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Forgetting in the recall-based elicitation of personal and social networks

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Abstract

Forgetting in the recall-based elicitation of personal and social networks poses a potentially significant problem for the collection of complete network data and unbiased measurement of network characteristics and properties. A comprehensive review of the literature shows that forgetting is a pervasive, non-trivial phenomenon in the recall-based elicitation of personal and social networks pertaining to a broad variety of social relations. There appear to be no good predictors of individuals' proportional level of forgetting, although the number of persons an individual recalls is moderately positively correlated with the number of persons he or she forgets. People seem to be more likely to forget weak ties than strong ties, but the evidence is mixed on this point. In any event, people still forget a significant proportion of their close contacts. Non-specific prompting for additional relevant persons, multiple elicitation questions, and re-interviewing enhance recall slightly to moderately and are the only methods currently available to counteract forgetting, albeit only partially.

When researchers collect data on personal and social networks, they often ask people to recall others to whom they are tied in some way (Marsden, 1990). A potential problem with such recall data is that individuals may forget relevant persons in response to network elicitation questions (Poole and Kochen, 1978). Forgotten network ties would make recalled network data incomplete and possibly distort measurement of various characteristics and structural features of personal and social networks. With respect to forgetting and related concerns about recall data, Hammer (1984) called for more ''...research to clarify the principles that underlie the responses we elicit at social network interviews'' (p. 369). She noted that persons recalled in network elicitation tasks are *samples* of the set of all persons who could be appropriately named and emphasized that researchers must take this fact into account in interpreting network data.

Accordingly, in this paper, I first review the literature comprehensively to assess the extent and patterns of forgetting in recall-based elicitation of personal and social

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Table 1
Summary of estimated levels of recall across studies

Study	Sample	Relation	Mean proportion recalled
Recall vs. recognition			
Bahrick et al. (1975)	50 recent high school graduates, USA	knowing (among high school classmates)	0.16 (matching and recognition) 0.22 (picture cues)
Hammer (1984)	16 participants, USA	close and/or regular contacts (recall), knowing (recognition)	0.10 (overall) 0.42 (know well) 0.57 (see > weekly)
Sudman (1985)	98 church members, USA	acquaintanceship (among church members)	0.16
	24 church members, USA	acquaintanceship (among church members)	0.35
	nine social club members, USA	acquaintanceship (among church members)	0.86
	five work group employees, USA	acquaintanceship (coworkers)	0.90
	four work group employees, USA	acquaintanceship (coworkers)	0.56
	20 work group employees, USA	acquaintanceship (among coworkers)	0.67
	10 work group employees, USA	acquaintanceship (among coworkers)	0.55
	eight work group employees, USA	acquaintanceship (among coworkers)	0.57
Sudman (1988)	78 residents of Decatur and Peoria, IL, USA	neighbors	0.61 (acquaintances) 0.91 (friends) 0.92 (close friends)
Hlebec (1993)	11 university student government members, Slovenia	informal discussion (among student government members)	0.81
Seamon and Travis (1993)	18 university professors, USA	students in current and past semesters	0.25–0.96 (picture cues)
Brewer (1993)	12 graduate students, USA	acquaintanceship [knowledge of] (among fellow students)	0.65
Brewer (1995a)	13 work group employees, USA	acquaintanceship [knowledge of] (among coworkers)	0.75
Brewer and Webster (1999)	217 university dormitory residents, Australia	friendship (among dormitory residents)	0.80 (overall) 0.97 (best friends) 0.91 (close friends) 0.74 (friends)

Table 1 (continued)

