

# Examining Memory for Heterosexual College Students' Sexual Experiences Using an Electronic Mail Diary

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To examine memory for sexual experiences, the authors asked 37 sexually active, nonmonogamous, heterosexual college students to complete an e-mail diary every day for 1 month. The diary contained questions about their sexual behaviors. Six to 12 months later, they returned for a surprise memory test, which contained questions about their sexual experiences from the diary phase. They were asked about their sexual partners, the types of sexual experiences they had, and condom use. Participants underreported the number of partners they had, but they overreported both sexual experiences and condom use. The results have implications for both sexual health educators and for people who engage in high-risk sexual behaviors.

*Key words:* sexual behaviors, recall, diary, memory, memory distortion

Approximately 6,500 young people (ages 15–24) contracted HIV each day in 2000 (Joint United Nations Program on HIV/AIDS, 2000). Meanwhile, epidemiologists track the growth of HIV cases, policymakers design health strategies, and educators implement interventions—all of which are based on what people say they do (and do not do) regarding sexual activity. However, we know little about which methods for gathering sexual behavior data are reliable and which are systematically biased. Thus, we lack sufficient information to make decisions about strategies and interventions. In this article, we describe a method by which psychology can inform policy and education about the nature of memory for sexual behaviors.

Most of the research on memory for sexual behavior has used retrospective reports (Fortenberry, 1995), the same method that

yields inaccurate reports for more general health events (Stone, Jurkkan, & Bachrach, 1999). However, one promising technique asks participants to log their sexual experiences in a daily diary (Leigh, Gillmore, & Morrison, 1998). Once the diary period is complete, researchers compare retrospective reports with baseline diary entries (e.g., Hornsby & Wilcox, 1989; Reading, 1983). Unfortunately, even with these methodological improvements, diary research has produced conflicting results. For example, Ramjee, Weber, and Morar (1999) found female sex workers underreported sexual encounters, condom use, partners, and clients; on the other hand, Coxon (1999) found that gay men overreported every type of sexual activity.

Thus, even when researchers are aware of biases that might influence reports about sexual experiences and the circumstances surrounding them, their methods still do not adequately minimize or even detect those biases. Moreover, previous research has said little about the role of memory distortions in how people report sexual behaviors. Below, we examine two of the memory biases that may influence participants' reports.

## Memory Biases

Previous diary studies have allowed at least two memory biases to go undetected. First, a *completion bias* occurs because there is no way to tell when participants actually log information about any particular experience. A careless person might complete the week's diaries just before sending them back to the researchers, thus compromising baseline truth (see also Leigh et al., 1998). Second, a *rehearsal bias* occurs when participants are able to study previous diary entries before sending the diaries back, promoting better recall.

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In the study we present here, we addressed the memory-related shortcomings in previous research by using a daily e-mail diary in which participants recorded each sexual encounter. We minimized the completion bias because the e-mail time stamp encouraged participants to return their daily diaries within a 24-hr deadline. We minimized the rehearsal bias because once the completed diary was sent, it was deleted from the participant's e-mail outbox. Between 6 and 12 months later, participants recalled the experiences reported in their diaries in a surprise memory test. If we found that participants were accurate, we could conclude that retrospective surveys are an inexpensive and efficient way of gathering information about these behaviors. However, if we found that participants were inaccurate, then we could conclude that retrospective surveys—although convenient—produce data that are unreliable. Finally, if we found that participants were systematically inaccurate, then we might be able to develop a statistical means to correct survey data.

## Method

### Participants

Participants were self-identified heterosexual unmarried male and female college students who usually had sex at least once a week and who were not in committed relationships. We chose this sample because college is a unique environment that encourages a high level of risky behaviors, and many college students have little awareness or appreciation of the consequences of those behaviors (Kim, Larimer, Walker, & Marlatt, 1997). Participants were recruited from an advertisement in the campus newspaper and were paid \$50 for completing the study. Forty-nine students took part, 28 men and 21 women from the University of Washington, ages 19–37 ( $M = 23.36$ ,  $SD = 5.54$ ). They were assigned anonymous e-mail accounts, and their true identities were known only by a person outside the study who processed their payments.

