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Stability and Change in Sexual Orientation and Genital Arousal over Time

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ABSTRACT

Longitudinal work suggests that sexual orientation can change over time in men and women. These studies, however, may be susceptible to the bias of self-report. The current study therefore examined self-reported sexual orientation in addition to an objective correlate: genital arousal to erotic videos showing males or females. For 52 men (19 heterosexual, 19 bisexual, 14 homosexual) and 67 women (31 heterosexual, 18 bisexual, 18 homosexual), these measures were taken twice, with approximately 1 year between sessions. For self-reported sexual orientation, women reported lower relative stability (weaker correlation) than men over time, even though women did not change more overall (no stronger mean difference) than men between sessions. Bisexual individuals reported lower relative stability and more mean change than heterosexual and homosexual individuals. For genital arousal, across all groups, response patterns were correlated over time to a similar extent and showed little difference between sessions. Moreover, change in self-reported sexual orientation did not correspond with the change in genital arousal, regardless of sex. Perhaps self-reports overestimate changes in sexual orientation, since these changes were not reflected in physiological sexual response.

One hypothesis is that sexual orientation is a stable trait, which is possibly determined during early development and does not change later in life (Bogaert & Skorska, 2020; Breedlove, 2017; Farr et al., 2014). Support for this notion comes from case studies of males who had their genitals surgically removed due to a rare medical condition called cloacal exstrophy, and who were surgically re-assigned and raised as females. Despite these profound changes, the vast majority of these individuals later identified as males with attraction to females (Diamond et al., 2011; Meyer-Bahlburg, 2005; Reiner, 2004; Reiner & Gearhart, 2004; Zucker, 1999). These results suggest that at the very least, male sexual orientation is not malleable even in the face of severe social and physical manipulations. Moreover, conversion therapies, which make deliberate efforts to change male and female sexual orientation in adulthood, show little to no evidence that change is possible (Drescher et al., 2016; Haldeman, 1994). One author supported the effectiveness of reparative therapies (Spitzer, 2003); however, this has been criticized, as it was impossible to judge whether the reports of those undergoing therapy were truthful (Armelli et al., 2012; Drescher & Kenneth, 2013). Research into gender behavior also supports the idea that sexual orientation is a stable trait that forms early, since childhood gender nonconformity (femininity in males and masculinity in females) is a robust predictor of a non-heterosexual sexual orientation in adulthood (Bailey et al., 2016; Bailey & Zucker, 1995; Watts et al., 2018; Xu et al., 2021).

Others have argued that sexual orientation is subject to change in some individuals. This hypothesis has found support in longitudinal studies that assessed change, in addition to relative stability, in self-reported sexual orientation over time (Diamond, 2008; Dickson et al., 2003, 2013; Mock & Eibach, 2012; Ott et al., 2011; Phillips et al., 2019; Savin-Williams et al., 2012; Xu et al., 2021). Across these studies, change between sessions was usually assessed via a difference in means, and relative stability via correlation analysis. In general, findings of this work indicate that (1) relative stability is very prevalent, on average, but some degree of mean change in sexual orientation/attraction is observed, (2) women are less stable, and are slightly more likely to report mean change in their orientation/attraction than men and (3), across sexes, bisexuals are less stable, and are more likely to show mean change in their sexual orientation/attraction than monosexual (heterosexual or homosexual) individuals.

Our above assessment is based on previous work using self-reports of sexual identity and sexual attraction, as we did not notice substantial differences in the pattern of change shown by these two measures. We did not focus on self-reported sexual behavior, as previous work has questioned the validity of such measures, in particular (Bailey et al., 2016; Savin-Williams & Ream, 2007). Within the reviewed studies, there was variability in the age of the participants, including adolescents, aged 12–17 (Ott et al., 2011; Phillips et al., 2019; Xu et al., 2021), young adults, aged 18–30 (Diamond, 2008; Dickson et al., 2013; Savin-Williams et al., 2012); middle age, 40–60; (Mock & Eibach, 2012). These studies also varied in the follow-up time, ranging from 1 to 10 years (e.g., Mock & Eibach, 2012; Ott et al., 2011). However, despite this variability, we observed the aforementioned patterns of relative stability and change in sexual orientation and attraction.

Across these studies, we also observed some patterns with respect to the direction of the change. Within men, bisexual men tend to change equally toward homosexuality and

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heterosexuality (Ott et al., 2011; Savin-Williams et al., 2012). Within women, bisexual individuals change more toward heterosexuality than homosexuality (Phillips et al., 2019; Savin-Williams et al., 2012), or report no clear directional change (Diamond, 2008). Given these several possible patterns, in the present work, we focused broadly on change without making predictions about direction. However, in our analyses, we considered two types of change: directional (e.g., from heterosexual to more homosexual) and absolute (change in either direction).

Aforementioned longitudinal studies come with inherent limitations. For instance, analyses might not account for the non-independence of measurements over time or the loss of information when several time points are examined. In addition, the low rates of non-heterosexual individuals (relative to that of heterosexuals) could result in an overestimation of the actual change in orientation. One way to address this latter limitation is to enroll a similar number of participants across sexual orientation groups, and then to compare results with previous research that used larger (but not balanced) samples. For this reason, in the current study, we aimed to obtain a similar number of heterosexual, bisexual, and homosexual participants of each sex.

Longitudinal studies are also limited due to their common reliance on self-reports, as individuals may not correctly report their sexual orientations (Savin-Williams et al., 2012). For instance, in the Add Health data set, a considerable proportion of the participants who reported a change in their orientation were confused, did not understand the measure, or dishonestly reported their orientation: Of the males (age 12–17) who reported same-sex attraction in the first wave, only 11% percent of them showed consistency in their same-sex attraction over time, with 48% of the sample becoming exclusively attracted to the opposite sex at follow-up, 35% indicating no attraction to any sex and 6% indicating attraction to both sexes. Such a striking inconsistency is unlikely to be driven purely by true change in sexual identity (Savin-Williams & Joyner, 2014).

Although Add Health did not contain options such as "not sure" or "don't want to answer" to account for inaccurate responding in sexual orientation, they did include a measure of delinquency and one of honesty (which asked participants whether they replied truthfully to the questionnaires). Non-heterosexual individuals who showed inconsistency in their sexual orientation were considerably more untruthful in their responses and more likely to exhibit delinquent behavior. This provides further support for the idea that a non-trivial proportion of the change observed in self-reported sexual orientation may be inaccurate (Savin-Williams & Joyner, 2014).

