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A field assessment of child abuse investigators' engagement with a child-avatar to develop interviewing skills

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ABSTRACT

Background: Child investigative interviewing is a complex skill requiring specialised training. A critical training element is practice. Simulations with digital avatars are cost-effective options for delivering training. This study of real-world data provides novel insights evaluating a large number of trainees' engagement with LiveSimulation (LiveSim), an online child-avatar that involves a trainee selecting a question (i.e., an option-tree) and the avatar responding with the level of detail appropriate for the question type. While LiveSim has been shown to facilitate learning of open-ended questions, its utility (from a user engagement perspective) remains to be examined. **Objective:** We evaluated trainees' engagement with LiveSim, focusing on patterns of interaction (e.g., amount), appropriateness of the prompt structure, and the programme's technical compatibility.

Participants and setting: Professionals ($N = 606$, mainly child protection workers and police) being offered the avatar as part of an intensive course on how to interview a child conducted between 2009 and 2018.

Methods: For descriptive analysis, Visual Basic for Applications coding in Excel was applied to evaluate engagement and internal attributes of LiveSim. A compatibility study of the programme was run testing different hardware focusing on access and function.

Results: The trainees demonstrated good engagement with the programme across a variety of measures, including number and timing of activity completions. Overall, knowing the utility of avatars, our results provide strong support for the notion that a technically simple avatar like LiveSim awake user engagement. This is important knowledge in further development of learning simulations using next-generation technology.

1. Introduction

Interviewing a child about suspected child sexual or physical abuse is a complex and challenging task that requires specialised training (Benson & Powell, 2015a; Krause et al., 2017; Powell, Wright, & Clark, 2010; Rischke et al., 2011). The essential elements of child investigative-interviewer training include the establishment of an interview framework that maximises narrative detail, clear

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instruction about the application of the framework, effective ongoing practice, expert feedback and regular evaluation of an interviewer's performance (Powell & Wright, 2008). The role of practice in particular has been demonstrated by research showing a proportional increase in desirable questions and behaviours, followed by a decline in performance when no practice has been maintained (Lamb, Sternberg, Orbach, Esplin, & Mitchell, 2002; Lamb, Sternberg, Orbach, Hershkowitz, et al., 2002; Powell et al., 2008; Sternberg et al., 2001).

For performance to be maintained over time, practice needs to be repeated at spaced intervals and must target specific goals tailored to an individual's ability level (Powell, 2008; Rischke et al., 2011). Furthermore, when a simulation (as opposed to a field interview) is staged using a trained actor portraying a child being interviewed, the responses given by the trained actor need to include those that would normally provoke an inappropriate question (e.g., silence, lack of specific detail, or an irrelevant or ambiguous response) (e.g., Powell et al., 2008; Powell et al., 2022). When practising a skill, one learns what to do by making correct responses as well as correcting errors (Benson & Powell, 2015a; Cederborg et al., 2021; Cyr et al., 2021; Ford et al., 2019). Today, researchers seek to develop online avatar-based programmes that enables sufficient practicing of interviewing skills during and after training programmes, and within the frames of limited resources in money and personnel. The current study adds to the field by focusing on user engagement among professional field workers (mostly CPS workers and police officers) using an existing online child avatar training tool, the LiveSim introduced by Guadagno and Powell (2012). User engagement is critical for trainees to stay in the training programme and includes behavioural engagement manifesting in for example, time spent in the programme and number of interview sessions and questions trainees practice.

Training programmes in communicative skills use various simulation approaches for staging practice in identifying appropriate questions and generating them orally. Practising new skills on the job with children who are reporting abuse raises ethical, legal, and pedagogical issues (Powell, Cavezza, et al., 2010). Besides privacy issues regarding trainers accessing interviews to provide feedback, learning is most effective when it is done in short bursts of time in tailor-made exercises that target specific subskills, where performance can be objectively measured in standardised exercises and interview complexity (in terms of respondent style) matches a trainee interviewer's ability level (e.g., Lamb et al., 2018; Powell et al., 2008; Powell et al., 2016).

Considering all the different ways in which simulated interviews can be staged, having the role of the child played by a research assistant with sufficient content knowledge to provide effective feedback (referred to as a trained actor) is currently the most useful method (Powell et al., 2022). Using a colleague trainee or untrained layperson is not as effective as a trained actor, as they provide responses that reflect superior memory and language skills compared to how child witnesses typically behave in these contexts, and they do not systematically reinforce desirable questioning (Powell & Wright, 2008). Furthermore, using school children engaging in interviews about an innocuous staged event (e.g., a magic show) gives little control over what challenges will be addressed and provides limited opportunities to respond to reluctant disclosures, off-topic responses and poor articulation of sexual terminology and acts (Powell et al., 2022). Trained actors can adapt their performance to an interviewer's ability level and respond to questions in a way that is reminiscent of the challenges that interviewers encounter in the workplace with actual children (Powell et al., 2008).

Using trained actors, however, also presents practical challenges. Actors require extensive training; for example, in a study by Powell et al. (2008), trained actors playing the role of a child did 12 weeks (approximately 25 h in total) of training before entering mock interviews as a child. Such instruction is a major financial investment for educational institutions, especially if trained assistants move on to other jobs and more people need to be trained. Furthermore, using trained actors who disclose abuse requires manual scheduling around other commitments, potential negative psychological consequences for the actor (which requires monitoring) and refresher training to ensure that individual actors' responding is consistently reliable over time. All these factors require considerable resources, administration time and budgeting.

One alternative to using trained human actors is digital avatars. Within fields such as clinical social work (Huttar & BrintzenhofeSzoc, 2020 for a review; Washburn & Zhou, 2018) and medicine (Battagazzorre et al., 2021; Bracq et al., 2019 for review), it has been shown that virtual clients provide efficient training opportunities in communication skills. Although there are currently no avatars in the child investigative interview training field that can respond to *any* question asked by an interviewer without the need for a human research assistant to be present, the technology is now available to build these avatars (Aneja et al., 2021).

Importantly, extant research using more primitive technology has been encouraging. For example, Powell and colleagues (Benson & Powell, 2015a; Powell et al., 2016) showed the benefit of using a digital avatar in training child investigative interviewers. Their avatar (a stand-alone activity that does not require human assistance) involves the trainee interviewer choosing among the best of four question options. The activity is self-paced and mimics the response style of a 5-year-old girl regarding alleged child sexual abuse (CSA). Once a trainee selects a question, the child-avatar responds with the level of detail appropriate for the question type, written feedback is given on the question choice (if requested), and four new questions are generated for selection (Guadagno & Powell, 2012). The response elicited is connected to the type of question asked, providing indirect feedback by giving more elaborate and forensically relevant responses when desirable (e.g., open-ended) questions are chosen and briefer and/or less relevant responses when closed questions are chosen (Guadagno & Powell, 2012). The avatar has been used as part of e-Learning programmes and as a standalone tool (e.g., used once a week for four weeks among novice interviewers), and it has been found to lead to improvements in interviewers' use of non-leading, open-ended questions with professional groups of teachers (Brubacher et al., 2015) social work students (Casey & Powell, 2021) and child investigative interviewers (Powell et al., 2016).