### Procedure

**Diary phase.** Seven e-mail diaries were sent to each participant at the beginning of the week. They completed each diary the morning after the target day. Daily diaries contained a maximum of 18 questions (see the left-hand side of the Appendix), and participants were branched to a certain set of questions depending on their response. They completed one diary for each different partner. We sent only seven daily diaries for the week, but participants could request additional daily diaries for additional partners if necessary. Sent mail was not copied to their e-mail outboxes. Although we could not control whether they sent themselves copies of the diaries, they had no reason to do so, because they did not expect a memory test later. Those who did not return a diary by the end of the following day were sent a reminder e-mail. This cycle was repeated for 4 weeks, after which they were told they would be contacted in 6 to 12 months for an interview to investigate their perceptions of sexual issues. We chose this delay because it is similar to those in many surveys of sexual health, such as the National Sexual Health Survey, in which participants report their behavior over the last 12 months. Although we were not interested in total behaviors over the last 12 months, we were interested in memories that might date back that far. Participants took the memory test 6 to 12 months after the diary phase ended, but the exact delay was dependent to some extent on participant availability.

**Memory test.** Participants completed a memory test of the sexual experiences they had had during the diary phase. The survey was administered on a computer at a location convenient to them.

At the beginning of the memory test, participants were instructed to report their activities from the diary phase. We did not remind them of the specific month or the specific dates during which they recorded their experiences. There were four parts to the test. In Part 1, participants reported the number of times they had engaged in the different sexual activities; these answers corresponded to questions in the diary (see the right-hand side of the Appendix). In Part 2, participants rated their accuracy using a Likert-type scale with anchors from 1 (*not at all accurate*) to 5 (*very accurate*). In Part 3, participants told us about strategies they used to answer the condom use and partner questions. They chose among five options: (a) "It's a total guess. I can't remember"; (b) "I just remembered, but I don't know how"; (c) "I'm estimating based on my usual experiences in a typical month"; (d) "I'm estimating because I remember some (but maybe not all) of my experiences during that period"; (e) "I paid more attention during the study period because of the daily e-mail." An additional two questions assessed social desirability, but the results from these questions are not reported here.

Unknown to participants, the computer program recorded how long it took them to complete the memory test. The questions took approximately  $M = 23.73$  ( $SD = 10.52$ ) min to answer, and times ranged from 11.3 min to 49.9 min. Afterward, participants were debriefed.

## Results

The data from 37 participants (26 men and 11 women) were retained for analysis (12 participants dropped out of the study or did not return to complete the memory test). Two subjects returned one e-mail diary 1 day late; we included these data because they were 0.2% of the total data: 2 diaries/(37 participants  $\times$  28 days). All participants expressed surprise at the memory test, because they expected to complete a survey on sexual health issues.

Because there was no effect for retention interval ( $F < 1$ ), we collapsed the data over the length of time between the diaries and the memory test. Overall, participants had a total of 112 sexual partners (range 0–10).<sup>1</sup> They had vaginal intercourse 209 times ( $M = 5.65$ ,  $SD = 5.44$ , range 0–20); anal intercourse 29 times ( $M = 0.81$ ,  $SD = 2.49$ , range 0–11); performed oral sex 109 times ( $M = 3.11$ ,  $SD = 2.59$ ; range 0–12); and received oral sex 140 times ( $M = 3.89$ ,  $SD = 3.26$ , range 0–14). As the number of reported partners increased, so did the time it took participants to complete the test ( $r = .67$ ,  $p < .01$ ), suggesting that they followed instructions. Pretest and posttest reports of sexual partners were related ( $r = .53$ ,  $p < .01$ ), as were reports of total sexual experiences ( $r = .46$ ,  $p < .01$ ). It is interesting to note that the greater the number of partners, the more times participants had intercourse ( $r = .39$ ,  $p = .02$ ).

