Young male construction workers' electrical risk perceptions

Centre for WHS

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Executive summary

Young male construction workers are overrepresented in workplace electrical injury statistics, with the most common mechanisms of injury being contact with live distribution wires, such as overhead powerlines, underground powerlines and fixed wiring. Current risk controls aim to remedy unsafe behaviours by increasing knowledge and skill through education programs and awareness raising campaigns. While these approaches play an important role in this space, a new approach is required, as workers, particularly younger males, continue to underestimate the likelihood of personally being involved in an incident and the severity of such incidents. Even when aware of the risks, evidence suggests that many young workers continue to engage in risky behaviours; a phenomenon explained by dual processing cognitive models of risk behaviour. Such models explain this behaviour in terms

of the interaction between a rational, slower, reflective system (targeted by traditional education methods) and a fast, automatic, impulse system. Cognitive interventions that use procedures aimed at targeting cognitive processes (e.g., attention, memory, decision-making) have successfully been used to modify these automatic cognitive processes, and thus alter risk perceptions and subsequent behaviours, both in clinical and non-clinical contexts.

In this study, we designed and explored the utility of two novel, self-administered, brief computerised cognitive interventions in increasing electrical risk perceptions and improving safe work intentions and behaviours in young adult male (aged 17-34 years) construction workers in relation to three risk areas; overhead powerlines, underground powerlines and fixed wiring.

Method

The cognitive training and assessment methods that underlie both interventions are based on scenario-based cognitive bias modification training procedures that have been successfully applied to a number of clinical and non-clinical behaviours. To enhance the relevance, acceptability, and effectiveness of the interventions, we developed, piloted (*N* = 5 interviews) and utilised real-life scenarios, reflecting safe and risky electrical practices across the three risk areas, to train and assess risk perceptions. Thirty scenarios were initially developed along with survey measures for assessing electrical risk perception, intentions, and behaviours.

The main study was conducted online, and outcomes were assessed at three time-points: pre-intervention (baseline), immediately post-intervention, and after two weeks. Participants (*N* = 224) were randomly allocated to one of the two intervention groups or to the control group. Both interventions utilised Cognitive Bias Modification-Interpretation training procedures, involving a word-fragment completion task based on the scenarios. Each scenario described a typical work site situation the participant may find themselves in, preceded by a picture of the risk area, then either a safe or risky behaviour associated with the risk area. The last sentence resolved the interpretation of that behaviour in either a negative or positive manner, and the word that resolved it in that manner was fragmented. Participants were asked to enter the missing letters to complete the word and were provided with automated feedback. Intervention 1 included both safe and risky behaviours, while Intervention 2 included only risky behaviours. These interventions were designed to train the user to negatively appraise the risky behaviours (both interventions) and positively appraise the safe behaviours (Intervention 1 only), thereby increasing risk perception of the risk areas. Scenarios used for Intervention 1 focused on peer norms and social evaluation of the risky or safe behaviour, and Intervention 2 focused on the potentially fatal consequences of poor safety practices. The control group completed filler tasks of the same scenario-word-fragment-completion format and similar degree of cognitive complexity but of unrelated content.

Immediately post-intervention, all participants completed a similar scenario-based task for 12 previously unseen scenarios, each involving risky behaviours across the three risk areas. This time, the final word in the scenario was missing. As participants filled them in, their word choices reflected an appraisal of the situation as being positive, negative, or neutral. Risk perceptions were evaluated as the sum of scenarios in which the participants correctly interpreted the depicted risky behaviour as being negative for each risk area.

Participants who completed the two-week follow-up online survey (n = 133) were asked to rate the perceived frequency and severity of negative consequences arising from the risky behaviours depicted in the post-intervention scenarios. A further (indirect) measure of risk perception and intentions towards risky electrical behaviours were measured at all three timepoints, while risky behaviour was assessed at baseline and at 2-weeks follow-up. Follow-up telephone interviews were conducted with a subset of participants to gain feedback on the training and survey material (n = 10).

Results

Self-report survey results were equivocal with regard to the effectiveness of the interventions, as the groups did not significantly differ in their risk perceptions, intentions, or behaviours following the intervention, relative to the control group. However, findings from the follow-up interview data suggested that the scenarios were well-designed, realistic, and useful. When considering such findings in combination, they suggest that there may be potential individual differences in the extent of engagement with both the intervention task itself as well as an individual's perceptions of safety practices more generally. Participants provided feedback on potential improvements for the future implementation of the training paradigm. Results suggested that the relevance of the three risk areas (i.e., overhead powerlines, underground powerlines, and fixed wiring) varied in different construction contexts. This finding was reflected in the qualitative feedback, and also in the finding that all three groups perceived fixed wiring as a higher and more negative risk, in both how they responded to scenarios in the cognitive assessment phase and how they later (at 2-weeks follow-up) rated the perceived frequency and severity of negative consequences arising from the scenarios.

Future directions

Findings from the present research indicate important next steps for refining and improving the training paradigm. Scenarios can be further refined on the basis of the feedback provided, and potential individual differences impacting upon engagement with the intervention and risk behaviours generally should be investigated systematically.

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Introduction

Background

Young, male construction workers are overrepresented in NSW electrical injury statistics (SIRA, 2018). Thus, there is a need for greater understanding of the unsafe behaviours of these workers that cause electrical incidents, so as to devise interventions that influence such behaviours. The Centre for Work Health and Safety (Centre) partnered with the School of Psychology & Counselling at the Queensland University of Technology to explore innovative, brief, behavioural change approaches that may contribute to improvements in electrical safety and, in turn, contribute to overall targets consistent with Action Area II of the Work Health and Safety Roadmap for NSW, which aims to eliminate or significantly reduce electrical incidents (SafeWork NSW, 2018).

Current approaches and interventions typically aim to increase explicit awareness of the hazards and risks that occur on worksites through traditional educational and instructional methods. However, more implicit, impulsive and automatic cognitive processes may result in young workers continuing to engage in risky behaviours regardless of an increased knowledge and awareness of these hazards and risks. Such automatic cognitive processes can be targeted through a cognitive approach known as cognitive bias modification, which has been used to implicitly retrain individuals' appraisals of threat, or risk-related situations and contexts, and in turn lead to accompanied desired change in targeted symptoms or behaviours.

This study focused on the application and utility of cognitive models and procedures for targeting electrical risk perception in young male construction workers, resulting in improved safe work intentions and electrical workplace behaviours.

Project outputs and demarcation of scope

The overall project comprises several discrete outputs. The first output is the current report, the purpose of which was to address the fundamental research questions.

Second, in addition to the report, we have outputs from the overall project that include a Queensland University of Technology undergraduate Psychology Honours (fourth-year) student thesis that has been delivered to the Centre for Work Health and Safety. This thesis was conducted by Laura Williams (supervised by Drs Melanie White and Sherrie-Anne Kaye) and applied the theoretical framework of Protection Motivation Theory to understanding electrical risk perceptions and behaviour of young male construction workers pre to post intervention (Williams, 2019, "Effects of Cognitive Bias Modification Interventions on Young Workers' Electrical Safety").

Finally, a journal article is being prepared from the larger project, drawing upon aspects not presented in this report, and will be disseminated upon publication. Consistent with journal and copyright requirements, the journal article will present further and complementary insights from those presented in the present report, which have emerged from the overall project and survey data. A link to the article will be available via the Centre for Work Health and Safety and Queensland University of Technology websites upon publication.

Aim of the current study

Young males tend to hold optimistic biases about the probability and severity of being involved in an incident. While current risk controls play an important role in reducing risky behaviours, a new approach is required to target these cognitive biases and alter risk perceptions and subsequent behaviours. Evidence supports the efficacy of cognitive interventions in modifying cognitive processes (i.e., attention, memory and interpretation biases) that are theorised to underlie risk perceptions and risky behaviours. Such interventions have also been shown to lead to changes in associated behaviours, in both clinical and non-clinical contexts. However, as this methodology had not yet been applied to construction workplace safety contexts, the purpose of this study was to:

1. Test the efficacy of two novel, self-administered, brief computerised cognitive interventions (compared to a control group condition) in increasing electrical risk perceptions in young male construction workers; and
2. Establish the time course of intervention-induced changes to risk perceptions and safety behaviour by examining outcomes at baseline (pre-intervention), immediately post-intervention (post-intervention), and two weeks post-intervention (2-week follow-up).

Literature review

Electrical risks in construction worksites

Construction sites are high-risk workplaces as evidenced by injury statistics around the globe. In Australia, the third-highest proportion of workplace-related fatalities are attributed to the construction industry (Safe Work Australia, 2019). In 2018, the construction industry employed 9.5% of the workforce but accounted for 17% of workplace fatalities in Australia (Safe Work Australia, 2018; Australian Industry and Skills Committee, 2020).

Fatalities resulting from electrical risks contribute substantially to these rates, as electrical incidents are more likely to result in fatality than the average construction incident (Suárez-Crebador, Rubio-Romero, & López-Arquillos, 2014). Electrical harms include electric shock via direct or indirect contact with electricity or through "step-and-touch" potentials. Related harms also include arcing, explosion, fire and toxic gases as well as secondary harms, such as falls from heights (Safe Work Australia, 2016). Between the years 2002 and 2014, the second highest number of fatalities was associated with electrical services on construction sites, with 53% of these stemming from contact with electricity (Safe Work Australia, 2015). In New South Wales, the construction industry represents 20.1% of electrical injury claims, with the main sources of contact with electricity being overhead powerlines, underground powerlines, and fixed wiring (12.2% of electrical injury claims; SIRA, 2018).

Analysis of the injury statistics also reveals the vulnerability of young male workers, particularly those who are not electrically trained (Gammon, Vigstol, & Campbell, 2019). Specifically, New South Wales electrical injury compensation claims suggest that 55.9% of claims are by workers aged between 15 and 34 years old and 71.6% of claimants are male. While electricians represent the leading occupation in New South Wales construction claims (35.1%), combined it is those with limited electrical training that are most at risk. This includes those with restricted electrical licences, such as plumbers (8.6%), air conditioning and refrigeration mechanics (5.6%), as well as other miscellaneous technicians, trade workers (7.3%) and labourers (18.9%; SIRA, 2018).

These statistics mirror those of electrical injuries and fatalities internationally (e.g., Lombardi, Fargnoli, & Parise, 2019; Zhao, Thabet, McCoy & Kleiner, 2014), suggesting that current risk controls may be less effective for young adult, male construction workers who are not licensed electricians.

Current electrical safety practices

The construction industry has implemented various control measures to manage electrical risks to young construction workers. The main intervention is systematic risk management, applying the *hierarchy of risk control*. This is a system by which duty holders eliminate or minimise electrical risks through a combination of controls (Safe Work Australia, 2012). Specifically, once risks are assessed, WHS regulations require duty holders to decide on whether it is reasonably practicable to (1) *eliminate* the risk completely, (2) *substitute* the process/material with one that is less hazardous, (3) *isolate* it to prevent workers from coming into contact with the risk, (4) use *engineering controls*, (5) implement *administrative controls*, and/or (6) distribute *personal protective equipment* (PPE).

Applying the hierarchy of control to electrical risks therefore commonly include planning and eliminating or minimising the need to work on or near live electricity. It also includes licencing workers, establishing routine on-site procedures, and installing signage, reminders and engineering solutions, such as exclusion zones, residual current devices, electricity sensors and detectors, and using non-conductive materials and PPE (e.g., Zeng et al., 2010; Neitzel, 2013).

