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Abstract

Research has long recognized that many biases and shortcomings of humans severely limit their ability to accurately detect deception, and this may lead to great risks in government or military operations. One possible method to improve humans' deception detection ability is to train them to recognize cues of deception. To do this, we need to create effective training curricula and educational tools. This paper focuses on describing how we use existing research on deception detection to guide the design, development and evaluation of such a training curriculum. Research-authenticated cues of deception are selected, organized and presented as the core of the training curriculum. Real-life examples and analyses are created to illustrate the cues and provide learners detection practice with immediate feedback. Besides traditional instructor-led lecture-based training, we also implement this curriculum with a Web-based, learner-centered multimedia training system called Agent99 Trainer. Experiments are conducted to study the effectiveness of our training curriculum and to compare the two training implementations. The initial results show that our training curriculum significantly improves human deception detection accuracy and the Agent99 Trainer system provides training as effective as the instructor-led, lecture-based training.

Keywords: Deception detection, deception detection training, Web-based training, training curricula, evaluation

Introduction

Buller and Burgoon (1996, p.205) define deception as "a message knowingly transmitted with the intent to foster false belief or conclusions". "White lies", which are polite behaviors such as people showing appreciation for a gift that they actually don't like, may be relatively harmless if undetected. However, deception executed with malicious intent can bring great risks to individuals, organizations, or even nations, if it remains undetected. Therefore, it is important for people to be able to accurately detect deception. Although people often think they are good detectors, research recognizes that humans have many biases and shortcomings that severely limit their ability to accurately detect deception. In fact, research results show that humans are generally poor at detecting deception; they are correct just slightly more than 50 percent of the time (Kraut, 1980; Miller & Stiff,

1993). Consequently, it is critical to help people improve their deception detection accuracy in order to reduce the potential threats to security.

A lack of real knowledge of unfailingly reliable cues and strong reliance on a few "unauthenticated" cues contribute to human's vulnerability to detect deception (Levine et al., 1999). As researchers authenticate more cues of deception, training becomes a more valid way to help individuals understand the nature of deception and thereby improve their ability to detect it. However, prior methods of training people in deception detection have mixed findings. In fact, some training has resulted in a reduction in detection accuracy (DePaulo & Pfeifer, 1986). Also, although information technology has been applied to education for a long time, none of the earlier deception detection training attempts used IT-supported training tools. Therefore, it is an immense challenge to develop both effective training curricula and IT-supported training tools for deception detection. The study described in this paper is an attempt to design, develop and test such a deception detection training curriculum and its Web-based implementation. Guided by research findings related to cues of deception and deception detection training, we developed the training curriculum as a combination of three components: specific instructions on deception detection knowledge, practices on real-life examples of deception, and analytical feedback to the practices. Creating such a training curriculum involved selecting reliable cues of deception, organizing and explaining these cues, and finding examples of human communication that can illustrate these cues. The training curriculum was implemented with two training methods: 1) a traditional instructor-led, lecture-based training and 2) a Web-based learner-centered multimedia training system called AGENT99 Trainer. The study expected that the training curriculum would be able to effectively improve the subjects' detection accuracy. In addition, the study anticipated that the Web-based training tool would be at least as effective as the traditional lecture-based training in improving detection accuracy, while providing benefits such as anytime and anywhere accessibility and repeatability. The initial experiment tested the effectiveness of the training curriculum by measuring the learners' deception detection accuracy before and after receiving training. Pre and post tests in the form of judging the veracity of human communications were specially created for measuring learners' deception detection accuracy. The experiment also compared the training effectiveness of the two delivery methods. Results of this experiment supported our hypotheses.

In the following sections of this paper, first we introduce some of the background research for both deception detection and training for detecting deception. Next, we describe the development of our training curriculum. Then the implementation of the curriculum within the Agent99 Trainer system is introduced briefly.[1] Afterward, we present the study design and procedures for the evaluation of the training curriculum and the comparison between the two training delivery methods. Finally, we provide a summary of our findings, as well as a discussion of the findings and the need for future research.