### Memory for Sexual Experiences

The next analyses addressed the main focus of this study, which was whether memory for sexual experiences changed over time. We first examined whether participants would remember how many partners they had had during the diary phase. A paired  $t$  test showed that they underreported partners, claiming a mean of 2.12 ( $SD = 0.24$ ) while reporting a mean of 3.03 ( $SD = 0.36$ ) in their diaries,  $t(32) = 2.42$ ,  $p = .02$ . The effect size was medium ( $f = 0.49$ ) (Cohen, 1988).

<sup>1</sup> During the diary period, none of the participants reported having intercourse more than once a day with the same partner.

Next, we examined memory for specific sexual experiences and calculated how many instances of vaginal intercourse participants had during the diary phase. We performed similar calculations to determine total instances of oral sex performed, oral sex received, and anal intercourse. We used these four measures as a benchmark for what participants actually did and compared it with how participants answered the corresponding memory test questions.

The left-hand side of Figure 1 shows that participants did not accurately recall the sexual experiences that they recorded earlier in a diary. The dark bars represent posttest recall; the white bars represent diary entries. A repeated measures multivariate analysis of variance (MANOVA) showed that participants clearly said they had much more sex than they actually did,  $F(3, 32) = 7.02, p < .01$ .<sup>2</sup> Post hoc within-participant contrasts showed that participants overreported all types of sexual experiences. They reported having more vaginal intercourse, receiving more oral sex, and performing more oral sex than they actually did,  $F(1, 34) = 17.86, 9.87,$  and  $6.86$  respectively, all  $ps < .01$ . The effect sizes were all medium ( $f = 0.69, 0.52,$  and  $0.44,$  respectively).

Because only 12 participants reported instances of anal sex, we analyzed it separately. The right-hand side of Figure 1 shows there was a tendency for these participants to recall their experiences more accurately. The difference between memory reports and diary entries was not significant,  $t(11) = 1.02, p = .33, f = 0.30$ .

Although we found no consistent gender differences, comparisons were problematic because of the small number of women in the study and the differences in variances between the two groups. We are therefore reluctant to speculate about gender differences. There was no effect for retention interval: Participants claimed to have had far more sex than they actually did during the diary phase, regardless of when we asked them to report their experiences. Overreporting was especially prominent for vaginal intercourse, which was misreported by a factor of 4.

It is interesting to note that participants who initially reported having no experiences of a particular type were not especially accurate at posttest. For example, of the 4 participants who had no vaginal intercourse, 2 accurately reported 0 experiences at posttest,

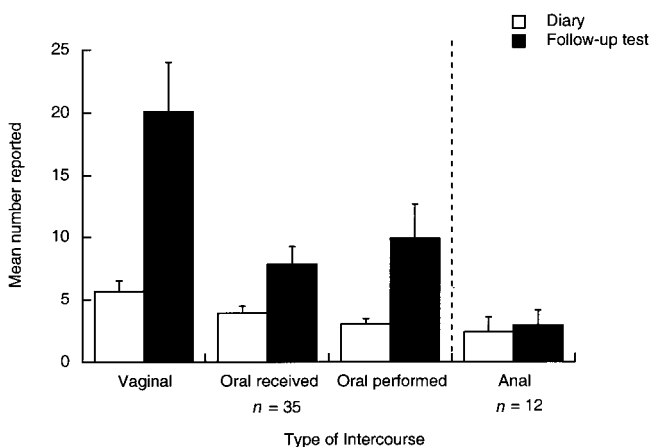


Figure 1. Number of reported instances of intercourse in the diary and during the follow-up test. Error bars represent the standard error of the mean.

whereas 1 reported 8 instances and another reported 9. Of the 5 participants who did not receive oral sex, only 1 accurately reported 0 such encounters, whereas the remaining 3 reported between 3 and 12 encounters. Similarly, the 2 participants who did not perform oral sex later reported performing it either 3 or 5 times. Participants were most likely to report accurately their anal sex experiences. Of the 29 participants who did not have anal sex during the diary phase, 83% (24) accurately reported not doing so, but the remaining 17% reported anywhere between 1 and 4 such experiences.