Training is considered an administrational control when used to teach the procedures and practices involved in managing a specific risk or hazard (Safe Work Australia, 2016) but can also take the form of compulsory safety training or public education, such as awareness raising campaigns, to enhance awareness of safety and safety practices generally (such as the implementing the hierarchy of control) or of specific hazards and associated health risks or negative outcomes (Namian, Albert, Zuluaga, & Behm, 2016). Training can thus be an effective way to influence young workers' risk perceptions and facilitate safer workplace behaviours.

Research aiming to understand and improve electrical safety commonly cite ineffective training as a significant contributor to incidents. Recommendations have included more thorough introductory training, followed by periodic refresher training, and making sure that programs are hands-on, interactive, and culturally and linguistically appropriate, for both electrical and non-electrically trained workers (e.g., CDC, 2011; Zhao, Thabet, McCoy & Kleiner, 2014). This supports the need to move away from the instructional approach to education, which focus is on the dissemination of explicit facts, protocols, and consequences (Haslam et al., 2005; Wilkins, 2011). Instead training needs to embrace new technology and innovation, using gamification, such as virtual reality (Zhao & Lucas, 2015; Mo et al., 2019) and scenario-based simulations (Halpin, Halpin, & Curtis, 2015) to not only train technical but non-technical skills, such as situation awareness, decision making and communication (Saurin, Wachs, Righi, & Henriqson, 2014).

Cognitive bias modification to target risk perceptions

While the abovementioned risk management controls and education materials play an important role in influencing electrical risk perception, it is clear that a new approach is needed, as workers, particularly younger males, continue to hold optimistic biases about their relative probability of being involved in an accident (White, Cunningham, & Titchener, 2011). Additionally, they underestimate the consequence of such accidents in terms of resulting severity of injuries or risk of fatalities if such an incident was to occur (Shin, Lee, Park, Moon, & Han, 2014; White, et al., 2011). Further, evidence suggests that even when aware of the risks, many individuals continue to engage in those risky behaviours. This discrepancy may be explained by dual processing models of risk behaviour (Gladwin, Wiers, & Wiers, 2017), which describe two different ways in which people perceive and make decisions about potential risks, and how these aspects interact. Specifically, these models propose that people process information and make behavioural decisions using a rational, reflective, slower, and more controlled information-processing system, and/or a fast, automatic, associative, and impulsive system (Smith & DeCoster, 2000). The controlled system is more likely targeted by educational interventions. The impulsive system is generally untapped by current training methods, as training programs tend to involve didactic and instructional approaches to safety education, and assess outcomes based on rote learning (e.g., (Haslam, et al., 2005; Wilkins, 2011).

Importantly, the ability to reflect on and take in information (using the controlled system) becomes compromised in situations such as times of cognitive load, fatigue, stress, and substance use. As such, automatic processes of the impulsive system are likely to increase their influence over behaviour in such contexts, potentially leading to poor judgements of risk and subsequent risky decision-making. Recently, there have also been calls for researchers to test ways to simultaneously target both systems to achieve, theoretically, superior training effects on risk-related cognitions and behaviour (e.g., Gladwin et al., 2017).

One such methodology for assessing and altering risk perceptions and subsequent behaviours involves cognitive bias modification-interpretation (CBM-I). CBM-I targets negative and positive evaluative memory traces, in order to implicitly retrain people's appraisals of certain behaviours. This approach is similar to evaluative conditioning studies, which, for instance, pair negative images with target stimuli (such as alcohol), in order to alter perceptions of risky behaviour (Houben, Havermans, & Wiers, 2010; Houben, Schoenmakers, & Wiers, 2010). Based on information processing theory, scenario-based CBM-I techniques are thought to require potentially deeper engagement with the materials to be able to respond, which, in turn, may lead to deeper, more sustained changes in risk perceptions, intentions, and behaviours. This is important, as research has found that high-engagement safety training is associated with greater safety risk perception in the construction context than low-engagement training methods (Namian, et al., 2016).

CBM-I-based word fragmentation and sentence completion tasks were initially developed to treat anxiety (MacLeod & Mathews, 2012). Since then, the tasks have been applied to a range of clinical and non-clinical behaviours (Jones & Sharpe, 2017). For instance, this type of effective cognitive bias training has been effectively translated into non-clinical risk contexts, such as young adults' hazardous drinking perceptions and behaviours. One study found that a CBM-I intervention was able to reduce bias towards alcohol-related stimuli in young adults with moderate to heavy drinking habits, in contrast to those who took part in the control condition (Salemink, Woud, Roos, Wiers, & Lindgren, 2019).

Previous research has also demonstrated that changes in risk perception may be achieved through addressing beliefs about what is socially expected among peers. Personal narratives that highlight the negative outcomes of risk behaviour have been used effectively to target risk perception, with particular emphasis on peer "injunctive" norms (Rimal, Yilma, Ryskulova, & Geber, 2019). An injunctive norm represents the social approval of a behaviour by relevant peers, and the perceived expectation of what 'should' be done in a given situation (Deutsch & Gerard, 1955). Hence, these types of personal narratives effect change in risk perceptions by positioning the reader to consider how their own peers might be appraising their risky or safe behaviours.

An intervention for electrical risk perception

Given prior success in translating cognitive bias training to non-clinical risk contexts (e.g., young adults' hazardous drinking perceptions and behaviours), the current research developed and tested the application of a scenario-based CBM-I task paradigm to the context of electrical risk perceptions in construction workers. Specifically, two types of cognitive training interventions were developed and tested. Each intervention combined explicit exposure to information and messaging around electrical risks and safety behaviours with implicit cognitive training methods. The implicit training aimed to (i) increase the depth of processing and elaboration of the risk information, to enhance risk perception of the described hazards; (ii) train participants to automatically negatively appraise risk behaviours and positively appraise safe behaviours [Intervention 1] and (iii) enhance memory formation and automatic retrieval of that information when in the workplace, and particularly in the context of other cognitive load or stressors, to prime safer work behaviours as the automatic response [both interventions].

Intervention 1 training, with its focus on social evaluation and "injunctive" peer norms, was expected to modify participants' perception of social norms in the desired direction, which, in turn, would contribute to safer workplace behaviours (Rimal, et al., 2019). Intervention 1 used this methodology to implicitly train negative and positive interpretations and appraisals towards electrical safety worksite scenarios, via a word fragmentation task. Intervention 2 used similar scenario-based and word-fragmentation task methods to implicitly train participants' attention and processing of electrical risks and increase risk perceptions (associated with risk of injury or fatality more directly). In this way, both CBM-I-style interventions targeted negative or positive evaluative memory biases, similar to previous evaluative conditioning studies that have paired target stimuli (such as alcohol) to negative pictures (Houben, Havermans, et al., 2010; Houben, Schoenmakers, et al., 2010), but in more context-rich worksite scenarios of high salience to the target population of young male construction workers.

While these represent novel applications to the electrical risk and worker safety field, importantly, these methods have an extensive evidence base as cognitive interventions in applications to other cognitive or behavioural targets. Further, this methodology has been successfully applied to assess and modify other risk perceptions and risk behaviours, including young people's binge drinking behaviour. To date, it has not been applied to construction workplace safety contexts and offers the potential of a novel, low-cost and easy-to-implement intervention with potential appeal to the young male demographic.

Method

General overview

This study comprised two phases: the development and pilot-testing of materials, and the main study (see *Figure 1* for an overview). The first phase involved developing both the incident scenarios for use in the intervention and measures for assessing electrical risk perception in young males (aged 17 to 34 years). These materials were subject to expert review and pilot-testing with members of the intended target population (i.e., young males).

As a result of such testing, some aspects required refinement. The revised versions were used in the main study (online survey), which was conducted over three timepoints. A web-delivered, computerised program was developed using a combination of relevant construction site images and text-based scenarios, alongside Likert-scale survey items, to (1) assess workers' risk perceptions pre and post intervention [for all participants in both the intervention and control groups] and (2) train workers to more deeply process the information and interpret the risks in a safer, more realistic manner [intervention groups only].

Qualtrics software platform was used to administer the online surveys and intervention tasks. Outcomes were assessed at baseline (pre-intervention), immediately following the intervention (post-intervention), and at two weeks after the intervention (2-week follow-up). Follow-up interviews were conducted over the phone with a subset of participants from the main study.

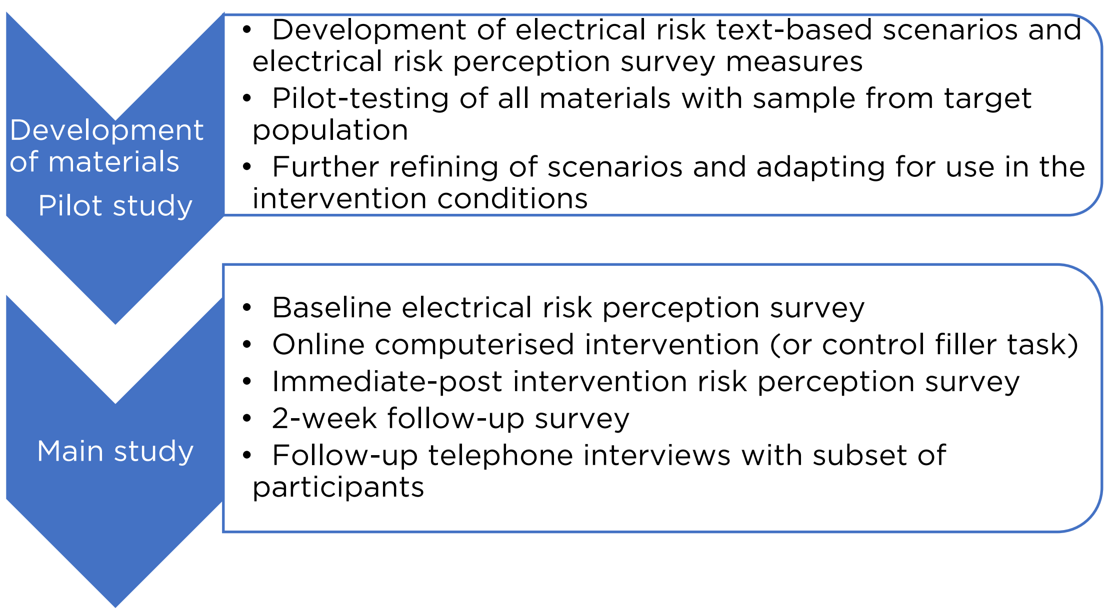


Figure 1: Phases of the research

Development of materials

Incident scenarios

Thirty incident scenarios were developed, evenly distributed across the three key electrical risk areas under investigation in this study; namely, overhead powerlines, underground powerlines, and fixed wiring. These scenarios reflected a range of safe and risky practices with regard to electrical safety, and the positive or negative consequences of these behaviours. Materials were informed by publicly available resources and websites, such as Safe Work Australia (Safe Work Australia, 2014) and 'Dial before you dig' (Dial Before You Dig, 2019), and several of the sample scenarios provided by these sources were adapted for use in the present study. Other scenarios were designed based on information derived from relevant workplace electrical safety incidents within the Australian context (NCIS 2012) or from those provided by the Centre. Images reflecting different electrical risks were sourced from an online stock photography provider (Shutterstock Inc., http://www.shutterstock.com/) and were used to accompany the scenarios to help ensure standardisation of the scenarios (see *Appendix G*). All materials were identified and developed in consultation with industry contacts from within the construction/electrical industry and SafeWork NSW. The scenarios were developed for use primarily in the interventions but also as immediate post-intervention assessment items to assess participants' appraisals of the risk scenarios (i.e., electrical risk perceptions).

Assessment of risk perceptions, intentions and behaviours

To further assess risk perception within the context of electrical safety, and across timepoints, survey items measuring risk perceptions, intentions, and behaviours were adapted for use from previously established scales (see *Measures*).