Background

Detecting deception is hard for humans because they lack real knowledge of unfailingly reliable cues and are heavily influenced by biases or strong reliance on a few "unauthenticated" cues (Levine et al., 1999. From a theoretical standpoint, it therefore should be possible to train people to detect deception more accurately, as long as there are research-authenticated cues available. Research studies on deceptive communication have already authenticated many behavioral cues that may distinguish a deceptive communication from a truthful one, based on the communicators' verbal or nonverbal behaviors, and research continues to reveal even more cues or indicators of deception. In 1981, Zuckerman, DePaulo, and Rosenthal published the first comprehensive meta-analysis on deception cues. They analyzed all research studies reporting verbal and nonverbal cues of deceptive communications and summarized them into 19 behavioral cues of deception (Zuckerman et al., 1981). They grouped these cues into four different categories: attempted control, arousal, affective/emotional states, and cognitive complexity. That is, deceivers may try to control their verbal and nonverbal displays, they may be aroused, they may experience specific affects (e.g. guilt), and they also may be engaging in a cognitively more demanding task than people who are telling the truth. Zuckerman team suggested that cues associated with these four categories might be the most likely indicators of deception. In a recent review of the initial Zuckerman meta-analysis, DePaulo, Lindsay, and Malone (2001) analyzed more research studies, resulting in a more comprehensive list of cues that contains 158 cues of deception, each of which has a measure indicating its reliability. The 158 cues were grouped according to the applicability of the following five questions:

1) Are liars less forthcoming than truth tellers?
2) Do liars tell less compelling tales than truth tellers?
3) Are liars less positive and pleasant than truth tellers?

[1]For a detailed description, please refer to (Lin et al. 2003).

4) Are liars tenser than truth tellers?
5) Do deceptive self-presentations include fewer ordinary imperfections and unusual contents than truthful ones?

The DePaulo meta-analysis and the Zuckerman meta-analysis mentioned focused on behavioral cues that may indicate deception. In addition, recent studies have pointed out that there may be linguistic indicators of deception such as *group references*, *qualifiers*, and *vague language* in communication text (Zhou et al., 2003). All these research studies provide a good knowledge base for training people to improve their deception detection accuracy.

Although research has shown that it is *possible* to increase people's ability to detect deception through training, not all training programs can do so (Kassin & Fong, 1999). Different training content may result in different training effects. Before the Zuckerman study in 1981, no research-authenticated cues were available so earlier attempts of deception detection training had no alternative to using a "practice" and "self-taught" strategy, in which either 1) the observer evaluated the veracity of a communication after viewing a "normal", truthful communication of the subject/potential deceiver (Brandt, 1980a; 1980b), or 2) the observer evaluated the veracity of a communication and immediately received outcome feedback (true or false) on the correctness of his or her judgment (Zuckerman et al., 1984). Improvement gained from this type of training is limited and not generalizable, because observers can only become better at detecting deception in the subjects they study. Observers can even "learn" erroneous cues during the self-taught learning process, and if erroneous knowledge is not corrected it may result in a negative training effect (DePaulo & Pfeifer, 1986), i.e., lower detection accuracy after receiving training. After authenticated cues had become available and been accepted by many researchers, investigators began adding explicit instruction in using the cues of deception to their training programs (DeTurck et al., 1990, 1991; Fiedler & Walka, 1993; Vrij, 1994). However, it must be decided which cues should be used to train people. In the early 1990s, instruction typically focused on nonverbal cues of deception. It was not until recently that attempts have been made to provide instruction in the use of both nonverbal and verbal cues (Porter et al., 2000). This training in both types of cues resulted in post-training average deception detection accuracy of 76.7%, highest of all the training studies we reviewed. Effective deception detection training therefore apparently needs to include instruction on all authenticated cues and indicators, including both the verbal and the nonverbal.

