

Using Spaced Learning Principles to Translate Knowledge into Behavior: Evidence from Investigative Interviews of Alleged Child Abuse Victims

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Published online: 3 August 2010
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Abstract The present study assessed the progress of 13 investigative interviewers (child protection workers and police officers) before, during, and after an intensive training program (n=132 interviews). Training began with a 2-day workshop covering the principles of child development and child-friendly interviewing. Interviewers then submitted interviews on a bi-weekly basis to which they received written and verbal feedback over an 8-month period. A refresher session took place two months into training. Interestingly, improvements were observed only after the refresher session. Interviews conducted post-refresher training contained proportionally more open-ended questions, more child details in response to open-ended questions, and proportionally fewer closed questions than interviews conducted prior to training and in the first half of the training program. The need for ‘spaced learning’ may underlie why so many training programs have had little effect on practice.

This research was supported by a Premier’s Research Excellence Award to Kim Roberts.

The authors would like to sincerely thank the interviewers who took part in the training and parents and children who participated. The authors also thank Brian Mainland, Leanne Best, Nicole Phythian, Nicole Davis, Val Vorstenbosch, Lisa Gravel, Nicole Keir, Taryn Moss, Adrian Pasquarella, Ashley McNight, Erica Campbell, Danielle Peters, Stephanie Jarvis, and Jemila Pirbhai for their assistance with transcription and coding.

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Keywords Child memory · Child eyewitness testimony · Investigative interviewing · Child abuse

Introduction

Overview of the Current Study

Despite widespread acceptance of international guidelines on how to interview child victims and witnesses of abuse, the majority of training programs result in few differences in interviewing practices before and after training (e.g., Warren et al. 1999). While training programs are effective in improving interviewers’ knowledge of child development and the recommended techniques (e.g., a reliance on open-ended questions such as *tell me what happened*, allowing the child to lead the interview), actual practice does not mirror such knowledge (Warren et al. 1999). Typically, investigative interviews are characterised by a reliance on closed questions that elicit one-word responses from children (e.g., *Did he have his clothes on? What is his name?*), rather than open-ended questions that encourage narrative responses from children (Gilstrap 2004; Lamb et al. 2002b). In the current study, we take an in-depth look at the *progression over time* in interview quality. Based on human learning theory, we expected that the most dramatic improvements in interview quality would be seen after ‘refresher training’.

It is well-established in educational fields that concentrated instruction that takes place in a short period of time may have little effect on long-term retention (e.g., Bellezza and Young 1989; Braun and Rubin 1998; Challis 1993). Students who ‘cram’ might do well on an exam that takes place shortly after the cramming session, but retain

little of the information over long periods of time. A more effective studying technique is to ‘space’ learning so that material is reviewed at regular intervals. Such reminding of material after some forgetting can boost memory for the material and lead to long-term retention (e.g., Roberts et al. 1999; Price et al. 2006; Read and Connolly 2007). This could be because exposure to similar material cues retrieval to the previously encountered material and, thus, strengthens memory (e.g., Bellezza and Young 1989). Alternatively, the increased effort needed to retrieve information after a delay ensures greater retention than if material is presented soon after initial exposure (e.g., Jacoby 1978). One possibility, then, for why investigative interviewers frequently fail to incorporate what they have learned into interviewing practice may be that the principles of learning have not been considered in investigative interviewing training programs. Rather, training tends to be concentrated into a few days or a couple of weeks with no formal follow-up (e.g., Aldridge and Cameron 1999; Warren et al. 1999). In this study, we tracked progress in interview quality by 13 investigative interviewers over a period of eight months. The principles of spaced learning were incorporated into the training program and interviews were evaluated in each 2-month block. Thus, it was possible to track when evidence-based interviewing techniques were incorporated into child interviews.

The Quality of Investigative Interviews of Children

Child witnesses are often required, by law, to describe the alleged abuse in great detail. Although child witnesses were once considered unreliable because of immature memory or language abilities, and susceptibility to suggestion (Bala 1999), contemporary research shows that children are capable of providing accurate information about their experiences (see Bruck and Ceci 1999; Lamb et al. 2008). Importantly, children are able to describe actions, people, conversations, and other forensically-relevant details when they are given adequate opportunity to do so, that is, when they are invited using open-ended questions (e.g., *Tell me what happened, And then what happened?*). Even children as young as 3 or 4 can describe details in response to such questions (Goodman and Reed 1986; Marin et al. 1979). Responses elicited with open-ended questions are also more likely to provide an accurate representation of the event(s) in contrast to closed questions (e.g., Dent and Stephenson 1979; Lamb and Fauchier 2001). Thus, children’s ability to convey information is affected not only by the qualities of their memories, but also by the types of retrieval mechanisms employed and the quality of the communication between them and their interviewers (Bala 1999). It is critical, then, that investigative interviewers use open-ended questions when

questioning children and that training programs are optimized to facilitate the transition from closed to open-ended interviewing.