Study	Sample	Relation	Mean proportion recalled
Test–retest			
Barrera (1980)	45 undergraduates, USA	six categories of social support; testing interval = 2–3 days	0.90 (overall) 0.78–0.87 for specific support relations
Moxley (1988)	29 psychiatrically disabled persons, USA	personal network members (unspecified); mean testing interval = 7 days	0.90
Schwarzenbacher and Baumann (1990)	30 adults, Austria	personal and social support network members; testing interval $= 7 \pm 2$ days	0.78–0.92 for specific support relations
Tracy et al. (1990)	22 primary caregivers in ''at-risk'' families, USA	important persons; testing interval = 2–4 weeks, mean = 20 days	0.85
van Groenou et al. (1990)	69 adults, the Netherlands	important persons; testing interval = 4 weeks	0.78
Veiel (1990)	71 undergraduates, Germany	social support network members; testing interval = 4 weeks	0.99 for kin 0.92 for non-kin
Arnold (1994)	29 single mothers with young children, Germany	social support network members; testing interval = 2–4 weeks	0.81 overall 0.71–0.83 for specific support relations
Brewer et al. (1999a)	156 persons at high risk for sexually and parentally transmitted infections, USA	sexual partners, drug injection partners for recall periods of 1 or 2 years	0.75–0.86 for sex partners 0.61–0.78 for injection partners; other methods indicate 0.40–0.93 for sex partners and 0.28–0.87 for injection partners

networks pertaining to diverse types of social relations. I then make several conclusions about forgetting and note implications for the collection and interpretation of recall-based network data.

Studies of forgetting typically involve one of three general types of research designs: comparisons between recall and recognition data, comparisons between recall data and objective records of interaction, and comparisons of recall data elicited in two separate interviews within a short period of time. Individuals' responses to prompts and cues in network elicitation interviews provide supplemental evidence of forgetting. While many of the studies I review here were not designed to examine forgetting specifically, their

results indicate that forgetting is a pervasive and significant phenomenon in the elicitation of personal and social networks. (See Table 1 for a summary of most of the studies reviewed in this paper.)

1. Recall vs. recognition

Comparisons between recall and recognition data provide a powerful and direct means for studying forgetting. Bahrick et al. (1975) interviewed 50 subjects a few months after they graduated from high school in Ohio, USA. The mean proportion of high school classmates that subjects recalled is only 16% of the mean proportion of classmates they later recognized correctly in picture and name matching and recognition tests and 22% of the mean proportion of classmates correctly recalled in response to picture cues. Other cohorts of subjects who graduated from high school 1 to 50 years prior to the interview showed similar levels of forgetting. Bahrick et al. (1975) also found that subjects were more likely to recall classmates who were close friends than those who were only acquaintances.

Hammer (1980; 1984) conducted two studies based on sampling designs that are variants of the random walk procedure (Klovdahl et al., 1977). Subjects recalled persons in response to various personal network elicitation questions. After the recall portion of the interview, the interviewer presented each subject with a list of other persons who were mentioned by other subjects interviewed earlier in the sampling process, and asked the subject to indicate which of these persons she or he knew. Hammer (1984) found that the proportion of all ties that were recalled (aggregated across her 16 subjects) is only 0.10. These subjects recalled 42% of persons known very well, 33% of persons seen in the last week, and 57% of persons seen more than once a week. Subjects forgot 21% (i.e., recalled 79%) of persons known very well, seen more than once a week, *and* seen in the last week. There were no differences between men and women in forgetting ties within frequency and recency of contact categories. Hammer (1980; 1984) observed that persons known well and seen frequently and recently were more likely to be recalled than persons not known well and those not seen frequently or recently. Her estimates of the proportion of ties recalled, though low, are likely to be underestimates because the list of persons presented to subjects probably did not identify all of their potential ties (e.g., a subject might have known other persons not mentioned by any of the other subjects).

Sudman (1985) described an extensive study in which members of social and work groups and churches in Illinois, USA, were asked to recall acquaintances who belonged to their respective groups and churches (ranging in size from 18 to 283 members). After a subject free listed as many of his or her acquaintances in the group that he or she could, the interviewer prompted the subject to recall other acquaintances by cueing with specific social situations and relations. Following the recall portion of the interview, the interviewer read the names of all persons who belonged to the subject's group and asked the subject which persons he or she knew. Across these eight socially bounded communities, the mean number of acquaintances recalled ranges from 16% to 90% of the mean number of acquaintances recognized. The ratio of the mean number of recalled

acquaintances who were considered friends to the mean number of recognized acquaintances who were considered friends actually is lower for each of the eight communities than the corresponding ratio for acquaintances only. In other words, friends were *less* likely to be recalled than persons merely considered acquaintances. Interviewers also asked subjects to explain why they recognized some acquaintances but did not recall them. The primary reason subjects gave was that they ''did not think of them,'' which Sudman (1985) interpreted as random forgetting. The second most frequently cited reason was the small amount and short length of interaction subjects had with the forgotten acquaintances.