We also wanted to examine the possibility that, in addition to training content, training methods also influence training effectiveness. Deception detection training research indicates that the most effective training is obtained when instruction is combined with practice judging the veracity of real communications, followed by outcome feedback on the judgments (Vrij, 1994). Therefore, we decided that explicit instruction, practice and feedback are three critical components of effective deception detection training and that in combination, their performance is superior to that of either "instruction only" training or "practice only" training. However, the question of how to incorporate all three critical components persists. Previous research has investigated only one type of deception detection training: instructor-led, lecture-based training in a classroom setting. The use of high-tech instructional technology in such training programs has been limited to showing communications videos. Nevertheless, it is widely accepted that properly designed computer systems can be excellent training tools (Rosenberg, 2000). We believe that a Web-based, multimedia, learner-centered training system can be an invaluable instructional tool for deception detection training by providing such advantages over instructor-led training as self-paced, unlimited access at anytime and anywhere.

Testing the effectiveness of a deception detection training program is another remaining challenge. Earlier research studies have described the design and procedure of their evaluations. But, although many studies have used pretest-posttest comparison on the communication veracity judgment tests, no evaluation tool is available in the literature. As a result, we had to create our own. As Frank and Feeley pointed out in their meta-analysis on deception detection training (Frank and Feeley, 2002), many potential pitfalls can complicate the seemingly easy pretest-posttest design and inject bias into the evaluation results. For example, if the same communicator (person who participates in the communication that is to be judged by the subjects) appears repeatedly in the same test (pretest or posttest) or appears in both tests, the subjects may pick up some cues specific to that communicator rather than the general cues they learn from the training curriculum. As a consequence, the evaluation results will be biased by factors other than training. To avoid this kind of bias and ensure experiment validity, there must be a sufficient number of different communicators in both the pretest and the posttest. Frank and Feeley recommended 10 as a minimum number of communicators for the total two tests, taking into consideration some statistical requirements and the time limit for the judgment tests (If the test takes more than 30 minutes, subjects usually become tired and stop concentrating on their judgments.). These research studies and recommendations guided us through the creation of judgment tests and the design of the evaluation of our training program, as will be discussed in the *Judgment Test Creation* and *Experiment* sections.

Training Curriculum Development

As has been discussed, an effective deception detection training program should be a combination of three critical components: explicit instruction, practice and feedback. To avoid a negative training effect caused by erroneous cues (DePaulo & Pfeifer, 1986), the instruction and feedback must be based on research-authenticated cues of deception. Therefore, we first studied and selected cues of deception reported in literatures. Based on the results, we developed our training curriculum content to include: (1) a videotaped lecture on cues of deception, (2) real communication examples extracted from the records of previous deception research studies, and (3) analyses for each example based on the cues taught in the lecture. Both the instructor-led lecture-based training and the Agent99 Trainer system used the same curriculum, so that the effectiveness of the instructional methods could be compared. In addition, to avoid instructor bias the same instructor presented the lecture under both conditions.

The creation of judgment tests for evaluation is included in this section as a special component of content development. The judgment test cases were extracted from the same sources as the practice examples in the training curriculum. A pilot study was conducted to help us select and organize the test cases into two separate tests and to ensure that the two tests were statistically equivalent. This is discussed in further detail below.

Lecture on Cues of Deception

The content of the lecture includes a definition of deception, basic methods of deception detection, categories of behavioral cues of deception, and groups of linguistic indicators. The behavioral cues were selected primarily from the previously mentioned DePaulo meta-analysis (DePaulo et al., 2001). The meta-analysis provided a comprehensive list of cues, including the effects size and significance of each cue. Therefore, we chose significant deception cues ($p < .05$) having the largest effect sizes ($d > |.20|$) as would be explained in detail in our training lecture. They included *higher voice pitch, more passive statements, more negative statements, fewer details, more pauses, more response latencies, and more distancing of the storyteller from the story told*. However, we did not organize these behavioral cues into the same five categories as in the DePaulo meta-analysis because categorization based on their five questions might have been difficult for learners to understand. Our theorizing about the strategic nature of deception led us to propose another five categories of cues based on their etiologies, i.e., the deceptive behavior revealing the cues. These categories were *arousal*, *emotion*, *cognitive effort*, *memory process*, and *communication tactics* (Burgoon & Blair, 2003). This categorization uncovers the causal relationship between deceptive behaviors and cues. For example, *more negative statements* is listed in the *emotion* category, because it describes a behavior arising from a deceiver's negative or guilty emotion when deceiving. We believe our new categorization provides a useful organization that can help learners understand and memorize cues. For each category of cues, definitions and other relevant information about the cues were extracted from original research referenced in DePaulo's meta-analysis. Besides these behavioral cues, we also selected several linguistic indicators described in a recent study about deception detection in text-based computer-mediated communication (Zhou et al., 2003) for inclusion in the training curriculum. Based on definitions from that study, each indicator was explained in detail. One or two sentences were presented as examples illustrating each indicator.