In many cases, applying child-friendly techniques like open-ended questioning has proven difficult to implement in the field, even when interviewers understand the necessity of interviewing in a manner that does not impair children’s ability or willingness to accurately report their experiences (Warren et al. 1999). As another example, research by Cederborg and colleagues examined the quantity and quality of information provided by children in investigative interviews when interviewers relied on their own interviewing strategies (Cederborg et al. 2000). Overall, 57% of the details reported by children were elicited by option-posing questions (e.g., asking the child to affirm, negate, or select an investigator-given option) and suggestive utterances (e.g., utterances that focused the child’s attention on details the child had not previously mentioned, or utterances that communicated the expected response; *“He forced you to do that, didn’t he?”*). A mere 8% of the information obtained from child interviewees was elicited by open-ended invitations. Findings from several other studies (e.g.,; Davies et al. 2000; Lamb et al. 2000; Walker and Warren 1995) reached similar conclusions. Interviewers’ reliance on option-posing and suggestive prompts reduces the completeness and, possibly, the accuracy of information obtained from children, potentially contaminating reports to such an extent that they may be unusable or inadmissible in a court of law.

Training Programs in Investigative Interviewing

The literature assessing investigative interviewer behavior is sparse, and that which does exist reveals that training does not always lead to change. Aldridge and Cameron (1999) compared the investigative interviewing skills over a 9-month period of British police officers and social workers who had undertaken a training course with a control group who did not receive training. Interviewers participated in an intensive research-derived training course that lasted one week, and focused on relevant matters of law, memory processes, and developmental psychology (including children’s cognitive, language, and memory abilities). Interviews were analyzed to determine the number of invitations, open-ended questions, and closed questions. No differences were found between the interviews of trained and untrained interviewers. In fact, closed questions and leading questions (e.g., questions that typically elicit unreliable information) were found to occupy over half the total number of questions used by both sets of interviewers. Aldridge and Cameron’s results are echoed by those of Warren and colleagues who analyzed the pre- and post-training

interviews of a group of U.S. interviewers (Warren et al. 1999). The content of the course was similar to that in Aldridge and Cameron's study, however, the course extended into a second week in which interviewers were taught interview strategies and were provided feedback on their baseline interviews. While Warren and colleagues found that interviewer knowledge about interview content increased following the training course, overall, interview behavior did not change. The lack of improvement indicates that the frequently adopted model of short intensive training of investigators may not be effective, and we suspect that this is partly due to the absence of distributed or spaced learning models.

Recent Research on Training Programs in Investigative Interviewing of Children

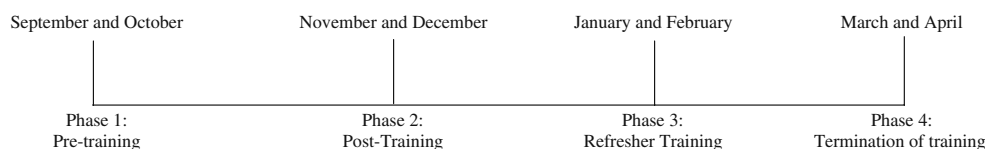
A substantial amount of research over the last decade has focused on training courses that highlight the importance of extensive interviewer training and feedback. For example, the National Institute of Child Health and Human Development (NICHD) protocol (see Lamb et al. 2008 for a review of the protocol and findings) was developed partly because of the poor uptake of open-ended interviewing (Orbach et al. 2000). In brief, the NICHD protocol provides a template for all phases of the investigative interview. It incorporates open-ended questioning and is flexibly structured, emphasizing developmentally appropriate questioning without relying on suggestive questions and interviewing aids, thus enhancing open-ended retrieval during the interview. Interviewers trained in its use adhere to recommended practices (e.g., avoid leading and suggestive questioning) more so than interviewers who are not trained (e.g., Orbach et al. 2000). Additionally, interviewers who rely on the protocol elicit more information using open-ended questions, conduct more organized interviews, and are more likely to follow closed questions with open-ended probes than interviewers who questioned alleged victims of the same age, without use of the protocol (Orbach et al. 2000; Sternberg et al. 2001b). Consequently, children interviewed using the NICHD protocol tend to provide more details than do children interviewed without the protocol (Orbach et al. 2000; Sternberg et al. 2001).

