Evaluation of Interviewing Techniques to Enhance Recall of Sexual and Drug Injection Partners

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Background: **People with multiple sex partners forget a significant proportion of their partners, and drug injectors forget a large proportion of the persons with whom they inject drugs. This incomplete reporting poses a problem for partner notification and social network research on infectious disease.**

Goal: **To evaluate supplementary interviewing techniques to enhance recall of sex and injection partners.**

Study Design: **One hundred thirty-nine persons at high risk for HIV participated in a randomized trial of interviewing techniques. After participants freely recalled their partners, interviewers administered one of five techniques to elicit partners who might have been forgotten. Four experimental techniques involved cues (locations, role relationships, personal timeline, and partners recalled prior to cues) developed from memory research. Alphabetic cues served as a control technique. To assess the cumulative effects of the techniques, all five techniques were administered to another 19 participants.**

Results: **In the randomized trial, the techniques varied moderately in effectiveness and time efficiency. When administered as a set, the five techniques increased the number of sex and injection partners elicited by 40% and 123%, respectively, on average. The techniques were most effective with individuals who recalled many partners before the cues and/or sensed they might be forgetting partners. The available evidence indicates cue-elicited partners are as valid as partners recalled before the cues. On epidemiologically significant variables, cue-elicited partners also are similar to partners recalled before the cues.**

Conclusion: **The supplementary techniques counteract forgetting appreciably and may promote more effective partner notification and more complete description of risk networks.**

PARTNER NOTIFICATION[1–2] and social network research on infectious disease[3–4] are critical for understanding and preventing transmission of HIV and sexually transmitted diseases. Both activities involve individuals recalling their sexual and drug injection contacts. For effective partner notification and description of network structure, reported sexual and injection contact information must be as complete as possible.[5]

Research indicates that when people try to recall all those with whom they have a particular social relation (e.g., friends, coworkers), they tend to forget a substantial proportion of persons.[6] In particular, sexually active persons with multiple sex partners forget a significant proportion of their sex partners, and drug injectors forget a large proportion of the persons with whom they inject drugs (i.e., their injection partners).[7–8]

To address this problem, in prior work we developed recall cues and strategies that imitate individuals' natural recall processes.[9] We studied what kinds of partners tended to be recalled together in clusters to describe how individuals associate from one partner to the next. We also noted what kinds of partners tend to be mentioned earlier or later in recall to identify salient dimensions along which individuals organize their partners in their memories.

Our research and development process yielded four experimental interviewing techniques focused, respectively, on partners' roles, locations, chronology, and network ties. We designed these supplementary techniques to be implemented after an individual has freely listed all the partners she or he can remember. In this report, we review these techniques and describe our evaluation of their effectiveness

The authors thank the many individuals on the staffs of Street Outreach Services, Harborview Medical Center Sexually Transmitted Diseases Clinic, the University of Washington's Project S.U.R.E./Seattle Methamphetamine Study, and the Seattle-King County-Public Health's downtown Needle Exchange Program, HIV Alternatives Testing Study, Needle Outreach and Education Network, RAVEN Study, Spring Street Clinic, and Young Men's Study for assistance with participant recruitment and other study activities. They also thank King Holmes for advice, Claire Rasmussen for help with data coding, and Susan Barkan, Ronald Fisher, Elizabeth Loftus, Geoffrey Loftus, John Miyamoto, Stephen Muth, John Potterat, and two anonymous reviewers for helpful comments on this research.

Supported by a research grant from the National Institute on Drug Abuse, no. DA10640.

An earlier version of this paper was presented at the 20th International Sunbelt Social Network Conference, April 15, 2000, Vancouver, British Columbia, Canada.

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Received for publication February 1, 2001, revised April 6, 2001, and accepted April 11, 2001.

and efficiency in eliciting partners who otherwise would be forgotten.

The role cues include terms that refer to types of relationships people have with their partners. We derived these cues from individuals' descriptions of their partnerships. To administer these cues, the interviewer says every role, in an individually randomized order, and for each cue asks the interviewee to think of all the persons with whom she or he has the kind of relationship described. The interviewer then asks the interviewee to mention any of these other persons if she or he had sex or injected drugs with them during some defined recall period but previously forgot to mention them.

The location cues include terms that refer to kinds of locations where people interact, have sex, or inject drugs with their partners. We also derived these cues from individuals' descriptions of their partnerships. The procedure for administering these cues follows that for the role cues, except that in presenting each cue, the interviewer asks the interviewee to think of all the persons with whom he or she has interacted, had sex, or injected drugs in that location. The Appendix shows the full list of the role and location cues used in the current study.

We developed two techniques based on partners' chronology. Our main technique is to sketch out a timeline of prominent events in the interviewee's life during the recall period and then work through this timeline to cue the interviewee's memory for additional partners. (Pomeroy et al[10] used a related technique). For this technique, the interviewer records information on a calendar that shows the months and major holidays for the recall period. The information recorded includes: the interviewee's current and past residences including vacations, business trips, and time spent in hospitals, jails, and treatment facilities; important events that happened to the interviewee's family and friends including the interviewee's own marriages or steady relationships and others' marriages, divorces, births, and deaths; daily activities including employment, training, schooling, and changes in the daily routine; and, for drug injectors, events related to their drug use including periods of abstinence, periods of especially heavy use, overdoses, changes in drugs, and sources of drugs. Once this timeline is established, the interviewer begins at the start of the recall period and progresses forward through time. The interviewer identifies relevant points and periods in time defined by the events on the calendar and asks the interviewee to think of other persons with whom she or he had sex or injected drugs at about that time but has not yet mentioned.