A set of PowerPoint slides was developed as the basis and outline of a lecture on cues of deception. The definitions and explanations of cues and indicators selected were written into a script. For the purpose of putting the lecture into the Agent99 Trainer system, an instructor presented the lecture based on the slides and the script in a studio, and the presentation was videotaped as a 34-minute lecture video. The same instructor also presented to the lecture-based training sessions using the same set of slides and script.

Examples of Deception Cues and Analyses

Because deception detection is considered a complex problem and deep understanding of cues of deception requires extensive experience and high levels of cognitive processing (Zuckerman, 1984), practice is a "must-have" component of deception detection training, where learners typically are allowed to watch real-life examples of deceptive or truthful communications and make judgment on their veracity. Research results have shown that providing practice without additional instruction may improve human's deception detection accuracy (Brandt, 1980a, 1980b; Zuckerman et al., 1984) and that providing outcome feedback (indicating whether the judgment is true or false) can result in even greater improvement of detection accuracy (Zuckerman et al., 1984). However, simple outcome feedback does not point out the reasons for an outcome and thus cannot offer explicit directions for improvement (Azevedo and Bernard, 1995). Therefore, we decided to include in our lecture not only real-life

examples illustrating the cues but also analytical feedback for each example in order to help learners develop a deep understanding of each cue.

The practice examples in our curriculum were selected from a series of research studies about interpersonal deception detection (Burgoon et al., 1994, 1996, 1999; Zhou et al., 2003). We chose examples in different media types (video, audio, and text) so that learners could learn to detect deception under varying communication conditions. Video and audio examples were selected from the video records of the first three Burgoon studies (Burgoon et al., 1994, 1996, 1999). In these studies, pairs of subjects conducted face-to-face interviews, and the interview process was videotaped. In each interview, the interviewee was asked several questions about his/her job, life, attitude or feelings, and he/she was told to lie in answering some specific questions. Based on the original data of these experiments (e.g. the interviewee's self-rating of his/her veracity on each question), we chose those deceptive or truthful conversations that illustrated the cues taught in the lecture. Each example contained only the conversation about one question, making it short enough (1-3 minutes) to avoid boring the learners. Text examples were selected from a recent study about computer-mediated deception (Zhou et al., 2003). The setting of this study was similar to that of the previous studies; the only difference was that the interviews were conducted through a computer chat program, e.g., Microsoft NetMeeting. We looked at the text messages, and extracted paragraphs of deceptive or truthful conversations as our text examples. A group of deception detection researchers reviewed a number of candidate examples to decide which examples should be incorporated into the curriculum. Furthermore, the researchers provided an analysis for each example, describing the deception detection cues that were presented. Considering our desire to limit the training duration to approximately one hour in the evaluation stage, we finally selected 21 examples, including16 video and audio examples and 5 text examples. All 21 examples were listed in the Agent99 Trainer system with accompanying analyses presented textually. In the lecture-based classroom training, the instructor presented the same 21 examples to learners, and the analyses were given verbally by the instructor.