Due to these concerns, some have questioned whether self-reports provide meaningful information about sexual orientation (Berg & Lien, 2006, 2009). Further research has therefore focused on a correlate of sexual orientation which is free of the limitations of self-report: genital arousal to sexual stimuli (Bailey et al., 2016; Chivers, 2017). The current study used this physiological measure to examine whether previously suggested patterns of relative stability and change over time found in self-reported sexual orientation are reflected in sexual arousal.

Men and women differ in their genital response to erotic videos: Most men typically exhibit a category-specific arousal, showing greater response to their preferred sex over the other sex. However, most women exhibit a nonspecific pattern of arousal, showing similar sexual response to both sexes, regardless of their sexual preferences (Bailey et al., 2016; Chivers, 2017). One exception to this sex difference are bisexual-identified men, who, unlike heterosexual and homosexual men, can show bisexual, thus less-specific, responses (Jabbour et al., 2020). We further address this finding below. Another exception are homosexual women, who are more category specific than other women; however, they still show bisexual responses, and this difference within women is small compared to the sex difference in the link of sexual orientation to the category specificity in arousal (Raines et al., 2021; Rieger et al., 2015). As a result, self-reported sexual orientation links more strongly to genital responses in men than in women (Bailey, 2009). Because other work suggests that self-reported sexual orientation is, across men and women, relatively stable over time but that some change is possible on average (Savin-Williams et al., 2012), we speculated that in general, sexual arousal patterns will also show relative stability over time, but that mean change will be possible. The expression of sexual arousal may differ between men and women (in general, stronger response to one preferred sex in men; stronger bisexual response in women), but this difference is independent of our proposal that, on average, relative stability in sexual response is found in both sexes, even in the presence of some change.

In addition to women generally exhibiting a nonspecific sexual arousal pattern, there is, across their self-reported sexual orientations, more variability in women's sexual arousal patterns than men's (Rieger et al., 2015; Suschinsky et al., 2009). It is unknown whether women's increased variability means that women change more in their arousal than men, because higher variability in women at a given time point does not necessarily translate to more change in women. However, given that longitudinal studies indicate that women's self-reported sexual orientation shows less relative stability and more average change than men's (Phillips et al., 2019; Savin-Williams et al., 2012), we hypothesized that women exhibit less relative stability and more mean change than men in their sexual arousal patterns over time.

Further differences should be considered. Unlike monosexual men, who are usually aroused to one preferred sex, bisexual men show bisexual arousal as a group (Jabbour et al., 2020). Bisexual men also exhibit greater variability than monosexual men, as some bisexual men display bisexual arousal and others do not (Rieger et al., 2005; Slettevold et al., 2019), which may mean that bisexual men are more likely to change in their arousal over time. There is no clear evidence that the arousal patterns of bisexual women are more variable than those of monosexual women (Rieger et al., 2015). However, because both bisexual men and bisexual women change more in their self-reported sexual orientation over time (Mock & Eibach, 2012; Savin-Williams et al., 2012), we hypothesized that bisexual individuals of either sex would show less relative stability, and more change, in their genital arousal patterns over time as compared to monosexual individuals.

Finally, because sexual orientation is reflected in sexual arousal patterns, at least in men (Bailey et al., 2016), a further proposal is made. In theory, if self-reported sexual orientation changes, sexual arousal should undergo a corresponding change. To our knowledge, this hypothesis has never been tested systematically. The final aim of the research was to address this question.

In sum, the present study examined the arousal patterns of men and women with varying sexual orientations at two separate time points. We measured participants' sexual orientation and genital arousal twice, with approximately 1 year between sessions (median of 12.68 months). Relative stability in sexual orientation and arousal was measured using a Pearson correlation, while mean change over time was calculated through within-sample *t*-tests. Drawing on findings from the aforementioned longitudinal studies, and the assumption that relative stability and mean change in sexual orientation are reflected in sexual arousal patterns, we examined several hypotheses.

The first three hypotheses relate to relative stability:

Hypothesis 1: Self-reported sexual orientation will be significantly correlated over time, as will genital arousal.

Hypothesis 2: The significant correlation of sexual orientation over time will be weaker in women than in men, as will the correlation of sexual arousal.

Hypothesis 3: The significant correlation of sexual orientation over time will be weaker in bisexual individuals than in monosexual individuals, as will the correlation of sexual arousal.

The next three hypotheses relate to mean change.

Hypothesis 4: Self-reported sexual orientation and sexual arousal will show change, on average, across time.

Hypothesis 5: Women will exhibit, on average, more change in sexual orientation and sexual arousal than men.

Hypothesis 6: Bisexual individuals will exhibit, on average, more change in their sexual orientation and sexual arousal than monosexual individuals.

The final hypothesis concerned the link of sexual orientation and arousal over time.

Hypothesis 7: Change in sexual orientation will reflect change in sexual arousal.

Method

Participants

We recruited through university mailing lists, posters at university and town, Pride festivals, and craigslist.org. Originally, 53 men and 72 women took part in two separate sessions. Due to technical issues with the apparatus, data from 6 individuals were excluded, leaving 52 men and 67 women. Based on previous research (Rieger et al., 2015), our aim was to recruit a minimum of 70 men and 70 women, and more, if possible. Due to COVID-19 lockdowns, this was cut short as the lab shut down. The mean (SD) age at the first session was 24.1 (11.3) years for men and 24.7 (9.3) years for women. Among men, 88% identified as White and 12% as mixed-race, Black, or Asian. Among women, 85% identified as White and 15% as mixed-race, Black, or Asian. The data were collected at the Department of Psychology, University of Essex, from 2017 to early 2020. Men were compensated £30 and women were compensated £50 for their time, and at each timepoint. Women were compensated more than men due to the more intrusive measurement. The University of Essex's Ethics Committee approved this study (GR1702).

Self-reported Sexual Orientation

Participants reported their sexual orientation identity and sexual attraction on two 7-point scales at both sessions (Kinsey et al., 1948). The following numbers refer to the first session. For sexual identity, a score of 0 meant "exclusively heterosexual" (N = 15 men, N = 15 women), 1 for "almost exclusively heterosexual" (N = 4 men, N = 17 women), 2 to 4 stood for varied degrees of bisexual identity (N = 19 men, N = 17 women), 5 stood for "almost exclusively homosexual" (N = 5 men, N = 6 women), and 6 for "exclusively homosexual" (N = 9 men, N = 12 women). Exact wordings for questions on sexual orientation identity and sexual attraction are listed in the Appendix.