Sudman (1988) described a study in which 39 residents of Decatur and Peoria, IL, USA, were asked to recall their neighbors. After subjects finished recalling neighbors, interviewers gave subjects the names of neighbors and asked them to indicate those they recognized. The mean numbers of recalled neighbors who were considered acquaintances, friends, and close friends are 61%, 91%, and 92% of the mean numbers of recognized neighbors who were considered acquaintances, friends, and close friends, respectively. For both of the Sudman studies, the estimates of the proportion of persons recalled are only approximate because they are based on mean numbers recalled and recognized, as opposed to the mean proportion of persons recalled by individual subjects.

Hlebec (1993) interviewed 11 members and advisors of the University of Ljubljana (Slovenia) student government. Subjects first recalled other members and advisors with whom they discussed student government matters informally. Later, on a written list of all members and advisors, they indicated those with whom they discussed student government matters informally. On average, subjects recalled approximately four-fifths of the members and advisors with whom they reported having discussed government matters informally (mean = 0.81, median = 0.80, s.d. = 0.20, range = 0.33 to 1.0).

Seamon and Travis (1993) studied university professors' memory for students in their current and past semester classes (class sizes ranged between 18 and 62). For two sets of nine professors, the mean proportions of students who they freely recalled range between 25% and 96% of the mean proportions of students who they correctly recalled in response to picture cues.

Brewer (1993) interviewed 15 students in an interdisciplinary social science graduate program at the University of California, Irvine, USA. Subjects recalled other students in the program and later indicated the students they recognized in a pile sort task. On average, subjects recalled about two-thirds of the students they recognized ($n = 12$, mean and median proportion recalled = 0.65, s.d. = 0.14, range = 0.41 to 0.84). Forgotten persons tended to be in program cohorts more chronologically distant (and presumably more socially distant) from a subject than recalled persons. Brewer (1995a) interviewed 13 employees in the public relations department of a southwestern U.S. university. Subjects recalled their fellow employees in the department and later reported which employees they recognized in a pile sort task. On average, subjects recalled three-quarters of the employees they recognized (mean proportion recalled = 0.75, median = 0.74, s.d. = 0.09, range = 0.60 to 0.91). Forgotten persons were more likely to be part-time employees, on leave, have begun working in the department recently, and have an office away from the main department office.

Brewer and Webster (1999) reported a detailed study of forgetting of friends and its consequences on measuring friendship networks. All 217 residents of an Australian university dormitory first recalled as many of their friends in the dormitory as they could. Then, on a complete list of dormitory residents, these subjects indicated other friends they forgot to recall. On average, subjects forgot 20% of their friends. Twenty-six percent of subjects who had a close or best friend forgot one or more close or best friends. Subjects' age, sex, and years of residence in the dormitory were unrelated to the proportion of friends forgotten. However, the number of friends recalled correlated moderately with the number of friends forgotten ($r = .44$). Recalled and forgotten friends did not differ appreciably in terms of several characteristics (sex similarity to subject, proximity of friend's room to subject's room, length of residence in dormitory, similarity to subject in length of residence in dormitory, and betweenness/closeness/degree/information centrality in the dormitory social network). Forgotten friends were slightly more peripheral in subjects' personal networks than recalled friends. Subjects on average had modestly closer relationships with recalled friends than forgotten friends, as indicated by reciprocated friendship choices and subjects' ratings of relationship strengths.

Brewer and Webster (1999) also found that forgetting had little influence on mean levels of personal network density. In addition, personal network size and density based on recalled friends only were fairly good proxies (in correlational terms) for personal network size and density based on recalled and forgotten friends combined (rs between 0.89 and 0.93). However, forgetting affected the measurement of some social network structural properties, such as density, number of cliques, betweenness/closeness/degree/information centralization, and individuals' closeness centralities. That is, observed values on these structural measures were notably different for data based on recalled friends only and data based on recalled and forgotten friends combined.