Furthermore, Pompedda, Santtila and colleagues (e.g., Haginoya et al., 2021; Kask et al., 2022; Pompedda et al., 2017) developed avatars that play the role of a child aged four to six years in interviews about alleged sexual abuse. Their research showed improvements in interview quality regarding type of questions and details obtained after conducting four to five avatar training sessions, with the first session as a baseline and the last as an outcome. Using the avatar, an interview trainee verbalises a question, and a human operator manually codes the question type into the software, subsequently activating an algorithm-based child response from the

avatar presented as a short video clip (e.g., [Haginoya et al., 2021](#); [Pompedda et al., 2015](#)). By responding in a developmentally typical way (e.g., answering yes/no questions with short answers), the avatar gives indirect feedback to the trainee interviewer about the differential effect of various question types. Between sessions, the operator gives broad feedback on the appropriateness of the questions asked and the amount of detailed information obtained. Recently, this research group have tested a fully automated avatar classifying interviewer questions and selecting a pre-recorded avatar-response based on algorithms ([Haginoya et al., 2023](#)) illustrating a needed step in offering flexible and self-paced practicing tools.

Overall, the results of prior work including avatars suggest that such tools can be useful in teaching interviewing skills and that a technologically advanced avatar that can replace (in its entirety) the role of a human software operator may be worth investing in. Research on the use of avatars in interview training is still in its infancy, however, and has focused thus far on the utility of avatars in increasing appropriate question usage. Broader research is needed that examines avatar utility from a *human-computer interaction* (as opposed to performance competency) perspective. Here, we refer to a human's (i.e., a practitioner's) relationship with a technological device, focusing on willingness to engage the programme, ease of use of the system, and the compatibility of the software (i.e., the system's degree of accessibility and the reliability of the technology ([Petrick, 2020](#))). For none of the avatars developed within the field of investigative interviewing, except for LiveSim, has field data that can be used to evaluate user engagement, been collected. Except for one recent study conducted by [Kask et al. \(2022\)](#) testing the effect of human-dependent avatar training with and without feedback among police officers ($N = 17$) on field child investigative interview quality, all avatars have been tested in the laboratory. Still, LiveSim is currently the only tool that has been used to train large numbers of professionals across multiple regions and over an extended period of time. Research in related fields have demonstrated the importance of examining use in the field from a learning perspective ([Huttar & BrintzenhofeSzoc, 2020](#); [Stathakarou et al., 2018](#)).

1.1. The current study

We build on prior research regarding the usefulness of digital avatars in child investigative interview training by examining practitioners' decisions regarding access (time and frequency of usage) and programme compatibility (technical properties such as visuals, audio, and flow across different platforms). Specifically, the work draws on a large pool of data collated over nine years of professionals' use of a child-avatar during online learning programmes on child interviewing and graduate students' training sessions. Registration data on the usage of LiveSim has not been published earlier. Although evaluation of a current avatar does not establish the efficacy of a future avatar (built on more advanced technology), practitioner perspectives and behaviours are nonetheless useful in understanding their needs, the factors that constrain or enable new training methods to be used and how training can be improved in a practical sense.

2. Methods

2.1. Description of the avatar

The avatar (hereby referred to as LiveSim) was developed as a training tool for assisting child investigative interviewers in identifying and choosing the best questions. The LiveSim exercise operates autonomously and unfolds in real time to simulate a relevant interviewing context of practising the substantive phase of an investigative interview with a 5-year-old child who alleges CSA. The programme was typically delivered alongside numerous practical activities that were spread over several months (a few hours per week). Participants only needed to do the exercise once to obtain credit for its completion; they only needed to click start and then use the exit-prompt or go back to end it. LiveSim, however, was available for the participants to use multiple times if they wanted. See [Benson and Powell \(2015a\)](#) for a description of how the Live Sim was integrated into the broader training programme.

To operate LiveSim, participants had to log in with their student ID every time they used it. For each attempt, hereby referred to as a session, they were given a unique session number. Trainees initially read a short paragraph containing a case referral description and were then instructed to elicit an account of what happened to the 5-year-old child who alleges child sexual abuse, commencing with the prompt, "Theresa, tell me what you have come here to talk to me about today".

After commencing the session and reading an introduction, the trainees saw information panes showing how much time had transpired in the session, the visually illustrated child-avatar, the question options, transcript, and a question-evaluation (optional) (see [Appendix 1](#) for illustration). During an interviewing session, the trainees chose what they considered the best question (out of four options), with an additional exit-prompt offered as well. Once they selected a question in step 1, the child-avatar responded verbally (audio), and four further question options were generated in step 2 depending on the question chosen.

In addition to written feedback at each step, feedback was given indirectly with the avatar's verbal response. For example, one question or prompt was the most desirable (in terms of eliciting a detailed and accurate response), which was in turn responded to with the most detail about the alleged event ([Guadagno & Powell, 2012](#)). If a yes/no question was asked (e.g., "Did he give you anything?"), the child-avatar responded with yes or no, whereas an open-ended question would have been responded to with more elaborate detail (see [Appendix 2](#) for an example transcript). The simulation was self-paced but took approximately 30 min to complete. The computer programme tracked the number of times the participants accessed the simulation and each chosen question. The option-tree of four questions for each step provided many pathways for eliciting narrative details of the abuse. The design of optional questions builds on a total of 226 questions.

2.2. The architectural underpinning of the avatar

LiveSim consists of a combination of four separate modules with the possibility of customisation and editing (i.e., the panels for a transcript and evaluation of questions). Adobe Flash was originally the core software used to build and run LiveSim until it was updated to HTML5 in 2020. The interview structure was developed by two research fellows who prepared the question-and-answer scripts, the logic of the multiple pathways through the interview and the coding of these paths in Extensible Markup Language (XML). This was done manually. With the given purpose of eliciting information about an alleged abuse, the trainee chose one out of four question options at step 1 in the interview. After the avatar's response, four further question options were provided at step 2 dependent on the first question chosen (a total of 16 questions). At step three this structure gave $(4 \times 4) \times 4$ question options with a total of 64 questions and so on. Questions could overlap with earlier steps, e.g., "U-hu", "What happened next?", if suitable for the path the interview took. The design had a total of 226 questions to choose from. All question-and-answer pathways, over 1000 in total, were checked to ensure that they functioned correctly completing the scenario. For each step, the developers marked one question as most correctly phrased to choose next (i.e., most open-ended). The correct/incorrect coding of prompts was related to identifying question types and their impact and based on empirically based coding manuals the trainees had previously learned in the eLearning programme they attended. For example, they learned that open ended questioning was encouraged in the beginning ("Tell me everything...", "What happened next?") eliciting the narrative. Choosing the prompt "Tell me everything about Jerry" would be incorrect if this was chosen prior to the child providing a narrative about what occurred with Jerry.

A software developer created the XML structure (the code and content that ran the e-simulation). The visual illustration and voice of the avatar were based on the filming of a real child (backlight to anonymise her) and a prerecording of a child-sounding adult speaking each response. The actual scripted words and the code for enacting the simulation behaviour were delivered to the "state" logic controller (i.e., software developer) in the form of an XML script, as described above.

Computer instructions such as "ActionScript" and XML scripting were used to enable the simulation architecture to present the required behaviours of objects (e.g., the child) and the simulated events over time in a series of "states" in the system that responded to trainee-user interactions. Simulation settings prescribed by the trainer/administrator can be managed and/or tracked by the database and saved.