The training procedure for interviewers using the NICHD protocol (outlined in Orbach et al. 2000) begins with a multi-day seminar focused on child development principles as they relate to recommendations for developmentally-appropriate interviewing. Following training, interviewers partake in regular group review sessions and discuss transcribed interviews, illustrating both desirable and risky practices. Rather than an intensive training session that is terminated after a relatively short time (e.g., a couple of days), the NICHD program involves continuous informal reminders of the material provided in the first training session and has been shown to be highly effective in improving reliance on open-ended questions in investigative interviews (see Lamb et al. 2008).

Summary

It has proven surprisingly difficult to increase the use of open-ended questioning in investigative interviews with short and intensive, one-time courses, even though the interviewers can be highly knowledgeable of the material presented in the courses. Although the NICHD protocol has been very successful, the studies were not designed to specifically test the *time-line* of progress in interview quality, nor the effects of more formal follow-up sessions (in contrast to informal feedback regarding interview quality). According to the principles of spaced learning, formal instruction that takes place a while after previous instruction should have a significant impact on the learning and behavior of interviewers. Tracking progress at systematic time points will also provide answers to the often asked question of how much training do interviewers need before behavior modification occurs. Thus, in the current study, we delivered an investigative interviewing training program comprised of two 2-day sessions spaced 2 months apart with feedback provided on a continuous basis (see Fig. 1). We compared interviewer behavior and children's reports before training with those conducted 2, 4, and 6 months following. A between-subjects design would allow inclusion of a control group of interviewers who received no training, yet it would be unethical to withhold training. Further, as the results of training programs without spaced learning elements are clear and consistent (these programs result in little behavior change), and as we wanted to assess behavior from the same group of interviewers at four different time points, we chose a within-subjects design. A within-

Fig. 1 Time line showing the different training phases



subjects design is also beneficial to control for individual differences in interviewer behavior.

Method

Participants

The sample consisted of 13 investigative interviewers who volunteered to participate in a joint agency training program (males n=3). The relative representation of police and child protection workers was representative of the overall pool from which interviewers were drawn, and each interviewer had an average of 2 years experience interviewing children. All investigations conducted by participating child protection workers and police officers were included in the analyses (informed consent was given). About half of the cases involved physical abuse, 11% involved allegations of a sexual nature, and the rest involved other kinds of domestic disturbances (e.g. significant fighting between parents, see Table 1). This sample is thus likely to be representative of the range of cases investigated by interviewers questioning children who may have been, or are currently being, harmed, and probably reflects a sample that is broader in range than field studies of sexual abuse alone.

Sample

Each interviewer submitted between 12 and 32 interviews. Pre-training (n=33), post-training (n=42), post-refresher (n=33), and interviews conducted after training had ended (n=24) were compared using Chi square tests of independence to confirm that there were no differences in children’s age, gender, frequency of contact with the investigative agency, the relationship between the child and the alleged perpetrator, and the nature of the allegation across phases. No significant

differences were found. Note that there may be small decreases in the sample size in individual analyzes due to missing or incomplete data.

Procedure

The project was conducted over an 8-month period divided into four phases:

Phase 1 *Pre-Training*. Interviewers recorded and submitted interviews for transcription and coding in the September and October prior to commencement of formal training.

Phase 2 *Post-training*. Training took place in November and began with two days of introduction to child-development principles and an overview of structured protocols similar to the well-established NICHD protocol (Orbach et al. 2000). Interviewers received considerable practice in developing and using open-ended questioning techniques and pausing (e.g., *Tell me more; What happened next?*), while restricting closed questions (e.g., *What was his name?*). Instructional modules included Family Ecology, Cognitive Development, Conceptual Development, and Social Development. Modules were presented with the goal of explaining the underlying motivation for the recommended interview components described below:

- (i) Formal *introduction* of the interviewer and his/her role;
- (ii) *Ground rules* (including promise to tell the truth, it’s okay to say “I don’t know,” and correct the interviewer if he/she is wrong);
- (iii) A *Practice interview* involving a structured discussion of a non-allegation-related event;

