraction item is used to help classify individuals reporting one of the two lowest (most heterosexual) responses on the sexual identification item. Individuals reporting 0 on the identification item are classified as heterosexual unless they report one of the two highest answers on the same-sex attraction

item (in which case, they are classified as heteroflexible). Similarly, individuals reporting 1 on the identification item are classified as heteroflexible unless they report one of the two lowest answers on the same-sex attraction item (in which case they are classified as heterosexual). Heterosx = heterosexual; Homosx = homosexual; [men/women] = replace with the subject's biological sex or with the phrase "individuals of your same sex"

With this simple modification of the classification algorithm, it was able to correctly classify 97.3% of participants with respect to the latent sexual orientation classes from the LPA, yielding a kappa of .95. As shown in Table 1, the M-SOCS continued to demonstrate high agreement with the classes extracted by the LPA within 27 different demographic subgroups examined, suggesting a high level of generalizability. Furthermore, the classes created by the M-SOCS continued to show the same pattern of results across the background and outcome variables to that obtained with the LPA classes (Table 5 in "Appendix").

Discussion

Using SEM-based LPA on indicators of sexual identity, behavior, and attraction in a large and sexually diverse sample, we identified four fundamental classes of sexual orientation: heterosexual (65%), homosexual (12%), bisexual (12%), and heteroflexible (15%), a less widely studied class representing individuals who self-identify as predominantly heterosexual but also report a fair amount of same-sex behavior and attraction. The current study

not only represents the first data-driven approach to identifying meaningful and distinct classes of sexual orientation, it also offers researchers a straightforward, two-item algorithm (the M-SOCS) for creating empirically based sexual orientation groups in current and future studies. Thus, the study answers critical needs in the field (e.g., Institute of Medicine, 2011; Wolff et al., 2016) by: (1) clarifying the four primary sexual minority groups that parsimoniously represent the overwhelming majority of between-person variance in sexual orientation, (2) offering a concrete method of standardizing the assessment and classification of sexual orientation in research studies, and (3) empirically delineating and clarifying the boundaries of heteroflexibles, a high-risk sexual minority group.

This work joins the growing chorus calling for including sexual orientation information as standard practice in research (Institute of Medicine, 2011), along with other demographic information collected like race and ethnicity, especially in national population surveys. The results highlight the potential importance of standardizing methods of assessing and classifying sexual orientation groups across studies, as the groups identified by the LPAs in the current study demonstrated meaningful

and distinct profiles on background measures, psychological functioning, and risk behaviors.

Categorizing sexual orientation using a standardized approach across a myriad domain of studies (e.g., health, workplaces, schools) is critical for advancing research on the lives of sexual minorities and the disparities that they face in the areas of health, school, and employment. The current study also reveals important implications for accurately identifying individuals at elevated risk in healthcare settings. The current results would suggest that adding the two M-SOCS questions to standard intake forms may help to identify individuals who have elevated health risks that could otherwise go unnoticed. Doing so may help to reduce the health disparities gap faced by sexual minorities. Finally, this work has important implications for policy, as current estimates of sexual minorities in the population may be missing a sizeable minority of individuals at elevated risk. Larger—and more accurate—estimates may help policy makers advocate for more resources to serve these groups in an effort to reduce health disparities.

The current work developed the M-SOCS, a straightforward, two-item algorithm based on items commonly found in studies of sexuality to create classes of sexual orientation. This contribution could facilitate the adoption of a standardized, multivariate conceptualization of sexual orientation across studies and fields, which would help integrate the literature on sexual minorities. The M-SOCS algorithm also helps to clarify how common forms of sexual orientation branching can best be handled by delineating the boundaries between heterosexuals, heteroflexibles, and bisexuals.

The findings of the current study lend a data-driven voice to the widespread calls for researchers to deepen the methods by which they measure and define sexual orientation (e.g., Badgett, 2009; Beaulieu-Prevost & Fortin, 2015; Gates, 2011, 2012; Sell, 1997, 2007; Wolff et al., 2016).⁴ We would encourage researchers to adopt a multivariate conceptualization of sexual orientation by including separate items assessing sexual identity, attraction, and behavior so as to avoid obscuring meaningful branching between those various aspects of sexual orientation. At a minimum, we would recommend including the two items of the M-SOCS (the single-item Kinsey scale with its original 7 response options along with a single item assessing level of same-sex attraction on a 6-point Likert scale) in new studies being designed, as that would allow researchers to construct the four-groups suggested by our LPA. In studies that have already been conducted, we would encourage researchers to adopt the four-group classification system proposed by the current analyses to the degree that their data allow.