2.3. Participant trainee interviewers

The sample includes data from 2009 to 2018, with 606 participants (75.6 % female, 15.8 % male and 8.6 % unknown) practising over a total of 885 unique avatar sessions. The unequal distribution of gender led to the exclusion of this category in the analysis. The participants represent a variety of professional backgrounds (giving a variation in the size of subgroups from three to 254 participants), with the majority being graduate trainees within psychology and social work (37.0 %), police officers (29.2 %) and child protection workers (13.4 %). Other groups of professionals were employed in, for example, youth services, as schoolteachers and school investigators, and in churches. The data were mainly gathered in Australia, but the United Kingdom and Singapore are also represented. Every participant granted consent for their data to be registered and used for this research. Ethics approval for this study was given by Griffith University (GU Ref.: 2018/156).

2.4. Analysis

The data were collected and organized in Excel. Analyses were performed using advanced scripting and database queries to extract the desired information. Visual Basic for Applications (VBA) and macros (procedures) were used for analysis. Testing of usability and accessibility was conducted by the third author by logging into LiveSim and starting an interviewing session on a range of devices reflecting the most commonly used hardware.

The variables from the register data included in this study were (1) prompts chosen: LiveSim consists of 226 possible questions (prompts); (2) timestamps: for each log in and log out of the programme and each prompt chosen; and (3) correct-incorrect prompts: for each step of choosing a question, one option is better than the others (i.e., the most open-ended, according to the context for asking). We also included the participants' professional background.

3. Results

3.1. User engagement

The first group of analyses focused on user engagement with the programme.

3.1.1. Number of sessions

Initially, we wanted to explore to what extent LiveSim was used. This was done by analysing the number of sessions participants practiced with LiveSim, using session numbers created each time participants logged into the programme. The 606 participants attended a total of 885 unique sessions (range: 1–8, median: 1) with an average of 1.5 times. Almost all (98.2 %) completed at least one full session, that is a minimum of 11 turns, and 66 participants (almost 11 %) used it three or more times, including one participant doing the simulation eight times.

3.1.2. Time for completion

Next, we reviewed the average time participants used to complete an interview session using minutes as the unit of measurement. Exploring descriptive data, the range was from a minimum of 0.12 min, that is 7.2 s, and a maximum of 1369.9, that is 22 h 49 min. Three sessions were more than 1000 min in duration, the fourth longest being 436 min. Time spent are unlikely to be actual times of engagement. Users are thought to be disrupted by phone calls, work related tasks or private concerns, and included in the results for illustration of the advisable flexibility among field workers. For central tendency, the three sessions of more than 1000 min were excluded, showing an average of 29.1 min with a median of 17.3 min ($SD = 47.4$).

3.1.3. Frequency of turns per session

Next, we investigated whether a participant chose to make use of a training session and exercise by performing multiple prompt–answer interactions (i.e., turns). By computing descriptive statistics of the turns per session practiced, we found the average number of questions asked per session to be 29 ($SD = 20$). The median value was 24, meaning that half of the 885 sessions comprised 24 or more turns. The range in turns of practice was from zero to 215, revealing a wide variation in the extent to which participants used it regarding how many prompts they practiced. The optional exit-prompt was never chosen at any time by a participant.

3.1.4. Frequency of turns per participant

Regardless of how many sessions a participant practiced, we found five participants having done more than 200 turns of practice, with the maximum being 254 prompts chosen from the option-tree structure. Across all the participants, the average was 43 prompts chosen during the total time spent practising using LiveSim. The median value was 34, that is half of the participants practiced 34 or more prompts across sessions. However, the analysis revealed a relatively high number of sessions, with zero ($n = 18$) or one ($n = 26$) turn, comprising 5 % of the total number of sessions. A possible explanation can be an external disruption, such as phone calls or other tasks during working hours.

3.1.5. Time of use

Timestamps were analysed for log in and log out times after time zone differences were taken into account and adjusted for. Analysis of the timestamps revealed that the participants used the LiveSim at various times of the day and night (see Fig. 1) with a peak time from 12 midday to 2 p.m. and heightened activity in the evening until 11 p.m. Overall the main activity across the entire sample was during regular daytime working hours.

One group of particular interest regarding patterns of log ins and log outs was professionals working in the field. Police employees ($n = 117$) and child protective workers ($n = 81$) were the only subgroups totalling enough participants to conduct separate analyses on patterns of use related to the time of day. Activity among police employees is illustrated in Fig. 2.

Within the group of police employees ($n = 117$), the analysis showed some activity around the clock except for no log ins at 3 a.m. and between 6 and 7 a.m. The largest number of log ins (11 % or more of the sample) was between 8 a.m. and 6 p.m., but there was still considerable log-in activity between 8 p.m. and 9 p.m. (12 %). The overall pattern of log outs follows the log ins.

Furthermore, the pattern of use regarding the time of day among child protective workers ($n = 81$) was analysed, with their activity illustrated in Fig. 3.

Within the group of child protective workers, we found no log-in activity between 12 midnight and 7 a.m. The largest number of log

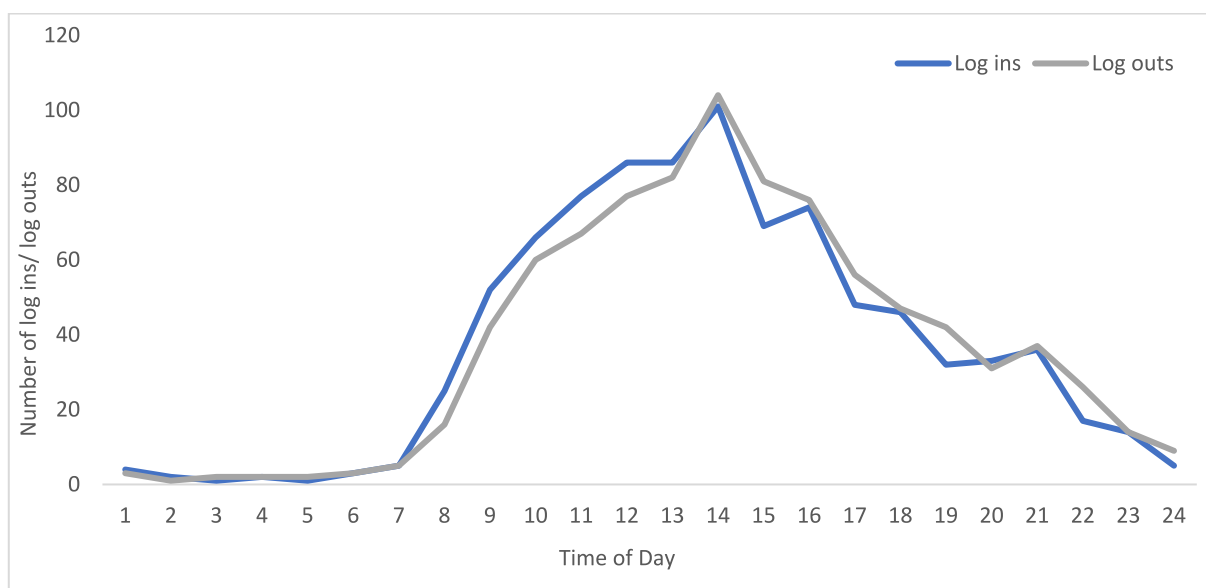


Fig. 1. Log in and log out times into the LiveSim.

