Using Instructional Videos to Promote Correct Use of Child Restraint Systems: Qualitative Consumer Input and Quantitative Testing

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Abstract

Despite efforts to increase best-practice child restraint use, misuse remains a significant threat to child passengers. Although users are receptive to audiovisual instructions, current videos are not designed based on user needs and there has been no research on how to increase adoption of video information. We developed instructional videos using consumer-input and testing. The first video prototype was developed from recommendations elicited from two focus groups (n =17). The instructional videos were then tested on 20 aspects of correct use in two iterative rounds with different participants. Exposure to the video in the first round resulted in an average rate of correct installations of 86% across four participants. After round one, the video was revised according to observed errors and participant feedback. In the second round, average correct use was 90% for eight participants. Through consumer-input and iterative consumer-testing, instructional videos can be effective in communicating correct use information.

Background

Child restraint systems are effective in reducing the risk of injury to child passengers in a motor vehicle crash (Durbin, Elliott, & Winston, 2003; Elliott et al., 2006; Du et al., 2008). However, child passenger injury and death remains a major public health problem (World Health Organisation [WHO], 2008). Legislation on the age-appropriate use of restraints has been effective at increasing the number of children using the right restraint for their size, but has not had a significant effect on whether these restraints are being used correctly (Brown et al., 2013). Age-appropriate and correct use are vital to optimal crash protection (Du et al., 2010; Elliott et al., 2006). In Australia, observations have demonstrated high rates of misuse, with 53-74% of children showing errors in how the child restraint is installed or how the child is secured in the restraint (Brown et al., 2010; Keay et al., 2013; Koppel et al., 2013). Similarly high rates of misuse are seen in other high income countries (Greenwell, 2015). Correct installation of the restraint in the vehicle and correct securing of the child in the restraint requires the restraint to be used exactly as specified by the manufacturer.

Information from the manufacturer on how to install and use the restraint correctly is typically supplied as instruction manuals and labels affixed to the restraint. Studies in Australia and overseas have shown that targeting this product information to increase the appropriate and correct use of a restraint is promising (Brown, Fell, & Bilston, 2010; Rudin-Brown et al., 2004; Kramer et al., 2015). The most consistently effective interventions, however, involve providing hands-on demonstrations to users (Tessier, 2010; Lane, Liu, & Newlin, 2000). One-on-one demonstrations are time- and cost-intensive. There is a need to identify mechanisms to realise the beneficial effects of demonstrations while reducing resource requirements.

Delivering correct use information via online video may be one way to achieve the benefits of demonstration efficiently. Instructional videos are known to be effective at modifying behaviour (Toung et al., 2014). Learning theory also supports the notion that modelling behaviour via video could improve behaviour through demonstration of best practice (Bandura 1977). In fact, one study

found that procedural video was as effective as live demonstration in teaching dental procedures to students (Alqahtani et al., 2015).

Video instructions can also aid comprehension and usability for users with low literacy (Hoffman, Gallardo, & Carlson, 2016; Abed, Himmel, Vormfelde, & Koschack, 2014; Sobel et al., 2009). A study of discharge instructions for parents of children in an emergency department found that a brief video was more effective than written instructions alone at improving caregiver knowledge and satisfaction (Block & Block, 2013).

Another benefit of video is that once delivered, videos are not constrained by location, time, or resources. Like existing child restraint product information, videos can be used independently, repeatedly, and in the user's own time (Ruiter et al., 2015; Gysels & Higginson, 2007; Green et al., 2004). Unlike written product information however, online video can reach a wide audience (Plantin & Daneback, 2009) without incurring additional costs or resources to deliver (Tuong et al., 2014).

It is easy to see why some manufacturers are beginning to provide video instructions on how to install and use the restraint online, but there is no evidence base for how to develop or test whether they are effectively communicating correct use. In the absence of evidence on how to design and deliver instructional videos for child restraint users that are effective at minimising misuse, we can adapt techniques used in the design of other consumer-centered educational material.