Pilot study

Methodology

All materials underwent pilot testing with young male construction workers (aged 22 to 34 years) to ensure the realism and relevance of the scenarios and images as well as the comprehensibility of the survey items. Participants (N = 5) were recruited for individual interviews through flyers and emails to construction workplaces (see *Table 1* for further demographic information). It was evident by the fifth participant that no new information was emerging and, therefore, data saturation was achieved.

One member of the project team (SN) conducted the telephone interviews (see *Appendix A* for question guide). All interviews were audio recorded and hand-written notes were taken throughout each interview. The telephone interviews took approximately 60 minutes and, within which, participants reviewed the images, scenarios and survey questions. These materials were provided to participants via email prior to taking part in the interviews. Verbal feedback was sought from the participants in response to questions about the perceived relevance of the electrical risks and incidents being addressed as well as the ease of understanding the study materials. By conducting the interviews, SN was able to become familiar with the data and, therefore, undertook initial data analysis in a concurrent manner with data collection. To enhance both the reliability and validity of the interpretations, MW worked with SN to finalise the analysis. Members of the project team (MW, CK, SN, SK, LW) then met to further finalise the selection of scenarios for the main study.

Results

Participants gave predominantly positive feedback on the realism and utility of the various scenarios. All participants reported that the scenarios were relevant in regards to the potential risks that could occur in each of the three electrical risk areas. Participants reported that they believed that ”everything was covered” and “well thought out”. All participants found the scenarios to be realistic for both themselves and the average construction worker. Three participants made suggestions or provided alternative outcomes and strategies used in the risk scenarios, based on their field experience. Based on the feedback provided, the scenarios were further refined with minor wording changes. More scenarios were generated than required, so that those rated most positively could be selected for the main study. Hence, of the 30 scenarios, 24 were selected. These comprised 8 per risk area, half of which were then adapted for training, and half for assessment purposes, in the main study (see *Incident scenarios* and *Appendix E* for more detail).

Table 1: *Pilot participant socio-demographic characteristics.*

		N
Highest level of education completed	Less than Year 10 or equivalent	-
	Year 10 Certificate or equivalent	1
	Year 12 Certificate or equivalent	1
	TAFE course	2
	Other Trade Qualification	1
	University Degree	-
Job within the industry	Labourer	2
	Trainee/Apprentice	-
	Trade Assistant	-

	Tradesman	1
	Supervisor	-
	Other	2
Years' experience in the construction industry	0-2	-
	2-4	1
	4-6	-
	8 +	4
Level of electrical safety training completed	None	1
	Licensed electrician	-
	Trade certificate restricted electrical license	-
	Apprentice electrician	-
	Site safety induction (i.e., 'white card' training)	4
	Other electrical license	-

Main study

Participants

Individuals were considered eligible to participate if they were male, aged 17 – 34 years, currently employed in the construction industry in Australia, and not a licensed electrician (see *Tables 2 and 3* for demographic information). They were recruited via paid social media advertising (administered by QUT Social Media) and email approaches to relevant businesses. Each participant received a $30 Bunnings/Wish e-gift voucher upon completion of the initial session and again after the 2-week follow-up survey, and an additional $20 e-gift voucher for completing an optional follow-up telephone interview.

After screening survey data for invalid responses (see *Overview statistical analyses* for more detail) and attrition from the intervention component, 224 participants who had completed the intervention component were retained for the main study analysis. Of these, 133 participants had completed all three timepoints of the survey, and 46 participants consented to being contacted for follow-up telephone interviews. Twenty of these participants (split evenly across the two different intervention groups) were approached for an interview, and 10 agreed to take part. Table 2 provides a summary of the participants who undertook the intervention, and those who continued to subsequent stages.

Table 2: *Summary of sample information at each timepoint.*

	N	M_{age} (*SD*)	Intervention Group		
			1	2	3
Completed intervention	224	25.69(4.52)	72	77	75
Completed intervention and all surveys	133	25.76(4.25)	43	41	49
Follow-up interviews	10	25.2(4.57)	3	7	-

Table 3: *Socio-demographic characteristics of participants.*

		N	%
Highest level of education completed	Less than Year 10 or equivalent	1	0.4
	Year 10 Certificate or equivalent	21	9.4
	Year 12 Certificate or equivalent	97	43.3
	TAFE course	58	25.9
	Other Trade Qualification	18	8.0
	University Degree	29	12.9
Workers who are currently studying	Currently studying	93	41.5
	Not currently studying	131	58.5
a. *Study load*	Full-time	36	16.1
	Part-time	57	25.4
b. *Study course*	Bachelor's degree or higher	14	6.3
	Advanced diploma or associate degree	5	2.2
	Diploma	7	3.1
	Certificate IV	4	1.8
	Certificate III (or trade certificate)	57	25.4
	Certificate II	4	1.8
	Year 12	1	0.4
	Other	1	0.4
Job within the industry	Labourer	54	24.1

	Trainee/Apprentice	102	45.5
	Trade Assistant	7	3.1
	Tradesman	19	8.5
	Supervisor	18	8.0
	Other	24	10.7
Years' experience in the construction industry	0-2	55	24.6
	2-4	101	45.1
	4-6	36	16.1
	8 +	32	14.3
*Level of electrical safety training completed**	None	36	16.1
	Licensed electrician**	5	2.2
	Trade certificate restricted electrical license	17	7.6
	Apprentice electrician	103	46
	Site safety induction (i.e., 'white card' training)	104	46.4
	Other electrical license	3	1.3

N = 224.

**Participants selected any option/s that applied*

***Note that none of these participants identified as a licensed electrician in the screening survey, and were therefore included in current analyses and reported results. However, for completeness, analyses were run again excluding these five participants, and the pattern and statistical significance of results were unchanged.*

Measures

Computerised cognitive intervention

The cognitive intervention was embedded within the online survey, and training scenarios varied between the intervention groups in terms of format. Immediately prior to the intervention task, all groups undertook a brief mental imagery task, adapted from Lothmann, Holmes, Chan, and Lau (2011). This task was included to help participants better imagine themselves in the subsequent workplace scenarios as they read them. Participants were asked to imagine a common situation (e.g., arriving home from work after a long day, and smelling dinner being prepared). They were then asked to describe this experience (in open-ended text fields) in terms of what they could see, hear, touch, smell, and taste.

Intervention 1 involved a CBM-I paradigm, in which participants undertook a fragmented word completion task based on the incident scenarios. For this intervention, scenarios were written in the second person, similar to the approach implemented by Lothmann, et al. (2011), and were ambiguous in terms of their interpretation until the final word, which was presented as a fragment with one letter missing that participants had to complete. This final word fragment was either a negative or positive interpretation of the preceding incident, evenly split across the three risk areas. The negative interpretation reflected an unsafe behaviour resulting in a negative consequence, the positive interpretation reflected a protective response to an unsafe situation. Participants were required to fill in the missing letter for each scenario, presented one at a time, and were provided with automated feedback, allowing them to re-enter the letter if the response was incorrect, or progress to the next scenario if correct. A forced delay was implemented, such that responses could not be entered until 5 seconds after each scenario appeared. This was designed to increase the likelihood that participants would engage with the scenario before providing a response.

As an example, one scenario in Intervention 1 involving risky behaviour around underground powerlines, read as follows:

> "You are digging trenches at the worksite and come across an electric cover mat. At this stage, the trench is about 600-800mm deep, and you are using a jackhammer to dig through the hard ground. You recall a previous week on site when you'd come across a wire while digging in this way. You joke about it to the guy working besides you and continue to dig. The other guy gives a forced smile, looking [un_asy]."

An example of a safe behaviour scenario for underground powerlines read:

> "You and the team are working on a new building site, excavating at the corner of the building to make footings for piling. You've got a Dial before you Dig site map, and it looks like there is no wiring in the vicinity. The excavator has been used to move a lot of the top layer of earth out of the way, and now it's just down to shovels. Just in case, you finish the task by hand digging as you get further below the surface, making sure to use non-conductive tools and pothole any potential assets. Just as well you do, because you soon come across a gas pipe – you and the other guys look up at each other in [r_lief]".

The methodology in Intervention 2 was similar to the CBM-I task, but this time the scenario was written from the perspective of a 'peer' and focused directly on the consequences of risky behaviour. Scenarios were written in the first person (similar to Rimal, et al., 2019) and focused on the consequences of risky behaviour. The final sentence typically included a fatal consequence or a strongly worded message regarding safe behaviour and contained a fragmented word to be completed by participants; completion of this fragment invariably resulted in a negative interpretation of the scenario, and again, automated feedback was provided.

As an example, one scenario involving fixed wiring in Intervention 2 read:

> "The other day I was replacing a tiled roof with a metal roof on a 2-storey house with a guy I've worked pretty closely with. We installed metal battens and screwed down the metal roofing sheets onto the metal battens. One of these roofing screws pierced an electrical conducting cable. The roofing material and parts of the structure became energised, probably including the metal guard rail – and I watched as my workmate was [k_lled] instantly."

For the control group, a set of neutral scenarios, unrelated to the construction workplace or electrical risk, were developed, with some items adapted from previous studies by Woud, Fitzgerald, Wiers, Rinck, and Becker (2012) and Lothmann, et al. (2011). As with other conditions, each scenario finished with a fragmented word that was missing one letter in the final sentence. As an example, one scenario involved flying out of town for on holidays read:

> "You're flying out of town on holidays and have arrived with just enough time to check in, so that you can board on-time. As you approach security, you see that the queue is very...[l_ng]"

In the assessment phase, all participants received the same set of 12 new electrical risk scenarios, written in the same format as Intervention 1, divided evenly among the 3 electrical risk areas. In this phase, the final word was entirely missing, and participants had to complete the sentence. Participants' responses were subsequently coded as reflecting a negative, positive, or neutral interpretation of the preceding electrical risk context.

Table 4: *Scenarios according to intervention group and risk area.*

	Intervention 1	*Intervention 2*	*Control group*	*All groups*
	Training	Training		Assessment
Overhead	4	4		4
Underground	4	4		4
Fixed	4	4		4
Neutral			12	

Note: To minimise response set bias, three distractor scenarios were randomly presented in all three *groups (Intervention 1, Intervention 2, Control Group) during the training phase. As an example: "You are at the cinema with a friend. You are starving as you have not yet eaten lunch. Your friend goes to buy a treat. "Here's one for you", and he hands you a large...[popc_rn]". These distractor scenarios were adapted from the study by Woud et al. (2012).*

Electrical risk perception survey

Risk perception was assessed in terms of participants' perceptions of the scenarios. This was measured in two ways, immediately following the intervention, and at the 2-week follow-up survey. In the assessment phase, the number of negative-coded sentence endings were summed for each participant, split according to the risk area. Hence for each risk area, the maximum number of negative-coded responses could be 4 (reflecting the 4 scenarios tested). In the 2-week follow-up survey, the assessment scenarios were provided for the participant, who had to rate the perceived frequency and severity of an injury or fatality occurring in each scenario, using a risk matrix adapted from Pandit, Albert, Patil, & Al-Bayati (2019), and scored using their provided formulae. Scores on this measure could range between .0016 to .8125 with higher scores indicating a higher perception of risk in terms of frequency and severity.

An indirect measure of risk perception (perceptions of adhering to safety procedures) was also administered, as were items assessing intentions toward electrical risk and safety behaviours. These were both assessed at three timepoints. These survey items were adapted from previous research (Kaye, Lewis, Algie, & White, 2016; Kaye, White, & Lewis, 2013; Lewis, White, Ho, Elliott, & Watson, 2017) to be relevant within an electrical safety context. Each construct (i.e., risk perception, intention) was assessed separately within the context of each of the three key risk areas.