2. Recall vs. objective records

Comparisons between recall data and objective records of interaction also yield straightforward indications of forgetting. Bernard et al. (1982) interviewed 57 scientists who used an early version of electronic mail. Over a 5-month period, subjects participated in a number of interviews in which they were asked to list the others they had communicated with via electronic mail for specific periods varying in length and recency. All electronic mail communications (except content) involving any of the subjects were recorded unobtrusively by computer. Across subjects and interviews, the mean proportion of persons actually communicated with during the recall period for a particular interview who were *forgotten* is 0.66.

In two separate studies, Freeman and Romney (1987) and Freeman et al. (1987) observed who attended a particular colloquium session that was part of a university colloquium series. In each study, a few days after the session, those who attended were asked to recall all the persons who were present at the session. The researchers noted that subjects forgot many persons who were present (the results reported do not specifically indicate the proportion of attendees who were recalled).

3. Test–retest recall interviews

Comparisons of recall data from two separate interviews within a short period of time offer a third means for estimating the degree of forgetting. While test–retest designs are not nearly as strong as the others already discussed, they often provide the only practical way for estimating forgetting for particular types of relations. Some of the differences between the sets of persons mentioned in response to network elicitation questions during different interviews may reflect genuine changes in network membership. However, if the interval between interviews is short (1 month or less), forgetting likely accounts for most of the persons who are listed in one interview but not the other. Test–retest studies are also likely to underestimate forgetting, because they lack definitive information on other persons who might have been forgotten in both interviews (since they are based on recall data only and do not involve comparisons with more complete data based on recognition or objective records of interaction).

To compute the level of forgetting for most of the test–retest studies I review here, I first assumed that any person mentioned in one interview but not the other was forgotten in the interview s/he was not mentioned. All test–retest studies I included did not limit the number of persons that subjects could list. I also assumed that the levels of forgetting and number of persons recalled were equal across interviews. In fact, the numbers of persons mentioned in the two interviews were very similar in the studies that reported such results. (A quantitative summary of these results is not possible due to the different ways researchers reported their results.) Thus, persons who are recalled in the second but not the first reflect the phenomenon of reminiscence (i.e., when somewhat different information is recalled on separate occasions in response to the same question) (Brown, 1923). In addition, the number of persons mentioned in the first and second interviews also correlated fairly strongly ($r >= 0.88$) in the two studies that reported such correlations (Barrera, 1980; Arnold, 1994). Correlations between interviews for the number of persons in particular categories (e.g., specific social support relations), though, tend to be somewhat weaker and more variable (Barrera, 1980; Schwarzenbacher and Baumann, 1990; Veiel, 1990; Arnold, 1994).

For each study requiring additional computations to estimate the level of forgetting, I noted or calculated the mean Jaccard coefficient for the sets of persons mentioned by a subject in the two interviews. In this case, the Jaccard coefficient equals the number of persons mentioned in the first interview who were also mentioned in the second divided by the number of unique persons mentioned in either or both interviews. One minus the Jaccard coefficient indicates the proportion of all persons mentioned in either or both interviews who were recalled in only one interview (i.e., forgotten in one interview). Because I assumed forgetting was equal across interviews, I divided this quantity by two to produce an estimate of the proportion of persons that were forgotten in a single interview. Then I subtracted this proportion from one to obtain the proportion of persons that were recalled in a single interview.

Barrera (1980) examined the test–retest reliability of an instrument for measuring social support that focuses on six categories of social support (material aid, physical assistance, intimate interaction, guidance, feedback, and social participation). The instrument also includes an elicitation question about persons with whom the subject is

likely to be in conflict. Forty-five undergraduates were interviewed on two occasions separated by 2 or 3 days (cf. Barrera et al., 1985). My computations are based on those persons whom subjects ''. . . typically regarded as providers of the supportive function that was described in each category'' (p. 9). The mean proportion of social support network members recalled in a single interview for all questions combined is 0.90. The mean proportions of network members recalled in a single interview for specific categories of support are somewhat lower: 0.80 for intimate interaction, 0.87 for material aid, 0.80 for guidance, 0.79 for feedback, 0.82 for physical assistance, and 0.85 for social participation. The mean proportion of persons with whom the subject is likely to be in conflict recalled in a single interview is 0.85.