Judgment Tests Creation

We decided to test the effectiveness of our training curriculum using a basic pretest-posttest design, in which learners would be assessed on the accuracy of their deception detection prior to training and then after receiving training. In most studies of deception detection, human detection accuracy is measured as the percentage of correct judgments in a set of judgment tasks (i.e., judging the veracity of a short conversation). Two judgment tests therefore needed to be created. Following the recommendations of Frank and Feeley (2002) that we described in the *Background* section, we designed the pretest and posttest such that each consisted of 6 test cases (short conversations), from a total of 12 different pairs of communicators. Each test took about 15 minutes to complete, and learners judged the veracity for each test case. To make the judgment tests consistent with the training content, all test cases were extracted from the same sources and had the same format as the practice examples in the training curriculum. However, none of the communicators in the test cases appeared in the training examples, to ensure that the learners' detection accuracy would not be biased by previous exposure to specific communicators. To test the learners' ability to detect deception under various communication conditions, the test cases were presented in different media types, two each in text, audio, and video formats. Half the test cases were deceptive and half were not, enabling us to control for guessing and easily determine whether scores were above or below chance (Frank & Feeley, 2002).

A pilot study was conducted to help us choose the test cases, group them into two separate tests, and ensure that they had the same difficulty level. Candidate test cases were extracted and reviewed by the researchers to ensure that the cases represented cues taught in the lecture. The researchers also estimated the detection difficulty level for each candidate case, and then grouped the cases by media type, veracity, and detection difficulty level into two balanced sets. The test cases were randomly ordered within each set, based on those characteristics. In the pilot study, two groups of untrained undergraduate students took the two tests separately. The average detection accuracy scores for each test and each test case were then calculated. We had expected no significant difference between the average detection accuracy scores for the two tests but were prepared, if there were a significant difference, to check the score of each test case to determine the case's actual difficulty level and make some adjustments. However, since the pilot results showed that the scores for the two candidate tests were not significantly different, we assumed they had the same difficulty level, and used them as the pre-test and post-test in our experiment.

Agent99 Trainer Implementation

The effect of a training curriculum can be different under different delivery methods. Computer-assisted instruction systems, especially Web-based training systems, usually are agreed to be more effective training delivery methods than traditional lecture-based training (Cornell, 1999). Therefore, we implemented our training curriculum in a Web-based training system called Agent99

Trainer, which was adapted from a previously developed system called LBA (Learning by Asking) (Zhang, 2002). LBA, designed as a general training tool, provides learner-centered training and has the time and space independence of Web-based technologies as well as the richer information channel of multimedia technologies. However, because deception detection training is different from general-purpose training, we had to tailor this general training tool to fulfill such special requirements of deception detection training, as incorporating the three critical components: explicit instruction, practice and feedback. LBA supports only one of these, explicit instruction, by providing multimedia online lectures in a module called *Watch Lecture*. Consequently, another module called *View Example with Analysis* was incorporated to deliver the practice examples and analytical feedback. These two modules were implemented in Agent99 Trainer as follows (Figure 1 shows the interfaces of these two modules):

Watch Lecture module presented the lecture on deception cues through a combination of digital media that includes a video stream of the lecture, a set of presentation slides, and a script of the lecture video. In our application, the lecture was virtually segmented into different topics, and each segment of video was then synchronized with one slide and a segment of the script talking about the same topic. Therefore, when learners played the video sequentially, the associated slides and script would automatically be displayed, just as an instructor does when changing slides for a lecture in a classroom. In addition, navigation buttons and pull-down menus were provided so that users could switch to any topic or its associated practice examples on demand, with no restriction on the sequence of the video.

View Example with Analysis module linked the 21 examples in the curriculum to the relevant cues taught in the lecture. One category of cues could have multiple examples linked to it. Learners could choose to view the same example in three different media types (video, audio and text), so that they could focus on cues in different communication channels (visual, vocal, and textual or linguistic cues) for the same example. Furthermore, a link to an expert analysis was provided for each example, so that learners could get immediate analytical feedback after having viewed an example and made their own judgment regarding that example. Again, buttons and menus in this module are designed to help learners switch easily between different examples, as well as between examples, analyses, and the lecture.