### Memory for Condom Use

To determine whether condom use was reported as inaccurately as sexual experiences were, we calculated the total number of times participants reported in their diaries that they used condoms for vaginal intercourse. We divided this total by the number of times participants reported having vaginal sex during the diary period to get their percentage of condom use. We performed similar calculations to determine the percentage of condom use for oral sex—collapsed over whether it had been performed or received—and anal sex. We then compared participants' diary reports of percentage of condom use with what participants reported in the corresponding posttest questions.

Figure 2 shows that condom use was also overreported. The dark bars represent the percentage of condom use reported on the posttest; the white bars represent the percentage of condom use reported in the daily diaries. Participants clearly overreported condom use for both vaginal intercourse, Wilcoxon's signed-rank  $T(29) = 60, p = .02, f = 0.34,$  and oral sex, although this result was only marginally significant,  $T(33) = 16, p = .06, f = 0.32$ .

Again, we analyzed anal sex separately. The right-hand side of Figure 2 shows there was a tendency for condom use to be overreported at the memory test; it was not significant,  $T(10) = 5.00, p = .13,$  although the effect size was medium ( $f = 0.49$ ). For all types of intercourse, there were no gender differences and no effect for retention interval on reports of condom use.

These results show that both men and women overreported condom use for vaginal, oral and anal intercourse during the follow-up memory test.

### Methods of Recall

One factor that might have influenced reporting of intercourse and condom use is the method by which participants answered these questions. Recall that at the memory test, we asked them how they answered questions about the number of partners and frequency of condom use. We found that no one strategy was more

<sup>2</sup> Some dependent variables were not normally distributed; however, Tabachnick and Fidell (1996) noted that when the assumption of normality is not met because variables are skewed, the MANOVA is robust to violations of normality, particularly when the  $n$  of the smallest cell is at least 20. For post hoc analyses, variables that were normally distributed were analyzed using parametric tests; variables that were not normally distributed were analyzed using nonparametric equivalents.

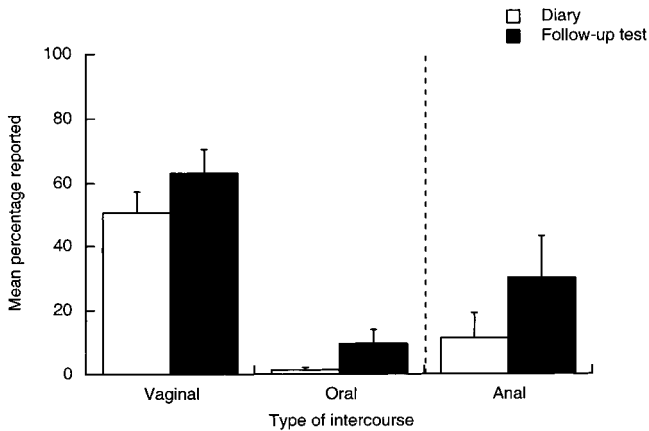


Figure 2. The percentage of condom use reported during the diary phase and the follow-up test. Error bars represent the standard error of the mean.

accurate than the others ( $F < 1$ ), although the most frequently cited strategies were estimation based (30% of participants).

