

# Partner naming and forgetting: Recall of network members<sup>☆</sup>

David C. Bell<sup>a,\*</sup>, Benedetta Belli-McQueen<sup>b</sup>, Ali Haider<sup>c</sup>

<sup>a</sup> *Department of Sociology, Indiana University-Purdue University Indianapolis (IUPUI),  
425 University Blvd., Indianapolis, IN 46202-5140, United States*

<sup>b</sup> *Center for Success and Independence Houston, TX, United States*

<sup>c</sup> *Karachi, Pakistan*

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## Abstract

Network researchers must contend with recall, forgetting, alters whose names are not known, and other potential biases in estimating the size of personal (ego) networks. We use data from a longitudinal study of sexual and drug use ego networks. Results show 6% forgetting for 30-day sex partners, 18% for drug use partners, and 26% for close friends. Forgetting is decreased by behavioral specificity and salience. Forgetting increases with network size and time frame. In the domain of sex relationships, global estimates of network size, at least over a period of 30 days, are equivalent to estimates from partner naming 92% of the time if anonymous partners are accounted for.

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## 1. Introduction

Network studies, whether structural studies of social networks or relationship studies of ego networks, depend on the accuracy of informants' self-report data (Marsden, 1990; Tourangeau et al., 2000). In turn, the accuracy of informants' self-reports will determine the accuracy of inferences drawn from such data (Brewer and Webster, 1999; Stone et al., 1999; Wasserman and Faust, 1994). Sometimes all potential network members are known to the investigator (e.g., a list

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\* Corresponding author. Tel.: +1 317 278 1336; fax: +1 317 278 3654.

E-mail address: [dcbell@iupui.edu](mailto:dcbell@iupui.edu) (D.C. Bell).

of employees for a company network). But in many cases there is no list and the investigator has to rely on informant free recall of alters.<sup>1</sup> In this paper, we will examine the accuracy of free recall using a unique dataset in which informants were interviewed about their networks up to 13 times at 3-month intervals. We will address two research questions. The first has to do with describing and explaining the forgetting of alters. The second question has to do with the relative accuracy of global estimates and naming as measures of network size.

### *1.1. Global estimates versus naming*

The simplest and most direct measure of ego network size is a global estimate, a single number produced by the informant as an estimate of the number of alters in a network (what Brewer et al., 1998 refer to as a “direct estimate”). Psychologists of survey response as well as network researchers have identified several ways an informant may produce a global estimate of network size. First, the estimate may be produced by implicit enumeration (Blair and Burton, 1987; Burt, 1987; McCarty et al., 2001; Sudman et al., 1996; Tourangeau et al., 2000). In this process, the informant mentally enumerates the alters and reports the count. Reports summarized by Tourangeau et al. (2000) suggest that, when informants provide a global estimate of the frequency of past behaviors, they use implicit enumeration about one-fourth of the time. Implicit enumeration appears to be more common in estimates of numbers of alters. When informants are asked to estimate the number of lifetime sex partners, they use implicit enumeration 70% of the time (including 28% who have kept a running tally in memory) (Brown and Sinclair, 1997, cited by Tourangeau et al. (2000)). In one network study, two thirds of informants reported using implicit enumeration to arrive at their global estimates, especially for small numbers of alters (Brewer et al., 1998).

In addition to implicit enumeration as a method by which informants directly estimate network size, Tourangeau et al. (2000) describe several other estimation methods, of which rates and impressions are relevant to network size estimation. Global estimation may be based on informants’ awareness of an average rate at which events occur (Blair and Ganesh, 1991; Menon, 1993), which is then converted mentally into an estimate of number of alters. Another general method of global estimation is for an informant to rely on a general impression (Tourangeau et al., 2000), which is essentially a matter of guessing. Impressions or guessing are often detectable as “heaping”, in which estimates tend to be clustered around common numbers such as multiples of 5 or 10 (Brewer et al., 1998; Conrad et al., 1998; Huttenlocher et al., 1990). Global estimates of the number of sex partners are likely to use round numbers when there are more than eight partners (Tourangeau and Smith, 1998).

As an alternative to asking for a global estimate of ego network size, a researcher may ask a study informant for a list of partners, an explicit naming of the network. Compared to global estimates, the naming method provides greater depth of information because the investigator can ask about each alter, but this depth comes at the expense of valuable interview time.

Both naming and global estimates are self-reports, and thus both are liable to potential biases. Both often involve the same recall process. As we have seen, most people who make global estimates of number of alters say that they carry out an implicit enumeration. Naming makes this

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<sup>1</sup> Since our concern in this paper is with informants’ self reports, when we say “network” without qualifier, we are referring to an informant’s ego network. We will use “alter” to refer in general to a person to whom an informant has a link of some kind. When we specify a particular kind of relationship, we refer to the alter as a “partner” or “friend”: sex partner, drug use partner, close friend.

enumeration explicit. Naming can lead to informant exhaustion as informants come to believe they have spent “enough time” retrieving names (Krosnick, 1991). However, since naming is more explicit and in network research is often under the gentle coercion of an interviewer, naming is inherently produced by enumeration (see a similar argument on interviewer demand in Schräpler, 2004).

## *1.2. Recall and forgetting*

Whether in naming or in global estimates, there are a number of potential biases in self-reports. An informant may guess at the size of their network without trying very hard to remember specific alters; they may forget one or more alters; they may omit alters because they do not know their names or identities; or they may intentionally or unintentionally conceal (or invent) some alters.

### *1.2.1. Alter recall*

When informants give a global estimate or when they are asked to name members of their ego network during interviews, the quality of the data collected depends on informants' ability to recall and report their alters. However, humans can be fragile measuring instruments. Studies comparing free recall to recognition of names from a list find that recall can be as low as 10% (Hammer, 1984) and as high as 90% (Brewer and Webster, 1999; Sudman, 1988). Using partner concordance as a way to identify successful recall, studies have found varying levels of agreement between informant and alter (52–85%) for high school buddies (Alexander and Campbell, 1964; Kirke, 1996), adult best friends (Laumann, 1969), and intimates (Hammer, 1984; Shulman, 1976). Research on partner concordance involving behaviorally based network alters have found agreement rates of 93% for sex partners, 82–83% for non-injection drug use partners, and 76–90% for drug injection partners (Adams and Moody, 2005; Bell et al., 2000). Studies using objective and independent measures of interaction have suggested that, for some kinds of relationships, respondents can recall fewer than half of all alters (Bernard and Killworth, 1977; Bernard et al., 1981, 1982; Milardo, 1989). Some of this research is summarized in Brewer (2000) and Marsden (2005).