The risk perception item was repeated for each risk area and assessed risk perception (i.e., perceptions of enacting electrical safety procedures) by requiring participants to rate on a 7-point semantic differential scale (ranging from [1] 'safe' to [7] 'unsafe') their perception of adherence to electrical safety procedures.

Two items assessing intention to adhere to electrical safety procedures were rated on a 7-point Likert scale, where responses ranged from [1] 'strongly disagree' to [7] 'strongly agree'. The two items were, "In the next 2 weeks, I intend to follow safety procedures for working around [risk area]" and "In the next 2 weeks, it is likely that I will follow safety procedures for working around [risk area]". These two items were summed and averaged to provide a mean score of intentions.

Behaviour regarding adherence to electrical safety procedures was assessed at both baseline and at the 2-week follow-up. Participants were asked to rate how often in the past two weeks they had followed safety procedures, for each electrical risk area. Items were rated on a 7-point Likert scale, ranging from [1] ‘never’ to [7] ‘very often’, and included an option of ‘not applicable’.

Qualitative feedback on the training and survey material was also sought through an open-ended question within the 2-week post-training survey.

Table 5: *Measures for assessing risk perceptions, intentions, and behaviours.*

Measures	*Baseline (pre-int.)*	*Immediate post intervention*	*2-week follow-up*
Risk perceptions (negative-coded endings in scenarios)		✓	
Risk perceptions (severity and frequency ratings)			✓
Risk perceptions (perceptions of adhering to safe practices)	✓	✓	✓
Intentions to engage in safe behaviour	✓	✓	✓
Behaviour (adherence to safe practices in past 2 weeks)	✓		✓

Procedure

Ethical approval was obtained from QUT (approval number 1900000361). The main study was conducted in two online sessions. The pre-intervention survey (baseline), intervention, and immediate post-intervention surveys were undertaken in one session. A follow-up survey was administered two weeks later (2-week follow-up).

At baseline (see *Appendix B*), the survey comprised demographic questions and items assessing participants’ electrical risk perceptions and past behaviours. Participants were then randomly allocated to one of the two interventions or to the control group, and undertook the relevant fragmented sentence completion task. Preceding the intervention, participants were required to engage in a brief mental imagery task (see *Appendix E*), in which they had to imagine themselves in a familiar, non-work-related situation and then describe what they could hear, see, taste, smell and feel during that exercise. This task was again undertaken prior to the assessment versions of the risk scenarios (sentence completion task), using a new situation.

Following the cognitive intervention (word completion task; see *Appendix E* “training”) and completion of the risk scenario assessment items (sentence completion task; see Appendix E “assessment”), survey measures of electrical risk perceptions and intentions were administered again (see *Appendix C*), and then at the 2-week follow-up (see *Appendix D*). All participants were provided an open text field and invited to leave any comments regarding the study at the conclusion of the follow-up survey. For a subset of participants, follow-up phone interviews were conducted (see *Appendix F*).

Overview statistical analyses

Prior to data analyses, screening of the survey data involved reviewing and deleting all duplicate responses. In addition, the survey data were also screened for invalid and inappropriate responses (e.g., responses consistently not relevant to questions). Survey data across the four timepoints were linked through a confidential unique identification code created by the participants in the baseline survey so as to ensure participant confidentiality.

In line with the research aims, analyses were conducted to (1) assess the efficacy of the two cognitive interventions (compared to a control group condition) in increasing electrical risk perceptions in young male construction workers, and (2) establish the time course of intervention-induced changes to risk perceptions and safety behaviour by examining outcomes at baseline (pre-intervention), immediately post-intervention (post-intervention), and two weeks post-intervention (2-week follow-up).

Mixed design Analysis of Variance (ANOVA) analyses were conducted for the dependent measures of risk behaviours, intentions, and perceptions. An ANOVA is a statistical method used to test for differences among 2 or more means (which are represented by an Independent Variable; IV). A standard one-way ANOVA can have either a between-subjects design (different participants contributing to each mean) or a within-subjects design (the same participants contributing to each mean, allowing the repeated measurement of an outcome). A mixed design ANOVA extends on this by including at least one between- and one within-subjects independent variable (Murrar & Brauer, 2018). This study implemented a combination of 2x3 and 3x3 mixed design ANOVAs, with the difference between these two tests due to the number of levels of each IV. For instance, a 2x3 mixed design ANOVA has two IVs, with two levels in IV1 (e.g., baseline behaviour, follow-up behaviour) and three levels in IV2 (e.g., Intervention 1, Intervention 2, Control), while a 3x3 mixed design ANOVA has two IVs, with three levels in IV1 (e.g., Intervention 1, Intervention 2, Control) and three levels in IV2 (underground powerlines, overhead powerlines, fixed wiring).

It is worth noting that the sample size varied between some of these measures, due to attrition at the 2-week follow-up timepoint. This aspect was taken into consideration when planning the most appropriate analyses to optimise adequate statistical power. The full sample size (N = 224) was used for analysing risk perception in terms of responses to the scenarios immediately after the intervention (i.e., number of negative-coded sentence completions). For the other analyses, which required completion of the 2-week follow-up survey, the sample size consisted of the 133 participants (59%

of the sample). Given the statistical complexity and reduced power with a smaller follow-up sample size, analyses involving all three timepoints were conducted separately for each electrical risk area. Any follow-up analyses of significant effects applied a Bonferroni correction, which is an adjustment made to the p-values when multiple statistical tests are performed at the same time and is used to control for the family-wise error rate.

Risk perceptions (negative-coded sentence endings in scenarios)

For all participants who undertook the intervention and the sentence completion task immediately following the intervention (N = 224), a 3 x 3 mixed design ANOVA was conducted, to investigate whether the number of negatively-coded sentence completions were different according to the intervention condition participants were in, or the electrical risk area presented in the scenario.

Risk perceptions (frequency and severity ratings)

To assess risk perception in terms of frequency and severity ratings, a 3 x 3 mixed design ANOVA was conducted investigating whether 2-week follow-up risk perception scores varied according to intervention condition, or the electrical risk area presented in the scenario.

Risk perceptions (perceptions of adhering to safety practices)

To assess risk perception over the three time points (in terms of how safe-unsafe participants rated the enactment of safety procedures), three separate 3 x 3 mixed design ANOVAs were conducted (one for each risk area), which investigated whether these ratings changed over time (baseline, immediately post-intervention, 2-week follow-up), and whether this differed depending on the intervention condition.

Intentions

To assess changes in intentions related to risk perceptions, three separate 3 x 3 mixed design ANOVAs were conducted (one for each electrical risk area), investigating whether intentions changed across the three time-points (baseline, immediately post-intervention, 2-week follow-up), and whether this varied according to intervention condition.

Behaviour

To assess changes in behaviour related to risk perceptions, three separate 2 x 3 mixed design ANOVAs were conducted (one for each electrical risk area), investigating whether behaviour changed between baseline and 2-weeks follow-up, and whether this varied according to intervention condition (Intervention 1, Intervention 2, Control group).

Follow-up interviews

Participants were invited to take part in an optional follow-up interview, for which they were contacted by a member of the research team (SN) via telephone approximately two weeks after the main study and took on average 20 min to complete. In the interview, participants were asked a series of questions regarding their perceptions of the scenarios, survey measures, and efficacy of the intervention in terms of changing their perceptions of risk and intentions. Suggestions as to potential improvements of the interventions or their delivery method (web-based/app) were also gathered for subsequent refinement. All interviews were audio recorded and hand-written notes were taken throughout each interview. The participants' responses were analysed using thematic analysis to identify common themes.

Results

Risk perceptions (immediately post intervention)

To investigate whether there were differences in risk perceptions (number of negative-coded sentence completions) among the three intervention groups, a mixed 3 x 3 mixed design ANOVA was conducted (between groups by repeated measurement of outcomes), with the independent variables of condition (intervention and control groups) and risk area (overhead, underground, and fixed wiring).

There was a significant main effect of risk type ($F(2, 220) = 27.83$, $p < .001$). However, the effect of condition was not significant ($F(2, 221) = 0.19$, $p = .826$). There was also no significant risk type by condition interaction ($F(4, 442) = 0.84$, $p = .501$; Figure 2). These results indicate that the number of negative-coded sentence completions varied according to the electrical risk area, but that this effect was the same across the different intervention and control conditions. Responses did not vary according to which condition participants underwent.

Follow-up comparisons for the main effect of risk area were undertaken to determine the specific electrical risk areas that were associated with more negative-coded responses. In order to control for multiple comparisons, a Bonferroni correction of $p < .017$ was applied. The findings indicated that regardless of intervention condition, both fixed wiring and overhead powerline scenarios were associated with a significantly greater number of negatively coded responses (i.e., greater number of negative interpretations, and thus greater risk perceptions), in comparison to the underground powerlines scenario ($p < .001$). Fixed wiring scenarios also received more negative risk perceptions than overhead powerlines scenarios ($p = .008$).

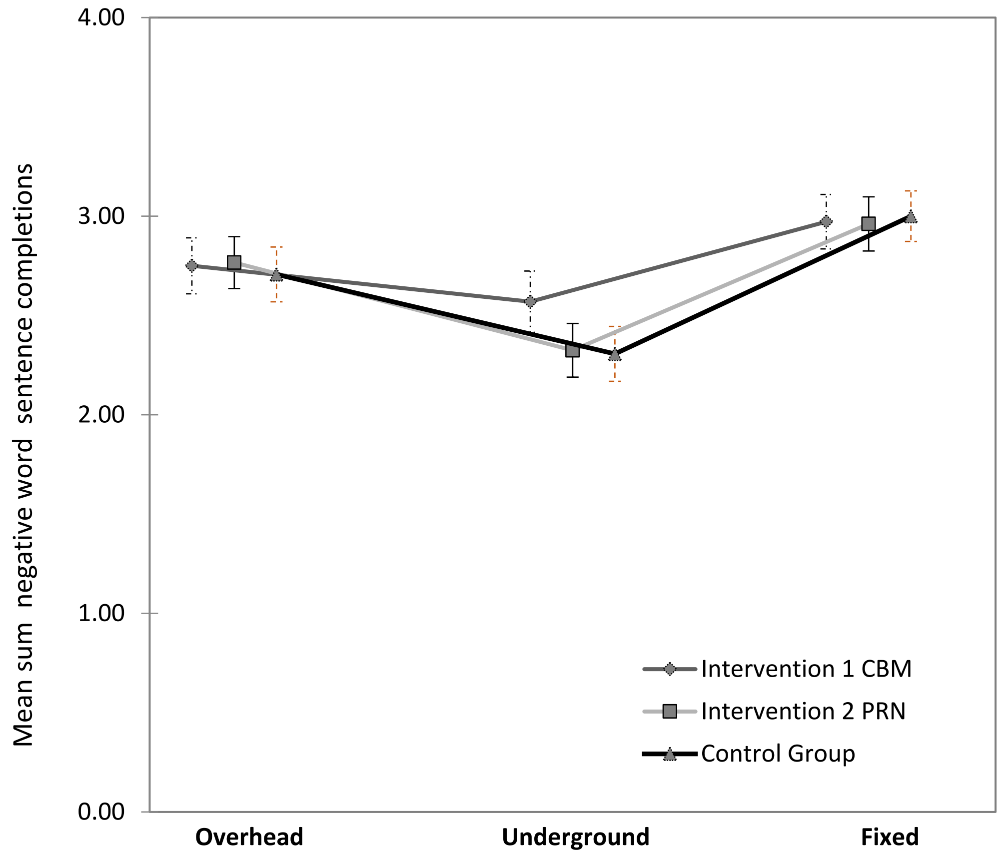


Figure 2: Number of negative interpretations across risk scenarios (immediate post-intervention), according to electrical risk area and intervention condition. Error bars indicate ±SE.