Responses to the question on sexual orientation identity and sexual attraction were highly correlated in both men (Session 1, $r(50) = .98$, $p < .0001$; Session 2, $r(50) = .98$, $p < .0001$) and women (Session 1, $r(65) = .96$, $p < .0001$; Session 2, $r(65) = .96$, $p < .0001$). We averaged participants' scores on the two scales, separately for each session. On this composite scale, scores from 0 to 1 corresponded with a heterosexual orientation, scores from 1.5 to 4.5 with a bisexual orientation, and scores from 5 to 6 with a homosexual orientation.

Sexual Arousal

Stimuli

Participants viewed 6 sexually explicit videos, 3 featuring a man and 3 featuring a woman. All videos lasted 3 minutes and featured the actor masturbating in a bedroom. Stimuli were chosen in a previous pilot study that assessed the sexual appeal of 200 pornographic clips, and the most highly rated were used in the present study (Rieger et al., 2015). Before and after each sexually explicit video, participants were shown 2-minute clips of nature scenes to facilitate a return to a non-aroused state. The videos were presented in full screen on a monitor with a resolution of 1024 by 768 pixels.

Genital Data

A BIOPAC MP150 data acquisition unit and the software AcqKnowledge measured genital data every 5 milliseconds. Signals were sampled at 200 Hz, low-pass filtered (10 Hz), and digitized (16 bits). In men, a strain gauge measured changes in penile circumference. The increase in the gauges' circumference were calibrated prior to each session across

5-mm steps using a cone. Women's genital arousal was assessed via change in vaginal pulse amplitude (VPA), using a vaginal photoplethysmograph. The VPA signal was sampled at 200 Hz, and high-pass filtered at 0.5 Hz with 16 bits resolution. VPA was measured as peak-to-trough amplitude for each vaginal pulse. VPA signals exhibit both convergent and discriminant validity (Suschinsky et al., 2009).

Procedure

Upon providing written consent, participants were taken to a private booth to view stimuli on a TV screen. Men were instructed to place the gauge halfway along their penis, and women to insert the vaginal plethysmograph until touching a rubber stopper, resulting in 2 inches of insertion. Sessions began with a neutral video of clouds, followed by a sexually explicit video. The order of the sexually explicit videos was randomized, but a sexual video was always followed by a randomly selected neutral video. One session lasted for approximately 120 minutes.

Participants went through the exact same procedure twice. The aim was to have them return to the lab exactly a year after the first session. However, because part of the sample was comprised of international students, some left the country and were only able to return after more than a year, and for five of our participants, up to 3 years later. This variability caused a positive skew in our data, with the result that the mean time (14.83 months) was longer than the median time (12.68 months). We did not want to exclude participants for not returning after exactly a year, as every repeated assessment was valuable. Furthermore, the inclusion or exclusion of time between sessions as a co-variate in analyses had no effect on the findings reported below, and time itself was not a significant predictor of arousal patterns.

Data Processing

Following previous procedures (Watts et al., 2018), genital data were averaged, separately for each participant and each session, across the duration of each stimulus. These averages were then standardized within participants, producing a z-score for each participant and stimulus. Then, standardized responses to the 5 seconds preceding each sexual stimulus (following the display of a neutral stimulus, and after the participant had returned to baseline) were subtracted from the standardized response to the sexual stimulus, in order to correct for their baseline level of arousal. We then computed, for each participant, average responses across all sexual stimuli of a given type (female or male), which reflected their responses to each sex as compared to baseline. These standardized responses were used to calculate contrast scores. For each participant, separately by session, a value of zero meant equal arousal to both sexes, positive values meant stronger arousal to same sex over other sex stimuli, and negative values stronger arousal to the other sex over the same sex.

Another variable used in the present study was participants' responses to their less-arousing sex, or their minimum arousal. For each participant and session, we selected the mean response to whichever stimulus category (male or female) each participant was less aroused to. Bisexual men, if they show bisexual arousal, should respond more strongly to their less-arousing sex than monosexual men (Jabbour et al., 2020). Additionally, women should respond more strongly to their less-arousing sex than men, because women of all sexual orientations are more likely to respond to both sexes (Raines et al., 2021).

With these variables (self-reported sexual orientation, genital response to same or other sex, genital response to less-arousing sex), we computed directional and non-directional measures of change across sessions. Directional change calculated via the difference in scores (Session 2 minus Session 1). Non-directional change was the absolute value of this difference between sessions.

Results

Descriptive Analyses

Figure 1 outlines changes in self-reported sexual orientation between sessions. Sexual orientation was based on the composite score per session. For illustrative purposes, we collapsed the scores into three groups, with a score of 1 or below being classified as heterosexual, a score of 5 or above as homosexual, and scores between 1.5 and 4.5 as bisexual. Note that all of the following statistical analyses treat the composite sexual orientation score as a continuous variable. In the present section, the discussion of heterosexual, bisexual and homosexual groups is purely to aid interpretation of results. Overall, 5 men (9.6%) and 13 women (19.4%) changed their sexual orientation group. In men, 5 out of 19 bisexual individuals (26.3%) reported a change, while homosexual and heterosexual men reported no change. In women, 5 out of 18 bisexual individuals (27.8%) reported a change, along with 6 out of 31 heterosexual (19.4%) and 2 out of 18 homosexual individuals (11.1%). These descriptive statistics point to the possibility that women may report more change than men and that, within each sex, change is most likely to be reported by bisexual groups. Amongst women, homosexual participants stood out as the least likely to report a change, while the heterosexual and bisexual groups exhibit relatively similar patterns of change. No such descriptive statistics were presented for the measures of genital arousal, as arousal scores cannot be divided into discrete categories in the same manner as self-reported sexual orientation.

Relative Stability

Hypothesis 1 stated that self-reported sexual orientation and genital arousal are relatively stable (correlated) over time. Hypothesis 2 stated that relative stability is weaker in women than men, and Hypothesis 3 posited that bisexual individuals have weaker relative stability than monosexual individuals. We computed Pearson correlations across participants, separately for men and women, and separately for bisexual versus monosexual participants. We did this for self-reported sexual orientation and the two measures of genital response (arousal contrast and minimum arousal). If a measure was positively correlated between sessions, it was considered as relatively stable.