(a) (b)

Figure 1. Interfaces of the *Watch Lecture* Module (a) and the *View Example with Analysis* Module (b)

Experiment

We tested the effectiveness of our deception detection training curriculum by assessing improvement in learners' deception detection accuracy. Since the development of our training curriculum was guided by previous research findings for deception detection and deception detection training, we expected learners to improve their detection accuracy significantly after being trained with our curriculum; no matter what delivery method was used. However, we also expected Agent99 Trainer to be at least as effective a training method as the lecture-based training method, because the Agent99 Trainer implementation provides self-paced, repeatable access to the curriculum. Therefore, we had hypothesized that:

H1: Learners receiving our training curriculum would improve their deception detection accuracy more than if they had received no training, i.e., our training curriculum would have a positive training effect, and

H2: Learners receiving training through Agent99 Trainer would improve their deception detection accuracy as much as or more than if they had received training by an instructor-led, lecture-based training.

These two hypotheses were tested in a pretest-posttest cross-treatment experiment that was conducted at a research university in the Southwest. Twenty-eight undergraduate students registered in summer classes in the MIS department were recruited as participants and randomly assigned to two treatment groups. There was no control group in the experiment because of the limited number of participants. However, the validity of the experiment was not in jeopardy, because a pilot study had been conducted before the experiment. Its results had demonstrated that the pre-test and post-test had equivalent difficulty levels, and that there had been no practice effect between the pre-test and post-test. Therefore, the difference between the post-test and the pre-test scores for each treatment group could be assumed to be only due to the effect of the training curriculum. So we tested the first hypothesis by comparing the pretest and posttest scores for each group.

The second hypothesis was tested by comparing the learners' detection accuracy improvements between the two treatment groups. One of which received training by Agent99 Trainer, while the other group received traditional instructor-led, lecture-based training. The experiment lasted about 2 hours. The first half hour was used in both groups for the pre-test, which is a judgment test (15 minutes), and a few questions about learners' demographic information and communication styles (another 15 minutes). After a one-hour training session, subjects were given another 15-minute judgment test as a posttest and were asked to complete a survey about their satisfaction with the training program. During the one-hour training period, the students in the Agent99 Trainer group were asked to watch the lecture and practice deception detection with the examples by themselves, through the Agent99 Trainer system in a computer lab with Internet connection. At the same time, the instructor who had taught the video lecture presented the same lecture and examples for the students in the lecture group in a classroom setting. The only difference between the two treatment groups was the different delivery methods for the training curriculum.

Results and Discussion

In the analysis, the deception detection accuracy for each judgment test was measured by the number of correct judgments divided by the total number of test cases (6 in our experiment). This measure was calculated for each subject for both pre-test and post-test as the dependent variable. Two independent variables were used in this experiment: *treatment* (Agent99 or Lecture) and *time* (pre- or post-). We conducted a 2 x 2 ANOVA with repeated measures on the *time* factor. Results revealed a significant main effect for the *time* factor, $F(1, 27) = 32.29$, $p < 0.001$, eta square = 0.545. No significant main effect for the *treatment* factor and no significant interactions were found in this experiment (see Table 1). Therefore, the first hypothesis was supported (the training curriculum improved learners' deception detection accuracy), and the second hypothesis was not rejected (the Agent99 group performed no differently than the lecture group, even though the detection accuracy of the Agent99 group did improve slightly more than did the lecture group).

Table 1. Detection Accuracy Means as a Function of the *Treatment* and *Time* Factors

		time		
treatment	N	pre*	post*	p-Value
Agent99	14	.4222 (.1651)	.6889 (.2077)	<.001 **
Lecture	14	.4405 (.2129)	.6429 (.1582)	<.001 **

*Numbers are means (standard deviations).