### *1.2.2. Forgotten alters*

Some partners may be unintentionally omitted when an informant attempts to enumerate alters (Brewer et al., 1999). Omission can occur because of forgetting, a result of memory decay over time (Anderson, 1990; Sudman and Bradburn, 1982; Wixted and Ebbesen, 1991). For example, memory decay may be involved when self-reported frequencies of partner interactions tend to fluctuate more the greater the interval between event and recall (Catania et al., 1993; Kauth et al., 1991). We consider forgetting in greater detail below.

### *1.2.3. Anonymous alters*

In addition to forgetting, where an informant has previously known the requested information but has forgotten it, are those cases where the informant does not know the information. Ego network interview name generators usually ask for a name, nickname or initials. If the researcher is interested in friendships or advice networks, anonymity may not be a problem. Friendships are developed over time, so the case of a friend whose name is unknown is ordinarily rare. Similarly, people usually receive advice from others they know and respect. However, some theoretically and personally meaningful relationships may form with persons whom an informant cannot identify by name. For example, a one-time drug partner met in a park, or a one-night stand met at a bar

may be alters whose names are not reliably stored memory (Sudman and Bradburn, 1982) and may never even have been communicated. Informants are likely to omit such relationships from a global estimate or a list of names unless specifically asked about alters whose names are not recalled.

### *1.3. Sources of forgetting*

Leaving aside the problem of anonymous alters whose names are not known, there are a number of potential factors that can tribute to forgetting.

#### *1.3.1. Network size*

Forgetting can depend on network size (Brewer et al., 1999; Brewer and Webster, 1999). This principle suggests that when one has only one or two alters of a given type, it is relatively easy cognitively to keep track of them. However, as the number of alters increases, it appears to become increasingly difficult to recall additional alters. Behavioral estimates based on impressions are more likely as the number of events increases (Blair and Burton, 1987; Conrad et al., 1998).

#### *1.3.2. Behavioral specificity*

In addition to depending on network size, recall of alters also clearly depends on the type of behavior that constitutes the relationship (Sudman and Bradburn, 1982). Network name generators may ask about behavior-based relationships or about affective relationships (Campbell and Lee, 1991; Milardo, 1992; van der Poel, 1993). In their study using a 2-year time frame, Brewer et al. (1999) found higher levels of forgetting for drug injection partners than for sex partners. From the point of view of recall, behavioral links have the advantage that the distinction between link and non-link is relatively clear: either a behavior occurred or it did not. Kogovsek and Ferligoj (2005) report that responses to questions about behaviors of alters (frequency of contact) are more consistent and more accurate than emotional questions (closeness) (see also Clair et al., 2003; Harvey et al., 2004). Fischer (1982), for example, found a great deal of variation in how informants interpreted the term “friend”. Thus, an imprecise concept like friendship (Brewer and Webster, 1999) or acquaintanceship (Brewer, 1993; Sudman, 1985) may have higher levels of “forgetting” because of the indeterminacy of the threshold (where does the difference between “friend” and “not-friend” lie on the dimension of emotional closeness) or the indeterminacy of the alter’s relation to the threshold at any interview (is the emotional closeness to this alter above or below the cut-off). Furthermore, informants may have different thresholds for a given term (Feld and Carter, 2002; Kashy and Kenny, 1990). Against this pattern, Kirke (1996) found a high level of partner concordance over the terms “friend” and “pal” in her sample of adolescents in Ireland.

#### *1.3.3. Salience*

Certain name generators may refer to types of relationships that are highly salient and involving, and thus easier to remember than others (Sudman and Bradburn, 1982). Along these lines, Marsden and Campbell (1984) suggest that emotional closeness is the best conceptualization of strong ties. Stronger friendships relationships are more likely to be recalled than weaker ones (Brewer, 2000; Campbell and Lee, 1991; White and Watkins, 2000). Less salient and less absorbing interactions have been found to involve greater amounts of forgetting, such as telephone conversations (Milardo, 1989) and other day-to-day communications (Bernard and Killworth, 1977; Bernard et al., 1981). Stable relationships are more easily recalled (White and Watkins, 2000), as are higher frequency relationships (Burt and Ronchi, 1994). Because of salience, rare

events, high value events, and continuing events are most often recalled (Sudman and Bradburn, 1982). Thus, occasional partners and partners not very close to the respondent may be more likely to be forgotten. In their study using a 2-year time frame, Brewer et al. (1999) found higher levels of forgetting for drug injection partners than for sex partners (see also Bell et al., 2000).

#### *1.3.4. Time frame*

Network self-reports appear to be compounded of specific memory and enduring cognitive map (Freeman and Romney, 1987). Specific memories decay over time, as discussed above. Thus, recall of specific events has been found to be worse for events distant in time than for those close in time (Bernard et al., 1984; Graham et al., 2003). In compensation for memory decay, people often form cognitive structures in memory, and these structures may be enduring and powerful (Killworth and Bernard, 1976). My memory of whether we have met in the past week will be built up in part of my specific memory of individual interactions with you and my cognitive map which says that we “always” meet for lunch on Wednesdays. Recalled relationships may thus represent the long-term pattern of social relationships as recorded in the cognitive map (Freeman et al., 1987). Implicit enumeration of behavioral counts is less likely as the time frame increases (Burton and Blair, 1991). Blair and Burton (1987) report that episodic enumeration rarely occurs over time frames as long as 6 months. Bachman and O’Malley (1981) found that high school students reported higher rates of drug use for short time periods and tended to underestimate drug use over longer time periods. This pattern of time dependence in global estimates has been referred to as “telescoping”. Kogure et al. (2001) found that forward telescoping (overestimating recent events by including events from outside the time frame) occurred in a time frame of under 2 years, while backward telescoping (underestimating by considering only part of the time frame) occurred for events more than 3 years old (see also Bradburn, 1983; Prohaska et al., 1998). This pattern has been suggested to occur because persons have a sense of a “customary” or typical network (Brewer, 2000; Freeman and Romney, 1987; Hammer, 1984; Sudman and Bradburn, 1982). For example, to the extent that alters in one’s network may have episodic interactions, a global estimate with a short-term time frame may include some of the “customary” network members, even though there were no interactions within the time frame. Some empirical evidence has suggested that measures that tap into typical networks may have more predictive validity than short-term measures (Chang and Krosnick, 2003). When persons participate in joint drug injection or sexual behaviors, they are more likely to agree on their 6-month behaviors than on their 1-month behaviors (Bell et al., 2000).