In addition to this timeline technique, we also tested a method recommended by the US Centers for Disease Control and Prevention for eliciting sex partners.[11–13] Using this method, the interviewer simply asks interviewees at the outset to recall their partners in reverse chronological order. In contrast to all of the other methods, therefore, this technique does not follow but replaces free recall of partners.

The network technique involves using the partners that a participant freely lists as cues, following our general approach for enhancing recall in semantic domains.[14] For this network technique, the interviewer reads back to the interviewee the names or descriptions of the partners the interviewee already has recalled. For each partner, the interviewer asks the interviewee to think of other persons who know, hang out, or interact with that partner, and to list any of these other persons if she or he had sex or injected drugs with them during the recall period but previously forgot to mention them.

To assess the effectiveness of these cues, we compared them, along with a control set of cues, in a randomized trial. For the control technique, the interviewer says each letter of the alphabet to the interviewee. For each letter, the interviewer asks the interviewee to think of all the persons he or she knows whose name begins with that letter, and to mention any of these other persons if she or he had sex or injected drugs with them during the recall period but previously forgot to mention them. We chose this alphabetic procedure as the control method because people do not recall their partners in alphabetical order or cluster partners in recall by the first letter of their names.[9] Then, to evaluate the cumulative effects of the techniques, we administered all the techniques as a set to a separate sample.

Methods

Participant Recruitment

Between February and October 1999, we recruited 158 persons presumed to be at high risk for sexually and parenterally transmitted infections from the largest HIV testing clinic in Seattle, Washington (n = 40), the public STD clinic in Seattle (n = 1), a study of young men who have sex with men (n = 2),[15] the largest needle exchange location in Seattle (n = 54), a large epidemiologic study of drug injectors (n = 47),[16] a small study of methamphetamine injectors (n = 5), and an outreach services project for gay and bisexual methamphetamine injectors (n = 9). All participants/clients from the latter three sources were eligible for the current study. All clients at the HIV testing clinic who attended the clinic to be tested were eligible to participate, as were all clients at the STD clinic not involved with partner notification who reported four or more sex or injection partners in the last year. Participants in the study of young men who have sex with men were eligible if they reported multiple partners in the preceding year. The staff at all recruitment sites except the needle exchange referred prospective participants to the current study. At the needle exchange location, we randomly selected individuals through a process based on the order in which they exchanged and invited them to participate in an immediate interview. Of those invited to participate, 27% were interviewed.

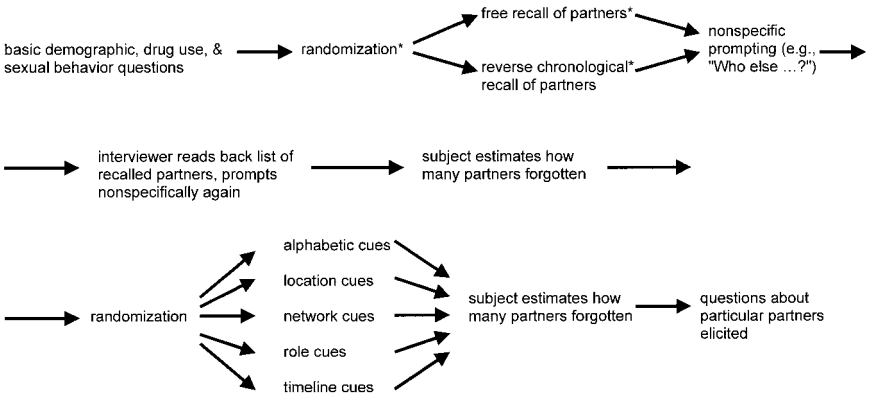

Fig. 1. Schematic of experimental design and interview structure for the randomized trial. * = Participants randomized here only for recalling sex partners; drug injectors recalled their injection partners freely.

Procedures and Design

This research was separate and independent from all other studies and all services provided by the recruitment sites. We each conducted private, face-to-face interviews using microcomputers in closed rooms at the HIV testing clinic and at a drop-in social and health services center oriented primarily toward homeless people.

Randomized trial. Figure 1 shows a schematic of the experimental design and interview structure for the randomized trial. After answering a series of basic questions about their demographic characteristics, drug use, and sexual behavior, participants recalled their partners for the past year, a typical period for HIV contact interviews[12]. To evaluate the effectiveness of eliciting sexual partners at the outset in reverse chronological order (the CDC-recommended approach), we randomly assigned participants to recall their sexual partners in reverse chronological order (with instructions to list the most recent partner first and then continue to mention progressively earlier partners) or to recall their sex partners freely without instruction on the particular order of recall. Drug injectors recalled their injection partners freely. We elicited sexually active drug injectors' injection partners first and then, if time permitted, their sex partners.

In the elicitation question, we defined sexual partners in detail as all anal, oral, or vaginal sex partners. We also defined injection partners in detail as all persons with whom the participant injected drugs. This definition includes all persons with whom a participant shared needles or other injection paraphernalia and those to whom a participant administered injections or from whom he or she received injections[7] Full definitions can be found at http://faculty.washington.edu/ddbrewer/trevinstr.htm. We asked participants to list all partners in the recall period, take as much time to recall as necessary, and refer to partners by first names, nicknames, initials, or brief descriptions.

We attempted to elicit participants' partners as exhaustively as possible before administering the supplementary techniques. When a participant indicated that he or she did not have or could not recall any more partners, the interviewer prompted nonspecifically (e.g., "Who else have you had sex/injected drugs with in the past year?"). The interviewer prompted in this way until the participant insisted that he or she could not recall any additional partners. Then the interviewer read the list of partners back to the participant slowly to ensure that all recalled partners were correctly recorded, and prompted again. Next, the interviewer asked the participant to estimate how many, if any, additional partners in the recall period she or he could not recall specifically. At this point in the interview, we randomly assigned a participant to one of the five interviewing technique conditions: alphabetic, location, network, role, and timeline cues.* The Web page mentioned earlier details the introductions we gave to this part of the interview.