Risk perceptions (2-week follow up)

An analysis was conducted to assess risk perceptions (in terms of perceived frequency and severity) at 2-weeks follow-up (N = 133). A 3 x 3 mixed design ANOVA was undertaken, with condition and risk area on 2-week follow-up risk perception scores.

The main effect of risk type was significant ($F(2, 127) = 5.14$, $p = .007$), while the main effect of condition was not significant ($F(2, 128) = 0.27$, $p = .798$). There was no significant condition by risk area interaction ($F(4, 256) = 0.74$, $p = .567$; Figure 3). These results indicate that perceived frequency and severity of risks varied according to the electrical risk area presented in the scenario, but not according to the intervention condition. While not statistically significant, it is worth noting that participants in Intervention 1 tended to provide higher ratings for fixed wiring, compared to the other groups.

Consistent with how participants responded to the sentence completion task in the immediate post-intervention assessment scenarios, follow-up pairwise comparisons indicated the difference between scenarios involving fixed wiring and underground powerlines was significant (p = .007). That is, participants perceived fixed wiring scenarios as riskier (in terms of severity and frequency ratings at this time-point) when compared to underground powerlines scenarios. There were no significant differences on risk perception scores between overhead powerlines and fixed wiring scenarios.

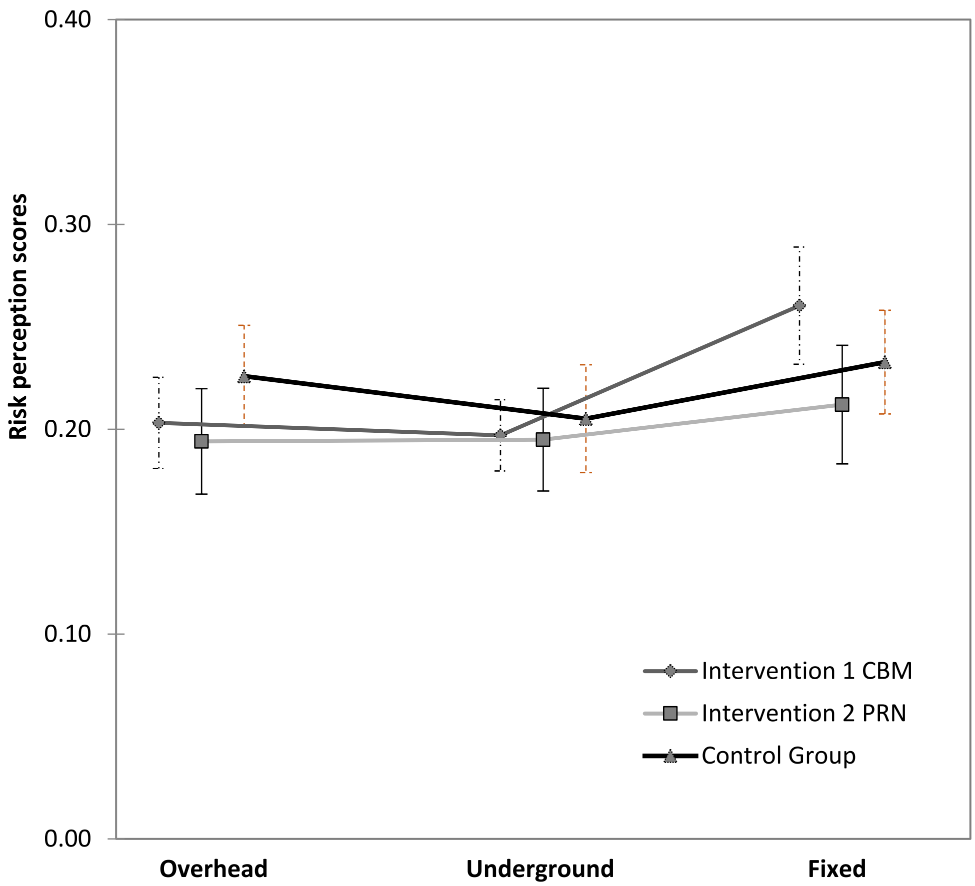


Figure 3: *Risk perception scores across scenarios (2-week follow-up), according to electrical risk area and intervention condition. Error bars indicate ±SE. Individual scores on each scenario can range from .0016 to .8125. The average score was computed for each risk area.*

Risk perceptions (all time points)

To investigate changes in risk perception over all timepoints, participants' perceptions of the importance of safety procedures in the context of each key electrical risk area between baseline, immediately post-intervention, and two weeks following were assessed (N = 133). At each time point, higher ratings indicated a more positive perception of the importance of safety procedures, and thus greater risk perception.

Three separate 3 x 3 mixed design ANOVAs were undertaken to assess differences between the three groups (Intervention 1, Intervention 2, and Control condition) at baseline, immediate post-intervention, and at 2-week follow-up.

Overhead powerlines

For the risk area of overhead powerlines, there were no significant main effects of time ($F(2, 129) = 1.31$, $p = .275$) or condition ($F(2, 130) = 0.12$, $p = .889$). Further, there was no significant risk perception by condition interaction ($F(4, 260) = 1.12$, $p = .349$; Figure 4A).

These results indicate that perceptions of risk (i.e., appraisal of enacting safety procedures) did not change over time or according to intervention condition, for overhead powerlines.

When observing the trends in Figure 4A, it is important to note that in all conditions, and at each time-point, mean ratings were high (the average was close to 6 on a 7-point scale), indicating a high perception of risk in general. This is further suggested by the low level of variability in responses (according to standard error in each condition).

Underground powerlines

For the risk area of underground powerlines, there were no significant main effects of time ($F(2, 129) = 2.51$, $p = .085$) or condition ($F(2, 130) = 0.33$, $p = .719$). There was also no significant risk perception by condition interaction ($F(4, 260) = 0.67$, $p = .616$; Figure 4B).

These results indicate that perceptions of risk (i.e., appraisal of enacting safety procedures) did not change over time or according to intervention condition, for underground powerlines. Again, trends in Figure 4B display high risk perceptions across the board, with low variability.

Fixed wiring

For the risk area of fixed wiring, there were no significant main effects of time ($F(2, 129) = 0.69$, $p = .502$) or condition ($F(2, 130) = 0.01$, $p = .988$). There was also no significant risk perception by condition interaction ($F(4, 260) = 0.31$, $p = .868$; Figure 4C).

These results indicate that perceptions of risk (i.e., appraisal of enacting safety procedures) did not change over time or according to intervention condition, for fixed wiring. Similar to the other risk areas, perceptions were high in each condition and at each time point (Figure 4C).

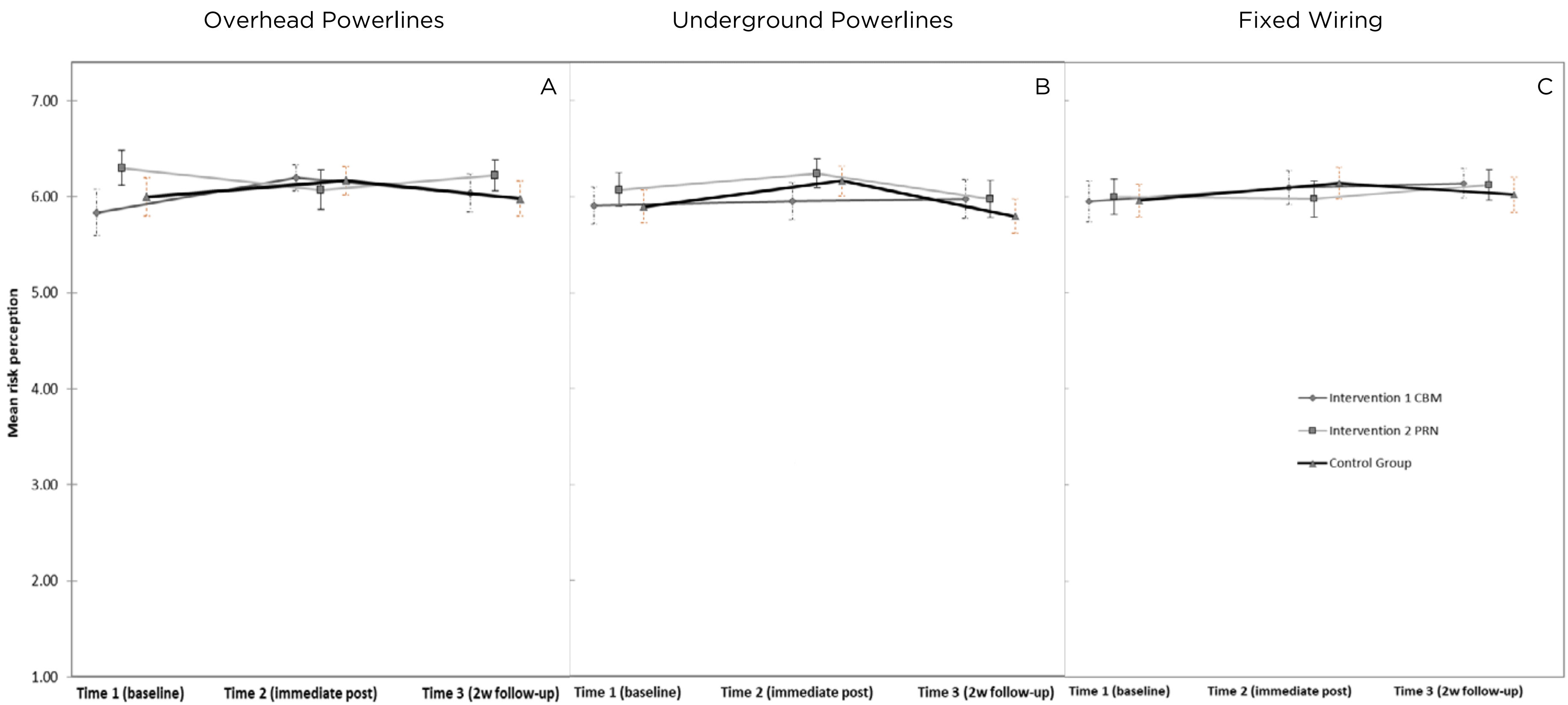


Figure 4: *Changes in risk perceptions (i.e., perceptions of enacting safety procedures) for overhead powerlines (A), underground powerlines (B) and fixed wiring (C), by intervention condition, between baseline, immediate post-intervention, and 2-week follow-up. Error bars indicate ± 1 SE.*

Intentions (all timepoints)

To investigate changes in intention to engage in risky behaviours, participants' intention to follow safety procedures in the context of each key electrical risk area, at baseline, immediately post the intervention, and at the 2-week follow-up were assessed by intervention condition (N = 133). At each time point, higher ratings indicated greater intentions to follow safety procedures.

Three separate 3 x 3 mixed design ANOVAs were undertaken to assess differences between the three groups (Intervention 1, Intervention 2, and Control condition) at baseline, immediate post-intervention, and 2-week follow-up.

Overhead powerlines

For the risk area of overhead powerlines, there were no significant main effects of time ($F(2, 129) = 0.78$, $p = .461$) or condition ($F(2, 130) = 0.22$, $p = .802$). There was also no significant intention by time interaction ($F(4, 260) = 0.79$, $p = .536$; Figure 5A).

These results indicate that for overhead powerlines, intentions to enact safety procedures did not change over time, nor did they vary according to the intervention group. As with risk perceptions, there was small variability in responses, and a high level of intention in each condition, at all timepoints.