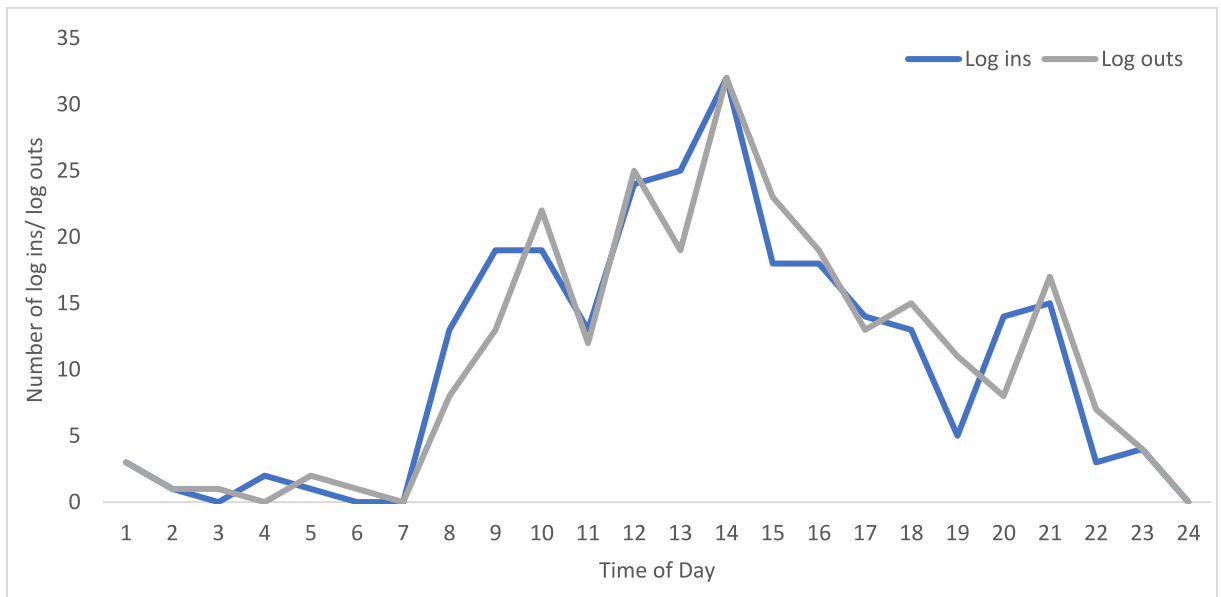


Fig. 2. Police employees: log in and log out times into the LiveSim.

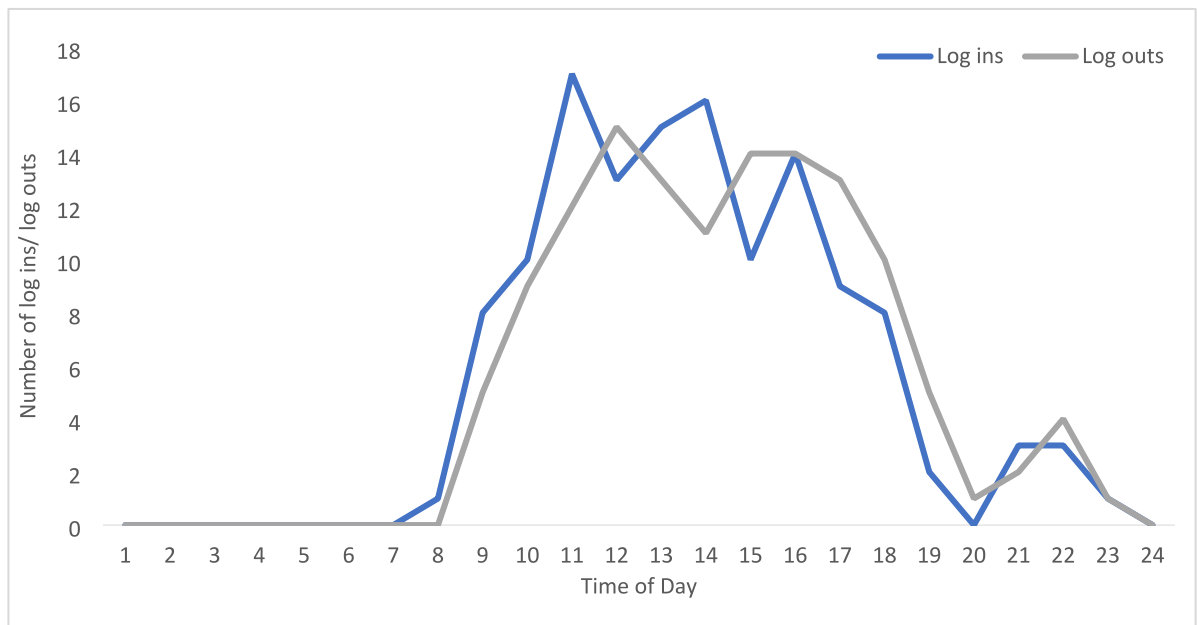


Fig. 3. Child protective workers: Log in and log out times into the LiveSim.

ins (12% or more of the sample) was between 10 a.m. and 5 p.m. as well as a small group (4% of the sample) with log ins in the evening between 9 p.m. and 11 p.m. The overall pattern of log outs follows the log ins.

3.2. Appropriateness of the prompt structure

In a training programme using option-tree design for practising recognition of recommended questions, the importance of having optional, high-quality questions is fundamental, facilitating a participant's reflection on question phrasing. To evaluate the internal attributes of the LiveSim, we conducted analyses on a descriptive level and took the evaluative aspects (correct or incorrect) of prompts into account to explore the use frequency of each prompt available in the programme. The correct/incorrect coding was in line with the coding manuals trainees had previously learned. Of the 226 prompts available, in addition to one interruption and one exit-prompt, 21

prompts were never chosen across the 885 sessions. This leaves 207 prompts chosen one or more times. The highest frequency for any prompt was 1436 ($M = 112.8$, $SD = 220$, median = 24.5). Related to desirable prompts, all 226 prompts had the potential to be valued as both “correct” and “incorrect” in accordance with best-practice recommendations, taking the context of a question into account. For example, choosing the prompt “Tell me everything about Jerry” early in the interview session, are met with feedback on the open characteristic, but still a recommendation to wait to ask this until the child has provided the narrative about what happened. Feedback being in line with best practice establishing what happened in the beginning of the substantial phase. Focusing on the frequency of prompts that were incorrectly chosen, the highest frequency was 1052 (prompt 221, “What do you mean when you say “special bits”?”). The same prompt, 221, was correctly chosen 11 times. In sum, the frequency was 14,541 incorrect choices made. In comparison, the total number of correctly chosen prompts was 11,185, and the invitational prompt 1 “Tell me what you have come to talk to me about today?” was correctly chosen 833 times and incorrectly 16 times.

Questioning in an investigative context is a complex skill that requires multiple practice opportunities and is expected to include making errors and learning from practising again. Finding more than 90 % of the prompts being used and the total frequency of prompts being incorrectly chosen in context to be higher than the number of prompts correctly chosen, supports the notion that difficulty level and nuances in the wording of prompts were challenging and by that, adapted to the avatar being a training tool.