Overall, the results of this initial evaluation of our training curriculum and the Agent99 Trainer implementation are encouraging, but they also introduce additional work to be done in the future. The overall training curriculum was found to be effective at improving learners' deception detection accuracy. However, studies need to be done to determine which part of the training curriculum (lecture, practice, and feedback) makes the most important contribution to this effectiveness. Also the current study did not tell which cues are more reliable or useful in the deception detection training. It is a little disappointing to discover that the Agent99 Trainer provided learning effects only as good as the traditional lecture-based training, not better, as we had hoped. We believe several factors may have contributed to this result. First, Agent99 Trainer was only partially implemented in this experiment; some functions about instructor-learner interactions (e.g., question answering or discussion forum) are still in the

conceptual design stage. Since students in lecture-based training settings can easily interact with the human instructor, they can more readily get explanations of what they do not understand, and consequently get more effective training. Second, we evaluated Agent99 Trainer in a controlled laboratory environment. Access was limited to a one-hour session – equivalent to instruction time in lecture-based training. However a strong advantage of a Web-based training system is assumed to be its capability of providing self-paced, repeatable training with unlimited access time. This benefit therefore needs to be measured in a longitudinal field study. Finally, the sample is small and composed entirely of undergraduate students. In reality, the major audience of our training curriculum would be military or government officers who need to make decisions about deception in their everyday work. The training effects of the curriculum might be different for a sample of these officers. It is therefore important to increase both the sample size and the sample diversity in the future research.

Based on this discussion, we intend first to implement the full functionality of Agent99 Trainer. Then, in a second- phase evaluation, we will explore the ways different system functions affect the training effectiveness of the system, which should lead to a better understanding of system-design effects on deception detection training. In addition, we will conduct experiments to test the effectiveness of different parts of the training curriculum (instruction, practice and feedback) as well as combinations of them. Different cues will also be taken as independent variables so we will learn which cues are suitable for the training curriculum. Furthermore, we plan to conduct a field study in a military or government setting. We expect to develop a training curriculum for use as part of an officers' career training program and make it possible for officers to use Agent99 Trainer with longer access time. Finally, we would like to investigate the effectiveness of training using a combination of instructor-led, lecture-based training and Agent99 Trainer, thereby achieving the advantages of both.

Despite the need for improvements, the research findings reported in this paper have both research and application impacts. They show that a training program for deception detection can be effective using either traditional instructor-led training or a Web-based training tool, as long as the training curriculum is developed correctly. This result implies that researchers in deception detection training should focus more on content development of the curriculum, such as the selection and organization of cues, rather than on delivery method. However, if the curriculum contents have been tested to be effective, it will be necessary and important to study the design of Web-based training tools based on both learning theories and deception detection requirements, because the success of Web-based tools in deception detection training can have enormous impact in practice. With today's pervasive Internet technology, the Web-based training tool can provide anytime-anywhere training of the clues that point to deception, and overcome the lack of human instructors of deception detection. Deception detection training will thus be able to be embedded in every security-related worker's daily life using such as Web-based training tool. In an era when homeland security is becoming more and more important for a nation, the benefit of such an on-the-job training program is obvious.

References

Azevedo, R. and Bernard, R. M. "A meta-analysis of the effects of feedback in computer-based instruction." *Journal of Educational Computing Research*, (13:2), 1995. pp. 111-127.

Brandt, D.R., Hocking, J.E., and Miller, G.R. "Effects of self-monitoring and familiarity on the ability of observers to detect deception," *Communication Quarterly*, (28), 1980a. pp. 3-10.

Brandt, D.R., Hocking, J.E., and Miller, G.R. "The truth-deception attribution: Effects of familiarity on the ability of observers to detect deception," *Human Communication Research*, (6), 1980b. pp. 99-110.

Buller, D. B. and Burgoon, J. K. "Interpersonal deception theory," *Communication Theory* (6), 1996. pp. 203-242.

Burgoon, J.K. and Buller, D.B. "Interpersonal deception: III. Effects of deceit on perceived communication and nonverbal behavior dynamics," *Journal of Nonverbal Behavior*, (18:2), 1994. pp. 155-184.

Burgoon, J.K., Buller, D. B., Ebesu, A., Rockwell, P. and White, C. "Testing interpersonal deception theory: Effects of suspicion on nonverbal behavior and relational messages," *Communication Theory*, (6), 1996. pp. 243-267.