After administering the cues, we asked participants again to estimate how many partners beyond those already mentioned she or he could not recall specifically to gauge the extent of forgetting after administering the supplementary techniques. We then asked questions about the characteristics of specific partnerships (e.g., frequency of contact, time since last contact, etc.) to permit comparisons between partners elicited by the cues and those elicited before the cues. Because of interview time constraints, these questions pertained to no more than eight partners. If a participant listed eight or fewer partners during the whole interview, we asked questions about each of these partners. If a participant recalled five or more partners before the cues and five or more partners in response to the cues, we asked questions about four randomly sampled partners from each of these two sets. If a participant listed more than eight partners during the whole interview, but fewer than five partners

* A second technique was administered to most of the participants in the randomized trial. This second technique was not assigned randomly, but determined by which technique was first. The analyses comparing the techniques in the randomized trial were based on the first technique only. However, the assessment of the validity of cue-elicited partners and the comparisons between freely recalled and cue-elicited partners were based on the first and second techniques combined.

before the cues or in response to the cues, then we asked questions about all of the partners in the smaller set and a randomly chosen sample of four to seven partners from the larger set, for a total of eight partners.

After these questions, we asked about the characteristics of cue-elicited partners related to the cues (i.e., locations where participants interacted with partners, partners' role relationships to participant, or network ties between cue and response partners) to measure the consistency between the cues and partners they elicited. We asked these questions about all partners, up to eight, elicited by a technique. We selected eight partners randomly if a participant listed more than eight in response to a given technique.

During the first 5 months of data collection, we invited all participants to return for a second interview 3 months after their first to enable test–retest measurement of forgetting. All participated anonymously in the first interview. When we invited participants to participate in a second interview, we attempted to collect locating information for contacting them later to schedule the second interview, although they were not required to give this information to continue in the study. If a participant did provide locating or identifying information, we destroyed it immediately after the second interview was completed or at the end of the study for those not successfully interviewed again. Of the 100 participants invited to return, 62 completed a second interview (mean follow-up interval = 98 days, median = 92, SD = 20, range = 67–179). The procedures for the second interview were identical to those for the first interview, except that in the second interview: (1) we elicited partners for the past 2 years (to ensure that partners recalled in the first interview would fall within the recall period), and (2) after administering the cues we systematically compared, with a participant's help, the partners mentioned in the first and second interviews to determine which were common to both interviews. For each interview, participants received a $20 gift certificate that could be used at one of several stores.

Combined techniques study. After 7 months of data collection, we closed enrollment for the randomized trial. For the remaining 2 months of data collection, we enrolled new participants in a study in which we administered all five techniques as a set to each participant to evaluate their cumulative impact. In this study, if a participant estimated having had more than five sex partners in the past year, we elicited his/her sex partners for the past year. If a participant did not estimate having more than five sex partners in the past year but estimated having more than five injection partners in the past year, we elicited his/her injection partners for the past year. Because of time constraints, participants recalled either sex partners or injection partners, but not both. Individuals who satisfied neither criterion were not included in the current study.

Participants in this combined techniques study recalled their partners (either sex or injection) freely, i.e., we gave them no instructions about the order in which they were to list partners. The order of administration of the supplementary techniques was fixed across participants for each type of partner. We ordered the techniques in terms of the proportion of participants in the randomized trial who listed additional partners in response to a technique. We reasoned that the techniques most likely to elicit additional partners should be administered first to maximize participants' motivation in responding. For sex partners, the order of the techniques was: location, alphabetic, timeline, role, and network. For injection partners, the order of the techniques was: location, alphabetic, network, timeline, and role. All other aspects of the interview in the combined techniques study were the same as in the randomized trial, except that we did not ask questions about particular partners.

Statistical Analysis

We used univariate summary statistics to describe participants' characteristics and the number of partners they recalled. We conducted χ^2 goodness-of-fit tests for categorical variables and z tests for interval scale variables to test whether participants were statistically representative of the study or clinic populations from which they were recruited. We computed a test–retest measure of forgetting (percentage of partners elicited before the cues in the first interview [1-year recall period] who were mentioned before the cues in the second interview [conducted 3 months later with a 2-year recall period]) to determine whether the participants displayed levels of forgetting comparable to those in our prior research.

To assess the impact of eliciting sex partners at the outset in reverse chronological or free order, we computed experimental effect-point biserial correlation coefficients and corresponding t tests that compared the two elicitation approaches in terms of the number of partners mentioned by specific points in the interview. For each of the different supplementary techniques, we calculated several measures of the technique's practical effectiveness, cue potency, and time efficiency. We computed η^2 (and corresponding F values) for interval scale outcome measures to indicate the amount of variance explained by technique in the randomized trial. We computed Goodman and Kruskal's τ[17] (and corresponding χ^2 values) to assess the proportional reduction in error in predicting the nominal scale outcome measure (i.e., whether a participant recalled additional partners in response to a technique) from technique in the randomized trial. For the combined techniques study, we simply summarized the measures with univariate statistics.

To describe individual differences in responsiveness to or the effectiveness of the cues, we calculated the Pearson correlations between demographic, behavioral, and contextual variables and selected measures of cue effectiveness.