Iterative consumer-testing, also known as user-testing, is successfully used in patient education information leaflet design to ensure comprehensibility and usability among the intended population. Although rarely if at all used in designing instructional videos, it is the gold standard in designing other forms of health information (i.e., patient information leaflets; Jay, Aslani, & Raynor, 2010). Further, user-testing is mandated in the European Union for the design of all new medicine information (Jay et al., 2010). The method of user-testing involves prototype information being initially designed according to best practice, then tested iteratively with small groups of the target population. Areas of low comprehensibility and usability are identified and revised between each group (Jay et al., 2010). Typically, user comprehensibility is tested by asking participants a series of questions requiring them to find and use key pieces of information contained within the information to be supplied with the product. However, Jay et al. (2010) note that these questions should be flexible and reflect areas of specific importance to the prototype.

In the absence of evidence on instructional videos design, the best approach is thus to develop prototype videos based on user needs and optimize these video prototypes by using a consumer-testing method to ensure they are effective.

This paper describes the development of instructional videos specifically designed to communicate correct child restraint use information to reduce errors in the use of child restraints. Consumer input, collected using qualitative analysis of focus group discussion was used to design the prototype videos and then iterative consumer testing was used to ensure comprehensibility and usability.

Method

Participants

Experienced and naive adult child restraint users were asked to participate in focus groups or consumer testing. We used a sample of high education participants recruited through University email distribution lists and Culturally And Linguistically Diverse (CALD) participants recruited from a Western Sydney playgroup in a low socioeconomic area based on low SEIFA rating (ABS, 2013) for the consumer-input focus groups. Participants for the consumer-testing trials were recruited through an existing participant database at NeuRA.

Procedure

The study comprised three stages.

Consumer-input

We used a semi-structured discussion guide to elicit feedback, audio recorded and transcribed groups, and coded transcripts using NVivo. Participant comments were coded as negative, positive, or neutral. Each sub-theme within these categories was counted for frequency. The use of flexible content analysis allowed us to capture all instances of a theme being present in conversation, explore the context in which these issues were raised, and general agreement or disagreement within and between groups. These themes were used to guide design of prototype instructional videos.

Participants were shown four videos relating to child restraint installation and use: three manufacturer videos and one home video:

a) Home video - full installation of a rear-facing restraint.
b) Manufacturer video - full installation of a forward-facing restraint.
c) Manufacturer video - short video on how to fix a twisted strap
d) Manufacturer video - short video on how to use a seat belt lock off system.

Prototype design

The key insights from consumer focus groups, combined with previous research on designing instructional videos for behaviour change, were used to design a prototype of new instructional videos for child restraint installation and use.

These instructional videos were then optimised through iterative consumer-testing.

Consumer-testing

Method. We used a procedure akin to user-testing: the prototype is tested using mixed methods to identify areas of improvement in the prototype, revised to accommodate these improvements, then re-tested to evaluate the effect of these revisions. This process was repeated until 90% of participants achieved at least 90% correct use. Participants installed a convertible forward-facing child restraint in a car and secure a child in the seat. We chose a convertible type design as it typically demonstrates the highest rate of misuse (Brown et al., 2010).

Outcomes. Videos are assessed quantitatively and qualitatively. We objectively assessed installation performance using a validated correct CRS use pro-forma with 20 installation and use questions (Keay et al., 2012). Errors in child restraint installation and use were summed out of 20 for each participant and averaged across the trial. Participants were also asked to provide subjective feedback on the installation task and use of video instruction using a structured questionnaire (qualitative).

Round one (Pilot). The first round of consumer-testing involved a pilot trial of four participants. Participants were asked to install the child restraint in the car, and secure the child dummy into the seat, using the instructional videos. No time limit was placed on the task. The researcher made notes on actions taken while using the videos and any comments made by participant. Following the installation, participants completed a short, semi-structured interview which was audio-recorded and transcribed.

Re-design of video prototype. Following the pilot trial of video instructions, the prototype was revised based on two sources of information:

a) Errors in child restraint installation and securing;

b) Subjective feedback on the video instructions.

Round two. Round two tested eight new participants. The same procedure for the pilot round one was used here.