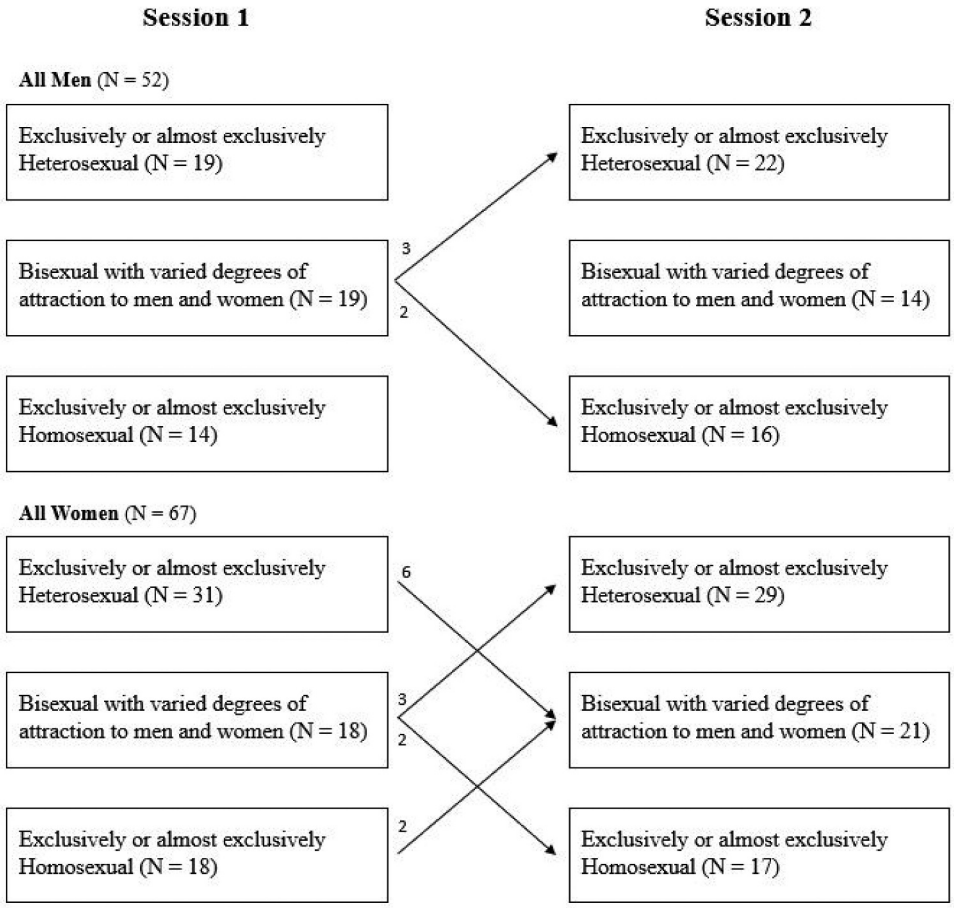

Figure 1. Change in self-reported sexual orientation across the two sessions. Note. Self-reported sexual orientation is based on a composite score. Those with a score of 0, 0.5 or 1 were classified as heterosexual, those with a score of 5, 5.5 and 6 as homosexual, and scores between 1.5 and 4.5 as bisexual.

Across men and women, all measures showed significant positive correlations between sessions (Table 1). Once split by sex, men showed, in general (across sexual orientations), stronger correlations for self-reported sexual orientation and genital arousal than did women, in general. In two out of three variables (all except minimum arousal) 95% confidence intervals of the correlations did not overlap between men and women, suggesting significant sex differences. We note, however, that this sex difference in correlations was only observed when men and women of different sexual orientations were pooled, but was not obvious, for instance, when only monosexual men and women were compared.

When sexual orientation groups were compared, the combination of bisexual men and women had weaker correlations than the combination of monosexual men and women with respect to their self-reported sexual orientation and sexual arousal. However, given the coefficients' 95% confidence intervals, this general difference (across sexes) between bisexuals and monosexuals in relative stability was only significant for sexual orientation, and not for the arousal measures.

These findings supported Hypotheses 1, 2 and 3 for self-reported sexual orientation, but only partially so for sexual arousal. That is, we found overall relative stability in self-reported sexual orientation, with women, in general, and bisexual individuals, in general, showing weaker relative stability than men and monosexual individuals, respectively. For sexual arousal we also found overall relative stability, but the sex difference was only apparent in one of the two measures, and although in the predicted directions, bisexual and monosexual individuals did not differ significantly.

General Change

Hypothesis 4 stated that self-reported sexual orientation and genital arousal patterns will, in general, change over time. We tested both directional and non-directional changes. For self-reported sexual orientation, we computed the directional change by calculating the difference of Session 2 minus Session 1. Thus, a value of zero indicated no change in self-reported sexual orientation, a positive value meant change toward the same sex, and a negative value meant change toward and other sex. For non-directional change, we computed the absolute values of the aforementioned difference. Here, positive values indicated a change in orientation toward either the same sex or the other sex.

For genital arousal measures, directional and non-directional changes were computed in a similar manner. For the contrast score–which indicated arousal to the same sex versus the other sex–directional positive change indicated stronger response for the same sex at Session 2 than Session 1, and negative change signified stronger response to the other