#### *1.4. Implementation issues in collecting network data*

The information that informants provide depends on their knowledge and their motivation to be accurate. Since informants are engaged in a process that in most cases they have not chosen (they have been recruited by strangers to provide information to other strangers for reasons known only to strangers), their commitment to absolute accuracy must be considered to be problematic. Informants are usually willing to give some effort to the process of providing information, but they cannot be expected to be exhaustive in their accessing of mental information, especially with interview fatigue from long interviews (Knoke and Kuklinski, 1982).

In addition to the limits of informant effort and ability to be accurate, informants may sometimes be motivated by social desirability to provide inaccurate (biased) information. Research on computer-assisted interviewing has suggested generally that sensitive behaviors may prompt reticence from informants (Des Jarlais et al., 1999; Kissinger et al., 1999; Kurth et al., 2004),

although some studies have found mixed (Perils et al., 2004) or negative results (Couper et al., 2003). Sexual information may be especially problematic. It has been suggested that people feel threatened when asked to report on their sexual activities and thus hesitate to reveal their sexual behaviors to others (Bradburn, 1983; Catania, 1999; Catania et al., 1986; Herold and Way, 1988). On the other hand, other investigators have found that respondents can be quite forthcoming about their sexual behaviors (Kinsey et al., 1948, 1953; Laumann et al., 1994, 2004). When rapport with interviewers is high, respondents have been found to reveal 93% of their sex partners (Bell et al., 2000). Just as social desirability has been discussed as a possible influence on validity in sexual behavior self-reports, it has also been discussed in relation to drug and alcohol use. A study of drinking during pregnancy indicated that women reported higher during-pregnancy drinking rates 5 years after delivery than they had reported during pregnancy (Ernhart et al., 1988). For drug use, underreporting is more severe depending on the stigmatization of the drug. Marijuana use appears to be reported more validly than cocaine use in the general population (Harrison, 1995) and in arrestee populations (Fendrich and Xu, 1994; Mieczkowski et al., 1991).

## **2. Method**

Data for this study were collected as part of the longitudinal Risk Networks Study (RNS II), an investigation of relationships between a community (non-clinical) sample of drug-using and nonusing persons and their partners, and the effects of these relationships on HIV transmission risk. The RNS sample for the RNS II was drawn from two previously recruited samples: the Risk Networks Study (RNS) and the Hispanic Cocaine Users Study (HCUS). The RNS sample had been recruited through random walk and peer-driven recruitment methods (Bell et al., 2000, 2002) and the HCUS sample through targeted sampling (Montoya et al., 2003). RNS II recruited 150 persons from the RNS sample and 52 persons from the HCUS sample. One of the consequences of this study design, in which informants were interviewed over a period of up to 7 years, is that study informants tended to be stable in residence and in relationships. Informants' relationships were not limited to the kind of short-term relationships that often predominate in transient populations such as college students. Thus, non-family relationships had a mean duration of some 9.9 years and a median of 7.0 years. Sex relationships had a median length of 1.8 years; drug use relationships, 1.6 years.

At baseline each study informant was informed as to the actual purpose of the study, types of information requested, the amount of time required, and their right to refuse participation. Interviews were conducted in English in a private room in a field research center. All informants were over the age of 18, verified by a driver's license or similar document. All informants gave written informed consent and were reimbursed \$25 for their time for each interview. Study procedures were approved by the Affiliated Systems IRB.

The complete sample of 202 informants is described in Table 1. Slightly more than half the sample were male. More than half were African American, about a fourth were Hispanic, and one-sixth were Anglo. The majority of informants were over 40. Almost half the sample had not been employed in the 6 months before the interview; almost a fourth of the sample were identified behaviorally as gay, lesbian, or bisexual. An informant who ever described sex with a partner of the same gender at any wave of the study was coded as gay/lesbian/bisexual. In addition, informants who described no sex partners at any wave were coded as not sexually active. Most of the eleven informants who were not sexually active reported that they were not in the mood for sex; three informants used abstinence to protect against disease. Almost 84% of the sample were drug users, defined as users of cocaine, heroin, or methamphetamine. Nearly half had used marijuana, more

Table 1  
Sample characteristics

	Frequency (%) ( <i>N</i> = 202)
Gender	
Male	113 (55.9)
Female	89 (44.1)
Race	
African American	111 (55.0)
Anglo	33 (16.3)
Hispanic	57 (28.2)
Asian	1 (0.5)
Age at baseline	
20–30	24 (11.9)
31–40	67 (33.2)
41–50	77 (38.1)
51 and over	34 (16.8)
Employment, previous 6 months (baseline)	
None	98 (48.5)
Odd jobs	24 (11.9)
Part-time	20 (9.9)
Full-time	60 (29.7)
Sexual behavior (full panel)	
Only straight (heterosexual)	144 (71.3)
Ever gay/lesbian/bisexual	47 (23.3)
Not sexually active	11 (5.4)
Drug use last 30 days (multiple responses)	
None	33 (16.3)
Alcohol	147 (72.8)
Marijuana	95 (47.0)
Crack cocaine	112 (55.4)
Powder cocaine	49 (24.3)
Heroin	30 (14.8)
Methamphetamine	16 (7.9)

than half had used crack cocaine, and about a fourth had used powder cocaine in the previous 30 days.