Williams and Hollan (1981) interviewed four women who had graduated high school 4 to 19 years prior to the study. They interviewed the women in multiple sessions that typically lasted 1 h (for a total of 4 to 10 h of interviewing time). During the interviews, subjects recalled their high school classmates. In each session, every subject listed additional classmates not previously mentioned. Williams and Hollan (1981) verified all recalled classmates' names against subjects' high school yearbooks. For the four subjects, the number of classmates listed in the first interview session ranged between approximately 40% and 53% of the total number of different classmates mentioned across all sessions.

Moxley (1988) reported a test–retest study of a procedure to elicit the personal networks of individuals with psychiatric disabilities. The specific elicitation question(s) involved is not described in the report. Twenty-nine individuals with psychiatric disabilities in Columbus, OH, USA, were interviewed on two occasions separated by 2 to 25 days (mean = 7.4 days). The mean proportion of personal network members recalled in a single interview by these subjects is 0.90.

Schwarzenbacher and Baumann (1990) investigated the test–retest reliability of person elicitation and numerical estimate (cf. Sudman, 1985) procedures for measuring personal and social support networks. The interview questions focused on relatives, neighbors, coworkers, recreational/free time social contacts, and social support relations such as advice. The researchers interviewed 30 adults who lived in various Austrian cities and towns on two occasions separated by 7 (± 2) days. The mean proportion of personal network members recalled in a single interview for particular categories of personal/support network members range from 0.78 to 0.92 for specific relations when computed by comparing persons mentioned only for the particular relation in each interview. When computed by comparing persons mentioned for a particular relation in one interview and for any relation in the other interview, the proportions range from 0.86 to 0.93 for specific relations.

Tracy et al. (1990) evaluated the reliability of a personal network elicitation question. Twenty-two primary caregivers in ''at-risk'' families were interviewed on two occasions separated by 2 to 4 weeks (mean interval = 20 days). The elicitation question focused on important people who ''. . . may have made [the subject] feel bad or good but who, in any event, had been significant or influential that month'' (p. 33). The mean proportion of personal network members recalled in a single interview is 0.85. Some of the discrepancy between persons mentioned in the two interviews might be attributable to the specific recall period (last month) for the elicitation question and the resulting lack

of complete overlap for the two interviews' recall periods. (All of the other test–retest studies I review here did not specify recall periods for the elicitation questions.)

van Groenou et al. (1990) investigated the test–retest reliability of several different procedures for delineating personal networks. They interviewed 69 adults in Groningen, The Netherlands, on two occasions separated by 4 weeks. One of the procedures they studied did not limit the number of network members subjects could list. For this procedure, each subject was asked simply to name persons who were ''...'(most) important to him/her''' (p. 123). The mean proportion of all personal network members recalled in a single interview is 0.78. The mean proportion of personal network members recalled in a single interview vary for specific types of ties: 0.94 for persons of ''great importance,'' 0.74 for other relatives, 0.69 for friends, and 0.58 for other persons. van Groenou et al. (1990) found that subjects' age, gender, loneliness, personal network size, pregnancy status, moving status, and imminent retirement status were not meaningfully or significantly related to the proportion of network members that were recalled in a single interview. In other words, they did not discover any good predictors of forgetting.

Veiel (1990) assessed the reliability and validity of a social support network elicitation instrument. The instrument includes 12 separate personal network elicitation questions focused on everyday psychological support, everyday instrumental support, instrumental crisis support, and psychological crisis support. Seventy-one undergraduates from three universities in the Heidelberg–Mannheim area in Germany were interviewed on two occasions separated by four weeks. Veiel's (1990) paper does not include Jaccard coefficients for the test–retest results or information with which to compute them. Instead, Veiel (1990) reported ratios indicating the number of network members named by a subject in the first interview who were also named in the second divided by the number of network members named in the interview which the subject listed fewer network members. In my computations, I treated these ratios as if they were Jaccard coefficients even though they result in over-estimates of the proportion of network members recalled in a single interview. The mean proportion of network members recalled in a single interview is 0.99 for kin and 0.92 for non-kin.