Studies including sexual orientation have commonly used a simple three-group classification system (heterosexual vs. bisexual vs. homosexual). The current results build on a growing body of work (e.g., Savin-Williams & Vrangalova, 2013)

validating a fourth main class of sexual orientation representing individuals who identify as heterosexual or mostly heterosexual yet report non-trivial amounts of same-sex attraction and same-sex sexual activity. This class of individuals has largely been lumped in with either heterosexuals or with bisexuals in previous studies. As heteroflexible individuals displayed a unique pattern of associations in the current study, failing to treat them as a distinct group could very likely obscure results. We would therefore suggest that researchers incorporate the classification of heteroflexibles into standard practice when designing studies and running their analyses.

The current results also characterized the heteroflexible class as having the highest levels of risk taking, and somewhat lower psychological functioning. These findings are largely consistent with findings from large-scale studies like ones using the National Longitudinal Survey of Adolescent Health data ($N = 13,715$; Everett, 2013; Fish & Pasley, 2015), as well as those from smaller studies (Austin et al., 2008; Corliss et al., 2009; Wohl et al., 2002; Zellner et al., 2009) studying “mostly heterosexuals” (e.g., Austin et al., 2004a), or those identifying as heterosexual yet reporting same-sex activity—also termed heterosexual MSM or WSW (e.g., Xu et al., 2010b). This group consistently shows higher risk on outcomes like substance use (Austin et al., 2004a; Corliss et al., 2008; Przedworski et al., 2014) and risky sexual behaviors and STIs (Austin et al., 2008; Corliss et al., 2009; Everett, 2013; Xu et al., 2010b; Zellner et al., 2009), as compared to heterosexuals (for an exception, see Xu et al., 2010a). They often fare worse when compared to other sexual minority groups as well, especially gay men and lesbians (e.g., Austin et al., 2004b; Fish & Pasley, 2015). Consistent with this pattern, our data showed that the heteroflexible group showed more risky behaviors as compared to heterosexuals (but not bisexuals or homosexuals), and worse psychological functioning as compared to heterosexuals and homosexuals (but not bisexuals).

The current findings build on this line of work by helping to clarify and establish the boundaries of the heteroflexible group, providing a standardized method of assessing and defining it in future work. We would argue that the heteroflexible group extracted in our LPA is very likely comprised of individuals spanning both heterosexual MSM and WSW as well as individuals who identify as “mostly heterosexual”—and therefore might serve as a method of integrating these two lines of research in future studies. In fact, in line with Fish and Pasley (2015), we chose to call this group “heteroflexibles” in an effort to create a conceptual label that spanned both previous operational definitions.

Both homosexual and bisexual groups showed health disparities as compared to heterosexuals. This pattern of risk and health disparities—with heterosexuals showing the least health risk across outcomes, bisexuals showing the greatest, and gay men and lesbians in between with no disparities on psychological functioning—consistently shows up in the literature (Dodge & Sandfort, 2007; Legate, Ryan, & Rogge, 2017; Ross et al., 2018; Semlyen et al., 2016). Research suggests that these health

⁴ Notably, this discussion is limited to a self-report survey method as it represents the most commonly used method of assessing sexual orientation; other methods (interview, psychophysiological, behavioral) are beyond the scope of this work.

disparities are due to minority stress (Meyer, 2003), which may also explain the especially high disparities faced by bisexuals, as they often face rejection and prejudice from both heterosexuals and homosexuals (Feinstein & Dyar, 2017).

The explicit goals of the current work were (1) to identify a parsimonious set of sexual orientation groups that capture the overwhelming majority of between-person differences on sexual orientation and (2) to develop a corresponding algorithm (the M-SOCS) that could be used across a wide range of research studies. Although we believe that the current findings have provided critical steps toward those goals, we acknowledge that the parsimony achieved comes at the cost of modeling the complete range of sexual orientation diversity that exists. As a result, the groups emerging from our LPAs do not represent all possible sexual orientations. If researchers are interested in smaller subpopulations like pansexual or asexual (all of which occur at exceedingly low frequencies—see Vrangalova & Savin-Williams, 2012), the M-SOCS will not serve their purposes. We also did not consider sexual fluidity, as the M-SOCS uses a cross-sectional approach to classify groups. Thus, it is possible that individuals tracked from adolescence through middle age might shift categories across time as their sexualities evolve. Interestingly, however, the two studies that we know of that accounted for changes over time found similar sexual orientation groups to ours (apart from differences due to time; see Fish & Pasley, 2015). Finally, some researchers may wish to avoid categorical classification systems entirely, as there is controversy over whether sexual orientation is continuous or categorical in nature (e.g., Bailey et al., 2016; Savin-Williams, 2016) and may instead want to keep sexual identification, attraction, and behavior as separate and continuous predictors (Brewster & Tillman, 2012; Matthews et al., 2014). Although there is inherent value in examining specific and focused subpopulations and in using more fine-grained analytic approaches, such studies typically require highly focused samples and assessments. The current study sought to meet the needs of a broader range of studies, sacrificing some diversity to develop and validate a standardized classification system (the M-SOCS) that could be used in most samples.