The RNS II collected longitudinal data from informants at 3-month intervals for over 3 years. Attrition, incarceration, involvement in drug treatment, and other contingencies affected the number of subjects available for interview at any given wave. In all, 193 of the 202 informants participated in at least one follow-up interview (so that forgetting could be detected). Over half of the sample were interviewed at least 11 times out of 13 waves.

## 2.1. Measures

### 2.1.1. Individual-level data

At each wave, the data included a core instrument that collected individual-level demographic information and information on sexual activity and injection/non-injection drug use (crack cocaine, powder cocaine, heroin, methamphetamine, and other drugs). More detailed questions



were asked about drug injection and sex because of the study's focus on HIV risk. Informants were asked, "In the last 30 days, how many men/women did you have any kind of sex with?" (male and female partners were asked about separately). "Sex" was defined as anything that either partner thought of as sex. Informants were asked how many of these men/women were persons whose name the informant did not know or could not remember. In retrospect, we wish we had asked about global numbers of drug use partners and about those whose names were not known, but we failed to do so in this study.

### 2.1.2. *Relationship-level data*

The instrument employed several name generators, where informants were asked to name all their sex and drug use partners in the previous 30 days, as well as close friends ("the people you consider to be close friends"). Drug use partners were alters with whom the informant used drugs (specifically crack/cocaine, heroin, or methamphetamine) in the same place at the same time. Alters could be drug partners with or without sharing drugs or sharing equipment. Drug injection partners and non-injection drug partners were named. For each name generator, the informant was prompted for any more alters in the category until the informant could name no more. An alter could be named in multiple categories (e.g., both close friend and drug partner).

Data collection was conducted by a trained interviewer using computer-assisted personal interview (CAPI) methods. Computer-assisted interviewing allowed us not only to solicit alter names, but also to compare the list of names spontaneously recalled to a list of previously named alters, so that each successive wave of data collection provided an opportunity to detect whether a study informant forgot a previously named partner. After all alters were spontaneously named, informants were presented with the name of each alter named at any previous wave but not named at the current wave. In this way we were able to determine why any alter had been omitted from the list of spontaneously generated names. Each such alter was coded as "forgotten" (if alter was currently a partner) or as "not a current partner" (if alter fell into the categories of "haven't seen in 30 days, not in contact now", "haven't seen in 30 days, still in contact", or "have seen, but not a partner now"). Similar procedures for identifying forgetting have been used in other longitudinal studies (Morgan et al., 1997; Wright and Pescosolido, 2002).

There is a potential problem in free recall of alters across multiple waves of measurement, in that informants may use different names for the same alter. In our procedures, these name conflicts were caught when the informant was presented with the previously used name and identified this person as the same as one of the spontaneously named alters. Our software then assigned the previous alter's ID number and combined the two names for use in subsequent waves. Another issue occurred when an informant reported that they could not remember the previously named alter: the alter was coded "not a partner". Occasionally an informant would report that an alter had died. We recorded this, but we learned from experience not to remove an alter from the names list until they had been reported as dead three times.

Of course, there were occasions where a partner was not named because the informant did not know the alter's name. One of the goals of the analyses we report here is to explore this issue.

A series of questions was asked about each alter. Connection was operationalized by a set of six items asking how much the participant trusted, respected, cared about, did things for, was listened to, and told important things to the partner. Responses were recorded on a scale from 0 to 10. These responses were combined (as a mean) into a single measure of the level of emotional connection felt by the participant toward the partner ( $\alpha$  reliability = .92). Connection is a measure of emotional intensity within a relationship. In addition, for sex relationships, we asked whether sex was "for sex" or "a close emotional connection".



Interaction frequency was measured by the number of days in the past 30 days that the informant and partner had seen or talked to each other. Interaction frequency is a measure of behavioral intensity of a relationship. Relationship duration was measured for close friends as the number of months they had known the partner. Similarly, for sex partners, informants reported the length of the sex relationship, and for drug use partners the length of the drug-using relationship. Relationship type. For each relationship, informants reported whether the partner was a spouse, other family member (child, parent, other family), boyfriend or girlfriend, best friend, or acquaintance (friend, acquaintance, drug buddy or other).

Over 13 waves of the study, almost 14,000 observations were collected on various social network alters who were active partners at the time of the interview; in addition, there were over 19,000 observations where alters were reported as not having been partners in the previous 30 days. Some of these alters were never named after the first mention; some were named in every subsequent wave after the first mention; and others were named intermittently. Of the 191 informants who reported any sex, 189 described sex relationships with a total of 830 partners, of whom 305 were sex partners in more than one wave (four informants gave global estimates of one sex partner for at least one wave, but did not have a sex partner whose name they knew); 159 informants described drug use relationships with 1413 partners, of whom 461 were drug use partners in more than one wave; and 200 informants described close friendships with 3522 alters, of which 2307 were named as close friends in more than one wave. An examination of alters shows that 63% of sex partners were described as sex partners only once, even though the informant was reminded of them at each subsequent wave. Similarly, 67% of drug use partners and 34% of close friends were described only once. Only 16 alters were described as sex partners in all 13 waves even though 63 informants were interviewed all 13 waves.

### 3. Results

The analyses were designed around two research questions. The first question had to do with recall and forgetting. We examined forgetting as a function of network size, behavioral specificity, and salience. To do this, we examined recall and forgetting for three relationship domains: 30-day sex partners, 30-day drug use partners, and close friends. The second question had to do with the association between global estimates and named estimates of network size. We were able to examine this question only in the sex partner domain.

#### 3.1. Recall and forgetting

We consider for this analysis only those alters who had been named in a previous wave of the study (that is, we did not consider the wave in which the alter was first named, because we could not detect forgetting until a subsequent wave). Results of these analyses are given in [Tables 2 and 3](#). In these tables, results are weighted. That is, if a given alter was mentioned by a given informant  $n$  times (after the first mention), those mentions were weighted by  $1/n$  to avoid over-representing stable informants who participate in many interviews and stable relationships described in many interviews. This weighting method effectively gives higher weight to forgetting occurring in short-term relationships with only one or two recall/forgetting occurrences.