Arnold (1994) studied the test–retest reliability of a version of the instrument of Barrera (1980) for measuring social support. She interviewed 29 single mothers with young children in the Hamburg area of Germany on two occasions separated by 2 to 4 weeks. The mean proportion of all support network members recalled in a single interview is 0.81. The mean proportion of support network members recalled in a single interview also varies somewhat across particular support relations: 0.83 for intimate interaction, 0.76 for material aid, 0.78 for guidance, 0.71 for feedback, 0.78 for physical assistance, and 0.78 for social participation. The mean proportion of persons with whom the subject is likely to be in conflict recalled in a single interview is 0.74.

Brewer et al. (1999a) conducted an extensive study of forgetting of sexual and drug injection partners among 156 persons in Seattle, USA, at high risk for sexually and parenterally transmitted infections. Brewer et al. (1999a) interviewed subjects on two occasions separated by either 1 week or 3 months. Interviewers elicited subjects' sexual and injection partners separately. Subjects assigned to the 1-week follow-up interval recalled partners from the last 2 years in each interview. Subjects assigned to the 3-month follow-up interval recalled partners from the last year in the first interview and

the last 2 years in the second interview. Subjects participated anonymously and were not asked to give full names of their partners.

Using four independent measurement approaches, Brewer et al. (1999a) documented substantial forgetting of partners. Test–retest comparisons were the primary approach and focused on the proportion of partners mentioned in the first interview who were also mentioned in the second. Regarding sexual partners, the mean proportions were 0.75 and 0.86 for subjects with the 3-month and 1-week follow-up intervals, respectively. Regarding injection partners, the mean proportions were 0.61 and 0.78 for subjects with the 3-month and 1-week follow-up intervals, respectively. On average, the additional sexual partners elicited in the second interview for subjects with the 1-week follow-up interval, excluding new partners first encountered between interviews, represented a 20% increase over those listed in the first interview on average. The mean increase for injection partners was 34%. For the same set of subjects, Brewer et al. (1999a; b) also estimated the extent of forgetting by comparing the aggregated number of all partners they recalled in either interview with an estimate of the aggregated number of *new* partners for a comparable period. They scaled-up their estimate from the number of new partners encountered by subjects between interviews. These calculations indicated that subjects, in the aggregate, recalled only 40% of their sexual partners and 28% of their injection partners for a 2-year recall period. The third measurement approach involved comparing recalled partners with diary logs of sexual partners for three subjects who had such records for varying length periods. These subjects recalled 74–89% of the partners in their diaries. The final measurement approach entailed dividing the number of partners a subject recalled by the sum of the number they recalled and the number he or she estimated having forgotten. These mean proportions ranged between 0.86 and 0.93 across partner types and recall periods.

Only two of 24 subject demographic, behavioral, and contextual variables correlated meaningfully with the test–retest proportion of partners recalled described earlier. Subjects who sensed they might have forgotten one or more partners recalled proportionally fewer of their partners than those who believed they had not forgotten any partners ($rs = -0.39$ and -0.18 for sexual and injection partners, respectively). Also, for subjects with the 1-week follow-up interval, the number of new partners between interviews correlated negatively with the proportion of partners mentioned in the first interview who were recalled in the second ($r = -0.40$ and -0.37 for sexual and injection partners, respectively). This association may reflect the well-established phenomenon of retroactive interference, which occurs when more recently learned information (such as recent new partners) inhibits the recall of information learned earlier (such as less recent or longer-standing partners). Among the subject variables unrelated to the level of forgetting were sex, number of partners recalled, sexual orientation, injection drug use, and interviewer-rated level of intoxication during the interview. For sexually active drug injectors, the proportion of sexual partners recalled correlated moderately with the proportion of injection partners recalled ($r = 0.43$), which suggests an underlying dimension of forgetfulness for partners of different types.

There were good predictors of the absolute number of partners forgotten. The number of partners recalled in the second interview correlated moderately strongly with the number of partners forgotten (sexual partners: $r = 0.67$ and 0.66 for 3-month and

1-week follow-up intervals, respectively; injection partners: $r = 0.53$ and 0.36). Similarly, subjects who thought they had forgotten partners actually had forgotten more partners in absolute terms (sexual partners: $r = 0.56$ and 0.89; injection partners: $r = 0.27$ and 0.24) than subjects who thought they had not forgotten any partners.