Results

Consumer-input

One high SES (n = 10) and one combined low SES and CALD (n = 7) focus group were convened. Across both groups, participants were 76% female, 29% were born outside of Australia, 35% spoke a language other than English, 12% were classified as having low education (below secondary school), and 6% were classified as low income (below $40,000 pa.).

The key insights elicited through these two consumer-input focus groups concerned length and focus of instructional videos, task sequence and numbering, use of role models, and preferences for specific content. These are discussed briefly below.

The home video had the highest frequency of dislike across both groups (n=24); the most common issue being that the information presented did not have enough context or background (n=6). A short manufacturer video focused on removing twisted straps had the highest frequency of positive comments (n = 32). This video rated highest on general like (n=10), good use of information and demonstrations (n=8), and good videography (n=9).

We also explored general recommendations for instructional videos given by participants across both groups. There was high consensus in and between groups on requiring that the video should be endorsed by a manufacturer (n=10) and accessible on phone (n=9):

"It has to be portable and accessible as well so if you're trying to install then you can have your phone there and go through it and you can do it step-by-step".

The low SES/CALD group preferred the role model to be more professional and authoritative (n=5), but also to use real children during the demonstration of securing the child in the restraint (n=6):

"Use real scenarios with real parents and children"

In terms of the content of information, most of the high SES group want videos to provide an orientation (n=6), numbered tasks (n=4), and reminders of correct use and its importance (n=5), for example:

"You could show where you could go wrong. Like some common mistakes…"

The CALD/low SES group suggested providing full-length installation videos with supplementary short-problem focused videos (n=5).

Consumer-testing

Over two iterative consumer-testing cycles, a total of 12 experienced and inexperienced child restraint users participated in an installation trial.

The demographic information for one participant in the first trial (round one; n = 4) was missing. All responding participants were male and aged between 18 and 35 years. Two of three respondents were from a non-English speaking background, two had high education (university graduate) and two were considered low income (less than $40,000 pa). Of the eight participants completing round two of consumer-testing, 75% were female, 50% born in Australia, and five spoke a language other than

English at home. Half of the participants were low education, and two were low income (four preferred not to say).

Round One (Pilot)

The installation video for round one can be found here: https://youtu.be/q5Dm7CTdmJI. The average correct installation and use rate for the pilot trial of four participants was 86% (average 17.25/20 correct). Remaining errors were harness slack (75% incorrect), tether strap slack (75% incorrect), seatbelt slack more than 25mm (50% incorrect), and harness and buckle not worn/engaged (25% incorrect).

Half of the participants (n =2) noted that the installation was difficult in their feedback on the trial, but most noted that the videos helped to visualize the tasks. When queried on whether any task was especially difficult, one participant noted that the seatbelt lock off system was too physically difficult to engage (resulting in seatbelt slack). All participants reported securing the child in the restraint was the easiest of all tasks. And two participants recommended that the video should have a separate instructional video for lengthening the harness straps before adjusting the headrest.

Revisions

Revisions to the video prototype for round one focused on emphasizing correct use of the restraint where the participants had misused in round one while incorporating subjective feedback. Changes to the prototype included:

a) To address seatbelt slack:
    i. Subtitle text changed from “Remove slack from the seatbelt” to “Make it tight”.
    ii. Method for pulling on seatbelt changed to show user pulling seatbelt with more force (see Figure 1).
b) To address tether strap slack:
    i. Subtitle text changed from “Tighten and remove twists” to two separate tasks, the first being “Tighten tether strap”
    ii. Added video clip for checking whether the strap was tight enough that includes both “Wrong: LOOSE” clip and “TIGHT” clip (see Figure 2).
    iii. The “TIGHT” clip has been amended to show the tether tighter than round one video (see Figure 3).
    iv. Method for pulling on the tether strap to tighten shows user with more force
c) To address misuse of harness buckle:
    i. The harness buckle “click” subtitle text is more visible by outlining with black, and changing action to a pull on the buckle to indicate the user checking it is secure.
d) To address harness slack:
    i. Subtitle text changed from “Pull to tighten” to “Tighten harness straps”
    ii. Method for pulling on harness adjuster strap to tighten shows user with more force
    iii. Subtitle text changed from “Loose” to “Wrong: LOOSE”
    iv. Angle of camera changed for video clips checking whether harness tight, so that the pinch test is more visible (see Figure 4).