3.3. Compatibility

For a computer-based programme to be useful, it must be compatible with different operating systems making the programme easily accessible and readily available at the times when users want to use it. Both usability and accessibility related to the reliability of LiveSim were tested by the third author running a technical compatibility test employing a range of devices reflecting the most-used hardware. The different combinations of devices were tested by a person not related to the project (age: 25–30, gender: female, education: biologist). The computers utilised standard monitors with a high-definition resolution. For macOS devices, laptops were used. Phones and tablets were the latest models from Apple and Samsung. Compatibility and functionality were assessed using three questions: 1) what is the perceived visual experience, meaning everything observed with the eye; 2) what is the perceived audio experience, meaning everything regarding sound and 3) experiences concerning reaction time when buttons were pressed and so on.

As a range, we used 1–5, where 1 was the worst experience and 5 was the best. Because the avatar was running in a browser, commonly used browsers were applied to test it, namely Safari, Chrome, Edge and Firefox. On mobiles and tablets, we tested Safari and Edge on iOS and Edge and Chrome on Android.

Overall, no technical difficulties were observed. All browsers and devices could run the simulation without problems. The visual experience was excellent on almost all devices besides mobile phones, where the small screen made it necessary to scroll left and right to see all the content of the simulation ($M = 4$, $SD = 1.26$). The audio was excellent on all devices ($M = 5$, $SD = 0$). On mobile phones, there was a brief lag between when questions were chosen and when a video started playing. This is because the phones switched to playing a video on full screen when they started, which negatively impacted the flow ($M = 4.5$, $SD = 0.89$). People with impairments are not taken into account by the avatar software since no functionality, such as reading the text aloud or a colour-blind mode, was available.

4. Discussion

The results of this study provide strong support for the broad utility of LiveSim as a learning tool for investigative interviewers of children. Although the tool was designed to enhance *knowledge* of what constitutes a good question (through recognition processes, as opposed to interviewers generating questions on their own), the findings indicate that avatars can play an important role in future training, as digital technology continues to improve. Three overriding findings support this conclusion, each of which will be discussed in turn.

First, the results revealed that trainees had good *engagement* with the simulation; their interactions with the programme exceeded the minimum requirement of completing a course. Although trainees only needed to complete the exercise once, and they could feasibly exit the programme in the first turn without penalty, almost all completed at least one full session of LiveSim (training eleven or more turns). Participants went on for an average of 29 turns. When considering the amount of training this indicates, one must remember the instruction given before starting LiveSim; to start directly on the substantive phase of the interview asking what the child came to talk about. Half of the sessions lasted 17 min or more (an average of 29.1 min). Combined with knowledge from the original testing of the programme that shows that participants in the LiveSim programme used approximately 30 min to elicit the avatar's report of abuse (Guadagno & Powell, 2012), our data supports that the LiveSim arouse interest and engagement, and trainees stuck to the exercise utilising the training tool.

Furthermore, 66 of the 606 trainees completed LiveSim three or more times, and one completed it eight times. We also find support for LiveSim evoking engagement in individual question interactions. On average, trainees practiced 43 prompts followed by the child-avatar response and feedback, and five trainees practiced for more than 200 interactions with the child-avatar.

From a training perspective, the fact that the trainees *voluntarily* sought strong engagement with the tool and made good use of it while it was available to them is important. High workload and inadequate time for training are the biggest concerns expressed by trainees (Benson & Powell, 2015b; Wright & Powell, 2006). Lack of engagement or update with training is the most widely reported concern among trainers, as highlighted by Lamb (2016), reflecting on the gap between recommended versus actual forensic interview practices. Anecdotally, cost of staging regular simulated practice exercises is also reported to be an issue, yet irrespective of how many times the trainees chose to access the programme, there was no additional financial cost to either the programme developers or the

trainees. It would not have been viable for the learners to have engaged so intensely with a human actor. The extra cost of scheduling and staging this would have been prohibitive.

Second, in terms of usability, the pattern of interactions with LiveSim indicates that when given *flexibility* of access, many trainees seek interaction with an avatar during both their work and home times, even though the latter was not a requirement. Although most log in attempts happened during the daytime and within working hours, use in the late evening was not uncommon, even among trainees such as child protection workers who do not formally work at night. Again, this flexibility of access would not have been possible with a human actor. The greater sense of control in the scheduling and length of a learning activity is a feature that cannot be underestimated. Flexibility in time management helps learners achieve their goals faster, assists in prioritising their work (to get more done in less time by reducing distractions) and is less stressful (Benson & Powell, 2015b; Brubacher et al., 2020; Wright et al., 2006). These features, in turn, have been shown to enhance the quality of learning as well as the sustainability of skills in the long term (Powell, 2008; Powell, Wright, & Clark, 2010).

Finally, despite technological issues being one of the main concerns in the electronic recording of children's evidence and the playing of that evidence in a trial (Burrows & Powell, 2014), the digital avatar demonstrated high reliability. Besides a minor visual limitation running LiveSim on mobile phones, no technical difficulties were observed across browsers and devices, given that LiveSim is, from a technical perspective, a very simple and straightforward application to implement. No complications were observed on either work or private devices, despite its creation over a decade ago.

In terms of the appropriateness of the prompt structure, the LiveSim also held up well. Of the 226 prompts available, 207 were chosen one or more times, which means that the trainees had exposure to the full range of questions leaving only 19 (8.4 %) of the presented prompts in the option-tree structure as non-chosen. Furthermore, there were no ceiling or floor effects on any item, that is, the distribution of the prompts chosen indicates that none of the options used were either too difficult or too easy to recognize as the most correct. Prompt distribution indicates that the wording of each prompt and the compositions of option-trees were designed to appropriately challenge interview trainees' knowledge.

4.1. Limitations

There are limitations in the data and aspects of the LiveSim architecture that are worth noting. First, the four optional prompts that trainees could choose between for each step of an interview were coded as correct or incorrect, related to the context of the interview as it proceeded. This gave complexity to the data regarding possible prompt–response combinations for each step in an interview, analysing, for instance, progression in questioning difficulty. Second, the possibility of looking into the learning effect of training was limited, as the results revealed that participants trained, on average, 1.5 times with LiveSim which may be too few training sessions to say anything about learning effects.

Furthermore, the heterogeneity in both professional backgrounds and the variation in context for using LiveSim, as part of an extensive eLearning programme or a student exercise, implies uncertainties related to interpretation of results (i.e., effect of theoretical knowledge, question-stem exercises) making analysis beyond descriptive statistics inadvisable. Nonetheless an independent study by Brubacher et al. (2015) did show enhanced performance of actual interview technique (assessed on independent mock interviews) after only four uses of the tool.

4.2. Concluding remarks

Overall, the pattern of interactions between a large sample of professional trainees and LiveSim supports that the simulation evoked good engagement. Almost everyone conducted at least one session, and trainees practiced on average 43 prompts each independent of the number of sessions they completed. The study also revealed that the online availability of the training tool was utilised, seeing login/logout – activity both during working hours and in most professionals' spare time. When considered in the context of the study by Brubacher et al. (2015) where LiveSim was used as the only questioning training tool, we can conclude that the question-answer approach of the current LiveSim programme provides a good starting point for the development of more sophisticated tools. As a next step, future avatar developers can focus their attention on technological advances. The immediate next step should be to enable the avatar to respond to any question that is stated orally.