Underground powerlines

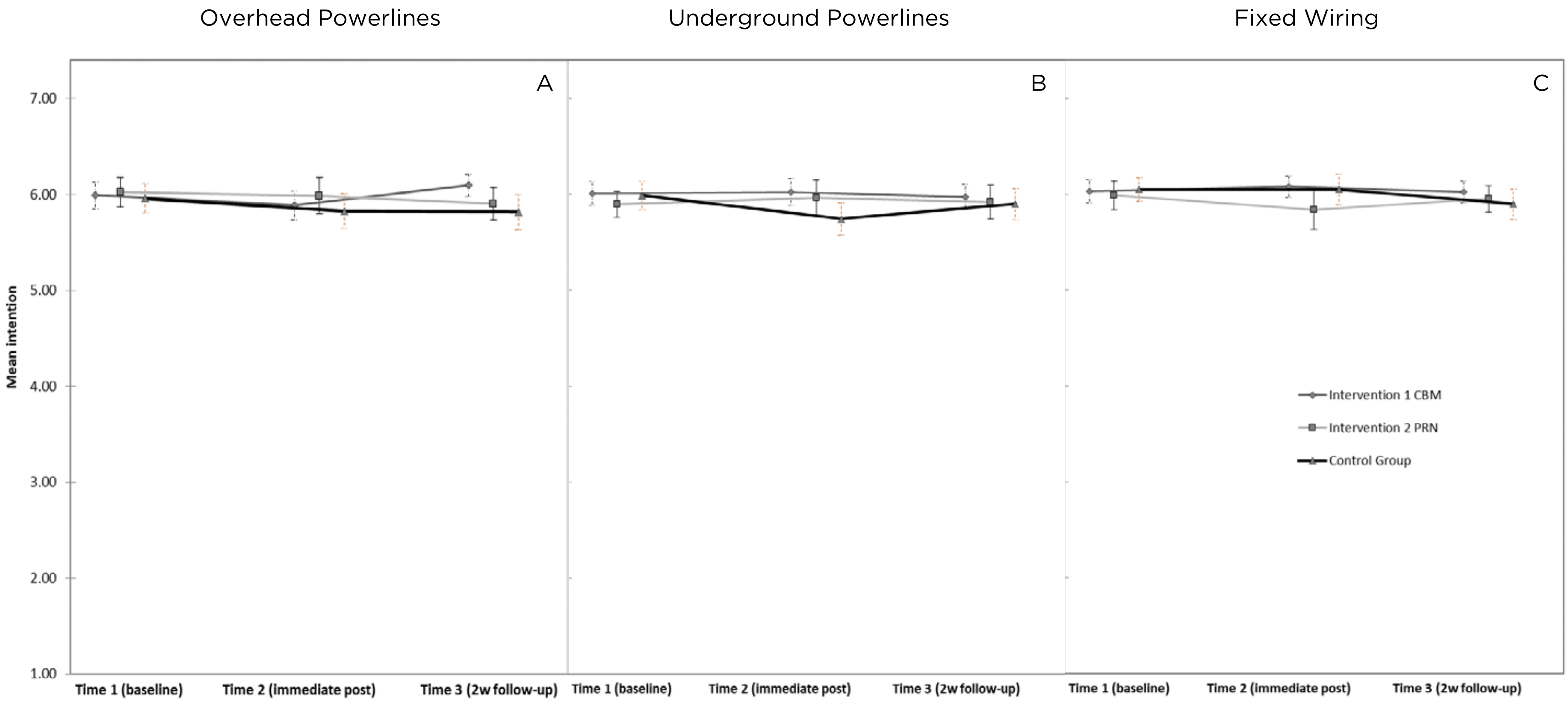
For the risk area of underground powerlines, there were no significant main effects of time ($F(2, 129) = 1.63$, $p = .200$) or condition ($F(2, 130) = 0.04$, $p = .961$). Further, there was no significant intention by time interaction ($F(4, 260) = 0.74$, $p = .564$; Figure 5B).

These results indicate that for underground powerlines, intentions to enact safety procedures did not change over time, nor did it vary according to the intervention group. Each group (at each time point) gave high ratings of their intentions to enact safety procedures.

Fixed wiring

For the risk area of fixed wiring, there were no significant main effects of time ($F(2, 129) = 0.48$, $p = .619$) or condition ($F(2, 130) = 0.22$, $p = .806$). There was also no significant intervention by time interaction ($F(4, 260) = 0.73$, $p = .571$; Figure 5C).

These results indicate that for fixed wiring, intentions to enact safety procedures did not change over time, nor did they vary according to the intervention group. Average ratings were again high at each time point and in each condition.



wiring (C), by intervention condition, between baseline, immediate post-intervention, and 2-week follow-up. Error bars indicate ± 1 SE.

Behaviour (baseline vs. 2-week follow up)

To investigate intervention-induced changes in behaviour, three separate mixed design ANOVAs were conducted (one for each risk area), assessing changes between baseline and the 2-week follow-up (within groups), for the three groups (between-subjects). At each time-point, higher scores on this measure indicated a higher frequency of adhering to electrical safety procedures.

Participants could indicate that the risk area and associated behaviour was 'not applicable' to them, and these respondents were excluded from the analysis for that risk area. Therefore, although analyses aimed to include all participants who had undertaken both the baseline and 2-week follow-up (N = 133), the number of participants varied according to risk type, and is reported with each analysis below. This number also provides some indication of the risk areas which were most relevant across participants.

Overhead powerlines

For overhead powerlines (N = 97), the main effect of time was not significant ($F(1, 94) = 1.09$, $p = .299$), the main effect of intervention condition was not significant ($F(2, 94) = 0.24$, $p = .785$), and the condition by time interaction was also not significant ($F(2, 94) = 1.26$, $p = .289$).

These results indicate that, in the context of overhead powerlines, there was no change in risk-related behaviours before to after the intervention, nor depending on which intervention condition participants were in (Figure 6A). Ratings at each time point and in each condition were slightly lower than on other measures, but still high across the board, with low variability in responses, as indicated by the small standard errors.

Underground powerlines

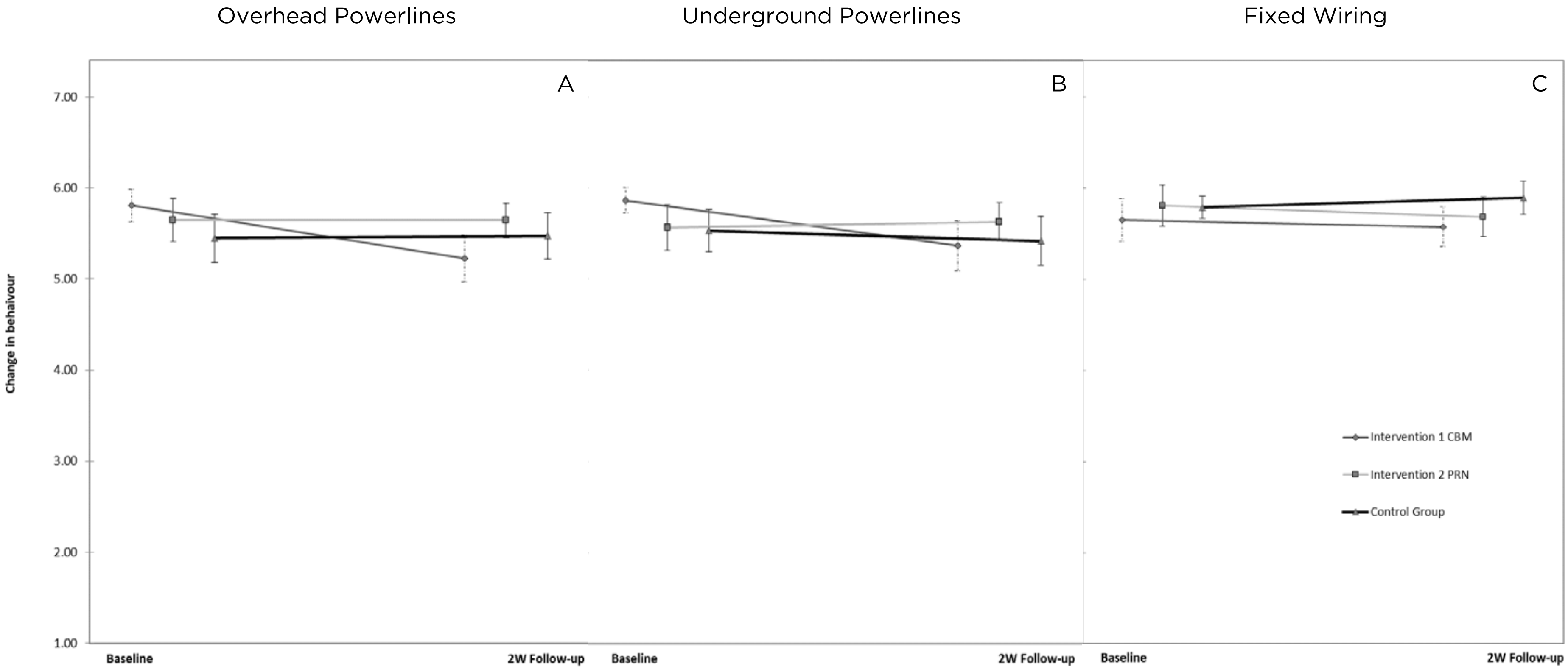
For underground powerlines (N = 103), the main effect of time was not significant ($F(1, 100) = 0.92$, $p = .340$), the main effect of intervention condition was also not significant ($F(2, 100) = 0.20$, $p = .299$), and the condition by time interaction was not significant ($F(2, 100) = 0.69$, $p = .503$).

These results indicate that, in the context of underground powerlines, there was no change in risk-related behaviours before and after the intervention, nor depending on which intervention condition participants were in (Figure 6B).

Fixed wiring

For fixed wiring (N = 120), the main effect of time was not significant ($F(1, 117) = 0.05$, $p = .830$), the main effect of intervention condition was also not significant ($F(2, 117) = 0.62$, $p = .538$), and the condition by time interaction was not significant ($F(2, 117) = 0.23$, $p = .792$).

These results indicated that, in the context of fixed wiring, there was no change in risk-related behaviours before to after the intervention, nor depending on which intervention condition participants were in (Figure 6C).



group, n = 38), underground powerlines (B: Intervention 1, n = 30; Intervention 2, n = 30; control group, n = 43) and fixed wiring (C; Intervention 1, n = 40; Intervention 2, n = 32; control group, n = 48), according to intervention condition. Error bars indicate ± 1 SE.

Qualitative feedback

Qualitative feedback was obtained in two ways; (1) through participants' responses to an open-ended question within the 2-week post-training survey (potential sample of 133 participants) and (2) verbal responses gained via a telephone interview (completed by a subset of 10 participants from the intervention conditions). For both sources, the data were analysed using thematic analysis to identify common themes of users' experience of electrical scenarios as well as their suggestions as to potential improvements of the interventions or their delivery method (web-based/app) for subsequent refinement.

Open comments from 2-week survey

Participants undertaking the follow-up survey at 2 weeks were invited to leave comments and feedback regarding the study. Comments were left by 27 participants (20%), with 9 participants in Condition 1, 5 participants in Condition 2, and 13 participants in Condition 3. Of these, several participants noted the importance of education around safety and compliance with safety procedures (n = 7), and several participants gave positive feedback on the scenarios and survey measures (n = 3). For example, one of these participants (23 years old; Intervention 1; supervisor; no formal electrical safety training) stated that they "…thought that (the survey) covered everything and also highlighted extra areas of concern". Another stated that, as a consequence of participating, they had a greater intention to be more cautious in future work.