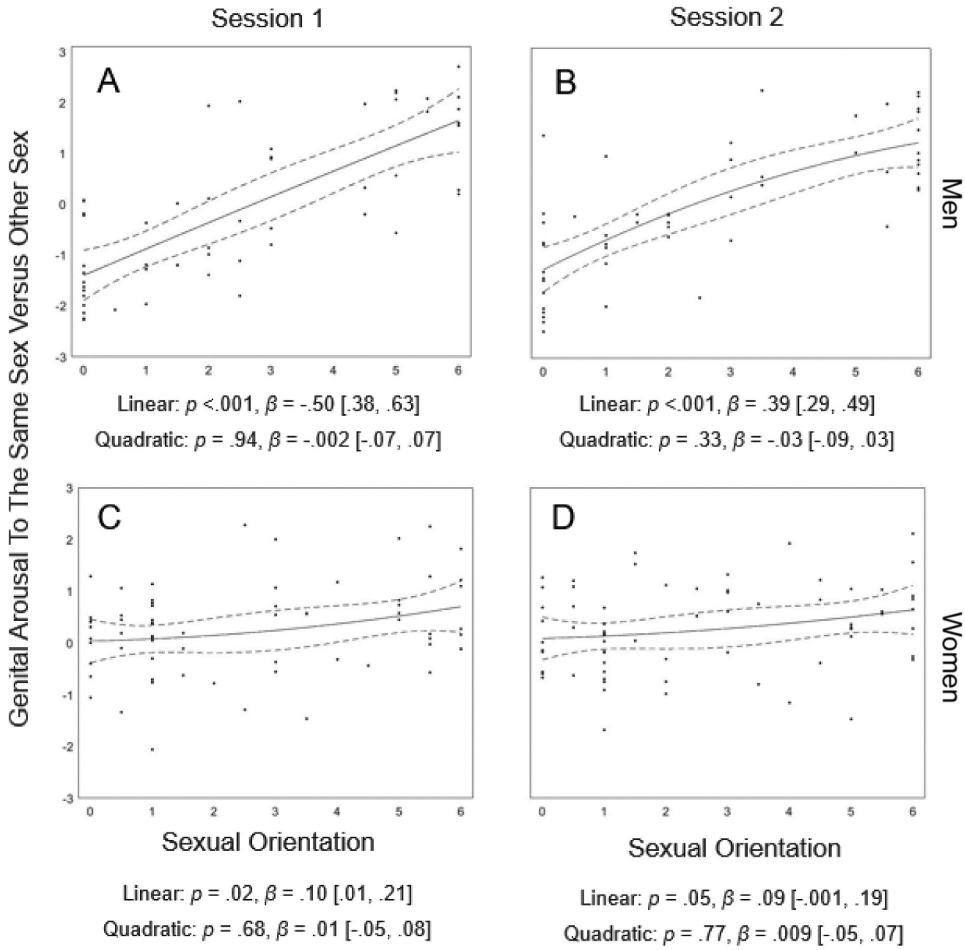

Figure 2. Reported sexual orientation in relation to genital responses (separated by session and sex). Note. On the Y axis, the scores represent genital arousal to same sex versus other sex, z-scored within participants. A value of zero indicated equal arousal to both sexes, a positive value stronger arousal toward the same sex; negative values stronger arousal toward the other sex. On the X axes, 0 corresponds with an exclusively heterosexual orientation, 3 to an equal orientation toward men and women, and 6 with an exclusively homosexual orientation. Dots show individual participants. Triple lines are regression coefficients with 95% confidence intervals. Statistics signify the linear and quadratic main effects of sexual orientation on sexual arousal.

sex at Session 2 than Session 1. The corresponding non-directional values meant a stronger response for either sex at Session 2, compared to Session 1.

For minimum arousal–which indicated people's strength of response to the less arousing sex–directional positive values meant stronger response to the less-arousing sex at Session 2 than Session 1, and negative values meant a weaker response to the less-arousing sex during Session 2. The corresponding non-directional values meant a stronger change (in either direction) in the response to the less-arousing sex.

We conducted a series of one-sample *t*-tests, comparing self-reported sexual orientation and sexual arousal difference scores against zero (no change). For directional change, and across both sexes, the effects were minimal and mostly not significant between sessions (the 95% confidence intervals of the difference scores included zero). For non-directional change, and across both sexes, changes were significant. This latter finding was consistent with Hypothesis 4, meaning that in general people changed, but in no specific direction (Table 2).

Group Differences in Change

Hypothesis 5 was that women exhibit greater change in self-reported sexual orientation and genital arousal than men. Hypothesis 6 stated that bisexual individuals show more change in self-reported sexual orientation and genital arousal patterns than monosexual individuals. We tested Hypothesis 5 and 6 simultaneously via regression analyses. To examine directional change in self-reported sexual orientation over time, we regressed directional change in self-reported sexual orientation–defined as the difference between Session 2 and 1–against self-reported sexual orientation at Session 1 and participant sex. We also tested whether bisexual individuals (who are in the mid-range of the Kinsey Scale) changed more than homosexual and heterosexual individuals (who are at the endpoints of the Kinsey Scale) via a curvilinear effect of sexual orientation at Session 1 on the sexual orientation change score. That is, if the relationship of sexual orientation at Session 1 with change in sexual orientation is stronger for bisexual than monosexual individuals, it should result in a quadratic effect of sexual orientation on change.

Table 1. Relative stability (correlation) of sexual orientation and sexual arousal between time 1 and 2.

	Men	Women	Both Sexes
Overall	*N* = 52	*N* = 67	*N* = 119
Self-reported Sexual Orientation	.97 [.94, .98]	.89 [.84, .93]	.95 [.93, .96]
Arousal Contrast Score	.77 [.63, .86]	.32 [.09, .52]	.62 [.51, .73]
Minimum Arousal	.29 [.02, .52]	.18 [−.06, .41]	.51 [.37, .64]
Monosexual	*N* = 33	*N* = 49	*N* = 82
Self-reported Sexual Orientation	.99 [.98, .99]	.97 [.94, .98]	.98 [.97, .99]
Arousal Contrast Score	.81 [.65, .90]	.25 [−.02, .50]	.66 [.52, .77]
Minimum Arousal	.35 [.07, .62]	.12 [−.16, .38]	.64 [.50, .75]
Bisexual	*N* = 19	*N* = 18	*N* = 37
Self-reported Sexual Orientation	.65 [.28, .85]	.75 [.43, .90]	.69 [.49, .83]
Arousal Contrast Score	.61 [.23, .83]	.43 [−.05, .74]	.53 [.25, .73]
Minimum Arousal	.02 [−.43, .47]	.40 [−.10, .73]	.26 [−.07, .54]

Note. Self-reported sexual orientation was based on a composite score, which averaged a continuous measure of sexual orientation identity with one of sexual attraction. On this scale, a score of 0–1 indicated heterosexual orientation, 1.5–4.5 indicated bisexual orientation, while 5–6 indicated homosexual orientation. The arousal contrast scores represent genital arousal to same sex versus other sex, z-scored within participants. A value of zero indicated equal arousal to both sexes, a positive value stronger arousal toward the same sex; negative values stronger arousal toward the other sex. The minimum arousal represents genital arousal to the less-arousing sex, z-scored within participants. A positive value indicated greater response to the less-arousing sex than to baseline. The monosexual group was created by combining the data from homosexual and heterosexual individuals. All scores are based on participant scores at Time 1.

Table 2. Mean change (t-test) in sexual orientation and sexual arousal between time 1 and 2.