We computed the correlations separately for participants assigned to a given technique in the randomized trial and for participants in the combined techniques study, and then calculated a sample-size weighted mean of the set of correlations for a particular independent variable.[18] Finally, we compared partners recalled before the cues with those elicited by the cues in terms of several partnership variables. For each participant who listed additional partners in response to the cues, we computed a point biserial correlation between each partnership variable and whether a partner was recalled freely before the cues or elicited by the cues. To summarize these across participants, we calculated the unweighted mean correlation[18] for each partnership variable.

Results

Participant Characteristics and Representativeness

Overall, 71% of the sample were men, and participants' mean age was 38.5 years (SD = 9.7, range = 20–65). Sixty-one percent of participants were white, 13% black, 6% Hispanic, 11% Native American, and 8% of some other or mixed ethnic/racial background (because of rounding error, the percentages do not sum to 100). Forty-one percent considered themselves homeless, and only 29% were employed or enrolled in a school or college. Of the sexually active participants, 39% were gay, 10% bisexual, 46% heterosexual, and 5% reported some other sexual orientation. Among the drug injectors, the primary drugs injected were heroin (71%), methamphetamine (9%), cocaine (4%), and speedballs (heroin and cocaine together; 17%). Most of the drug injectors (72%) had not been in drug treatment during the 30 days before the study, and 66% injected daily or more frequently.

The participants recruited from the HIV testing clinic were a 1.9% nonrandom sample of all the clinic clients tested during the recruitment period. These participants were representative of this client population in terms of age, education, injection drug use, and race/ethnicity (i.e., the sample characteristics do not differ significantly from expected values on these variables). However, they included slightly more men and persons who identified as gay than expected ($P < 0.05$). The participants recruited from the epidemiologic study of drug injectors were a 6.8% nonrandom sample of all the participants interviewed for that study during our recruitment period. These participants were representative of this participant population in terms of education, primary drug injected, race/ethnicity, sex, and sexual orientation. However, they were modestly older and less likely to be employed than expected ($P < 0.01$).

Number of Partners Recalled Before the Cues

In the randomized trial, the 79 sexually active participants who recalled their sex partners listed a mean of 7.5 partners before the administration of cues (median = 5, SD = 9.2, range = 1–51). The 95 drug injectors who recalled their injection partners listed a mean of 18.7 partners before the administration of cues (median = 13, SD = 18.4, range = 1–105).

Replication of Levels of Forgetting

The participants who completed a second interview 3 months after the first displayed levels of forgetting very similar to those reported previously for a different Seattle sample.[7] Before administration of the cues in the second interview, sexually active participants (n = 25) recalled a mean of 76% of their sex partners they listed before the cues in the first interview (median = 80%, SD = 0.24, range = 30–100%). That is, in the second interview, the participants forgot 24% of the sex partners they had mentioned 3 months previously, on average. Before administration of the cues in the second interview, drug injectors (n = 39) recalled a mean of 56% of the injection partners they listed before the cues in the first interview (median = 55%, SD = 0.28%, range = 0–100%). The mean percentages of sex and injection partners listed in the first interview who were recalled in the second interview in the earlier study[7] are 75% and 61%, respectively.

Free Versus Chronologically Directed Recall of Sex Partners

Due to interviewer and computer program errors, eight participants who had been randomly assigned to recall sex partners in reverse chronological order were inadvertently asked to recall their partners freely. Because these errors were haphazard and unintentional, we included these participants with the free recall group in the analysis. There is no meaningful or statistically significant difference between the number of sex partners listed before nonspecific prompting by participants who recalled freely (n = 41, mean = 6.2, SD = 7.3) and the number listed by participants who recalled in reverse chronological order (n = 38, mean = 6.7, SD = 7.9). The experimental effect-point biserial correlation (with reverse chronological recall coded as 1 and free recall as 2) is −0.03.

We obtained very similar results when we used the total number of partners recalled prior to reading back the list of partners to the participant and number of partners recalled prior to administration of the cues as outcome measures. We also found nearly identical results when we: (1) included in analysis only the 39 participants who had not recalled injection partners (and thus, had not yet been exposed to any recall cues) earlier in the interview, (2) excluded the eight participants who mistakenly received the free recall condition, and (3) excluded outliers (participants who recalled many more partners than [> 2 SD] the mean). Furthermore, the participants in the two conditions spent essentially the

TABLE 1. Summary of Effectiveness and Efficiency Measures by Technique for the Randomized Trial: Sexual Partners

Measure	Alphabetic (n = 15)	Location (n = 14)	Network (n = 17)	Role (n = 18)	Timeline (n = 15)	η^2/τ
Mean no. recalled before cues	4.93	6.07	9.12	7.89	9.20	0.03
Proportion of participants listing additional partners	0.40	0.43	0.12	0.28	0.40	0.06
Mean no. of additional partners elicited	0.80	0.79	0.29	0.61	0.87	0.03
Mean proportional increase in no. of partners elicited	0.12	0.10	0.01	0.05	0.05	0.13*
Mean no. of additional partners elicited per cue	0.03	0.06	0.01	0.04	—	0.07
Mean minutes to administer†	3.93	2.68	1.86	2.69	7.66	0.32‡
Mean no. of additional partners elicited per minute†	0.20	0.22	0.07	0.15	0.06	0.06

*$P < 0.05$ (not corrected for number of tests).
†Sample sizes for alphabetic, role, and timeline conditions are 14, 17, and 12, respectively.
‡$P < 0.001$ (not corrected for number of tests).

same amount of time recalling partners before the interviewer began prompting (experimental effect $r = -0.02$). Because there were essentially no differences between the free recall and chronologically directed recall conditions, in all subsequent analyses we combined participants in these two conditions.