Currently, there are no commercially available systems within communication skill training that allow realistic avatar interviewees to respond to orally asked questions, as in a human–human conversation (Aneja et al., 2021; Baugerud et al., 2021). However, recent technological developments with designated conversational agents or multimodal AI-driven avatars have made this possible. A Norwegian research team propose an empirically informed training system using dynamic child-avatars based on 3D rendering and AI methods within text, audio, and visuals in a complex system structure, making open-ended dialogues possible and the human–computer interface more realistic (Baugerud et al., 2021; Hassan et al., 2022; Salehi et al., 2022). The project makes use of advanced technology within, for instance, language modelling, training the model with mock interviews and real-life anonymised investigative interviews to synthesise child-avatars for dialogues. Current technology also allows for the development of avatars that are accessible to people with visual impairments or colour blindness.

With simulated practice being such an important factor in the training of investigative interviewers, the current study provides encouragement and justification for making use of recent technological advancements to invest in the development of more sophisticated tools. The quality of interview practice has been shown to have a major impact on the outcomes of child abuse investigations (e.g., La Rooy et al., 2015; Pipe et al., 2013). As interview trainees become more proficient at adhering to best-practice questions, researchers can use avatar technology to focus on other important topics, such as how interviewers can best support a child and respond

to certain emotions encountered in an interview (Brubacher et al., 2020; Karni-Visel et al., 2021). Knowing the impact that the quality of questioning has on witness reliability (see e.g., Lamb et al., 2018) and thereby a legal safeguard for a witness, supports the value of investing in flexible and efficient training tools such as avatars.

In the training literature on communicative skills, openness towards learning about the utility of effective information gathering is growing among other professions and non-forensic organisations such as health practitioners (Gilligan et al., 2021), family law and business (Powell & Brubacher, 2020). In the future, we therefore expect widespread interest in, and use of, digital and highly accessible interview training tools.

Declaration of competing interest

None.

Data availability

Data will be made available on request.

Acknowledgement

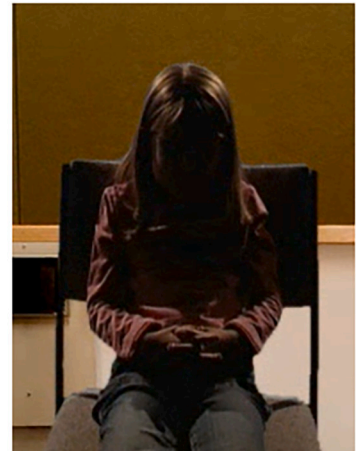
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Appendix 1. Screenshot of the LiveSim interface display



INTERVIEW

- What happens at Jerry's house?
- Tell me everything about what happens on Tuesdays, when you go to Jerry's house.
- Who's Jerry?
- Do you go to Jerry's house on any other days?
- That's all the questions I have to ask you today. Thank you very much for coming and talking to me.



TRANSCRIPT

Show Evaluation

You: Theresa, tell me what you've come here to talk to me about today.
Evaluation: It is useful to start by eliciting the child's understanding of the purpose of the interview. Doing this often elicits a disclosure from the child. Further, this question has been phrased very well i.e., it is non-leading and encourages an elaborate response. An excellent opening question.
Theresa: To tell you about Tuesdays, when I go to Jerry's house?

Time: 1 Minutes

Appendix 2. Example of a transcript after one LiveSim interviewing session

Unreal Interviewing

Evaluation

Student Name:	LS019
Student ID:	(Please fill in before submitting)
Student Email:	
Disclosure reached:	Yes
Number of interviewer prompts:	17
Number of ideal prompts:	8 of 17
Time (minutes):	31

Transcript

You: Theresa, tell me what you've come here to talk to me about today.

Evaluation: *It is useful to start by eliciting the child's understanding of the purpose of the interview. Doing this often elicits a disclosure from the child. Further, this question has been phrased very well i.e., it is non-leading and encourages an elaborate response. An excellent opening question.*

Theresa: To tell you about Tuesdays when I go to Jerry's house?

You: Tell me everything about what happens on Tuesdays when you go to Jerry's house.

Evaluation: *This is a good broad open-ended question, which utilises the child's terminology to elicit an elaborate response.*

Theresa: We played on the Playstation, and sometimes Jerry hires different games for us, and we play card games and board games.

You: Tell me everything that happened the last time you went to Jerry's house.

Evaluation: *This is an excellent broad non-leading open-ended question. It encourages elaborate detail about a specific time that the child visited Jerry's house.*

Theresa: Last week after school, we played on the Playstation, but we didn't have maccas that day.

You: I need you to tell me everything that happened the last time you went to Jerry's house, start from the beginning.

Evaluation: *This is an excellent broad open-ended question that focuses the child on a specific occurrence of the event in time. Further, the question encourages an elaborate response in sequential order (keeping in mind that children's ability to sequence events may be limited).*

Theresa: We went after school and I had twisties and he had the new Grand Theft Auto game and I got to play it first.

You: And then what happened?

Evaluation: *This is a good non-leading open-ended breadth question, which guides the child to provide further information in sequence. It is well placed here.*

Theresa: Then I played Go Fish and then Renee and I played Guess Who, but Jerry didn't play Guess Who with us.

You: Tell me everything about the last time you played Go Fish at Jerry's house.

Evaluation: *This is a good non-leading open-ended depth question. It encourages an elaborate response from the child about a specific activity previously mentioned by the child. Further, the question clearly specifies the time frame (i.e., the last time she played Go Fish at Jerry's house).*

Theresa: We were playing on the fluffy rug and he got more pairs than me, but I got the blue fish.

You: You said there were blue fish. Tell me all about the blue fish.

Evaluation: *While this question encourages an elaborate response, it focuses on (i.e., requests a description of) the blue fish. It would be better at this stage to elicit what actually happened (e.g., 'What happened with the blue fish', 'Tell me about the part where you played with the blue fish').*

Theresa: They weren't real blue fish, they were just on the cards.

You: Tell me everything that happened the last time you got the blue fish.

Evaluation: *This is a non-leading open-ended depth question that cues the child to provide more detail about a specific part of the event (i.e., getting the 'blue fish'). This question also cues the child to report a specific occurrence of the alleged event (i.e., the last time).*

Theresa: Jerry got to give me the special prize. It tickled and hurt a little bit.

You: You said it tickled and hurt. Tell me more about that part.

Evaluation: *This is a non-leading open-ended 'depth' question that invites the child to elaborate on an aspect reported previously.*

Theresa: I won and I got to get a rub on my special bits, but then Jerry did it a bit hard.

You: Tell me about how Jerry rubbed your special bits.

Evaluation: *Although it commences with the phrase 'Tell me', this question is actually a specific question that limits the child's response to only one or two words (i.e., 'How did Jerry rub your special bits?'). It is best to avoid 'how' questions as they can be difficult for children to answer, particularly when the question requires the child to take the perspective of another person.*

Theresa: With his fingers.

You: Tell me all about how it felt when you got a rub on your special bits.

Evaluation: *Although it commences with the phrase 'Tell me', this question is actually a specific question (i.e., "How did it feel...?"). The interviewer should refrain from using specific questions (where possible) until later in the interview. The aim at this stage is elicit a free-narrative account of what happened. An open-ended 'depth' question such as 'Tell me what happened when you got a rub on your special bits' is more likely to elicit this.*

Theresa: Tickle but a bit hurting.

. (continued).

You: Tell me all about what his finger tickled and hurt.