Recall and forgetting are related to number of partners in [Table 2](#). Results are presented separately according to the number of alters named at a given wave and the type of relationship. There were 166 informants who described 348 sex partners (after the initial mention) at 1243 occasions over the course of the study (because of weighting, each relationship has equal weight

Table 2  
Forgetting by domain

	Domain		
	Sex partner	Drug use partner	Close friend
Number of partners			
One partner	1.1%	7.3%	5.9%
Two partners	4.5	9.6	21.3
Three partners	5.5	15.6	29.5
Four or more partners	20.1	27.7	26.1
Relationship type			
Spouse	0.3%	0.5%	3.4%
Other family	–	19.4	23.1
Boy/girlfriend	2.7	3.7	4.4
Best friend	3.1	8.1	18.0
Acquaintance/friend	11.0	24.2	37.8
Meaning of sex			
Sex for sex	9.2%		
Sex for connection	3.3		
All partners	5.9	18.5	25.8
Number of informants	166	135	192
Number of partners	348	569	2483
Number of observations	1243	1376	8582

Note: Each relationship is weighted by 1/*n*, where *n* is the number of waves over which the relationship was observed.

no matter how many times mentioned). During waves where the informant described only one sex partner, the sex partner was forgotten (remembered only after an interviewer reminder) on 1.1% of those occasions (2 out of 803). On the 213 occasions where participants described two sex partners, only five partners were forgotten (4.5%). Forgetting increased as the number of partners enumerated increased. This measure of the percent of described partners who were forgotten is referred to by Wright and Pescosolido (2002) as a “forgetfulness bias coefficient”.

When a person had a single drug use partner, there was a 7.3% chance that the participant would forget them when they were naming drug use partners. If there were four or more drug use partners, there was a 27.7% chance that a partner would be forgotten. When participants were asked to name close friends, there was a small chance of forgetting a single partner (5.9%), but a larger chance of forgetting one out of two or more partners (21.3–29.5%). Thus we see similar patterns of increasing forgetting with increasing numbers of partners. Most statistical tests are deferred until the multivariate analysis below. Forgetting was greater for drug use partners (18.5% overall) than for sex partners (5.9%), and even greater for those who were named as close friends (25.8%). Across the three domains, we found that the rate of forgetting was lowest for spouses, and found increasing forgetting for boy/girlfriends, best friends, other family, and highest for acquaintances. This pattern was observed even for those named with the “close friend” name generator (37% forgetting of “close friends” described later in the interview as friends or acquaintances, and 23% forgetting of non-spouse family members). Using our question about whether sex was “for sex” or “a close emotional connection”, we found 9.2% forgetting (corrected for clustering) when sex was for sex and 3.3% when sex involved an emotional connection ( $\chi^2 = 19.6$ , d.f. = 1).

To gain an increased understanding of forgetting, we predicted the log odds of forgetting in a logistic regression analysis adjusted for clustering of waves within relationships (Table 3). Because

Table 3  
Predictors of forgetting

	Model I		Model II	
	Odds ratio	<i>p</i>	Odds ratio	<i>p</i>
Relationship domain (relative to drug use)				
Sex relationship	0.28	.001	0.23	.001
Close relationship	2.97	.001	3.11	.001
Relationship type (relative to spouse)				
Family member	4.67	.001		
Boy/girlfriend	1.13	.788		
Best friend	3.04	.001		
Acquaintance	7.05	.001		
Relationship quality				
Connection			0.96	.003
Relationship duration			0.99	.050
Interaction frequency	0.97	.001	0.96	.001
Gay/lesbian/bisexual	1.14	.075	1.14	.075
Control variables				
Wave number	0.95	.001	0.95	.001
Number of waves	1.01	.475	0.98	.059
Female	1.23	.001	1.22	.002
Age	1.02	.001	1.02	.001
Employment status	1.26	.024	1.27	.021
Black	1.05	.640	1.06	.569
Hispanic	1.19	.092	1.21	.067
Pseudo $R^2$	.096		.081	
Wald $\chi^2$	476.3 (d.f. = 15)		477.4 (d.f. = 13)	
<i>p</i>	<.001		<.001	

Log odds describe the relative probability of forgetting.  $N = 15,974$  observations; standard errors adjusted for 4346 clusters (alters).

of the collinearity between connection and relationship duration on the one hand and relationship type on the other, we have conducted two analyses. We omitted connection and relationship duration from Model I and omitted relationship type from Model II. The reference population for this analysis consisted of drug use relationships with spouses. Compared to these reference relationships, results showed that forgetting was significantly less likely in sex relationships (28% as likely) and significantly more likely in close relationships (2.97 times as likely). In Model I, spouses and boy/girlfriends were least likely to be forgotten and did not differ from one another. Family members, best friends and acquaintances were significantly more likely to be forgotten than spouses and boy/girlfriends, and were significantly different from one another. In Model II, emotional connection and duration of relationship significantly reduced forgetting. In both models, behavioral intensity of interaction reduced forgetting.

We examined several methodological and control variables. Forgetting declined over time (so that it was not a matter of informants learning to avoid naming alters over time to shorten the interview; in fact, this result may suggest that informants initially avoided naming some alters but learned over time that this strategy did not work). Forgetting did not differ significantly for stable informants who participated in more interviews. Women, older, and employed participants were more likely to forget partners than men, younger, or less fully employed participants.

Table 4

Estimated numbers of 30-day sex partners

	Men ( <i>n</i> = 106)	Women ( <i>n</i> = 85)	Always nonusers ( <i>n</i> = 28)	Sometimes nonusers ( <i>n</i> = 78)	Sometimes drug users ( <i>n</i> = 78)	Always drug users ( <i>n</i> = 85)
Number of sex partners						
Global estimate	1.44	1.97	0.90	0.84	1.66	2.26**
Raw named estimate	1.01	1.31*	0.84	0.80	1.10	1.40**
Corrected named estimate	1.43	1.90	0.85	0.82	1.67	2.18**
Full named estimate	1.44	1.91	0.85	0.83	1.70	2.20**
Correlation with global estimate						
Raw named estimate	0.61	0.48	0.93	0.98	0.40	0.50
Corrected named estimate	0.98	0.99	0.94	0.99	0.98	0.99
Full named estimate	0.98	0.99	0.94	0.99	0.99	0.99

\*  $p < .05$ , \*\*  $p < .01$ .