Effectiveness and Efficiency of Recall Cues

Randomized trial. Tables 1 and 2 show summary measures of the techniques' practical effectiveness, cue potency, and time efficiency in the randomized trial for sex and injection partners. Practical effectiveness here refers to the level of additional information that can be gained by applying a technique. The measures of practical effectiveness include the proportion of participants who recalled additional partners in response to a technique, the mean number of additional partners elicited by a technique, and the mean proportional increase these additional partners represent over the number of partners recalled before administration of the cues. The mean number of partners recalled before the cues gives a reference point with which to evaluate these measures. For a particular technique, the potency of a typical cue to elicit additional partners suggests the intrinsic effectiveness of the cue type, independent of the number of cues in that technique. We used the mean number of additional partners elicited per cue to measure potency. (This measure cannot be computed for the timeline technique because the timeline cues often were not well defined or discrete, but frequently were administered in a fluid fashion as connected series of events and periods.) The amount of time required to administer a technique and the number of additional partners elicited per minute during administration of a technique indicate that technique's time efficiency. The results in the tables are based on all participants who were administered the techniques. We observed a very similar pattern of results when we excluded outliers (participants

TABLE 2. Summary of Effectiveness and Efficiency Measures by Technique for the Randomized Trial: Injection Partners

Measure	Alphabetic (n = 21)	Location (n = 19)	Network (n = 18)	Role (n = 19)	Timeline (n = 18)	η^2/τ
Mean no. recalled before cues	12.90	17.00	28.44	14.95	21.56	0.09
Proportion of participants listing additional partners	0.81	0.90	0.78	0.42	0.67	0.13*
Mean no. of additional partners elicited	3.52	5.42	5.83	2.21	2.28	0.08
Mean proportional increase in no. of partners elicited	0.37	0.35	0.20	0.12	0.17	0.11*
Mean no. of additional partners elicited per cue	0.14	0.32	0.20	0.12	—	0.11*
Mean minutes to administer†	5.98	4.78	5.46	3.84	13.26	0.46‡
Mean no. of additional partners elicited per minute†	0.55	1.04	0.62	0.47	0.15	0.19‡

*$P < 0.05$ (not corrected for number of tests).
†Sample sizes for location and network conditions are 18 and 17, respectively.
‡$P < 0.001$ (not corrected for number of tests).

who recalled a very large number of partners [> 2 SD above the mean] before the cues.

Each technique elicited additional sex partners for at least some participants, but in each condition, most participants did not recall additional sex partners (Table 1). In terms of practical effectiveness, the alphabetic and location techniques appear strongest, each producing a 10% to 12% increase in sex partners elicited. From a practical standpoint, the role and timeline techniques were somewhat less effective, and the network technique was only mildly effective in eliciting additional sex partners. The location cues were more potent on a per cue basis than the other types of cues.

In terms of efficiency, most techniques took no longer than a few minutes to administer, although the timeline condition typically required several minutes to complete. For comparison, the mean length of time participants took to recall their sex partners freely before the interviewer read back the list was 1.80 minutes (n = 74). The location and alphabetic techniques were the most efficient, with one additional partner elicited for approximately every 5 minutes of administration, on average. In sum, each of the five techniques seem to be at least somewhat effective in eliciting additional sex partners, although the location and alphabetic techniques appear to be the most effective and efficient.

The techniques were substantially more effective and efficient in eliciting additional injection partners than in eliciting additional sex partners (Table 2). For all techniques except role, a clear majority of participants listed additional injection partners. Each technique elicited an appreciable number of additional injection partners on average, and these represent noteworthy increases in proportional terms. The location, alphabetic, and network techniques were more effective than the timeline and role techniques. In terms of cue potency, the location and network techniques clearly were superior to the alphabetic and role techniques. This means, for instance, that the average alphabetic cue was less than half as powerful in eliciting additional injection partners as the average location cue. The practical effectiveness of the alphabetic technique resulted mainly from the relatively large number (26) of mildly potent cues.

The techniques took somewhat longer to administer for injection partners than for sex partners, although the relative standing of the techniques regarding time efficiency was similar. For comparison, the mean length of time participants took to recall their injection partners freely before the interviewer read back the list was 3.67 minutes (n = 94). The timeline technique was very time-consuming, and far less efficient in eliciting additional injection partners per unit of time than the other techniques. Because the other techniques took reasonably similar lengths of time to administer, the most practically effective techniques—location, alphabetic, and network—were also the most time efficient.

Combined techniques study. The results from the combined techniques study show that the cumulative effect of all five techniques as a set is much greater than any one technique alone (Tables 3 and 4). Given the participant inclusion criterion, the participants in this study tended to recall more partners before administration of the techniques than in the randomized trial (injection partners: n = 14, mean = 34.1, median = 21, SD = 35.2, range = 9–140; sexual partners: n = 5, mean = 17.8, median = 14, SD = 12.9, range = 8–39). All participants listed at least one additional partner in response to the combined techniques. The mean proportional increases in the number of partners elicited by the combined techniques are striking: 40% for sex partners and 123% for injection partners. Each successive technique elicited additional partners from some participants not elicited by the previously administered techniques. The effectiveness, cue potency, and efficiency of the individual techniques in the combined techniques study generally were similar in level and pattern to those in the randomized trial.

Figure 2 displays the mean percentages of partners elicited at different points in the interview for the combined techniques study. Partners recalled before nonspecific prompting represent only about half of the partners that could be elicited in a single interview. As observed previously,[7] nonspecific prompting and reading back the list each elicit a significant fraction of partners. The cues in the combined techniques boost recall even more substantially, eliciting a major proportion of partners recalled in the interview.

Despite their effectiveness, the combined techniques did not eliminate forgetting. After the techniques had been administered, 50% percent of those who recalled sex partners and 71% of those who recalled injection partners reported that they had or might have had additional partners in the recall period whom they could not recall.