Mixed feedback was given regarding how safety behaviours are implemented within the industry. For instance, one participant stated, "while I take safety around electricity very seriously, I think the building industry generally has a very lax attitude towards it" (31 years old; control group; trainee/apprentice; site safety induction training). Another participant stated, "some of the scenarios used wouldn't occur because safety procedures in place in my company would have us stop and not continue until measures are put in place." (27 years old; control group; trainee/apprentice; apprentice electrician training). Another participant highlighted that discrepancies might exist in understanding of safety behaviours due to the extent of training – "We're made aware of electrical precautions in trade school. Labourers who aren't formally trained might be more at risk as they are relying on either knowing the dangers already or being told by another co-worker." (21 years old; control group; trainee/apprentice; site safety induction training). This sentiment was reflected in comments by other participants, who indicated that they had high awareness of safety procedures due to prior training. Some participants suggested improvements for the format and/or item content (n = 7), for instance, by increasing specificity of the scenario descriptions.

Follow up phone interviews

Out of the 47 intervention participants that volunteered for a follow-up interview, 20 were selected to be approached and 10 agreed to be interviewed; 7 of the participants were in Intervention group 1 and 3 were in Intervention group 2.

Realism and utility

The scenarios were described as being “eye-opening, relevant, and (they) make you think” by one participant (29 years old, Intervention 2, trainee/apprentice; no formal electrical safety training). Another (29 years old, Intervention 1, trainee/apprentice; no formal electrical safety training) stated that engaging with the scenarios had aided him in his decision-making in the workplace the following week, when he encountered a situation involving overhead powerlines. He additionally stated that “…usually questionnaires feel like someone out of the industry has been writing them, but in that case, it felt like it was really clear and didn’t feel out of norm”, adding that there is nothing he would change. Positive feedback was also given on the instructions provided with the task, with a majority of participants saying these were helpful (n = 9) and easy to understand (n = 10).

Relevance – job specificity

All of the participants said that they thought this type of training would be useful to include in the construction industry, with some participants (n = 3) suggesting it could be incorporated into site safety induction or other induction training for apprentices.

Most participants (n = 9) reported that the scenarios were informative and relevant within their field. However, one participant commented that certain aspects of the risk areas were not relevant to their area (i.e., powerlines), making the associated scenarios less relevant to them (19 years old, Intervention 1, trainee/apprentice; apprentice electrician training). Another participant suggested that some scenarios could be tailored more effectively to different contexts by including more specific processes and precautions to be put in place (29 years old, Intervention 1, trainee/apprentice; no formal electrical safety training).

Effectiveness – Change in intentions/risk perceptions

Half of the participants said their awareness of the risks had improved as a result of the training, with the other half saying they already had high awareness. There was a similar split for whether they thought their behaviour had changed. One participant stated, “I noticed I’m testing everything even if I’ve already done it”. He said this has made him a bit paranoid, but in a good way, as it “keeps (him) alive” (28 years old, Intervention 2, trainee/apprentice; apprentice electrician training).

All 10 participants reported that they thought the scenarios employed in the computerised intervention would increase awareness in others exposed to the training. In relation to this, one participant commented, “If they read (the scenarios) properly, then definitely yes. I found it engaged your thinking, so as I was reading it, I felt like I was in the job site in that particular situation and I was thinking about it.” (29 years old, Intervention 1, trainee/apprentice; no formal electrical safety training).

A suggestion for improvement reported by one participant (21 years old, Intervention 2, H&S coordinator; no formal electrical safety training) was that individuals undergoing this training could be questioned regarding how they would respond if the real-life scenario occurred.

Discussion

Overview of findings

This report presents the effects of two novel computerised cognitive interventions, designed to increase risk perceptions of key electrical risk areas in young male Australian construction workers. Two scenario-based CBM-I interventions were developed and implemented, and their impact on electrical risk perception, intentions and behaviours were compared to a control group.

Overall, results were equivocal with regard to the intervention efficacy, as risk perceptions did not significantly vary as a function of the intervention group. Safe behaviours and intentions to enact safety behaviours did not significantly increase following the intervention. Such findings are not in line with previous research that has successfully used this type of cognitive bias training in non-clinical risk contexts (e.g., young adults' hazardous drinking perceptions; Salemink at al., 2019), or with the results from other evaluative conditioning studies that have paired alcohol-related stimuli with negative pictures (Houben, Havermans, et al., 2010; Houben, Shoenmarkers, et al., 2010). It should be noted that some ceiling effects were observed on the measures assessing risk perceptions and intentions toward safety behaviours (i.e., high scores of risk perceptions and intentions at baseline). This may be due to socially desirable responding and, as a result, could have impacted on the results. Since this is the first time this methodology has been applied to the construction and electrical safety field, it is possible that participants may feel greater pressure to respond in a socially desirable (safe) manner than other participants responding in drinking contexts.

Although the quantitative (survey) measures produced equivocal results, qualitative feedback derived from an open-ended item in the survey as well as from the telephone interview was largely positive, particularly with regard to the realism and utility of the scenarios. Some participants acknowledged that the scenarios had subsequently helped them in their workplace by reminding them to take risks seriously and reflect more deeply on their own electrical safety practices. This finding suggests that there may be individual differences which influence the extent to which people engage with the intervention, and with risk-taking behaviour more generally. Further research could investigate these individual differences more systematically to inform subsequent tailoring of the interventions to those characteristics. For example, some studies have suggested that personality and other individual characteristics, which have been associated with greater risk-taking, may also influence the degree to which an individual processes health information content (Kaye et al., 2013). This may extend to the workplace safety field and, in particular, electrical risk and safety messages. A future study might utilise neurocognitive methods such as brain imaging (e.g., through ERP [event-related potential]) to assess differences in the degree to which the training scenario material was cognitively processed, and whether such differences predicted measures of training response.

The qualitative feedback also suggested that not all risk areas were relevant to particular worksites. It is possible that future work using this paradigm could tailor scenarios to be more pertinent to different jobs. Scenarios that apply within the context of individuals' workplaces may potentially increase the effectiveness of the intervention. Furthermore, other qualitative feedback indicated that while many in the workforce value safety procedures around electrical risks, these are often put to the side in the interests of 'getting the job done'. This safety versus efficiency trade-off is a common and well-known phenomenon in the workplace safety field (Grant & Guthrie, 2017; Newnam, Goode, Griffin, & Foran, 2016; Xiao, Sanderson, Clayton, & Venkatesh, 2010). This efficiency pressure and trade-off was not a specific focus of this study's research questions or design, which was concerned with increasing risk perceptions. Future research could systematically investigate ways in which this paradigm, or related cognitive procedures, could be modified to better target such competing motivations and the decision-making process.

Finally, based on the qualitative feedback from the follow-up interviews, one potential improvement could involve providing participants with choices on how to respond to a scenario, and "branching" the scenarios and outcomes based on these choices. This could potentially deepen the degree of task engagement and interaction, which has been shown to be an important predictor of training success (Namian, et al., 2016).

Those in the control group did not significantly differ in their risk perceptions immediately post-intervention, nor in follow-up surveys regarding their risk perceptions, behaviours, and intentions. It is possible that, although not undertaking the intervention, answering questions related to safety and risk within the workplace at baseline acted as an intervention in itself, heightening awareness of potential risky behaviours. Indeed, research has established the existence of a mere-measurement effect (Chapman, 2001).

In all three groups (the two intervention groups and the control group), perceptions of risk specific to the scenarios involving fixed wiring tended to be higher, such that participants provided more negative-coded sentence endings, and also rated scenarios in this risk area as higher in terms of frequency and severity. A potential explanation for this finding is that participants might be more familiar with the risks associated with fixed wiring than with overhead powerlines or underground powerlines.

While there was piloting of the scenarios and some scenarios were not taken through to the main study, the main study was based on a larger sample of respondents and thus gained further insight as to the realism and relevance of the scenarios. Review and coding of participants' responses to the sentence completion task suggested that some scenarios may have worked better than others and in future research, it may be required that these are revised accordingly. Specifically, one of the overhead powerline scenarios (#1: "Reckless" ending) and one of the underground powerline scenarios (#3: "Fear" ending) yielded more instances of inappropriate or neutral responses, potentially indicating that some participants had misinterpreted the scenario.

Study limitations

The present research was subject to some limitations. Firstly, it is difficult to determine the level of engagement with the scenarios, due to the online administration of the intervention. While there were checks in place to mitigate this (e.g., the forced delay before participants could input the final or fragmented word), it is worth considering that the equivocal intervention effects could be due in part to participants not processing the information deeply. Hence, one potential suggestion to minimise this limitation would be to administer the intervention in person to better gauge the level of engagement through observational methods or, in the context of future research studies, with the use of neurocognitive measures (e.g., brain imaging) that more directly assess processing of information (Kaye, White, & Lewis, 2017). Future research could also create audio or video materials to help convey the core information from the scenarios and reduce the level of text required to be read and interpreted.

Additionally, as indicated by ceiling effects across the survey measures, it is possible that some participants responded in a way they felt was socially desirable, despite the anonymous/de-identified nature of their survey data, which is somewhat typical in this field of research. This potential bias may have also been present and potentially heightened in the follow-up telephone interviews. However, the interviewer did not know the participants or record personally identifying information with the responses, and the pressure to respond in a socially desirable manner was expected to be less than if the interviews were conducted face-to-face. Future studies could include a social desirability scale in the survey to further attempt to control for this potential bias.

There may also have been some self-selection bias present in the follow-up interviews, with the ten participants who opted to participate in the interview potentially being more positive about the material used in this study, in comparison to the participants who opted out.

Conclusion and recommendations

Overall, while qualitative data suggested that the intervention training scenarios were well-designed, realistic, and useful, the quantitative data were equivocal with regard to the effectiveness of the interventions. The absence of significant effects over time, and between the intervention and control conditions could be due to a few reasons. Potentially, the results could reflect ceiling effects whereby participants were reporting high levels of agreement that they would intend to, and did enact, safety behaviours, indicating greater perceptions of risk. To the extent that such behaviours would be socially desirable, it is possible that social desirability bias may have influenced survey responses. However, the anonymous nature of the survey would have helped mitigate this potential bias as individuals were aware that they could not be identified from their survey.

It is also possible that the baseline surveys acted as an intervention in itself, encouraging reflection on electrical risks and safety behaviour; the existence of the mere measurement effect (e.g., Chapman, 2001) supports this suggestion, although we recognise that it is speculative and further research would be needed to confirm this explanation.

Finally, potential individual differences in the extent of engagement with both the intervention task itself and its effectiveness could have influenced the results. It is possible that any one, or a combination, of these possible factors could account for the findings and each of which could be examined in future research. Results suggested that the relevance of the three risk types (i.e., overhead powerlines, underground powerlines, and fixed wiring) varied in different construction contexts; a consistent finding that emerged was that fixed wiring was perceived to be a higher and more negative risk, with greater frequency and severity of negative consequences arising from the scenarios, than overhead or underground powerline scenarios.

Findings from the present research indicate important next steps for refining and improving this training paradigm. Scenarios can be further refined on the basis of the qualitative feedback provided, and potential individual differences impacting upon engagement with the intervention and risk behaviours generally should be investigated systematically.