Evaluation: *Although it commences with the phrase 'Tell me', this question is actually a specific 'Who' question. It is better at this stage of the interview to establish what happened.*

Theresa: My special bit that does wees.

You: Uh huh.

Evaluation: *This 'minimal encourager' is often effective in eliciting further information without interrupting. It is well placed here.*

Theresa: My mum says its my gina, but my cousin said it's a daisy.

You: Tell me everything you can remember about when he rubbed your gina. Every little detail is important.

Evaluation: *It is good to encourage elaborate information from the child, but a broad open-ended question is inappropriate here. It would probably be difficult for a child to provide such highly specific detail about the particular 'rubbing' act. Merely asking 'what happened when he...' would probably be sufficient.*

Theresa: His fingers tickled and hurt my gina. I didn't like it.

You: Uh huh.

Evaluation: *This 'minimal encourager' is often effective in eliciting further information without interrupting. It is well placed here.*

Theresa: My mum says its my gina, but my cousin said it's a daisy.

You: What happened when Jerry rubbed your gina?

Evaluation: *This is a non-leading open-ended 'depth' question. It encourages more detail about this aspect of the event.*

Theresa: He poked his fingers in my gina a bit too hard and it hurt.

You: That's all the questions I have to ask you today. Thank you very much for coming and talking to me.

Theresa: OK. Bye

. (continued).

References

- Aneja, D., Hoegen, R., McDuff, D., & Czerwinski, M. (2021, May). *Understanding Conversational and Expressive Style in a Multimodal Embodied Conversational Agent* Proceedings of the 2021 CHI Conference on Human Factors in Computing Systems.
- Battegazzorre, E., Bottino, A., & Lamberti, F. (2021). Training medical communication skills with virtual patients: Literature review and directions for future research. In N. Shaghghi, F. Lamberti, B. Beams, R. Shariatmadari, & A. Amer (Eds.), *Lecture notes of the Institute for Computer Sciences, social informatics and telecommunications engineering: Vol. 377. Intelligent Technologies for Interactive Entertainment. INTETAIN 2020* (pp. 207–226). Springer. https://doi.org/10.1007/978-3-030-76426-5_14.
- Baugerud, G. A., Johnson, M. S., Røed, R. K., Lamb, M. E., Powell, M. B., Thambawita, V., Hicks, S. A., Salehi, P., Hassan, S. Z., Halvorsen, P., & Riegler, M. (2021, August). *Multimodal Virtual Avatars for Investigative Interviews with Children* In Proceedings of the 2021 Workshop on Intelligent Cross-Data Analysis and Retrieval.
- Benson, M. S., & Powell, M. B. (2015a). Evaluation of a comprehensive interactive training system for investigative interviewers of children. *Psychology, Public Policy, and Law*, 21(3), 309–322. <https://doi.org/10.1037/law0000052>
- Benson, M. S., & Powell, M. B. (2015b). Organisational challenges to delivering child investigative interviewer training via e-learning. *International journal of police science & management*, 17(2), 63–73. <https://doi.org/10.1177/1461355715580912>
- Braçq, M.-S., Michinov, E., & Jannin, P. (2019). Virtual reality simulation in nontechnical skills training for healthcare professionals: A systematic review. *Simulation in Healthcare*, 14(3), 188–194. <https://doi.org/10.1097/sih.0000000000000347>
- Brubacher, S. P., Benson, M. S., Powell, M. B., Goodman-Delahunty, J., & Westera, N. J. (2020). An overview of best practice investigative interviewing of child witnesses of sexual assault. In I. Bryce, & W. Petherick (Eds.), *Child sexual abuse* (pp. 445–466). Academic Press. <https://doi.org/10.1016/B978-0-12-819434-8.00022-2>.
- Brubacher, S. P., Powell, M., Skouteris, H., & Guadagno, B. (2015). The effects of e-simulation interview training on teachers' use of open-ended questions. *Child Abuse & Neglect*, 43, 95–103. <https://doi.org/10.1016/j.chiabu.2015.02.004>
- Burrows, K. S., & Powell, M. B. (2014). Prosecutors' perspectives on using recorded child witness interviews about abuse as evidence-in-chief. *Australian & New Zealand Journal of Criminology*, 47(3), 374–390.
- Casey, S., & Powell, M. B. (2021). Usefulness of an e-simulation in improving social work student knowledge of best-practice questions. *Social Work Education*. <https://doi.org/10.1080/02615479.2021.1948002>
- Cederborg, A.-C., Lindholm, T., Lamb, M., & Norrman, E. (2021). Evaluating the quality of investigative interviews conducted after the completion of a training program. *Investigative Interviewing Research & Practice (II-RP)*, 11(1), 40–52. <http://urn.kb.se/resolve?urn=urn:nbn:se:su:diva-192409>.
- Cyr, M., Dion, J., Gendron, A., Powell, M., & Brubacher, S. (2021). A test of three refresher modalities on child forensic interviewers' posttraining performance. *Psychology, Public Policy, and Law*, 27(2), 221–230. <https://doi.org/10.1037/law0000300>
- Ford, K. J., Bhatia, S., & Yelon, S. L. (2019). Beyond direct application as an Indicator of transfer: A demonstration of five types of use. *Performance Improvement Quarterly*, 32(2), 183–203. <https://doi.org/10.1002/piq.21294>
- Gilligan, C., Powell, M., Lynagh, M. C., Ward, B. M., Lonsdale, C., Harvey, P., ... Nepal, S. (2021). Interventions for improving medical students' interpersonal communication in medical consultations. *Cochrane Database of Systematic Reviews*, 2. <https://doi.org/10.1002/14651858.CD012418.pub2>
- Guadagno, B., & Powell, M. (2012). E-simulation for the purpose of training forensic (investigative) interviewers. In D. Holt, S. Segrave, & J. L. Cybulski (Eds.), *Professional education using e-simulations: Benefits of blended learning design*. (pp. 71–86). IGI Global. doi:10.48/978-1-61350-189-4.ch005.