### 3.2. Naming versus global estimates

The second question we addressed was the correspondence between global and naming estimates of network size. Unfortunately, we had the complete data to conduct this detailed analysis only for sex partners.

We compared the global estimate of the total number of sex partners to three estimates based on naming. The “raw named estimate” was the number of spontaneously recalled sex partners. The “corrected named estimate” was the sum of the number of spontaneously recalled and anonymous partners. The “full named estimate” was the sum of the number of recalled, anonymous, and forgotten partners. Table 4 shows how these four estimates of sex network size differed by gender and by drug use. Observations for each informant were weighted by the inverse of the number of waves the informant was interviewed. Men’s and women’s global estimates did not differ significantly, but women named significantly more sex partners than did men. This difference lost significance when anonymous partners were added. Raw named estimates were not reliable proxies for global estimates for men or women ( $r = .61$  and  $.48$ ).

Table 4 also examines the effect of drug use on estimated number of sex partners. The first and fourth categories are informants who were either always nonusers (of cocaine, heroin, or methamphetamine during the previous 30 days) or always users. The middle two categories involve 78 informants who sometimes reported no drug use and sometimes reported drug use. The “sometimes drug use” column refers to their report of sex partners during the waves when they were currently drug users. All four measures of sex network size differed significantly by drug use. Sex networks were smaller when informants had not been using drugs and larger when they had been using drugs. The raw, spontaneous named estimate is a reliable proxy for the global estimate of sex partners for nonusers ( $r = .93$  and  $.98$ ), but not for drug users ( $r = .40$  and  $.50$ ). The large size of sexual networks in these data for drug users are probably related to the predominant use of cocaine, a stimulant, in Houston.

Table 5 shows a further comparison of the estimates of network size. We see that the raw named estimate (spontaneously recalled) differed from the global estimate 12.5% of the time, and when it differed it gave an estimate higher than the global estimate about one-fifth of the time and lower four fifths of the time. The corrected named estimate (recalled + anonymous) differed 8.2% of the time with little imbalance between underestimates and overestimates of the global estimate. We

Table 5

Discrepancy between global and named estimates of 30-day sex partners

	Raw		Corrected		Full	
	Discrepant	Discrepancy	Discrepant	Discrepancy	Discrepant	Discrepancy
Named estimate higher	2.6%	−1.06	3.2%	−1.13	3.7%	−1.18
Named and global estimates equal	87.5	0	91.8	0	91.7	0
Global estimate higher	10.0	5.62	5.0	1.60	4.6	1.61
All observations	12.5	0.53	8.2	0.04	8.3	0.03

Note: Raw = raw named estimate; corrected = corrected named estimate (raw + anonymous partners); full = full named estimate (corrected + forgotten partners). Totals do not always add to 100% due to rounding.

found that the raw estimate omitted on average 0.53 sex partners relative to the global estimate, while the corrected estimate omitted 0.04 partner.

We performed a series of logistic regression analyses (not shown) where the dependent variable was whether there was a discrepancy between the named estimate and the global estimate (ignoring direction of the discrepancy). In these analyses, waves were clustered within informants. These analyses, using the raw, corrected, and full named estimates each gave the same result: a significant positive effect of the number of sex partners on whether there was a discrepancy (raw, OR = 1.55; corrected, OR = 1.56; full, OR = 1.73; in each analysis,  $p < .001$ ). In addition, gay/lesbian/bisexual informants displayed a greater discrepancy between named and global measures (raw, OR = 2.21; corrected, OR = 2.42; full, OR = 1.95; in each analysis,  $p < .03$ ), as did drug users, but only for the raw estimate (OR = 2.31,  $p < .01$ ). These results are similar to those reported by Brewer et al. (1999, 2005).

#### 4. Discussion

When trying to measure the size of ego networks, researchers face potential biases in informant self-reports, depending on method, population, and domain. The researcher's methodological choices can reduce some of the bias.

##### 4.1. Network size

We have seen that the rate of forgetting increases as network size increases. This result is consistent with the effect of network size reported in other studies of network recall (Brewer et al., 1999; Brewer and Webster, 1999) and of the recall of events (Blair and Burton, 1987; Conrad et al., 1998). We found that the discrepancy between global and named estimates was both small and relatively balanced for the corrected (spontaneously recalled + anonymous) and full (recalled + anonymous + forgetting) named estimates, while the most frequent and most imbalanced discrepancy was between the raw named estimate and the global estimate. Based on these discrepancies, we infer that informants who give a global estimate of network size do not generally construct a complete internal list of alters except when there are only a few alters. Nevertheless, even though global estimates for larger networks are guesses, they tend to be quite consistent with full detailed estimates that consider named as well as anonymous alters. If concern is to learn about relatively small networks, then measurement of such networks by either enumeration or global estimation should suffer little loss of information as long as there are no anonymous alters.

However, attempts to identify larger networks are likely to suffer from higher levels of forgetting. Whether forgetting in large networks is substantively important will depend on one's research goals.

#### 4.2. *Behavioral specificity*

Behavioral specificity tends to reduce forgetting. Both sex partners and drug use partners showed lower amounts of forgetting than alters identified as close friends by a name generator. One reason for this difference in level of forgetting is likely to be the greater behavioral specificity of sex and drug use relationships compared to close relationships. Other investigators have found similar recall benefits for behaviors over emotions (Clair et al., 2003; Harvey et al., 2004; Kogovsek and Ferligoj, 2005). Furthermore, we have established that it is the behavior of drug use that affects forgetting, not some characteristic of persons who use drugs. Differences in forgetting of sex partners between drug users and nonusers were consistent for both global and named estimates of sex partners. Because we had 78 persons who used drugs on some waves and not on others, we were able to determine that the differences in sex partners was because of current drug use and not because of a general factor that differentiated those who ever use drugs.

From the point of view of recall, behavioral relationships have the advantage that the distinction between relationship and non-relationship is relatively clear. Relationships, on the other hand, that are characterized by feelings may be more difficult to distinguish, because closeness depends more on how one feels about a partner than what one has done with the partner.

