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Using interactive virtual presence to support accurate installation of child restraints: Efficacy and parental perceptions

David C. Schwebel, [a,*] M. Alison Tillman, [b] Marie Crew, [c] Matthew Muller, [b] Anna Johnston [a]

[a] Department of Psychology, University of Alabama at Birmingham, USA
[b] College of Engineering, University of Florida, USA
[c] SafeKids Alabama, Children's of Alabama, USA

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ABSTRACT

Introduction: Child restraint systems (car seats) reduce injury risk for young children involved in motor-vehicle crashes, but parents experience significant difficulty installing child restraints correctly. Installation by certified child passenger safety (CPS) technicians yields more accurate installation, but is impractical for broad distribution. A potential solution is use of interactive virtual presence via smartphone application (app), which permits "hands on" teaching through simultaneous and remote joint exposure to 3-dimensional images. *Method:* In two studies, we examined the efficacy of remote communication via interactive virtual presence to help parents install child restraints. Study 1 was conducted at existing car seat checkpoints and Study 2 at preschools/daycare centers. In both cases, existing installations were assessed by certified CPS technicians using an objective coding scheme. Participants then communicated with remotely-located certified CPS technicians via a smartphone app offering interactive virtual presence. Technicians instructed participants to install child restraints and then the installation was inspected by on-site technicians. Both before and after the remote interaction, participants completed questionnaires concerning perception of child restraints and child restraint installation, self-efficacy to install child restraints, and perceived risk of injury to children if they were in a crash. *Results:* In both studies, accuracy of child restraint installations improved following the remote interaction between participants and certified CPS technicians. Together, the two samples achieved a weighted average of 90% correct installations across a multi-point inspection. Both samples reported increased self-efficacy to install child restraints and altered perceptions about the accuracy of the child restraint installations in their vehicles. *Conclusions:* Findings support use of interactive virtual presence as a strategy to realize accurate installation of child restraints. *Practical applications:* Interactive virtual presence between certified CPS technicians and the public via smartphone app has potential to improve proper child restraint installations broadly, including to vulnerable and underserved rural populations.

1. Introduction

Motor-vehicle crashes are a leading cause of death among American children (National Center for Injury Prevention and Control, 2017). For the youngest children, child restraint systems (car seats; henceforth, "child restraints") reduce risk of serious injury and death (Berg, Cook, Comeli, Vernon, & Dean, 2000; Lane, Liu, & Newlin, 2000; Tessier, 2010). Unfortunately, parents experience significant difficulty installing child restraints correctly, with inaccurate installation rates typically ranging between 70% and 90% (Blair et al., 2008; Brown, Hatfield, Du, Finch, & Bilston, 2010; Duchossois, Nance, & Wiebe, 2008; Koppel & Charlton, 2009). Although incorrect installation is generally preferred over non-use, improving the accuracy of installation will reduce pediatric injury and death rates, and is encouraged by experts as the most effective strategy to preserve child safety in motor-vehicle crashes (Beringer-Brown, Pearce, & Rush, 2005; Lesire, Cuny, Alonzo, & Cataldi, 2007).

Experts propose various explanations for why child restraints may be installed incorrectly by parents, but one prominent explanation is the fact that installation is complex and difficult to complete properly. Installation techniques vary widely across vehicles and across child restraints, require frequent changes as children grow and develop, and incorporate manipulation of multiple straps and harnesses. For these reasons, individualized assistance and training to install child restraints by certified CPS technicians, such as those holding national child passenger safety certifications from Safe Kids Worldwide, yields installation rates that far surpass parental use of a manufacturer's instruction manual alone (Brown, Finch, Hatfield, & Bilston, 2011; Lane et al., 2000; Tessier, 2010). In most locales, however, only a small percentage of child restraints are installed with the assistance of certified CPS

* Corresponding author at: Department of Psychology, University of Alabama at Birmingham, 1300 University Blvd, CH 415, Birmingham, AL 35294, USA.
E-mail address: schwebel@uab.edu (D.C. Schwebel).

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technicians. In the U.S. state of Florida, for example, data from the Florida Occupant Protection Resource Center indicates that about 15,000 child restraints were checked or installed in the year 2015 (Florida Occupant Protection Resource Center, 2016). In that same year, there were over 224,000 live births in Florida (Florida Department of Health, 2016). Barriers to installation education include convenience to families and access to certified technicians given the labor and costs for governments or non-profit agencies to administer installation programs. Risk of incorrect child restraint installation is particularly high in rural areas (Hafner et al., in press).

A potential solution to these barriers is use of an interactive virtual presence app that provides augmented and merged reality for certified CPS technicians to work remotely with parents to install child restraints into their vehicles. Interactive virtual presence apps provide joint exposure to 3-dimensional images and simultaneous verbal and visual communication, such that a certified technician located remotely can communicate both verbally and visually with a parent to point, explain, instruct, and signify how to install a child restraint properly. Initial testing of such an app as a tool to install child restraints with a group of young adults offered evidence of efficacy. In a randomized experimental design with 39 young adults who had no previous experience installing child restraints, engagement with the app proved more effective in yielding accurate child restraint installations than use of an instruction manual alone (Schwebel, Johnston, & Rouse, 2017).