Table 1 Case information for interviews from each Phase

Phase	Phase 1 Pre-training	Phase 2 Post-training	Phase 3 Post-refresher	Phase 4 Termination
Child age (in years)	9.56	10.42	9.98	11.43
Child Gender (male%)	45%	61%	43%	58%
New (vs. ongoing) case	91%	78%	84%	81%
Single (vs. repeated) instance	44%	52%	24%	31%
Clear allegation present:	61%	62%	62%	64%
Allegation:				
Hitting	56%	30%	47%	50%
Sexual assault/touch	11%	26%	12%	6%
Fighting observed	11%	17%	18%	19%
Perpetrator (clearly defined):				
Familial	60%	64%	90%	63%
Relative/Mother’s partner	0.11%	0.04%	0.06%	0.13%
Stranger	0.05%	0.09%	0%	0%

- (iv) A clear *transition* to the substantive phase (where the allegation(s) was/were discussed);
- (v) A clear *closure* segment.

In November and December, following training, interviewers submitted interviews weekly for transcription and coding. For each interview, detailed feedback on each phase of the interview was provided: Written comments were given on interview structure, prompt usage, suggestions for improving the quality of prompts, and graphs to show proportionally the use of different prompts and the corresponding information they elicited. Interviewers then engaged in a 20–30 minute telephone feedback session with one of the trainers.

Phase 3 *Post-Refresher training.* In January (i.e., two months following the first training session), interviewers received an additional two days of training that involved review of the initial training session and in-class practice with interview scenarios and role playing. In January and February, following the refresher training, interviewers again submitted weekly interviews and received both written and verbal feedback on a weekly to bi-weekly basis for an additional two months.

Phase 4 *Termination of feedback.* Interviews were collected on a weekly basis for an additional two months (i.e., March, April), however, feedback from the primary investigators lessened and was only given on a by-request basis. Interviewers were also provided with peer reviews from their colleagues.

Thus, the data in the current study came from the following time line: Pre-training (September, October), Post-training (November, December), Post-Refresher training (January, February), and Termination of Feedback from trainers (March, April).

Coding

All interviews were coded for (a) adherence to components (i) to (v) outlined above, (b) the types of interviewer utterances, and (c) the amount of details provided by children.

Adherence to the components of the interview Two trained Research Assistants recorded whether each phase (e.g., Introduction, Ground Rules, Practice Interview) was present or absent. Intercoder agreement ranged from 85–90% throughout the study and discrepancies were resolved through discussion.

Interviewer Utterances The types of prompts used by the interviewers were coded into several categories (based on Price and Roberts 2010). Intercoder agreement for the interviewer utterances was 90% (interim agreement checks were gathered throughout the study to ensure that coding

remained consistently reliable over the 8 months of the study, and ranged from 85–94%).

- *Invitation*—Invites child to talk about an event with no cues from the interviewer (e.g., “Tell me more”, “What else?”);
- *Cued invitation*—Invites child to talk about something that s/he has already mentioned (e.g., “You said you play together. Tell me about playing together”);
- *Paraphrase*—Interviewer reflects back something the child has just said (e.g., “You mentioned that you felt sad”);
- *Directed narrative*—Directs the child towards a general topic but invites a narrative response (e.g., “Tell me about how things are at home”). Such prompts were present due to interviewers’ mandate to explore a set of general topics in children’s lives (e.g., “school”, “mealtime”). [Note: Although some researchers consider this prompt suggestive, we argue that in the present interviews it can be a desirable prompt. When an interviewer’s mandate is to explore all aspects of a child’s life, s/he must ask a very general question about “home” or “school” to direct the child’s attention. In such cases, a directed narrative is preferred to asking closed questions. Such questions are similar to the recommended questions in the NICHD protocol’s rapport-building section (Roberts et al. 2004)];
- *Directed specific*—Directs the child towards a particular topic and invites a brief response (e.g., “What was he wearing?”);
- *Option-posing*—Question provides child with two or more options (e.g., “Were you inside or outside?”);
- *Yes/No*—Question requires a “yes” or “no” response (e.g., “Did you go home right away?”). These questions were strictly coded such that if the appropriate grammatical response to a question was “yes” or “no”, the question was considered a yes/no question (e.g., “Can you tell me?”);
- *Suggestive*—Utterances containing information not mentioned by the child; or when interviewer leads child into a particular response (e.g., “You walked away immediately, didn’t you?”);
- *Facilitator*—Responsive device (e.g., “okay”, “hmm hmm”). Except where noted, child responses to facilitators were subsequently incorporated into the prompt asked immediately prior to the facilitator as in previous research (e.g., Lamb et al. 2002a,b).