### Self-Accuracy Ratings

We wondered if participants realized how inaccurate they were. For each event, we compared participants' accuracy ratings with their actual accuracy and found that they were uncorrelated, suggesting that people had little awareness of how inaccurate they were. Interestingly, although participants could not reliably rate their own accuracy, there was a relationship between self-accuracy ratings and the frequency of some sexual experiences. For example, as vaginal intercourse increased, self-accuracy ratings for it decreased ( $r = -.37, p = .03$ ); we found the same relationship for number of partners ( $r = -.33, p = .05$ ). However, frequency and accuracy were unrelated when participants reported how often they had anal intercourse, oral sex, or used condoms for vaginal intercourse or oral sex.

### Discussion

The major question in this study was how accurate people's memories are for their sexual experiences. Put simply, the answer is that they are not very accurate: In fact, participants overreported both sexual encounters and condom use while underreporting the number of their sexual partners.

The overreporting of sexual behavior is consistent with other research, such as Coxon (1999), in which participants overreported every sexual activity as well as condom use. However, Coxon's results might have been due to a completion bias. Participants, who used a month-long pen-and-paper diary, might have made their entries haphazardly, recording fewer experiences than they actually had. At test, they may have remembered their experiences fairly accurately, reporting those that they had logged during the diary phase as well as those they had not. Such a process would have led to what looked like the overreporting of sexual experiences and condom use. However, this completion bias cannot

account for our results. Because participants returned their diaries daily, they needed to be vigilant about reporting their experiences from the day before.

### Influences on Reporting

Because the completion bias cannot account for overreporting, we considered alternative explanations. Although our data do not definitely support one explanation over another, there are at least three other possible influences: decomposition, attitude change, and social desirability.

*Decomposition and availability.* In a decomposition strategy, participants take the typical number of times they engaged in a certain behavior during a short period of time and multiply it to estimate the incidence for a longer period of time (Bradburn, Rips, & Shevell, 1987). Such a process can lead to either underreporting or overreporting. Even if participants' decomposition strategies produced a biased estimate, this approach may not completely account for the degree of bias in our results. Bradburn et al. (1987) suggested that the availability of the experiences—the ease with which they come to mind—plays a role (see also the availability heuristic of Tversky & Kahneman, 1973). Although Bradburn et al. said that “in general, decomposition can be an effective technique for improving the accuracy of quantitative estimates” (p. 160), our results suggest that decomposition may result in overestimation to the extent that it is influenced by the availability of the behaviors in the shorter period of time. In other words, suppose participants were able to recall actual events from the diary period and use these as a basis for estimation. Because easily recalled events are judged as more frequent and more likely occurrences, increased availability would lead to overestimation during the memory test.

However, half the participants told us they used an alternative method, including guessing, just remembering but not knowing how, and paying more attention during the study period. Even those who claimed they paid more attention to events because they were using a diary were no more accurate than participants who used other recall methods.

*Attitude change.* Aside from making a strategic recall error, participants may have experienced an attitude change toward risky sexual behavior in the time between the diary period and the memory test. This change may have influenced their responses, because attitudes toward a behavior influence how it is recalled (Ross & Conway, 1986). For example, if those with a relaxed attitude toward condom use were exposed to a sexual education program during the delay interval, they may have changed their attitude toward risky sexual behavior, which in turn might influence recall during the memory test. People are unlikely to recall behaviors that run counter to their current point of view (Lydon, Zanna, & Ross, 1988; Wilson & Ross, 2001).

*Social desirability.* We do not know the extent to which social desirability played a role in our findings. On the one hand, participants might have overreported condom use because using condoms is responsible. On the other hand, participants might have underreported condom use because they thought condoms were not necessary in high-quality relationships. Although a mean of three sexual partners in a month might not meet a conventional definition of “high-quality relationships,” most college students

practice serial monogamy, characterized by brief but dedicated relationships (Seidman & Reider, 1994). Future research should consider using a reliable instrument, such as the Marlowe–Crowne Social Desirability Scale (Reynolds, 1982).

Another way in which social desirability may have influenced our results is that participants might have been reluctant to reveal sensitive information. Although we informed prospective participants exactly what we would ask them in the daily diaries, they may have been embarrassed to reveal sexually explicit information. However, because research has shown that people report a greater number of sensitive sexual behaviors when interviewed using a computer (Turner et al., 1998), this explanation is not a compelling account of our findings.