- Haginoya, S., Ibe, T., Yamamoto, S., Yoshimoto, N., Mizushi, H., & Santtila, P. (2023). AI avatar tells you what happened: The first test of using AI-operated children in simulated interviews to train investigative interviewers. *Frontiers in Psychology, 14*, 1133621. <https://doi.org/10.3389/fpsyg.2023.1133621>
- Haginoya, S., Yamamoto, S., & Santtila, P. (2021). The combination of feedback and modeling in online simulation training of child sexual abuse interviews improves interview quality in clinical psychologists. *Child Abuse & Neglect, 115*, Article 105013. <https://doi.org/10.1016/j.chiabu.2021.105013>
- Hassan, S. Z., Salehi, P., Røed, R. K., Halvorsen, P., Baugerud, G. A., Johnson, M. S., Lison, P., Riegler, M., Lamb, M. E., & Griwodz, C. (2022, June). *Towards an AI-driven talking avatar in virtual reality for investigative interviews of children* 2nd edition of the Game Systems Workshop (GameSys '22).
- Huttar, C. M., & BrintzenhofeSzoc, K. (2020). Virtual reality and computer simulation in social work education: A systematic review. *Journal of Social Work Education, 56*(1), 131–141. <https://doi.org/10.1080/10437797.2019.1648221>
- Karni-Visel, Y., Hershkowitz, I., Lamb, M., & Blasbalg, U. (2021). Nonverbal emotions while disclosing child abuse: The role of interviewer support. *Child Maltreatment, 1-10*. <https://doi.org/10.1177/10775595211063497>
- Kask, K., Pompèdda, F., Palu, A., Schiff, K., Mägi, M.-L., & Santtila, P. (2022). Transfer of avatar training effects to investigative field interviews of children conducted by police officers. *Frontiers in Psychology, 13*, Article 753111. <https://doi.org/10.3389/fpsyg.2022.753111>
- Krause, N., Pompèdda, F., Antfolk, J., Zappalà, A., & Santtila, P. (2017). The effects of feedback and reflection on the questioning style of untrained interviewers in simulated child sexual abuse interviews. *Applied Cognitive Psychology, 31*(2), 187–198. <https://doi.org/10.1002/acp.3316>
- La Rooy, D., Brubacher, S. P., Aromäki-Stratos, A., Cyr, M., Hershkowitz, I., Korkman, J., ... Lamb, M. E. (2015). The NICHD protocol: A review of an internationally-used evidence-based tool for training child forensic interviewers. *Journal of Criminological Research, Policy and Practice, 1*(2), 76–89. <https://doi.org/10.1108/JCRPP-01-2015-0001>
- Lamb, M. E. (2016). Difficulties translating research on forensic interview practices to practitioners: Finding water, leading horses, but can we get them to drink? *American Psychologist, 71*(8), 710–718. <https://doi.org/10.1037/amp0000039>
- Lamb, M. E., Brown, D. A., Hershkowitz, I., Orbach, Y., & Esplin, P. W. (2018). *Tell me what happened: Questioning children about abuse* (2nd ed.). Incorporated: John Wiley & Sons.
- Lamb, M. E., Sternberg, K. J., Orbach, Y., Esplin, P. W., & Mitchell, S. (2002). Is ongoing feedback necessary to maintain the quality of investigative interviews with allegedly abused children? *Applied Developmental Science, 6*(1), 35–41. https://doi.org/10.1207/S1532480XADS0601_04
- Lamb, M. E., Sternberg, K. J., Orbach, Y., Hershkowitz, I., Horowitz, D., & Esplin, P. W. (2002). The effects of intensive training and ongoing supervision on the quality of investigative interviews with alleged sex abuse victims. *Applied Developmental Science, 6*(3), 114–125. https://doi.org/10.1207/S1532480XADS0603_2
- Petrick, E. R. (2020). A Historiography of Human–Computer Interaction. *IEEE Annals of the History of Computing, 42*(4), 8–23. doi:<https://doi.org/10.1109/MAHC.2020.3009080>.
- Pipe, M.-E., Orbach, Y., Lamb, M. E., Abbott, C. B., & Stewart, H. (2013). Do case outcomes change when investigative interviewing practices change? *Psychology, Public Policy, and Law, 19*(2), 179.
- Pompèdda, F., Antfolk, J., Zappalà, A., & Santtila, P. (2017). A combination of outcome and process feedback enhances performance in simulations of child sexual abuse interviews using avatars. *Frontiers in Psychology, 8*, Article 1474. <https://doi.org/10.3389/fpsyg.2017.01474>
- Pompèdda, F., Zappalà, A., & Santtila, P. (2015). Simulations of child sexual abuse interviews using avatars paired with feedback improves interview quality. *Psychology, Crime & Law, 21*(1), 28–52. <https://doi.org/10.1080/1068316X.2014.915323>
- Powell, M. B. (2008). Designing effective training programs for investigative interviewers of children. *Current Issues in Criminal Justice, 20*(2), 189–208. <https://doi.org/10.1080/10345329.2008.12035804>
- Powell, M. B., Brubacher, S., & Baugerud, G. (2022). An overview of mock interviews as a training tool for interviewers of children. *Child Abuse & Neglect, 129*, Article 105685. <https://doi.org/10.1016/j.chiabu.2022.105685>
- Powell, M. B., & Brubacher, S. P. (2020). The origin, experimental basis, and application of the standard interview method: An information-gathering framework. *Australian Psychologist, 55*(6), 645–659. <https://doi.org/10.1111/ap.12468>.
- Powell, M. B., Cavezza, C., Hughes-Scholes, C. H., & Stooové, M. (2010). Examination of the consistency of interviewer performance across three distinct interview contexts. *Psychology, Crime & Law, 16*, 585–600.
- Powell, M. B., Fisher, R. P., & Hughes-Scholes, C. H. (2008). The effect of using trained versus untrained adult respondents in simulated practice interviews about child abuse. *Child Abuse & Neglect, 32*(11), 1007–1016. <https://doi.org/10.1016/j.chiabu.2008.05.005>
- Powell, M. B., Guadagno, B., & Benson, M. (2016). Improving child investigative interviewer performance through computer-based learning activities. *Policing and Society, 26*(4), 365–374. <https://doi.org/10.1080/10439463.2014.942850>
- Powell, M. B., & Wright, R. (2008). Investigative Interviewers' perceptions of the value of different training tasks on their adherence to open-ended questions with children. *Psychiatry, Psychology and Law, 15*(2), 272–283. <https://doi.org/10.1080/13218710802014493>
- Powell, M. B., Wright, R., & Clark, S. (2010). Improving the competency of police officers in conducting investigative interviews with children. *Police Practice and Research, 11*(3), 211–226. <https://doi.org/10.1080/15614260902830070>
- Rischke, A. E., Roberts, K. P., & Price, H. L. (2011). Using spaced learning principles to translate knowledge into behavior: Evidence from investigative interviews of alleged child abuse victims. *Journal of Police and Criminal Psychology, 26*(1), 58–67. <https://doi.org/10.1007/s11896-010-9073-8>
- Salehi, P., Hassan, S. Z., Lammerse, M., Sabet, S. S., Riiser, I., Røed, R. K., ... Powell, M. (2022). Synthesizing a talking child avatar to train interviewers working with maltreated children. *Big Data and Cognitive Computing, 6*(2), 62.
- Sathakarou, N., Scully, M. L., Kononowicz, A. A., Henningsohn, L., Zary, N., & McGrath, C. (2018). MOOC learners' engagement with two variants of virtual patients: a randomised trial. *Education Sciences, 8*(2), 44. doi:<https://doi.org/10.3390/educsci8020044>.
- Sternberg, K. J., Lamb, M. E., Orbach, Y., Esplin, P. W., & Mitchell, S. (2001). Use of a structured investigative protocol enhances young children's responses to free-recall prompts in the course of forensic interviews. *Journal of Applied Psychology, 86*(5), 997–1005. <https://doi.org/10.1037/0021-9010.86.5.997>
- Washburn, M., & Zhou, S. (2018). Teaching note—Technology-enhanced clinical simulations: Tools for practicing clinical skills in online social work programs. *Journal of Social Work Education, 54*(3), 554–560. <https://doi.org/10.1080/10437797.2017.1404519>
- Wright, R., & Powell, M. B. (2006). Investigative Interviewers' perceptions of their difficulty in adhering to open-ended questions with child witnesses. *International Journal of Police Science & Management, 8*(4), 316–325. <https://doi.org/10.1350/ijps.2006.8.4.316>
- Wright, R., Powell, M. B., & Ridge, D. (2006). Child abuse investigation. *Policing: An International Journal of Police Strategies & Management, 29*(3), 498–512. <https://doi.org/10.1108/13639510610684728>