Child Details These details referred to a word or words that were a complete subject (“I”, “you”, “she”), object (“ball”, “shirt”), preposition (“put on” is one detail), adjective (“white”, “hard”), other grammatical structure that provided information (e.g., “my”), or any other information-containing words. Words used only as a speech style (e.g.,

“like”, “umm”) were excluded from word counts and duplicate details were not included. Inter-coder agreement for the child details was 90% (interim agreement ranged from 89–96%).

Results

Adherence to Interview Components

Separate Chi-squared tests were conducted for each component of the interview to assess whether their frequency increased over the four time points (see Table 2). Three of the components increased over time: More interviews contained *Ground Rules*, $\chi^2(3, N=132)=10.45, p<.02$, and a *Transition to the Substantive Phase*, $\chi^2(3, N=132)=10.29, p<.02$, in Phase 3 (post-refresher) and Phase 4 (termination) compared to Phase 1 (pre-training) and Phase 2 (post-training); and more interviews contained formal *Closure*, $\chi^2(3, N=132)=10.44, p<.02$, at Phases 2, 3, and 4 compared to Phase 1. Interviewers included *Rapport Building* more often at Phases 3 and 4 than at Phase 1 but this did not quite reach significance, $\chi^2(3, N=132)=6.85, p=.08$. There was no improvement from Phase 1 to Phase 2. There was no significant improvement in the proportion of interviews which contained an *Introduction* or *Practice Interview*, $ps>.20$.

Interviewer Utterances

In order to determine whether and when interviewers improved in the quality of prompts employed throughout the 8 months, proportional scores were calculated. First, a sum was calculated of open-ended prompts (i.e., invitations, cued invitations and invitation occurrences) and proportions were calculated for each Phase by dividing the number of open-ended prompts by the total number of prompts in that Phase. Proportional scores must be used to control for the overall

number of prompts used. Proportional scores were also created separately for directed narrative prompts, and closed questions (i.e., directed specific, yes/no, option-posing, and suggestive). The proportional scores for each type of utterance were then entered separately into 4(Time Phase: Pre-training, Post-training, Post-refresher training, Termination of training) repeated-measures analyses of variance (ANOVAs). The Bonferroni correction was applied to all follow-up tests to control for multiple comparisons. The full set of means is displayed in Table 3. As will be seen in the following analyses, there was no improvement in the quality of interviewing between the pre-training and first post-training data; improvements occurred only after the refresher training session.

Open-ended prompts The 4 (Time Phase) ANOVA showed a main effect, $F(3, 124)=7.99, p<.001$ (see Table 3). Bonferroni tests showed that the proportion of open-ended prompts used at Phase 3 and Phase 4 was significantly greater than at Phase 1. Additionally, the proportion of open-ended prompts at Phase 3 was greater than at Phase 2 (Post-training).

Directed narratives The 4 (Time Phase) ANOVA was significant, $F(3, 124)=6.86, p<.001$. Specifically, the proportion of directed narratives at Phase 3 was significantly greater than at Phase 1, and significantly greater at Phase 3 and Phase 4 than Phase 1 and Phase 2.

Closed-ended prompts As expected, interviewer use of undesirable closed questions decreased over the course of the program, $F(3,124)=5.40, p=.002$. Specifically, the proportion of closed questions at Phase 4 was significantly lower than at Phase 1 and Phase 2.

Paraphrases Finally, there was no change in the proportion of paraphrases used by interviewers at any point in training, $F(3, 124)=0.82, p>.05$.