At the same time that specificity improves recall, certain types of behavioral specificity may be problematic because of social desirability (Catania, 1999; Catania et al., 1986; Herold and Way, 1988). Considerations of social desirability might have been expected to contribute to a greater discrepancy between global and enumerated estimates for gay/lesbian/bisexual informants than for straight informants. Although a trend in this direction was found in these data, the effect was not significant. Nevertheless, special care may need to be taken with this population because of stigma associated with gay sex.

#### 4.3. *Salience*

The third element in recall and forgetting is salience. Our results show that sex partners, highly salient alters, are reported more reliably (with less forgetting) than drug use partners, as others have also found (Brewer, 2000; Brewer and Garrett, 2001; Brewer et al., 1998, 1999). It seems reasonable that this is because sex relationships are more emotionally involving in general than drug use relationships. In support of this notion, we found more forgetting when sex was just "for sex", compared to when sex was part of a close emotional relationship. Our two statistical models used different variables to account for type of relationship. The results from using descriptive categories of spouse-boy/girlfriend-best friend-acquaintance-family were essentially the same (although with larger level of variance explained) as when we used more parsimonious theoretical concepts of emotional connection, indicating that relationship type was largely a proxy for emotional closeness, as similarly suggested by Marsden and Campbell (1984).

An apparent contradiction to the importance of salience arose in these data. Close friends, a name generator associated with emotional closeness, showed the highest levels of forgetting. In our sample of adults from high drug use neighborhoods, 21% of all alters (and 53% of non-family alters) whom informants named as a "close friend" later in the same interview were classified as "friend", "acquaintance", or "drug buddy" (which we classified together as acquaintances). We

also found a range of forgetting among those identified as close friends from 3 to 4% forgetting for spouses and boy/girlfriends compared to 38% forgetting of acquaintances. If all “close friends” involved emotional closeness, there are clearly differences in the emotional quality of these relationships. We suspect that the high level of “forgetting” of family members was not true forgetting but reflected an inference by informants that, in our interviews focusing on HIV risk, we did not “really” want to know about family.

We suspect, although we have no direct data, that the comparability of the global and named estimates in our data depend on both the behavioral specificity of the sex domain as well as its emotional salience. We suspect that as the cognitive and emotional complexity of the measurement domain increase, global estimates will become weaker and weaker approximations of named data (corrected for anonymous alters).

#### 4.4. *Time frame*

The fourth element in the accuracy of informant reports of network size is time frame. Our results show, at least for sex relationships in the past 30 days, that global and named estimates of network size are comparable when anonymous partners are accounted for. The effect of forgetting appears to be particularly serious for global estimates within long time frames, when we compare our results with other studies. [Brewer et al. \(1998\)](#), looked at data from studies in two cities, in which informants described partners over 6 months (Colorado Springs), and 1 year and 2 years (Seattle). Although Brewer did not subject the differences to statistical analysis, he reported that for a 6-month time frame the named estimate was lower than the global estimate, while for 1-year and 2-year time frames, the named estimate was higher than the global estimate. In our results with a 30-day time frame, we found that raw named estimates, when inaccurate, were almost four times more likely to be lower than global estimates. Thus, while informants may tend to miss partners (“guess low”, backward telescoping) in their global estimates when the time frame is long (and recall them as they provide names), it appears that when the time frame is short, informants tend to “guess high” (forward telescoping). Since research has shown that most informants attempt to conduct an implicit, silent enumeration to produce a global estimate ([Brewer et al., 1998](#)), it appears that this implicit global enumeration is especially sensitive to forgetting of relationships distant in time.

#### 4.5. *Limitations*

There are a number of potential limitations to this study. In the first place, this study takes place in a single city, so we do not know if forgetting is different in Houston from other locations. Second, we have only asked about certain kinds of relationships, so we cannot be sure that we would not have gotten different results from a different set of relationships. Furthermore, we only have global estimates for one of the relationship domains we studied. However, the relationship domains we studied vary in predictable ways along the theoretically meaningful dimensions of network size, behavioral specificity, and salience. Of course, since we do not know how many alters an informant has independently of the informant’s report, we cannot make definitive statements about absolute accuracy. We have, however, been able to make some estimates of the comparative validity of global and naming approaches.

One reason for the apparently low level of forgetting and moderate level of guessing may be the nature of our sample. Much of the literature on the threatening nature of sex partner questions appears to be concerned with largely middle and working class samples with informants with



what may be thought of as “conventional” moral standards. At the same time, surveys on sexual behavior by Kinsey et al. (1948, 1953) and Laumann et al. (1994, 2004) have shown that such data can be collected. Our sample, in contrast, is drawn from low income high drug use neighborhoods and consists of over four fifths “hard” drug users (cocaine, heroin, methamphetamine). Our drug users and the nonusers who live nearby do not seem to share the hypothesized reluctance to discuss sexual matters described for other populations. Our interviewers are not students, but are professional interviewers comfortable in these neighborhoods with this population. Our study informants not only seem to have little difficulty telling us who their sex partners are, but also describe their sexual behaviors in considerable detail and with considerable reliability (Bell et al., 2000; Dowling-Guyer et al., 1994; Needle et al., 1995).

Another limitation of our method is that we could not identify forgotten partners in short-term relationships. A person had to be a partner at two waves 3 months apart in order for them to be identified as forgotten. A “one-night stand” or a 1-month relationship, if forgotten, could never be detected unless the person became a partner named at a later interview. In this sample, a majority of both sex and drug use partners were reported only once. Not quite all of the one-mention alters were necessarily in short-term relationships, because some of them were described by the small number of study participants who were interviewed only one or two times.