	Men	Women	Both Sexes
Overall Directional Change	*N* = 52	*N* = 67	*N* = 119
Self-reported Sexual Orientation	.05 [−.14, .25]	.11 [−.05, .28]	.09 [−.04, .21]
Arousal Contrast Score	−.11 [−.38, .15]	.02 [−.22, .27]	−.03 [−.21, .14]
Minimum Arousal	.02 [−.16, .20]	−0.06 [−.24, .11]	−.03 [−.15, .09]
Overall Non-directional Change	*N* = 52	*N* = 67	*N* = 119
Self-reported Sexual Orientation	.37 [.20, .53]	.39 [.25, .53]	.38 [.28, .49]
Arousal Contrast Score	.69 [.50, .87]	.77 [.61, .92]	.73 [.62, .85]
Minimum Arousal	.45 [.32, .58]	.55 [.44, .66]	.51 [.42, .59]
Monosexual Directional Change	*N* = 33	*N* = 49	*N* = 82
Self-reported Sexual Orientation	.09 [−.06, .24]	.14 [−.03, .31]	.12 [−.002, .24]
Arousal Contrast Score	−.11 [−.47, .21]	.09 [−.18, .37]	.001 [−.22, .21]
Minimum Arousal	−.03 [−.21, .14]	−.23 [−.43, −.04]	−.16 [−.29, −.02]
Monosexual Non-directional Change	*N* = 33	*N* = 49	*N* = 82
Self-reported Sexual Orientation	.21 [.08, .34]	.33 [.17, .48]	.28 [.17, .37]
Arousal Contrast Score	.67 [.44, .92]	.81 [.66, .97]	.75 [.62, .89]
Minimum Arousal	.32 [.19, .45]	.54 [.41, .67]	.45 [.35, .55]
Bisexual Directional Change	*N* = 19	*N* = 18	*N* = 37
Self-reported Sexual Orientation	.02 [−.41, .46]	0 [−.49, .49]	.01 [−.29, .32]
Arousal Contrast Score	−.17 [−.68, .35]	−.08 [−.55, .38]	−.12 [−.45, .20]
Minimum Arousal	.41 [.06, .74]	.11 [−.31, .53]	.25 [.01, .51]
Bisexual Non-directional Change	*N* = 19	*N* = 18	*N* = 37
Self-reported Sexual Orientation	.63 [.26, 1.07]	.58 [.26, .91]	.60 [.39, .85]
Arousal Contrast Score	.70 [.38, 1.01]	.66 [.25, 1.06]	.68 [.43, .92]
Minimum Arousal	.67 [.40, .94]	.58 [.31, .84]	.63 [.45, .81]

Note. Self-reported sexual orientation was based on a composite score, which averaged a continuous measure of sexual orientation identity with one of sexual attraction. On this scale, a score of 0–1 indicated heterosexual orientation, 1.5–4.5 indicated bisexual orientation, while 5–6 indicated homosexual orientation. The arousal contrast scores represent genital arousal to same sex versus other sex, z-scored within participants. A value of zero indicated equal arousal to both sexes, a positive value stronger arousal toward the same sex; negative values stronger arousal toward the other sex. The minimum arousal represents genital arousal to the less-arousing sex, z-scored within participants. A positive value indicated greater response to the less-arousing sex than to baseline. The monosexual group was created by combining the data from homosexual and heterosexual individuals. All scores are based on participant scores at Time 1.

For genital arousal, we computed mixed-effects regression analyses to examine directional change, with sexual arousal contrast score or minimum arousal as the dependent variable. The fixed effects were participant sex, the linear and quadratic effects of self-reported sexual orientation, session, and their interactions. Participants were included as a random effect to account for repeated measures. The quadratic effect of sexual orientation was added to quantify whether bisexual individuals (midrange of the Kinsey Scale) showed more change in genital arousal than monosexual individuals (end points of Kinsey Scale). Thus, the relationship of sexual orientation with arousal could be differently curved between sessions, resulting in an interaction of the quadratic effect of sexual orientation with session.

Overall, there were few significant differences in directional change between men and women or between bisexual and monosexual individuals. This was the case for both directional change in orientation and directional change in genital arousal (Figures 2 and 3). For the sake of simplicity, we do not list the sheer number of these non-significant results. The finding closest to significance was that bisexual individuals responded more strongly to their less-arousing sex at Session 2, compared to Session 1 (Figures 3a and 3b). Nevertheless, across men and women, this difference was not statistically significant, $p = .09$, $\beta = -.04$, 95% CI [−0.09, 0.007], and the pattern did not differ by sex, $p = .49$, $\beta = .04$ [−.07, .14]. Note also that both men and women had very similar arousal patterns across the two sessions, and, in general, the association of sexual orientation with genital response was stronger in men than women (Figures 2 and 3).

So far, our analyses only addressed group differences in directional change. As individual participants could change their self-reported sexual orientation in either direction (Figure 1), it was informative to also check for the presence of non-directional change. We therefore computed additional regression analyses. The dependent variable was non-directional change (absolute difference) in sexual orientation or in sexual arousal measure (contrast score, minimum arousal). In each analysis, the independent variables were the linear and curvilinear effect of sexual orientation at Session 1, participant sex, and their interactions. The main effect of sex tested whether women exhibited more non-directional change than men at Session 2, compared to Session 1. However, we did not find any significant sex differences, either for non-directional change in sexual orientation, $p = .11$, $\beta = .25$, 95% CI [−.06, .56], or for non-directional change in sexual arousal (i.e., contrast score, $p = .80$, $\beta = -.04$, 95% CI [−.41, .31], minimum arousal, $p = .32$, $\beta = .13$, 95% CI [−.13, .40]). We also examined whether bisexual individuals changed more than monosexual individuals by testing the quadratic effect of sexual orientation at Session 1 on non-directional change in arousal patterns.