e) To address other user feedback:

i. Changed text colour to white with black outline

ii. Changed task headings to black screen with white text

iii. Added clip to lengthen harness straps before adjusting headrest

iv. Pronounced technique of using seatbelt lock off system

Figure 1. Modification to address seatbelt slack, round 1 (left) versus round 2 (right)

Figure 2. Modification to address tether strap slack, round 1 (left) versus round 2 (right)

Figure 3. Modification to address tether strap slack, round 1 (left) versus round 2 (right)

Figure 4. Modification to address harness strap slack, round 1 (top left, bottom left) versus round 2 (top right, bottom right)

Round Two

The installation video for round two can be found here: https://youtu.be/WjbcXlI20vU. For round two (n = 8), the average percent correct across the trial was 90% (average 18/20 correct use). Remaining errors in this trial were harness slack (87.5%), seatbelt slack more than 25mm (25%), seatbelt slack less than 25mm (25%), and tether strap slack (50%).

Five of the eight participants in round two found the installation task easy, with one participant noting that the video was "…really easy to follow". Securing the child in the restraint was agreed to be the most straightforward task. Almost all (n = 7) participants said they are confident in correctly installing the child restraint with using the video; four participants noted the video as specifically more favourable than written instructions. Participant recommendations for improvement to the video included: adding an overview of the installation at the beginning, use universally-understood symbols to amplify warnings, and use a picture during the task heading screen to show the child restraint installation task ahead. Participants provided positive feedback on the information, subtitles, headings, and colour used throughout the video.

Final Prototype

The final prototype to be used in the next stage of this project (controlled laboratory trial, not included in this paper) matches the video used in Round Two, incorporating the following user-recommended changes:

a) Overview of installation task on opening screen, including outline of the five key steps to installing and securing the restraint and child;

b) The triangle warning symbol (same as that used in the AS/NZS standard for child restraint product information 1754:2013) used where a warning is presented (see AS/NZS 1754:2013 page 93);

c) Picture of completed and correct task underneath each task heading slide; and

d) Use of a real child instead of child dummy in video.

Discussion

The aim of this study was to develop new instructional videos for child restraint installation and use that are effective at reducing the likelihood of misuse of restraints. Manufacturers are increasingly producing videos accompanying manuals, yet there is no evidence on how to design procedural videos for child restraint use. In the absence of best-practice evidence, we sought to determine whether videos designed using a modified method of user-centered design and consumer-testing could be effective in reducing misuse of child restraints in the lab.

The results from this study suggests that this user-centered design and testing method might be an effective method in addressing child restraint misuse, because: a) video prototypes based on user-input showed a relatively high correct use rate in the pilot trial, b) errors in restraint use were further reduced (and positive subjective feedback increased) in round two of consumer-testing, and c) videos displayed efficacy for all user groups, regardless of English proficiency or education attainment.

Firstly, the relatively high correct use rate in Round One (Pilot) of the user-trial could be an indication that developing videos based on user-input through focus groups is effective at guiding design. It is also possible that the improvement in correct use in this sample could be a result of video performing better than written instruction generally, and not necessarily the use of our user-centered videos. Either way, the first consumer-test showed an average correct use rate of 86%, which is relatively high compared to previous studies assessing misuse with volunteers in the laboratory (Klinich et al., 2014). And although we did not reach saturation of themes in the input stage, there was constructive feedback such as to use the video to warn of specific instances of misuse (i.e., twisted straps) and show the user how to fix them. Notably, the absence of common forms of misuse (i.e., twisted tether

straps, twisted seatbelt) suggests that the user-centered video design might have mitigated these, even in the first prototype.