Another potential limitation could result from our research design. One issue that can come up in a longitudinal study, especially a study with a sample from a comparatively recalcitrant population such as drug users, is that study informants have learned that every alter named will require a certain amount of time and effort to answer questions about that alter. As a result, one acknowledges that study informants can perceive an advantage to limiting the number of alters they name in order to shorten their interview. Thus, at least some of the alters who were “forgotten” may have been persons that the informant did not want to spend time talking about in the current interview. However, our procedure for catching such intentionally “forgotten” alters found little evidence for such suppression. Results showed that, contrary to this argument, informant forgetting *declined* rather than increasing over time. Furthermore, the low level of discrepancy between global estimates (with little overhead related to size) and enumerated estimates also argues against study self-censorship. Obviously, if an informant deliberately and consistently withheld a given alter, the alter would not be detected as forgotten, and this would introduce a bias to the list of named alters. However, our longitudinal data suggest that this may not be a major problem, at least in the population we studied. Informants would have had to remember, from wave to wave over a period of over 3 years, which alters to “forget”. While such a level of consistency is possible, it is not very plausible among heavy drug users.

#### 4.6. Recommendations

The results of the analyses reported here underline the importance of both theory and experience for measurement decisions. There are methodological decisions that one might make in order to improve recall and limit forgetting, but in some cases these decisions might thereby compromise one’s research aims. If one’s theory only requires the size of a network and does not require details about the relationships of which it is composed, then the global estimate seems to be as accurate as a corrected named estimate (including anonymous alters), at least for salient behavioral networks like sex networks. The ease of global estimates in terms of respondent burden also recommends the global method when only overall network size is needed.

At the same time, the amount of information that can be collected from naming methods recommends the naming method if this information is important to the research even though

the effort from investigator, interviewer, and especially the informant can be much greater. If much information is collected on each alter, informants may become inattentive or resentful as the interview continues. A compromise between global and naming methods may be possible. Instead of asking in detail about each alter, the investigator could define theoretically meaningful subsets of alters and ask about each subset separately. For example, the investigator could ask for global estimates of the number of “main” sex partners (who might be defined as emotionally committed, intended long-term partners), regular sex partners (frequent but not committed), and casual sex partners (infrequent) and then ask questions about these types of partners rather than about each individually. For this method to work, the theoretically defined subsets will have to be empirically homogeneous so that information provided about each subset will be meaningful.

If the investigator wishes to know both details about relationships and the overall network size, it is clear from our results that using a names list alone will be inadequate for those kinds of networks where names may be unknown or forgotten. In these cases, we recommend asking explicitly about the number of alters whose names are not known. One could ask, as we did, the number of alters “whose names you do not know or cannot remember”, or number of alters the informant “could not recall or did not want to mention” (Brewer et al., 1999).

In cases where alter naming is to be used, we recommend that global estimates be taken first and used as a general target for naming. A good strategy is to get a global estimate and then to continue to encourage recall up to that point, and then to continue urging recall to some extent after that point (Brewer et al., 2005). This strategy may be particularly important for behaviorally unspecific relationships like friendship. We recommend that in all panel studies of social networks informants be presented with previously described partners to minimize forgetting and also to learn the nature of network turnover. Since the amount of actual forgetting was low for behavioral partners, the expense of longitudinal data collection simply to detect forgetting would seem to be unjustified in most cases for such networks. This procedure, of course, requires that investigators solicit identifiable names, requiring substantial efforts to maintain confidentiality of this information on the part of researchers.

One’s theoretical goals may determine the extent to which one can methodologically improve precision. Short time frames, behavioral specificity, high salience, and small network size may be useful goals from the point of view of minimizing forgetting, but the feasibility of meeting these goals may depend on experience and theoretical focus. Small networks are feasible if one is studying sexual networks, unless one wishes to study prostitutes or some stimulant drug users (e.g., crack cocaine or methamphetamine) where large sexual networks are common. Behavioral specificity will improve recall, and if one wishes to study sexually transmitted diseases, the transmission of salient and identifiable pieces of information, or enacted social support, one can probably count on relatively good recall. However, if one’s theoretical interest is in stress, environmental diseases, potential power, or potential social support, then behavioral data may be unavailable or of low validity.

The time frame of network measures can be important. We found little discrepancy between global and named estimates (controlling for anonymous partners) for a 30-day time frame. Other researchers have found much greater discrepancies over larger time frames. However, time frame may be dictated by the investigator’s research question. In our research, we attempted to maximize both theoretical and measurement precision by using a 3-month repeated longitudinal design with a 30-day measurement window. We felt that the 30-day window would lower respondent burden for persons with changing networks and that we would recoup the loss of information with repeated longitudinal measurements. Of course, our method cost a few million dollars over the length of the study. On a more limited budget, we would have made different decisions.

The integral association of theory and measurement is clear in domains like friendship. If one is interested in a construct like friendship, one might find that it is difficult to specify a comprehensive set of relevant behaviors (McCallister and Fischer, 1983). One may choose to use an imprecise name generator like “Name your friends” instead. On the other hand, much of the imprecision in the concept of friendship lies in notions of friendship that differ among informants (Fischer, 1982). We recommend against a name generator like “close friend” (at least in adult samples like ours) unless additional information is collected on type of relationship in order to interpret the meaning of the name generator to the informant. The uninterpreted name generator seems to have such a broad range of meanings in our adult sample as to be potentially theoretically meaningless. Additional research is needed to determine whether our experience with the “close friend” name generator is a general phenomenon, whether it is characteristic of low income or drug-using populations, or whether it is a local phenomenon in Houston. Even when explicitly defined, a concept like friendship may not have an empirical metric. However, if one can formulate the concept of friendship in a theoretically precise way that can be communicated to the informant (e.g., whether friendship refers to short-term mood, medium-term feelings, or long-term persistence), then the imprecision of the informant’s threshold level for the concept can be reduced.

This discussion has considered some of the ways that theory and measurement work together in successful research. In many cases, it will be true that theoretical goals will trump measurement goals. It will often require creative invention of new measures and new measurement techniques to narrow the theory-measurement gap. Furthermore, imprecision can never be eliminated from measurement, so it is important to develop new techniques to measure the level of precision. For example, our longitudinal design and computer-assisted access to prior interviews allowed us to measure the level of forgetting in three domains of relationships. These estimates can thus be used in statistical analyses to adjust for forgetting using methods that are beginning to be developed (Handcock and Jones, 2004). Thus, investigators can have in their research arsenal techniques for reducing measurement imprecision such as forgetting and adjusting for the unavoidable imprecision that remains.

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