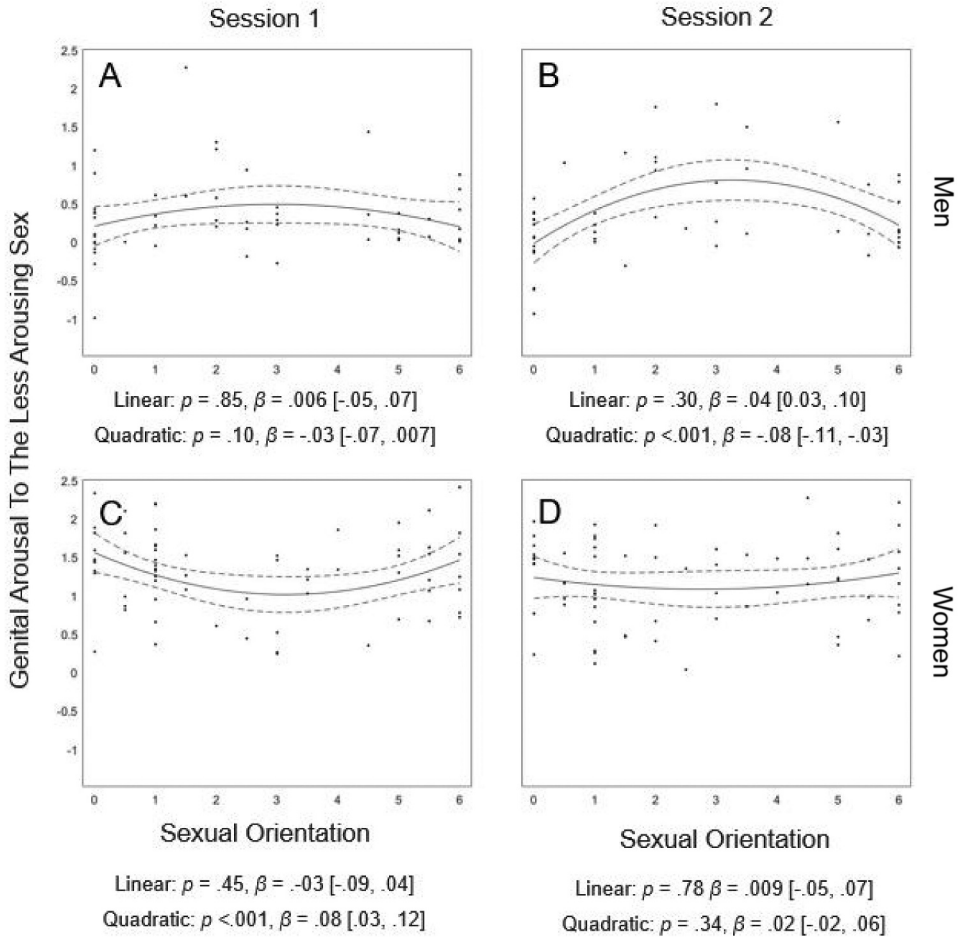

Figure 3. Reported sexual orientation in relation to genital arousal to the less arousing sex (separated by session and sex). Note. On the Y axis, the scores represent genital arousal to the less-arousing sex, z-scored within participants. A positive value indicated greater response to the less-arousing sex than to baseline. On the X axes, 0 corresponds with an exclusively heterosexual orientation, 3 to an equal orientation toward men and women, and 6 with an exclusively homosexual orientation. Dots show individual participants. Triple lines are regression coefficients with 95% confidence intervals. Statistics signify the linear and quadratic main effects of sexual orientation on sexual arousal.

Bisexual individuals (in general) changed more than monosexual individuals in a non-directional manner with respect to their self-reported sexual orientation (Figure 4), p <.001, β = −.05, 95% CI [−.08, −.03], but not with respect to their arousal contrast score, p = .42, β = .01, 95% CI [−.41, .32], or minimum arousal, p = .28, β = −.11, 95% CI [−.33, .10]. This difference in non-directional change between bisexual and monosexual participants did not differ by sex (i.e., the interaction of sex with the quadratic effect of sexual orientation was not significant: sexual orientation, p = .06, β = −.09, 95% CI [−.18, .02], arousal contrast, p = .35, β = .05, 95% CI [−.05, .16], minimum arousal, p = .71, β = −.01, 95% CI [−.09, .06]).

In sum, our results did not support Hypothesis 5, as men and women did not significantly differ between sessions in their self-reported sexual orientation or arousal. Hypothesis 6, which posited that bisexual individuals would change more over time than monosexuals, was confirmed for non-directional change in self-reported sexual orientation (Figure 4), but not for measures of sexual arousal.

Correspondence of Change in Self-Reported Sexual Orientation with Change in Sexual Arousal

Hypothesis 7 stated that change in self-reported sexual orientation would relate to change in sexual arousal. Using the same difference scores used to test Hypothesis 4, we correlated the change in participants' sexual arousal with the change in their self-reported sexual orientation. Directional change in sexual orientation was not associated with directional change in sexual arousal (contrast score, p = .57, $r(117)$ = .05, 95% CI [−.13, .23], minimum arousal, p = .98, $r(117)$ = −.001, 95% CI [−.18, .18]). Likewise, non-directional change in sexual orientation was not associated with non-directional change in sexual arousal (contrast score, p = .44, $r(117)$ = .07, 95% CI [−.11, .24], minimum arousal, p = .88, $r(117)$ = .01, 95% CI [−.16, .19]). There were no differences in these non-significant correlations between either men and women, or bisexuals and monosexuals. This was suggested by the non-significant interactions that tested for group differences between these relations (all p's ≥ .34, all β's −.03 to .11). These findings did not support Hypothesis 7.

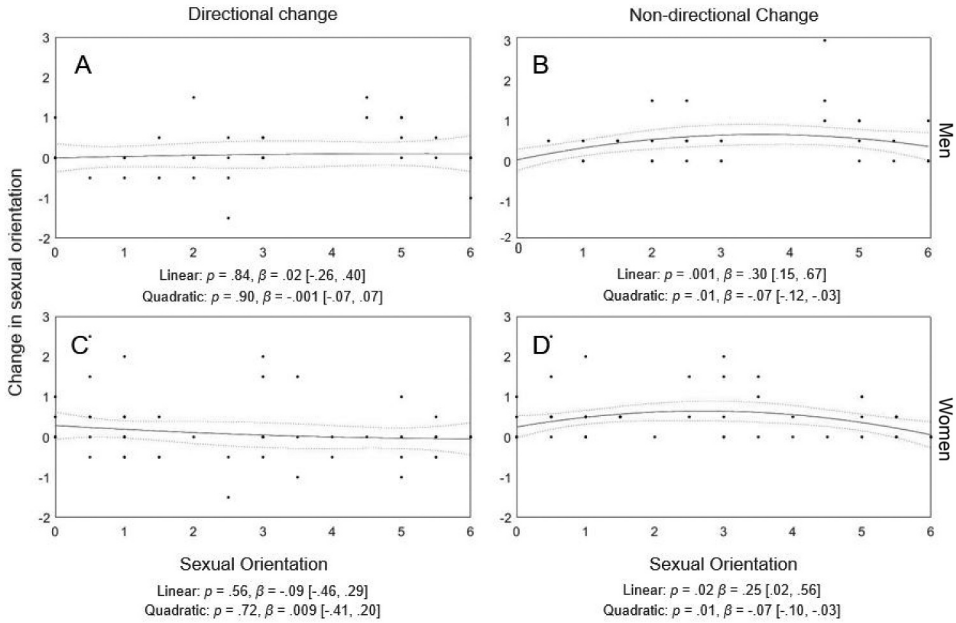

Figure 4. Change in sexual orientation over time, split by sex and type of change (directional and non-directional).
Note. A value of zero on the Y-axes indicated that the individual reported no change between Sessions 1 and 2. For directional change, positive and negative values are change toward the same sex and other sex, respectively. For non-directional change, positive values mean a change toward either sex. On the X-axes, 0 corresponds with an exclusively heterosexual orientation, 3 to an equal orientation toward men and women, and 6 with an exclusively homosexual orientation. Dots show individual participants. Triple lines are regression coefficients with 95% confidence intervals. Statistics signify linear and quadratic main effects of sexual orientation at session 1 on change in sexual orientation.