For partners mentioned in the first interview, Brewer et al. (1999a) also compared those recalled and those forgotten in the second interview on several partner, partnership, and network variables, such as frequency of sexual/injection contact, subject's knowledge of locating information about partner, time since last sexual/injection contact, relationship closeness, and core/periphery position in subject's personal sexual/injection network, among others. Recalled and forgotten partners did not differ substantially on any variable. Other analyses showed that forgetting remained noticeable even for particular categories of partners, such as those with whom the subjects had sexual/injection contact in the last month. The most common reason subjects gave for forgetting particular partners was ''don't know/just forgot/no reason.'' Other common reasons were that the most recent contact with the forgotten partner was a relatively long time ago (variably defined across subjects) and that the contact with the forgotten partners was marked by a negative memory or experience.

4. Supplemental evidence of forgetting from responses elicited by prompts and cues

In addition to the evidence from the three main types of research designs just reviewed, persons recalled in response to prompts or cues after subjects have finished recalling on their own also suggest forgetting because subjects would not have mentioned these persons otherwise. Alexander (1976) interviewed 11 Jamaican adults to elicit their kin. He found that when subjects free listed their kin, they often forgot relatives whom they later remembered during a systematic genealogical interview in which they were cued by specific genealogical links.

Jones and Fischer (1978) described a study in which 86 adults in Oakland, CA, USA, area were asked several personal network name generator questions focusing on specific exchange relations, such as persons one could talk with about work-related problems and from whom one could borrow money. Later in the interview, subjects were given the list of persons they had mentioned in response to the elicitation questions. Interviewers then repeated several of the elicitation questions and also asked subjects to indicate which of the persons on the list were sources for particular exchange relations. Overall, Jones and Fischer (1978) found that with the repeated elicitation questions, subjects listed 34% more persons than they had initially. They also noted that during the second set of questions subjects did not indicate 27% of the persons recalled initially as sources of exchange. Jones and Fischer (1978) concluded ''... that interviewees have surprisingly poor recall of the people they knew; in the absence of extensive probing they are likely to forget important people'' (p. 4).

Williams and Hollan's (1981) claimed they could not recall any more high school classmates after only a few minutes in the first interview session. The interviewer insisted that subjects continue recalling and they did, listing the vast majority of the classmates they did remember *after* reporting they could recall no more.

In Sudman's (1985), interviewers presented subjects with specific cues after subjects finished responding to the overall elicitation question about acquaintances. For the church groups, the cues focused on persons with whom subjects ''occasionally did things in church activities,'' ''church members with whom they ever went to the movies, restaurants, bars, dances, sports events, or other entertainment,'' and ''members with whom it was hard to get along'' (p. 137). For the work groups, the cues focused on subjects' supervisors, persons with whom subjects worked closely, persons with whom subjects socialized at or away from work, and persons with whom it was hard to get along. Sudman (1985) noted that ''...these prompting questions had little effect on increasing reports [recall]'' (p. 137), but he did not report quantitative results on this issue.

Brewer (1995a) prompted most of his subjects in two separate interviews by asking them to list any other persons (corresponding to the elicitation question) after they had finished recalling on their own. This non-specific prompting increased the number of persons recalled by a small amount (first interview: $n = 11$, mean = 4% increase, median = 0%, s.d. = 4%, range = 0% to 12%; second interview: $n = 7$, mean = 16%, median = 12%, s.d. = 24%, range = 0% to 70%).

Brewer et al. (1999a) used similar non-specific prompting questions by asking subjects (often repeatedly) to list any other sexual or injection partners from the recall period after subjects stopped recalling on their own and claimed they could recall no more. The interviewer prompted non-specifically until the subject insisted there were no other partners she or he could recall. The partners mentioned in response to these non-specific prompts accounted for approximately 5% of all partners a subject recalled, on average. After these non-specific prompts, the interviewer read the list of all partners back to the subject to ensure they were correctly recorded, and then prompted non-specifically again (repeatedly as appropriate). Partners mentioned in response to reading back the list and subsequent prompting accounted for another 5% of all partners a subject recalled, on average. In this study, non-specific prompting and reading back the list elicited moderately more partners in absolute and proportional terms for subjects who recalled many rather than few partners before the first non-specific prompt.