Table 2 The percentage of interviews containing each component at each Phase

Interview Component (expected chance percentage)	Phase			
	Phase 1 Pre-training	Phase 2 Post-training	Phase 3 Post-refresher	Phase 4 Termination
Introduction (66%)	58%	62%	73%	75%
Ground Rules (77%)	61%	74%	88%	92%
Rapport Building (82%)	70%	81%	92%	92%
Practice Interview (39%)	30%	38%	49%	38%
Transition to Substantive (53%)	47%	41%	64%	75%
Substantive Phase (97%)	100%	95%	94%	100%
Closure (48%)	24%	57%	55%	58%

Table 3 The proportions of each interviewer utterance type at each Phase

Utterance Type	Phase			
	Phase 1 Pre-training M (SD)	Phase 2 Post-training M (SD)	Phase 3 Post-refresher M (SD)	Phase 4 Termination M (SD)
Open-ended	.07 (.06)	.09 (.09)	.16 (.12)	.15 (.10)
Directed Narrative	.13 (.10)	.15 (.08)	.21 (.08)	.22 (.10)
Paraphrase	.05 (.06)	.05 (.05)	.04 (.04)	.07 (.10)
Closed-ended	.58 (.12)	.55 (.14)	.46 (.16)	.46 (.18)
Facilitators ^a	.30 (.15)	.29 (.14)	.39 (.20)	.42 (.19)

^a Facilitators were counted with the preceding prompt.

Facilitators Responses after facilitative devices (e.g., Mmm-hmm) were included with the previous prompt, however, a 4 (Time Phase) ANOVA on these data showed an increase in facilitators from Phase 2 to Phase 4, $F(3, 124)=4.10$, $p<.01$. This probably reflects the improved listening skills of the interviewers.

Child Details

The final set of analyses were conducted to see whether there was any increase in the amount and quality of information provided by children over the course of the spaced training. We compared the proportion of details elicited from open questions, directed narratives, closed questions, and paraphrases in separate 4(Time Phase) ANOVAs.

Although the proportion of information elicited by open-ended questions increased from Phase 1 to Phase 4, this difference was not statistically significant, $F(3, 121)=1.75$, $p=.16$. Similar nonsignificant increases were observed for directed narratives, $F(3, 121)=0.67$, $p=.58$, and paraphrases, $F(3, 121)=1.63$, $p=.19$. There was, however, a significant decrease over Phase of the proportion of information elicited by closed questions, $F(3, 121)=9.53$, $p<.001$. Bonferroni tests showed that significantly less information was elicited by closed questions at Phase 4 than at Phase 1 and Phase 2 (see Table 4).

Table 4 The proportion of details reported by children at each Phase as a function of interviewer utterance type

Utterance Type	Phase			
	Phase 1 Pre-training M (SD)	Phase 2 Post-training M (SD)	Phase 3 Post-refresher M (SD)	Phase 4 Termination M (SD)
Open-ended	.08 (.10)	.11 (.11)	.14 (.10)	.12 (.11)
Directed Narrative	.13 (.18)	.17 (.11)	.16 (.09)	.17 (.11)
Paraphrase	.03 (.03)	.02 (.03)	.02 (.02)	.01 (.01)
Closed-ended	.40 (.16)	.37 (.15)	.26 (.20)	.21 (.14)

Discussion

Training programs in investigative interviewing that include a single, though intense, learning session has not generally resulted in beneficial changes in interviewer behavior (e.g., Aldridge and Cameron 1999; Warren et al. 1999). While training and research has focused extensively on the use of certain interviewing procedures, for the most part, interviewers do not adopt these suggested strategies (e.g., Cederborg et al. 2000; Lamb et al. 2000; Walker and Warren 1995). Professional educators would not be surprised at this, however, because adult learning research shows clearly that information is retained for longer when the learning is ‘spaced’ (Schmidt and Bjork 1992). Because we scheduled a formal follow-up training session that took place two months after the initial training session, and because we had a record of the investigators’ interviews before and following each training session, we were able to track the temporal trajectory of changes in their interviewing behavior across a wide variety of interviews with a large sample of children over an 8-month period.

One of the most striking findings was that, although interviewers made an effort to employ some of the techniques immediately after training, changes in interviewer behavior were not observed until after a subsequent refresher training session. In general, compared to interviews done pre-training (Phase 1) and after the first training session (Phase 2), interviews at Phase 3 and especially Phase 4 (i.e., the phases

that followed the refresher training) contained significantly more open-ended prompts, more narrative questions about general topics (e.g., school, home), fewer closed-ended prompts, more utterances that contained facilitative support without asking a question, and clear ground rules, transitions, and closure sections. Perhaps most importantly, the proportion of information in children's reports that was elicited by risky, closed-ended questions (i.e., questions more likely to result in short and inaccurate responses; Goodman and Aman 1990; O'Callaghan and D'Arcy 1989; Peterson and Biggs 1997; Price and Goodman 1990; Saywitz et al. 1991) decreased significantly. These findings demonstrate that when forensic investigators use recommended interview procedures, they enhance the quality and quantity of the information elicited from alleged child victims. While this latter finding is not surprising, what the current study does reveal is that it is not only desirable but *essential* that training programs include a formal refresher training session for interviewer behavior to change (see also Price and Roberts 2010).