Effectiveness of particular cues. We also assessed which particular alphabetic, location, and role cues elicited additional partners in the randomized trial and combined techniques study. Nearly all such cues elicited additional partners from at least one participant. (Full results are available on request.)

Participant Correlates of Responsiveness to Cues

The number of partners a participant recalled before the cues predicts moderately to quite well the number of additional partners elicited by supplementary techniques (sex partners: weighted mean $r = 0.84$, total n = 109; injection partners: weighted mean $r = 0.44$, total n = 84).

TABLE 3. Summary of Effectiveness and Efficiency Measures by Technique in Order of Administration for the Combined Techniques Study: Sexual Partners (n = 5)

Measure	Location	Alphabetic	Timeline	Role*	Network*	Combined
Proportion of participants listing additional partners	1.0	0.40	1.0	0.25	0.50	1.0
Mean no. of additional partners elicited	3.60	0.60	1.80	0.25	1.00	7.00
Mean proportional increase in no. of partners elicited	0.20	0.02	0.14	0.01	0.04	0.40
Mean no. of additional partners elicited per cue	0.26	0.02	—	0.02	0.04	—
Mean minutes to administer	4.61	4.38	13.44	3.05	3.17	28.65
Mean no. of additional partners elicited per minute	0.81	0.13	0.13	0.06	0.23	—

*These techniques were administered to four participants only.

That is, in absolute terms, the cues elicited substantially more additional partners from the participants who recalled many rather than few partners on their own before the cues. A participant's sense before administration of the cues that there were other partners he or she could not remember also predicts fairly well the number of additional partners elicited by the supplementary techniques (sex partners: weighted mean $r = 0.55$, total n = 84; injection partners $r = 0.49$, total n = 109). In other words, participants who thought they might have forgotten some partners tended to recall more additional partners in response to the cues than participants who did not believe they had forgotten any partners.

We also measured the correlation between each of many variables and the proportional increase in the number of partners elicited by the cues. The number of sex partners recalled before the cues is substantially related to the proportional increase due to the cues (weighted mean $r = 0.51$; total n = 84). Similarly, a participant's sense before the administration of the cues that there were other sex partners she or he could not remember also predicts modestly the proportional increase (weighted mean $r = 0.34$, total n = 84). These relationships were weak for injection partners (number recalled before cues: weighted mean $r = -0.16$; total n = 95; subjective assessment of forgetting: weighted mean $r = 0.20$; total n = 95). The only variable at least modestly correlated with the proportional increase in injection partners elicited is a participant's self-rated level of embarrassment caused by the interview questions (weighted mean $r = 0.39$; total n = 91). The corresponding weighted mean correlation for sex partners is small (0.16; total n = 78), suggesting that the result for injection partners may be a fluke. Furthermore, the weighted mean correlations between the proportional increase in sex and injection partners elicited by the cues and the following 25 variables are less than 0.3 and show no discernible pattern: age, drug treatment, education, employment, frequency of sex, homelessness, injection frequency, interview date, interviewer, primary drug injected, race (white or nonwhite), discomfort, sex, sexual orientation (heterosexual or other), time of day, whether a prostitute, whether a client of a prostitute, whether sexually active, and interviewer-rated drug intoxication, honesty, motivation, openness, resistance, tension, and drug-related withdrawal. (Full results are available on request.)

Validation of Cue-Elicited Partners

It is important to assess whether partners elicited by the cues were genuine partners with whom participants had sexual or injection contact during the defined recall period. Participants could have "invented" partners to satisfy the interviewer's continued questioning or been unwittingly seduced by the cues into falsely recalling some persons as

TABLE 4. Summary of Effectiveness and Efficiency Measures by Technique in Order of Administration for the Combined Techniques Study: Injection Partners (n = 14)

Measure	Location	Alphabetic	Network	Timeline*	Role*	Combined
Proportion of participants listing additional partners	0.79	0.86	0.86	0.62	0.54	1.0
Mean no. of additional partners elicited	7.57	6.00	5.64	2.23	3.08	24.14
Mean proportional increase in no. of partners elicited	0.42	0.30	0.23	0.12	0.18	1.23
Mean no. of additional partners elicited per cue	0.45	0.23	0.23	—	0.17	—
Mean minutes to administer	6.53	6.03	8.31	12.97	4.88	38.72
Mean no. of additional partners elicited per minute	0.97	0.82	0.68	0.17	0.50	—

*These techniques were administered to 13 participants only. The sample sizes for these techniques are 13 for all the measures except the last two, for which the sample size is 12.

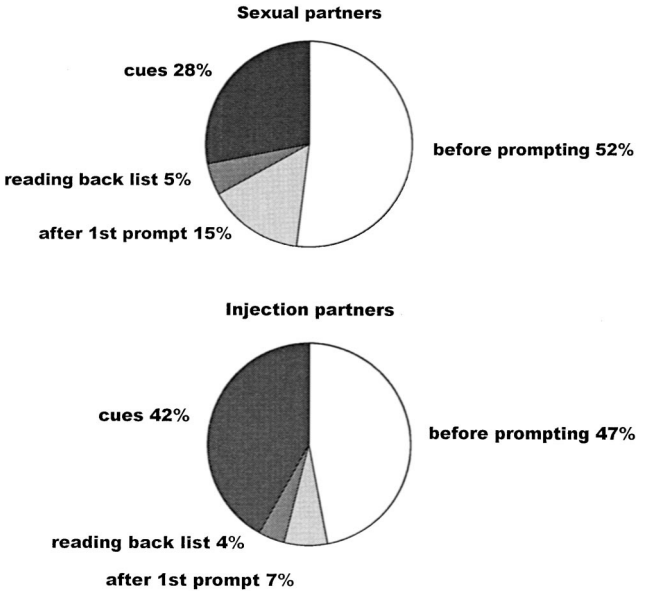

Fig. 2. Mean percentages of sex partners (n = 5) (top) and injection partners (n = 14) (bottom) elicited at different points in the interview, combined techniques study.

partners. Two main strategies were available to validate partners elicited by the techniques: (1) comparing cue-elicited partners with those listed in participants' personal records of their social contacts (such as diaries), and (2) noting whether partners elicited by the cues in the second interview included partners mentioned before administration of cues in the first interview.