Limitations and Directions for Future Research

Despite providing fundamental insights into the multidimensional classification of sexual orientation, the interpretation of the results of the current study is qualified by a number of limitations. First, we used self-report data in our analyses. Future work could extend these results by examining health records. Second, although the current study assessed the three primary dimensions of sexual orientation recommended in the literature (e.g., Wolff et al., 2016), additional components have been postulated (e.g., sexual fantasies, romantic [as opposed to sexual] attraction; Savin-Williams & Ream, 2007; Spitzer, 2003). Future work

could examine how such factors inform the groups identified in the current study, potentially uncovering additional sexual orientation groups. Third, the study made use of a non-representative sample, targeting sexually diverse populations to support the planned analyses. As a result, population estimates of the sexual orientation groups remain unknown. Because most existing large-scale, nationally representative datasets do not have the items used in the M-SOCS, future work should consider incorporating these items in surveys of nationally representative samples to help clarify this issue. Next, although we encourage researchers to adopt the M-SOCS for assessing and classifying sexual orientation groups, we recognize that this standardized approach might not be appropriate for all research settings. We acknowledge that there are other useful ways of organizing dimensions of sexual orientation (e.g., Klein, Sepekoff, & Wolf, 1985) and that more fine-grained analyses (Brewster & Tillman, 2012; Matthews et al., 2014) or analyses in specific subpopulations (Wohl et al., 2002; Zellner et al., 2009) might benefit from alternative conceptualizations. Thus, the M-SOCS is intended to promote conceptual clarity and consistency across a wide range of studies but not to the exclusion of more fine-grained investigations. Additionally, we recognize that it may not be possible to use the M-SOCS in studies that have assessed sexual identity in other ways besides the Kinsey scale (i.e., providing the common categories of sexual orientation—heterosexual, gay, lesbian, bisexual). It will be important to validate the M-SOCS with these sexual identity labels, and compare rates of those who would self-identify as heteroflexible versus rates when classified as heteroflexible using M-SOCS. Finally, as classes revealed demographic differences, researchers might consider including covariates important to their research question when planning analyses.

Conclusion

This research addresses a fundamental problem in the literature on sexual minorities by providing a data-driven, standardized approach for classifying sexual orientation in an easy to implement two-item algorithm: the M-SOCS. Importantly, our analyses revealed four classes of sexual orientation, including an understudied class of heteroflexible individuals who demonstrated a high-risk profile, which is consistent with the handful of studies examining this group. If implemented widely, this classification system could facilitate integration of findings across studies, which is necessary for advancing research on the lives of sexual minority individuals and reducing the health disparities that they face.

Appendix

See Table 5.

Table 5 ANOVA, χ^2 , and ANCOVA analyses examining the M-SOCS classes of sexuality