Burgoon, J.K., Buller, D. B., White, C. H., Afifi, W. A. and Buslig, A. L. S. "The role of conversational involvement in deceptive interpersonal interactions," *Personality & Social Psychology Bulletin*, (25:6), 1999. pp. 669-685.

Burgoon, J. K. and Blair, C. "The Strategic Nature of Deception -- Behavioral Cues for Deception Detection", working paper, 2003.

Cornell, R. "The Onrush of Technology in Education: The Professor's New Dilemma," *Educational Technology* (39:3), 1999. pp. 60-64.

DePaulo, B.M. and Pfeifer, R.L. "On-the-job experience and skill at detecting deception," *Journal of Applied Social Psychology*, (16), 1986. pp. 249-267.

DePaulo, B.M., Lindsay, J.J. and Malone, B.E. "Cues to Deception," *Psychological Bulletin*, 2001.

DeTurck, M.A., Harszlak, J. J., Bodhorn, D. and Texter, L. "The effects of training social perceivers to detect deception from behavioral cues," *Communication Quarterly*, (38), 1990. pp. 1-11.

DeTurck, M.A. "Training observers to detect spontaneous deception: The effects of gender," *Communication Reports*, (4), 1991. pp. 79-89.

Fiedler, K. and Walka, I. "Training lie detectors to use nonverbal cues instead of global heuristics," *Human Communication Research*, (20), 1993. pp. 199-223.

Frank, M.G. and Feeley, T.H. "To Catch a Liar: Challenges for Research in Lie Detection Training," *Journal of Applied Communication Research*, 2002, forthcoming.

Kassin, S.M. and Fong, C.T. ""I'm innocent!": Effects of Training on Judgments of Truth and Deception in the Interrogation Room," *Law & Human Behavior*, (23), 1999. pp. 499-516.

Kraut, R. "Humans as lie detectors," *Journal of Communication*, (30), 1980. pp. 209-216.

Levine, T.R., Park, H.S. and McCornack, S.A. "Accuracy in Detecting Truths and Lies: Documenting the "Veracity Effect"," *Communication Monographs*, (66), 1999. pp. 125-144.

Lin, M., Crews, J. and Cao, J. "Agent99 Trainer: Design and Implement a Web-based Multimedia Training System for Deception Detection Knowledge Transfer", submit to *2003 Americas Conference on Information Systems (AMCIS 2003)*, 2003. Under review.

Miller, G.R., & Stiff, J.B. *Deceptive Communication*, Newbury Park, CA: Sage Publications, Inc., 1993.

Porter, S., Woodworth, M. and Birt, A. R. "Truth, Lies, and Videotape: An Investigation of the Ability of Federal Parole Officers to Detect Deception," *Law and Human Behavior* (24:6), 2000. pp. 643-658.

Rosenberg, M. J. *E-Learning: Strategies for Delivering Knowledge in the Digital Age*, McGraw-Hill, 2000.

Vrij, A. "The impact of information and setting on detection of deception by police detectives," *Journal of Nonverbal Behavior*, (18), 1994. pp. 117-136.

Zhang, D. S. *Virtual mentor and media structuralization theory*, PhD dissertation, University of Arizona, Tucson, AZ, 2002.

Zhou, L., Twitchell, D., Qin, T., Burgoon, J. and Nunamaker., J. "An Exploratory Study into Deception Detection in Text-based Computer-Mediated Communication", *36 th Hawaii International Conference on System Sciences (HICSS-36)*, 2003.

Zuckerman, M., DePaulo, B.M., and Rosenthal, R. "Verbal and nonverbal communication of deception, in Advances in experimental social psychology," Berkowitz, L. (Editor), 1981, Academic Press: San Diego, CA. pp. 1-59.

Zuckerman, M., Koestner, R., and Alton, O.A. "Learning to Detect Deception", *Journal of Personality and Social Psychology*, (46), 1984. pp. 519-528.