The present study evaluates whether interactive virtual presence improves the accuracy of existing installation of child restraints in vehicles. We sought to accomplish two primary aims, each tested using a within-subjects design among a sample of parents and other adults who frequently drive with young children in their vehicle. First, we hypothesized communication with a remotely-located certified CPS technician using an interactive virtual presence app would increase the accuracy of existing child restraint installations. Second, we hypothesized participants would perceive higher safety, greater self-efficacy to install child restraints, and reduced risk for child injury following the remote virtual interaction with the certified technician.

Our hypotheses were tested among two samples. The first sample made appointments at car seat checkpoints and therefore had pre-existing concern about the safety of their installations. The second was recruited from individuals who were dropping off or picking up children at community preschools/day care centers and therefore had made no pre-existing effort to have their child restraint installations checked.

2. Methods

2.1. Participants

In Study 1, 20 adults ages 18–72 (mean = 35.90 years, SD = 12.05) were recruited from community-based car seat checkpoints at multiple sites in Northern and Central Florida. The Study 1 protocol was reviewed and approved by the Institutional Review Board at University of Florida.

Study 2 participants were recruited from two preschools/daycare centers in Birmingham, Alabama. Fifty-two adults ages 20–71 (mean = 35.59 years, SD = 10.59) were recruited during drop-off and pick-up times at the preschools. In some cases, parents expressed an interest in the study and then were scheduled for an appointment time in the coming few days. In other cases, recruitment and enrollment happened immediately. The Study 2 protocol was reviewed and approved by the Institutional Review Board at University of Alabama at Birmingham.

All participants in both studies provided informed consent to participate. Exclusion criteria were inability to communicate in English or inability to conduct the physical tasks required to install a child restraint. No potential participants were excluded from either study for these reasons.

2.2. Protocol

The study protocol was identical for both studies. Study 1 participants were approached during scheduled car seat checkpoints at multiple locations in Northern and Central Florida and Study 2 participants during drop-off and pick-up times at preschools and daycare centers in the Birmingham, Alabama area. In both cases, participants were permitted to schedule later appointment times to participate if they desired.

Following consent processes, participants responded to a 22-item baseline questionnaire addressing participant and family demographics, perceptions about child restraints and child restraint installation, and previous behavior and experience surrounding child restraint installations. While participants completed the questionnaire, an on-site certified CPS technician inspected the currently-installed child restraint and rated it using an objective rating scale, detailed below. Participants were not informed about the results of this inspection until after the study was complete. If more than one child restraint was present in the vehicle, a "target" child restraint for the research was chosen at random. Booster seats were excluded from the research.

Next, the participant was remotely connected to an off-site certified CPS technician, who instructed the participant on how to install the child restraint into the vehicle using an interactive virtual presence app. In most cases, this involved removing the existing child restraint installation and re-installing it. Participants were provided a tablet for this purpose; remote technicians used their own smartphones or tablets, as they preferred. Following the remote interchange, the on-site CPS technician again inspected the child restraint installation using an objective rating scale and without informing participants about the results of the inspection until the study was complete. During the inspection, the participant completed a 13-item questionnaire assessing their perceptions of the remote communication and child restraint installation process, as well as their broader perceptions about child restraints and child restraint installation. Prior to departure, all child restraints in the vehicle (including those not randomly selected as the "target" for research purposes if multiple child restraints were present) were re-inspected for safety. If needed, participants were assisted with re-installation by the on-site certified technician. Participants were offered a gift card to reimburse them for their time.

2.3. Interactive virtual presence app

Participants and remote technicians communicated using HelpLightning, a commercially available app that functions on smartphones and tablets. Prior to the study, remote technicians engaged in a 3-hour training session to learn how to use the app effectively. Participants were given instructions on the use of the app prior to connecting to the remote technician. No technical concerns about the app's functioning were expressed by participants or remote technicians.

In technical language, HelpLightning offers interactive visual and aural communication and a virtual interactive presence to users. It provides merged reality and virtual interaction. Users can instantly and simultaneously view and merge two real-time perspectives, offering opportunity for remote collaboration while interactively examining, pointing to, illustrating and discussing a video stream. In lay language, users requiring help – in this case the research participants – may place their smartphone over a targeted area to allow the expert – in this case the remotely-located certified CPS technician – to "freeze" that image and then point to particular areas with their hands and/or with software tools like arrows and pointers located within the app. Thus, for example, if the research participant was unsure where to connect a lower anchor, he or she could show the technician the back seat of the car and request that the technician point to the location of the lower anchor.

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