Class of constructs	Full sample	Classes approximated from 2-item algorithm				Omnibus test of differences across classes	Effect size of largest pairwise difference (Cohen's <i>d</i>)
Specific constructs examined		Heterosexual	Heteroflexible	Bisexual	Homosexual		
Number of participants	3180	1998	452	338	392		
Indicators of sexual orientation	<i>M</i> or %	<i>M</i> or % within each group					
Self-identification (Kinsey) ¹	1.4	0.1 ^D	1.5 ^C	3.2 ^B	5.7^A	$F(3, 3176) = 22,301.8^*$	14.04
(SD)	(1.96)	(0.35)	(0.61)	(0.43)	(0.43)		
Attraction to opposite-sex individuals	4.9	5.7^A	4.9 ^B	4.3 ^C	1.7 ^D	$F(3, 3127) = 2033.5^*$	4.36
(SD)	(1.59)	(0.65)	(1.3)	(1.37)	(1.11)		
Attraction to same-sex individuals ^a	2.6	1.4 ^D	3.8 ^C	4.5 ^B	5.5^A	$F(3, 3136) = 4058.1^*$	4.93
(SD)	(1.81)	(0.53)	(1.15)	(1.27)	(1.06)		
Opposite-sex partner in last year	72.1%	78.5% ^B	89.0%^A	73.2% ^B	16.8% ^C	$\chi^2(3) = 676.3^*$	1.02
(<i>n</i>)	(2257)	(1563)	(396)	(235)	(63)		
Same-sex partner in last year	23.9%	3.6% ^D	38.8% ^C	57.1% ^B	83.7%^A	$\chi^2(3) = 1453.6^*$	2.63
(<i>n</i>)	(744)	(70)	(168)	(182)	(324)		
Proximal sexual behaviors	<i>M</i>	<i>Ms</i> within each group					
Outness	2.8	1.7 ^D	2.1 ^C	3.1 ^B	4.0^A	$F(3, 1414) = 247.0^*$	1.86
(SD)	(1.48)	(0.86)	(1.05)	(1.28)	(1.47)		
# same-sex partners	0.8	0.1 ^D	1.0 ^C	1.6 ^B	3.8^A	$F(3, 3104) = 357.8^*$	1.06
(SD)	(2.45)	(0.29)	(2.01)	(2.71)	(4.99)		
# opposite-sex partners	2.1	2.2 ^B	3.0^A	2.3 ^B	0.4 ^C	$F(3, 3128) = 47.0^*$	0.94
(SD)	(3.26)	(3.25)	(3.43)	(3.78)	(1.67)		
Background factors	<i>M</i>	<i>Ms</i> within each group					
Sex drive	3.5	3.4 ^C	3.9^A	3.6 ^{BC}	3.7 ^{AB}	$F(3, 3164) = 20.7^*$	0.37
(SD)	(1.41)	(1.38)	(1.41)	(1.45)	(1.42)		
Sociosexual orientation	3.0	2.7 ^C	3.7^A	3.5 ^{BC}	3.6 ^{AB}	$F(3, 3167) = 79.5^*$	0.65
(SD)	(1.7)	(1.63)	(1.62)	(1.59)	(1.8)		
Sexual sensation seeking	2.9	2.7 ^C	3.4^A	3.2 ^B	3.1 ^B	$F(3, 3134) = 63.8^*$	0.63
(SD)	(1.16)	(1.1)	(1.14)	(1.16)	(1.18)		
Outcomes—psychological functioning	<i>M</i>	<i>Ms</i> within each group					
Self-esteem	4.3	4.4^A	4.1 ^{BC}	4.0 ^C	4.3 ^{AB}	$F(3, 3083) = 18.7^*$	0.37
(SD)	(1.03)	(1.01)	(1)	(1.11)	(1.04)		
Basic psychological need satisfaction	4.2	4.3^A	4.1 ^B	4.1 ^B	4.2 ^{AB}	$F(3, 3021) = 13.7^*$	0.23
(SD)	(0.76)	(0.75)	(0.75)	(0.77)	(0.8)		
Self-control	4.0	4.1^A	3.8 ^B	3.9 ^B	4.0^A	$F(3, 3143) = 26.3^*$	0.42
(SD)	(0.86)	(0.85)	(0.86)	(0.86)	(0.84)		
Psychological distress	2.5	2.3 ^C	2.7 ^B	3.0^A	2.5 ^{BC}	$F(3, 3027) = 25.5^*$	0.47
(SD)	(1.37)	(1.29)	(1.44)	(1.52)	(1.38)		
Outcomes—risk behavior	%	% within each group					

Table 5 (continued)

Class of constructs	Full sample	Classes approximated from 2-item algorithm				Omnibus test of differences across classes	Effect size of largest pairwise difference (Cohen's <i>d</i>)
		Heterosexual	Heteroflexible	Bisexual	Homosexual		
Specific constructs examined							
Problematic drinking in last 2 months	28.2%	27.6%	32.4%	24.3%	30.1%	$\chi^2(3) = 7.3$	0.18
(<i>n</i>)	(870)	(537)	(141)	(79)	(113)		
Hookup in last 2 months	37.5%	32.5% ^B	47.7%^A	39.0% ^{AB}	47.1%^A	$\chi^2(3) = 40.2^*$	0.26
(<i>n</i> out of 2152)	(808)	(417)	(157)	(96)	(138)		
Risky sexual behavior in last 2 months	38.5%	31.5% ^B	47.7%^A	38.8% ^{AB}	50.5%^A	$\chi^2(3) = 33.6^*$	0.35
(<i>n</i> out of 1229)	(473)	(204)	(93)	(64)	(112)		
Sexually transmitted infections—lifetime	22.4%	18.2% ^B	33.5%^A	25.8%^A	28.1%^A	$\chi^2(3) = 59.5^*$	0.29
(<i>n</i>)	(692)	(356)	(146)	(84)	(106)		

The highest values among the four groups have been bolded to facilitate interpretation

^aThese two items were used in the M-SOCS algorithm to create the classes and therefore, the group differences on them, particularly for the Kinsey scale, are a direct result of the algorithm. Different superscripted letters indicate significant differences between classes emerging from the pairwise comparisons. The Cohen's *d*'s for the omnibus tests were converted from the η^2 and χ^2 values of those tests to place them on a common metric

M = Mean

* $p < .001$; † $p < .01$

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