The average number of errors in installation and use were further reduced in Round Two of consumer-testing. The eight participants in the second round showed an average correct use rate of 90%, which is 4% more than the previous round. One of four participants critically misused the restraint by not engaging the harness buckle; this error was not present in round two. Further, tether strap slack was reduced by 25% across trials. Importantly, the severity of errors also reduced. Although both rounds showed 50% of participants with seatbelt slack in installation, all those with the error had seatbelt slack of more than 2.5cm in round one, while half (25%) had seatbelt slack of less than 2.5cm in round two. It is important to note here that harness strap slack appeared to increase from round one (75%) to round two (87.5%). This might be due to the limitation of using a child dummy in the installation task, which is discussed below.

Finally, the video instructions demonstrated efficacy in reducing misuse regardless of the demographics of participants. Across the respondents in consumer-testing groups, about half of participants identified as CALD, low income, and/or low education. Culturally and Linguistically Diverse (CALD) child restraint users have typically displayed a higher propensity for misuse in the real world (Bilston et al., 2011). The same is true for those with low education and literacy ability (Hoffman et al., 2016). The efficacy of video in reducing misuse in the diverse participants in this sample is probably explained by the lessened reliance on written correct use information when audiovisual instruction is available, which is clearly a barrier for those with low literacy. Evidence from other fields suggests that video does aid knowledge acquisition especially for those with low literacy (Sobel et al., 2009).

The low misuse rate in the first consumer-trial, combined with reduction in the number and severity of errors across consumer-trials, grants some evidence that designing instructional videos based on consumer-input and iterative consumer-testing is effective at developing videos that aid misuse reduction. Akin to the user-testing method used in the European Union to develop patient information leaflets, this method can be used as a guide by manufacturers to design instructional videos for child restraints. Although specific to the model of restraint being used, some key insights can be translated from the work here into other video designs, for example:

i. Videos should be short yet comprehensive (i.e., less than 5 minutes long);
ii. Videos should focus on key tasks in the order they must be conducted;
iii. Use task headings to orient the user to the current tasks;
iv. Subtitles should be simple, for example, “Make [seatbelt] tight” instead of “Remove slack from the seatbelt”
v. Coloured subtitles should be used sparingly to bring attention to correct or incorrect behaviours. For example, use red text for “Wrong: LOOSE” and green text for “TIGHT”;

To address some common misuses in child restraint installations, the following can be recommended as a guide:

vi. For specifically targeting a tight/secure installation, show the demonstrator using force to tighten tether straps, seat belts, and harness straps. For example, demonstrate by pulling on the seat belt strap with two hands (see Figure 1).
vii. For specifically targeting twisted straps and webbing, warn of twisted seatbelts, tether straps, and harness straps. Show demonstration of how to check for twists and remove

twists in each of these tasks before showing user how to tighten the seatbelt, tether, or harness;

Limitations

As mentioned above, harness fit was an issue in the consumer-testing trials. The dummy's chest was too narrow for the restraint being used which meant that achieving a 'snug' fit for the harness was not possible. One person in each trial was able to achieve a snug fit, but on inspection this had required the participant to pull the adjusted strap so tightly (beyond the intended length) that it pulled the crotch strap buckle out of position (i.e., the only way to achieve a snug fit was to malfunction the harness system). There are two potential ways to adjust the scoring for this limitation: removing harness fit as a variable and re-calculating averages across trials, or scoring very loose harness slack (more than 25mm) as incorrect and scoring harness slack (less than 25mm; unavoidable) as correct. The first method results in average correct installation scores across trials as 91% and 95% and the second method results in average correct rates of 86% and 93%, for rounds one and two respectively. Neither method changes the outcome of the consumer-trial significantly, so harness slack was included as a variable for the purposes of reporting results in this paper. Future research should consider the use of real children in the installation task.

Conclusions

This study adds to the evidence that communicating child restraint information through video is a potentially effective means of prevention. Research has found previously that increasing knowledge of correct use can be achieved through video (Shenoi et al., 2010). We now have preliminary evidence to suggest that correct behaviour can also be prompted through the same means. This is particularly important in the context of culturally and linguistically diverse users, and those with low education and literacy. The design method used here can be used by manufacturers and other research bodies to design instructional videos that have a high likelihood of being effective at communicating and demonstrating correct behaviours.

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