5. Conclusions and implications

These studies point to several conclusions about the recall of social ties. First, across a variety of relations, people forget a substantial proportion of their social contacts when asked to recall them. Even studies with relatively weak test–retest designs show noteworthy levels of forgetting. Studies with stronger research designs involving comparisons of recall data with recognition data or objective records of interaction tend to indicate much higher levels of forgetting.

Second, there appear to be no good predictors of the proportional level of forgetting. Two studies (Brewer and Webster, 1999; Brewer et al., 1999a) indicate that the *number* of recalled ties, however, is a moderate predictor of the absolute *number* of forgotten ties.

Third, people seem to be more likely to forget weak ties than strong ties, although the evidence across studies is mixed on this point. (Tie strength in these studies was

measured by closeness of relationship, reciprocity of friendship choices, duration of contact, recency of contact, and frequency of contact.) In any event, people still forget a significant proportion of strong ties.

Fourth, non-specific prompting for additional relevant contacts may increase recall by a modest amount. Such prompting may encourage people to search their memories more thoroughly, resulting in additional recalled persons.

Fifth, one study (Brewer and Webster, 1999) showed that forgetting can influence the measurement of various structural properties of personal and social networks. More research in other settings is required to determine the generality of these findings.

There are a number of implications of the research on forgetting. The evidence reviewed here indicates clearly that researchers must take to heart Hammer's (1984) that persons recalled in network elicitation tasks are samples of all the observation that persons recalled the definition of a given social tie. The research reviewed here further demonstrates that these samples often are not representative ones. Network researchers are beginning to recognize and address these facts. For instance, McCarty et al. (1997) developed a first name cued recall technique for eliciting personal networks that seems to yield more representative samples of personal networks than other recall elicitation methods (see also Brewer, 1997). However, it is not known whether the first name cued recall technique reduces forgetting and its attendant biases.

Forgotten ties may have negative practical consequences when the purpose of eliciting persons is to identify, and perhaps contact, *all* of those with whom an individual has a particular relation (e.g., as in partner notification/contact tracing for controlling the spread of infectious diseases (Toomey and Cates, 1989; Rothenberg and Potterat, 1999), personal network therapy for treating mental health problems (Schoenfeld et al., 1986), attempts to bolster individuals' social support networks, etc.). Forgotten persons (especially those who bridge otherwise unconnected sets of persons) in network research may also limit or distort understanding of the social network structures and processes involved with such phenomena as diffusion, social influence, and disease transmission. Moreover, forgotten ties may account for some apparently unstable, or non-persistent, ties in longitudinal studies of personal and social networks (Marsden, 1990; Suitor et al., 1997).

The validity of recalled ties has not been studied for all kinds of social relations. False recalls or intrusions — persons recalled who are not actually connected to the subject by a particular social relation — were quite rare in those studies where the validity of recalled persons was checked independently (Bahrick et al., 1975; Williams and Hollan, 1981; Brewer, 1993, 1995a; Brewer and Yang, 1994; Seamon and Travis, 1993). The Bernard et al. (1982), Freeman and Romney (1987), and Freeman et al. (1987) studies clearly involved a large proportion of recalled persons who did not technically meet the criteria for a valid recall. It is likely that most, if not all, of these persons were ''falsely'' recalled because of the very precise time- or event-specific recall periods stated in the elicitation questions. If the definition of the recall periods were relaxed, the ''false'' recalls would probably no longer be false (a point that Freeman and Romney, 1987 and Freeman et al., 1987 demonstrated explicitly). Given these findings on the recall of acquaintances, high school classmates, and persons with whom one has interacted in a particular setting, it can probably be safely assumed that

most, if not all, recalled ties for other kinds of relations are also genuine (cf. Hammer, 1984).

To collect personal and social network data that are complete, data collection methods based on recognition or objective records of social interactions should be used. When it is not possible to use such methods, researchers should apply the techniques to enhance recall indicated in the literature reviewed here. In particular, non-specific prompting, multiple elicitation questions (if appropriate), and re-interviewing have been shown to increase recall slightly to moderately. Other methods for enhancing recall of network ties need to be developed and evaluated with rigorous experiments. These specific supplemental cues and recall strategies should be tailored to the organization of persons in memory (cf. Brewer, 1995b; Brewer et al., 1997, 1999b).

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