Why exactly is the spacing of training sessions such an effective teaching technique? First, research on cognition and learning shows that memories and knowledge need to be 'consolidated' before they are stable enough to be retained for long periods of time (e.g., Litman and Davachi 2008). Complementary research on neuropsychological development, particularly the hippocampal area that is involved in memory formation (see Litman and Davachi 2008), shows that there is a neural basis for such consolidation. While psychologists have always speculated that memories need to move to a hypothetical 'long-term memory space' to be retained, spacing and subsequent consolidation provides such an opportunity. Knowledge does not equal behavior change, however, as has been found in some previous training studies. Thus, a second reason why the spaced training may have aided improvements in interviewing is that the consolidation period allowed the information to be retained and retrieved without effort such that resources were freed up to consider the relevance of the knowledge for behavior as well as to provide time to 'try out' the techniques. Many of the trainees commented at the refresher training session (when they were hearing about child development principles in interviewing for a second time) that now 'it clicked' (Price and Roberts 2010).

It was disappointing that the use of a Practice Interview did not increase, even after the second, refresher session. The Practice Interview appears to be one of the most important parts of an investigative interview when children are able to practice recalling information and interviewers are able to practice crafting open-ended questions (Roberts et al. *in press*). Past research has clearly indicated that when children practice answering open-ended questions before the Substantive phase, they go on to subsequently report

more information than children who have not had such practice (e.g., Sternberg et al. 1997; Roberts et al. 2004). The apparent (but not statistically significant) decrease in the use of the Practice Interview at Phase 4 may be attributed to the fact that the formal and rigorous feedback from the trainers ended at this stage, and was replaced by more casual feedback from peers. Other desirable practices (e.g., using facilitators) continued to increase at this time, however, such as a reduction in the use of closed questions. Another explanation may be that interviewers became more efficient at eliciting the needed information from children in a shorter period of time, and therefore did not feel that they needed to continue using practice interviews.

Limitations and Recommendations

In summary, while interviewers made a strong effort to include key elements in their interviews following the initial training session, improvements in the largest, most significant, yet most difficult portion of the interview (i.e., relying on open-ended questions in the substantive phase) were not observed until after a second training session conducted two months after the first. Principles of adult learning, specifically spaced learning theory, predicted and explained the results. The formal, follow-up sessions probably consolidated knowledge to the point when the training material 'clicked'. If interviewers understand why certain techniques and practices are recommended, it will undoubtedly result in better adherence to internationally-recognized guidelines on interviewing children.

It could be argued that the training did not result in behavior change until after the refresher session because the quality of the training was inferior although we think this is less likely than a spaced learning explanation. First, many different training programs have shown a similar absence of improvement in the absence of refresher training (e.g., Cederborg et al. 2000; Warren et al. 1999). Second, the training did ultimately result in improvement even though the content of the refresher training and the feedback was not fundamentally different to that delivered before the refresher session.

Even if the importance of spaced learning is accepted by agencies, such an approach may not be implemented because of concern regarding the cost of such ongoing training and feedback. It is important to note that a spaced training program may not necessarily be more costly than an intensive 'one-shot' program, however. Many 'one-shot' programs are a week long (e.g., Aldridge and Cameron 1999) and so the spaced training program we devised was not any longer: Two days of training were conducted at each of the first and the second (refresher) sessions. What differs from other training programs, is the *spacing* of the

training. Other programs need not include exactly the same spacing as the current one, but psychologists recommend that subsequent training takes place long enough after the first so that some forgetting has occurred but memory is still quite good. This is known as the ‘time window’ and is a fundamental aspect of learning across the lifespan from infants to seniors (e.g., Rovee-Collier et al. 1995).

A clear conclusion emerges from this research: It is recommended that training programs space learning to encourage maximum retention and behavior change so that child witnesses can be interviewed in the most developmentally-appropriate fashion possible thereby allowing them to disclose their experiences to the best of their abilities.

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