At the end of their participation in the study, eight participants examined personal records (diaries, day planners, or personal address or telephone lists) to report the individuals in the records who were sex or injection partners during the recall period. These participants had kept such records for reasons independent of the study and were not informed until the end of the study that the interviewer would ask them to consult these records. Five of these participants (all in the randomized trial) listed additional partners in response to cues in the first interview. Each of these participants indicated that their records were incomplete, and that some or even most partners were not recorded. For these participants, the proportion of partners mentioned during free recall (i.e., before the cues) who appeared in the records was roughly similar to the proportion of cue-elicited partners who appeared in the records. The percentages of injection partners mentioned during free recall and in response to cues who appeared in the records were comparable for three participants: participant 1: free = 21% (10/47), cue-elicited = 25% (2/8); participant 2: free = 38% (5/13), cue-elicited = 43% (3/7); and participant 3: free = 15% (8/52), cue-elicited = 5% (2/41). For two other participants, the sex partners mentioned during free recall were somewhat more likely to appear in the records than those mentioned in response to the cues: participant 4: free = 78% (40/51), cue-elicited = 33% (3/9); participant 5: free = 50% (7/14), cue-elicited = 0% (0/2).

If the cue-elicited partners in the second interview for the randomized trial were not valid, then they would not be represented among the partners mentioned before the cues in the first interview. Altogether, 25 drug injectors listed additional injection partners in response to the cues in the second interview, and had not recalled before the cues in the second interview all partners they had mentioned before the cues in the first interview. In response to the cues in the second interview, 12 (48%) of these participants listed at least one injection partner whom they had mentioned before the cues in the first interview. Nine sexually active participants listed additional sex partners in response to the cues in the second interview, and had not recalled before the cues in the second interview all partners they had mentioned before the cues in the first interview. In response to the cues in the second interview, seven (78%) of these participants listed at least one sex partner whom they had mentioned before the cues in the first interview. In considering these results, it is important to remember that the recall period for the second interview (2 years) was twice as long as that for the first (1 year). Consequently, the participants may have had contact with many of the cue-elicited partners in the second interview at points in time that did not overlap with the first interview recall period.

In addition, the characteristics of partners elicited by a particular technique are consistent with the specific cues that triggered them. For example, a participant's report of where he or she had interacted with a partner elicited by a location cue usually matched that location. (Full results are available on request.) Furthermore, if participants were inventing partners to satisfy the repeated questioning, regardless of cue type, then the number of additional partners elicited should be proportional to the number of cues administered across techniques. However, the results in Tables 1 and 2 show that the different techniques vary meaningfully in the number of additional partners elicited per cue. In summary, the evidence suggests that cue-elicited partners are genuine partners, and are probably as valid as those recalled before the cues.

Comparisons Between Freely Recalled and Cue-Elicited Partners

For each participant, we compared partners recalled freely before the cues with those elicited by the cues in terms of several partnership variables: relationship closeness, feelings toward partner, time since first and last sex or injection contact, frequency of sex or injection contact, time since last meeting, amount of locating information known, and risky injection contact (shared injection paraphernalia, injections received from partner, or injections given to partner). We computed a

point biserial correlation coefficient for each participant on a given variable and then summarized coefficients across participants. For each variable, the unweighted mean correlation is less than 0.26 (sample sizes range between 17 and 20 for sex partners and 45 and 63 for injection partners due to lack of variation on particular variables for some participants' partners. (Full results are available on request.) This indicates that freely recalled and cue-elicited partners did not differ appreciably on any of these epidemiologic and psychological variables.

To illustrate further the similarity between freely recalled and cue-elicited partners consider the reported time since last sex or injection contact. For participants who listed additional sex partners in response to the cues, the mean percentage of freely recalled partners with whom participants reported having sex in the 6 months before the interview was 71%. The corresponding mean percentage for cue-elicited partners was 47%. For participants who listed additional injection partners in response to the cues, the mean percentage of freely recalled injection partners with whom participants reported having injection contact in the 6 months before the interview was 76%, and the mean percentage of cue-elicited partners was 71%.

Discussion

Participants who completed two interviews in the randomized trial exhibited similar levels of forgetting partners, based on a test–retest measure, as participants in previous research. An experiment embedded in the randomized trial showed that whether participants were instructed to recall their sex partners freely or in reverse chronological order made no difference in the number of partners elicited before administration of the cues. All the supplementary elicitation techniques tested were at least somewhat effective in eliciting additional partners, although their effectiveness and time efficiency varied moderately. In combination, the five techniques substantially increased the number of partners elicited, but at the price of extra interviewing time. In fact, the combined techniques may be approximately two to three times more effective (in terms of the proportional increase in partners elicited) in eliciting additional sex and injection partners than a second interview.[7] However, even in combination, the techniques likely reduced forgetting, but did not eliminate it. The techniques were more effective in eliciting additional injection partners than in eliciting additional sex partners, which is consistent with the greater degree of forgetting injection partners.[7–8]

Our results indicate the techniques are most effective in eliciting additional partners, in absolute terms, with individuals who contribute the most to disease transmission: persons who recall many partners. The cues also are particularly effective with individuals who sense that they may have forgotten some partners. The participant correlates of responsiveness to the cues parallel quite closely participant correlates of forgetting partners.[7] This indicates that the supplementary techniques are most productive with those who tend to forget the most partners. Moreover, the available evidence suggests that cue-elicited partners are just as valid as freely recalled partners, and that cue-elicited and freely recalled partners do not differ substantially on epidemiologically significant variables.