Discussion

The present study examined: (a) the correlation of self-reported sexual orientation and arousal over time, (b) the mean change in orientation and arousal over time, and (c) the link between change in self-reported sexual orientation and change in sexual arousal. Before addressing any effects of time, it is worth examining the results by session. In general, patterns of sexual arousal in the present study were in agreement with those previously reported (Raines et al., 2021; Rosenthal et al., 2011). That is, heterosexual and homosexual men showed a strong preference for their preferred sex, while bisexual men, as a group, showed arousal to both sexes. Across sexual orientations, women showed arousal both to the same sex and other sex; however, homosexual women showed a slight tendency in arousal toward the same sex. One unexpected result was found in Session 1, where bisexual women showed somewhat less bisexual arousal than heterosexual women, if not homosexual women. It is unclear why this pattern occurred, and it was no longer the case in Session 2 (Figure 3).

With respect to relative stability (correlation) of self-reported sexual orientation over time, our results were similar to those found in a previous longitudinal study (Savin-Williams et al., 2012): (1) sexual orientation was relatively stable, overall, as suggested by the correspondence between sessions, (2) women, in general, showed lower relative stability than men, and (3) bisexuals, irrespective of sex, reported lower relative stability than other sexual orientations. For sexual arousal we also found overall relative stability, but it was weaker than for sexual orientation. Moreover, a sex difference in relative stability was only apparent in one of the two measures of arousal, and no significant differences in relative stability were found between bisexuals and monosexuals.

With respect to change (mean difference), for self-reported sexual orientation, our results were somewhat in agreement with previous work, but not entirely so (Mock & Eibach, 2012; Ott et al., 2011; Savin-Williams et al., 2012): (1) even though we did not find directional change over time, on average, there was non-directional change in participants' sexual orientations, (2) even though women did not exhibit more non-directional change than men, the difference was in the predicted direction, and (3) bisexual individuals changed non-directionally more than other sexual orientations. Regarding mean change in sexual arousal, our results only partially mirrored findings for sexual orientation: (1) non-directional mean change in sexual arousal occurred, on average, but (2) women did not change more than men, and (3) bisexual individuals did not change more than monosexuals. In sum, 5 out of 6 of our predictions related to relative stability and to change were confirmed for self-reported sexual orientation, whereas only 2 out of 6 were fully confirmed across measures of genital arousal.

Taken together, the current data were able to largely replicate previous findings with respect to self-reported sexual orientation, but this was not reflected in sexual arousal. There are several ways in which we can interpret the lack of change in arousal: One interpretation is that the assessment of physiological sexual arousal is subject to more measurement error than self-reports, which could weaken any true patterns in arousal (i.e., correlation, mean change). An alternative interpretation is that longitudinal patterns observed in self-reports provide an over-estimation of the actual change in self-reported sexual orientation. This is not to say that change in sexual orientation does not exist, but rather that change may be rarer than suggested by self-

report. Finally, it may be that change in self-reported sexual orientation truly happens subjectively but is not reflected by any corresponding change in physiological responses. Limited support for this assumption comes from one of our null findings, which indicated that change in self-reported sexual orientation was unrelated to change in sexual arousal.

Other limitations of this work need to be considered. It may be that with our sample, the proportion of individuals who exhibited a change in sexual arousal (or orientation) is simply too small to detect any reliable patterns. For instance, we can see in Figures 3a and 3b that bisexual men responded more to their less-arousing sex at the second visit, even though this difference between sessions was not statistically significant. Our lab was forced to close during the COVID-19 pandemic, which meant we were unable to bring back as many participants as originally planned. Despite this limitation, we believe the current findings are informative and may be used as a basis for future longitudinal studies of sexual arousal, which could employ larger participant cohorts.

In addition, due to the intrusive nature of the procedure, which is unavoidable for research on genital arousal, our study may have suffered from self-selection bias, and we simply do not know how patterns would look in those who do not participate. Furthermore, our study does not inform how patterns may change over longer periods, over and above 1 year, and future research could investigate this.

Another worthwhile avenue for future research may be to include pupillary responses to sexually explicit stimuli as an alternative measure of sexual arousal (Attard-Johnson et al., 2021). Even though previous work suggests that genital arousal and pupil dilation tend to show comparable findings (Rieger et al., 2015), the latter produces more noise and smaller effects, on average, and therefore require more participants. Still, including both genital arousal and pupil dilation would be ideal in future longitudinal studies of sexual arousal.

Research could also examine relative stability and change in both self-reported sexual orientation and sexual arousal during specific developmental periods (e.g., before, during, and after puberty), if this were ethically justifiable. Further, one may examine the precise reasons why some individuals exhibit change in their self-reported sexual orientation or sexual arousal. For instance, fear of rejection, discrimination, and cultural norms are a few of the factors that might influence change in self-reported sexual orientation, while exposure to new sexual experiences might contribute to changes in sexual arousal.

Conclusion

In this study, we followed up men and women of varying sexual orientations over time, examining their self-reported sexual orientation and objectively assessing their genital arousal to sexually explicit stimuli. We found that, on average, change in self-reported sexual orientation was more likely to be reported than change in genital arousal in both men and women, and that among all sexual orientations, bisexual individuals were the most likely to report any change. Furthermore, we found that change in self-reported sexual orientation was not reflected in genital arousal, providing tentative support for the notion that self-reports may overestimate change in sexual orientation.

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No potential conflict of interest was reported by the authors.

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Appendix

Questions asked to quantify sexual identity and sexual attraction:

Please choose the ONE that most accurately reflects your current understanding of your SEXUAL ORIENTATION:

0. Exclusively Heterosexual/Straight
1. Mostly Heterosexual/Straight
2. Bisexual Leaning Heterosexual/Straight
3. Bisexual
4. Bisexual Leaning Gay/Lesbian
5. Mostly Gay/Lesbian
6. Exclusively Gay/Lesbian

Which ONE of the following most accurately describes your current understanding of your SEXUAL ATTRACTION:

0. Only sexually attracted to the opposite gender
1. Mostly sexually attracted to the opposite gender, and rarely attracted to the same gender
2. Primarily sexually attracted to the opposite gender, but often attracted to the same gender
3. More or less equally sexually attracted to the opposite and same gender
4. Primarily sexually attracted to the same gender, but often attracted to the opposite gender
5. Mostly sexually attracted to the same gender, and rarely attracted to the opposite gender
6. Only sexually attracted to the same gender