### Conclusions

Overall, our results show that memory for sexual behaviors is systematically distorted. Participants overestimated the number of times they engaged in vaginal, oral, and anal sex and the frequency of condom use for each of these three activities, and they underestimated the number of partners they had during the study period. However, there are several limitations to this study. Volunteers in a study on sexual behavior are often more liberal than nonvolunteers and appear to have sex more often (for a review, see Catania, Gibson, Marin, Coates, & Greenblatt, 1990). Perhaps these participants, a self-selected sample, might have been proud of their relatively liberal sexual behaviors and exaggerated their experiences. However, exaggeration does not explain why our sample underreported their sexual partners. Although the results from our relatively small, heterosexual, college-student sample cannot easily be generalized to the rest of the population, college students regularly engage in risky behaviors and thus are a population worthy of study in their own right (Kim et al., 1997). We also do not know what effect a smaller retention interval, such as 1 month, might have had on recall accuracy.

To further improve baseline accuracy, researchers might look to the ecological momentary assessment (EMA) method (Shiffman & Stone, 1998; Stone & Shiffman, 1994). In the EMA, participants record details about activities (for example, smoking lapses, eating, or feeling pain) onto a handheld computer immediately after the event; additional entries are prompted randomly throughout the day. Because such a technique decreases the time between event and recording, there would be less opportunity for memory decay than there was in our study. In addition, future research might vary the type of diary used (EMA, e-mail, paper and pencil, World Wide Web) and delay to evaluate the relative strengths and drawbacks of diary type on later memory accuracy. Participant characteristics such as monogamy, age, or sexual orientation might interact with these types of behavioral record keeping. Such a study would make an important contribution to the literature.

The results of our research indicate that researchers and policymakers should be aware of distortions that exist in college students' reports of their sexual behaviors. Memory for sexual behaviors and the circumstances surrounding them is largely inaccurate—a result that complicates the design and implementation of sexual-behavior interventions with college students. For example, our findings suggest that young people will remember themselves as better behaved than they really were, and thus see

themselves as less at risk than they really are. Warnecke et al. (1997) found similar behaviors among women ages 50 and over: They overreported the frequency with which they obtained Pap smears, breast exams, and mammograms by 16%–51%. In other words, they saw themselves as less at risk for serious health problems but were actually more at risk. A clear—and tragic—implication of these memory distortions is that those who would benefit most from an intervention might not even realize the message is directed at them.

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## Appendix

### Examples of Questions Asked During the Diary Month and the Memory Test

Question position no.	Diary	Maps onto	Question position no.	Memory test
1.	Did you have sex with a partner?	→	18.	During the study period, how many times did you have sex with XX?
4.	Did you have vaginal intercourse?	→	21.	During the study period only, how many times did you have vaginal intercourse with XX?
5.	If yes to 4, did you or your partner wear a condom?	→	22.	Of those times, how many times did you or your partner wear a condom?
7.	Did your partner perform oral sex on you?	→	25.	During the study period only, how many times did XX perform oral sex on you?
8.	If yes to 7, did you or your partner wear a condom?	→	26.	Of those times, how many times did you or your partner wear a condom?
9.	Did you perform oral sex on your partner?	→	27.	During the study period only, how many times did you perform oral sex on XX?
10.	If yes to 9, did you or your partner use a dental dam?	→	28.	Of those times, how often did you or your partner use a dental dam?
11.	If yes to 9, did you or your partner use a female condom?	→	29.	Of those times, how often did you or your partner use a female condom?
12.	Did you have anal intercourse with your partner?	→	23.	During the study period only, how many times did you have anal intercourse with XX?
13.	If yes to 12, did you or your partner wear a condom?	→	24.	Of those times, how often did you or your partner wear a condom?

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