Forward telescoping, or remembering an event as having occurred more recently than it actually did,[19] is a type of error sometimes found in retrospective self-reports of behavior. It is important to consider whether the supplementary techniques exacerbated any tendency participants might have had toward forward telescoping in recalling their partners (i.e., recalling partners as within the recall period when in fact contact with them occurred before the recall period).

Our data suggest that cue-elicited partners are about as likely to be "telescoped" as partners recalled before the cues. First, cue-elicited and freely recalled partners appeared at roughly similar rates in the personal records (such as diaries or day planners) of most participants who had such materials. Second, cue-elicited partners in the second interview for the randomized trial included partners mentioned before the cues in the first interview for most participants who listed additional partners in response to the cues in the second interview and had not recalled before the cues in the second interview all partners whom they had mentioned before the cues in the first interview. Third, there were no large differences in reported time since last sex or injection contact between freely recalled and cue-elicited partners. Longer-term prospective studies involving diaries or multiple interviews (with a comprehensive recall period and administration of the supplementary techniques in the final interview), and studies comparing dates of contact reported by participants and their partners would allow further examination of telescoping in partner recall.

In 1947, Steiger and Taylor[13] commented on appropriate procedures for eliciting sex partners. They asserted that "experience in our [venereal disease] clinic leads us to believe that the patient must be induced to think chronologically. If this is not done, some of the [sexual] contacts will invariably be missed" (p. 57). This approach also is recommended by the US Centers for Disease Control and Prevention.[11–12] Our experimental comparison between such a chronological strategy and free recall indicates that it may not be necessary to instruct interviewees to recall their partners in a chronological fashion.

The ideal combination of supplementary techniques likely depends on the goal for eliciting partners (i.e., whether completeness of recall is a priority) and the time available for interviewing. The location and role techniques should be tailored to the local population that will be interviewed. This means that users of these techniques must collect information on the role relationships between indi-

viduals at risk and their partners and the locations where they interact before applying these techniques. The other three techniques (alphabetic, network, and timeline) do not require significant modification or prior information to be applied in different local populations. With all other factors equal, the location technique would appear to be the first choice if one were limited to a single supplementary technique because it is the most effective and time efficient for eliciting additional partners of each type. If it is practical to apply more than one technique, we recommend that users first determine whether technique effectiveness or time efficiency is more important for their activities, and then select the techniques that best satisfy these priorities.

Some of the techniques performed differently than we might have expected from our research on how people recall their partners.[9] The alphabetic technique, which we intended to be the control method, actually was reasonably effective in eliciting additional partners, due primarily to the large number of cues compared to the other techniques. Nonetheless, the potency of the alphabetic cues on a per cue basis was not always lower than that for the other types of cues. We find this surprising because participants in our earlier study[9] did not cluster or order their partners alphabetically in recall, indicating that the alphabet is not a salient scheme for organizing partners in memory.

Our earlier research also suggested that the network ties among partners play a fundamental role in how people organize their partners in memory. Participants' occasional spontaneous comments when listing multiple partners in response to a location cue (and sometimes other cues) indicated that their associations from one such partner to the next were based on the social connections among these partners. This may mean that the location cues (and to a lesser extent the other cues) serve the function of supplying the participant a context in which to search mentally for additional partners,[20] and that this search often proceeds in social network terms (consciously or unconsciously). Moreover, the apparent effectiveness and cue potency of the network technique may have been reduced somewhat by the interviewer reading back the list of partners before administering the cues. For some participants, reading back the list may have activated recall processes much like those activated by the network cues.

Ultimately, the value of these supplementary techniques will be determined by their effectiveness in identifying and locating previously unidentified or unlocatable partners in social network research and partner notification activities that involve actual tracing of partners. Next steps in future research might also include modifying these interviewing techniques and evaluating them for eliciting cluster suspects,[11,21] developing and testing other strategies for enhancing recall of partners, and assessing the value of reinterviewing after applying these techniques in an initial interview.

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Appendix

Location and Role Cues

Role cues. Acquaintances, associates,[i] boyfriends/girlfriends, current or past coworkers/bosses/employees, dealers/connections,[i] ex-boyfriends/ex-girlfriends, ex-wife/ex-husband/ex-partner/ex-mate, family/relatives/kin,[i] friends/good friends/old friends/best friends/close friends, friends/relatives of dealers,[i] friends/relatives of friends, friends/relatives of people with whom one has injected drugs or engaged in sex, mother/father of one's child,[s] neighbors, one night stands/flings/pickups,[s] roommates/people with whom one lives,[i] people one has dated,[s] people with whom one had sex for money

or drugs (date/trick/john/client), prostitutes, strangers/anonymous people, wife/husband/partner/mate

Location cues. Another city or town, bar/tavern/club, bathhouse,[s] beach,[s] Capitol Hill,[i] car/van/truck, computer bulletin board/chat room/online,[s] downtown,[i] drug treatment,[i] gym,[s] jail,[i] motel/hotel, on the streets, park, parties/social gatherings, rest stop/truck stop,[s] shelter/mission,[i] shooting gallery,[i] someone else's house/apartment, under the viaduct or bridge,[i] work,[i] your current or past house/apartment/place.

Note: [i]Injection partners only. [s]Sexual partners only.