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Appendix

Appendix A: Pilot study question guide

Demographic questions

Q1. What is your current age in years/months?	______ years _____ months
Q2. Is English your first language?	☐ Yes ☐ No (Please specify first language) ______
Q3. In what country were you born?	☐ Australia ☐ Other (Please specify) ______
Q4. What is the highest level of education that you have <u>completed</u>?	☐ Less than Year 10 (<10 years of schooling) or equivalent ☐ Year 10 Certificate (10 years of schooling) or equivalent ☐ Year 12 Certificate ("high school"/"secondary school") or equivalent ☐ TAFE course (e.g., Certificate or Diploma) ☐ Other Trade Qualification ☐ University Degree (e.g., Bachelor/Honours, Masters/PhD/ Doctorate)
Q5. What is your current employment within the construction/building installation industry?	☐ Labourer ☐ Trainee/Apprentice ☐ Trade Assistant ☐ Tradesman ☐ Supervisor ☐ Other (Please specify) ______
Q6. How many years' experience do you have in the construction/building installation industry?	☐ 0-2 ☐ 2-4 ☐ 4-6 ☐ 8 +
Q7. What electrical safety training have you done? (Tick all boxes that apply)	☐ None ☐ Licenced electrician ☐ Trade certificate restricted electrical licence (e.g., plumber with a restricted license/certificate to work on electric hot water systems) ☐ Apprentice electrician ☐ Site safety induction ☐ Other electrical licence (Please specify) ______

Semi-structured interview/focus group discussion guide

[The scenarios will be grouped into 4 areas: overhead powerlines, underground powerlines, fixed wiring, and control condition scenarios. After viewing the scenarios for each of the four areas, participants will be asked the following questions separately for each grouping]

Question prompts:

- What are your first impressions of these scenarios?
- What were you thinking/ feeling when you were reading these scenarios?

- How well do these scenarios capture what occurs within the workplace?
- Which of the scenario(s) do you prefer? Why?
- What (if any) improvements should we make to these scenarios?
- How realistic do you consider these scenarios to be? [follow-up prompt for this question and below questions: can you indicate which are better/worse in this respect?]
- How easily can you imagine yourself in these scenarios?
- How typical/familiar are the contexts of these scenarios?
- How realistic do you consider these scenarios to be for an average construction worker?
- How easily can you imagine an average construction worker in these scenarios?
- How typical/familiar are the contexts of these scenarios to an average construction worker?

Specific Feedback (participants' perceptions of the valence of the interpretations/word endings of each scenario):

Intervention 1: negative endings [RO will direct participants' attention to negative endings for condition 1 set, and ask the following questions]

- Did you generally perceive the endings as negative/positive/neutral?
- Are any of the endings more ambiguous than others [which ones]? If yes, how can we refine them to be more clearly negative?

Intervention 1: positive endings [RO will direct participants' attention to positive endings for condition 1 set, and ask the following questions]

- Did you generally perceive the endings as negative/positive/neutral?
- Are any of the endings more ambiguous than others [which ones]? If yes, how can we refine them to be more clearly positive?

Intervention 2: negative endings [RO will direct participants' attention to negative endings for condition 2 set, and ask the following questions]

- Did you generally perceive the endings as negative/positive/neutral?
- Are any of the endings more ambiguous than others [which ones]? If yes, how can we refine them to be more clearly negative?

[After viewing the scenarios, participants will be asked to read through Sections 1-3 of the baseline questionnaire, and Section 5: Risk Perception from the 2-week follow-up questionnaire, which will be used as part of the main study]

- What are your first impressions of the questionnaire?
- Are there any questions which don't make sense [which ones]? That you would change?
- What improvements would you suggest making to this questionnaire?
- Would you like to receive a brief summary of the findings from the main study of this research? If yes, participants will be asked to leave an email address and will be sent a summary of the findings on conclusion of the main study.

Thank you for taking part in this interview

Appendix B: Baseline survey (pre-computerised tasks)

Screen questions

Q1. Are you 17-34 years old?	☐ Yes ☐ No (redirected out of survey)
Q2. What is your gender?	☐ Male ☐ Female (redirected out of survey) ☐ Other (redirected out of survey)
Q3. Do you work in construction and/or building industry?	☐ Yes ☐ No (redirected out of survey)
Q4a. Have you been formally trained in electrical safety and hazard awareness?	☐ Yes ☐ No (skip next question)
Q4b. If yes to Q4a, then: What formal training in electrical safety do you have?	☐ Licenced electrician (redirected out of survey) ☐ Trade certificate restricted electrical licence (e.g., plumber with a restricted license/certificate to work on electric hot water systems) ☐ Apprentice electrician ☐ Site safety induction ☐ Other electrical licence (Please Specify) ______
If the participants' first four responses do not meet the studies' requirements participants will be redirected to the following page "We thank you for your time and interest in this research. Unfortunately, you do not meet the criteria for participation in this particular research study".	

ID Code The following set of questions is only to create a confidential code for you. You will need this code for the other surveys and tasks. By filling in this code your confidential responses can be matched with future surveys. Using a code like this maintains your anonymity as only you know the code. This information is confidential.	
What are the first two letters of your first name? e.g., your name is Alan = A L	
What are the last two letters of your middle name? (Write NA if you don't have a middle name). E.g., your middle name is John = H N	
What day were you were born: e.g. 5th day of the month = 0 5	

Section 1. Demographic questions

Please tick the box that best describes you. Be as honest as you can.

All answers are anonymous and confidential.

Q1. Is English your first language?	☐ Yes ☐ No (My First Language is… ______)
Q2. In what country were you born?	☐ Australia ☐ Other (Please Specify) ______
Q3. What is your current age (in years)?	________ years
Q4. What is the highest level of education that you have completed?	☐ Less than Year 10 (<10 years of schooling) or equivalent ☐ Year 10 Certificate (10 years of schooling) or equivalent ☐ Year 12 Certificate ("high school"/"secondary school") or equivalent ☐ TAFE course (e.g., Certificate or Diploma) ☐ Other Trade Qualification ☐ University Degree (e.g., Bachelor/Honours, Masters/PhD/ Doctorate)
Q5. Are you currently studying?	☐ Yes (redirected to Q5a) ☐ No (redirected to Q6)
Q5a. Are you currently studying full time or part time?	☐ Full time study (redirected to Q5b) ☐ Part time study (redirected to Q5b)
Q5b. What are you currently studying?	☐ Bachelor degree or higher ☐ Advanced diploma or associate degree ☐ Diploma ☐ Certificate IV ☐ Certificate III (or trade certificate) ☐ Certificate II ☐ Year 12 ☐ Year 11 ☐ Other, please specify: _____________
Q6. What is your job within the construction/building industry?	☐ Labourer ☐ Trainee/Apprentice ☐ Trade Assistant ☐ Tradesman ☐ Supervisor ☐ Other (Please specify) ______
Q7. How many years' experience do you have in the construction/building installation industry?	☐ 0-2 ☐ 2-4 ☐ 4-6 ☐ 8 +
Q8. What electrical safety training have you done? (Tick all boxes that apply)	☐ None ☐ Licenced electrician ☐ Trade certificate restricted electrical licence ☐ Apprentice electrician ☐ Site safety induction (i.e., 'white card' training)

	☐ Other electrical licence (Please Specify) ______
Q9. Is the risk of electric shock a problem in the construction/building industry?	☐ None ☐ Minor ☐ Moderate ☐ Serious
Q10. Have you ever experienced an electric shock or arc flash injury yourself at work?	☐ No ☐ Yes
Q11. Do you know someone who has experienced an electric shock or arc flash injury at work?	☐ No ☐ Yes

Section 2. Perceptions towards electrical safety procedures [PMT]

[These questions will be repeated for the three electrical risk areas of interest: when working around overhead power lines, when working around underground power lines, and when working around fixed wiring. Based on the findings from the pilot study, an image for each of these three electrical areas of interest will be inserted here/before the relevant question set.]

Thank you. In the next part, we want to know how much you agree or disagree with each statement. It doesn't matter if you don't know much about electrical safety procedures. Important to know:

Electrical risks are risks of death, electric shock or other injury caused directly or indirectly by electricity. Any reference to electric shock below includes electric arc flash/flashover injury.

		Strongly disagree	Moderately disagree	Somewhat disagree	Neutral	Somewhat agree	Moderately agree	Strongly agree
1	I feel electrical shock poses a serious safety risk	1	2	3	4	5	6	7
2	The thought of suffering an electrical shock scares me	1	2	3	4	5	6	7
3	I feel vulnerable to suffering an electric shock	1	2	3	4	5	6	7
4	I think I am susceptible to suffering from an electric shock	1	2	3	4	5	6	7
5	I know how to do the job enough that I don't need to follow electrical safety procedures	1	2	3	4	5	6	7
6	I feel that doing things my own way is better than following electrical safety procedures	1	2	3	4	5	6	7
7	I don't want to annoy my supervisor by insisting electrical safety procedures are followed	1	2	3	4	5	6	7
8	I seem tougher to my peers if I don't follow electrical safety procedures	1	2	3	4	5	6	7
9	I feel that following electrical safety procedures will	1	2	3	4	5	6	7

	help reduce my risk of experiencing an electric shock							
10	I feel that the evidence linking electrical safety procedures to lower rates of electrical shock is very strong	1	2	3	4	5	6	7
11	If I wanted to, I could easily follow electrical safety procedures to reduce my risk of shock	1	2	3	4	5	6	7
12	I am confident that if I follow electrical safety procedures, I can influence how safely I work around underground powerlines/overhead powerlines/ fixed wiring	1	2	3	4	5	6	7
13	Some electrical safety procedures are not really practical	1	2	3	4	5	6	7
14	Sometimes I am not given enough time to get the job done safely following electrical safety procedures	1	2	3	4	5	6	7

Section 3. Theory of Planned Behaviour (TPB)

Thank you. The next part is about three particularly risky work situations. It doesn't matter if you don't know much about electrical safety procedures. It is your understanding and opinions that we are after. *PLEASE NOTE: While making your way through this section of the survey, you might notice some questions to be very similar to one another. However, there are many different aspects of following electrical safety procedures. As such, we would very much appreciate your responses to each of the following questions in regards to the given, different contexts.*

Past behaviour

1. How often in the past 2 weeks have you followed electrical safety procedures for working around…

	N/A	Never	Rarely	Not often	Sometimes	Slightly often	Often	Very often
Overhead power lines	N/A	1	2	3	4	5	6	7
Underground power lines	N/A	1	2	3	4	5	6	7
Fixed wiring	N/A	1	2	3	4	5	6	7

Attitudes

Thank you. In the next part we want to understand what you think about electrical safety procedures. Assume you will be working around these types of electrical areas when answering the following questions.

1. For me, following safety procedures for working around overhead power lines in the next 2 weeks is (Please select a response on each line):

Good	1	2	3	4	5	6	7	Bad
Safe	1	2	3	4	5	6	7	Unsafe
Wise	1	2	3	4	5	6	7	Unwise

2. For me, following safety procedures for working around underground power lines in the next 2 weeks is (Please select a response on each line):

Good	1	2	3	4	5	6	7	Bad
Safe	1	2	3	4	5	6	7	Unsafe
Wise	1	2	3	4	5	6	7	Unwise

3. For me, following safety procedures for working around fixed wiring in the next 2 weeks is (please select a response on each line):

Good	1	2	3	4	5	6	7	Bad
Safe	1	2	3	4	5	6	7	Unsafe
Wise	1	2	3	4	5	6	7	Unwise

<u>Subjective norms</u>

In the next part, we want to understand what the people around you think about you and electrical safety procedures. Please provide a response for each context. Assume you will be working around these types of electrical areas when answering the following questions.

1. In the next 2 weeks, most people who are important to me would approve of me following electrical safety procedures for working around…

	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
Overhead power lines	1	2	3	4	5	6	7
Underground power lines	1	2	3	4	5	6	7
Fixed wiring	1	2	3	4	5	6	7

2. In the next 2 weeks, most people whose opinions I value would approve of me following electrical safety procedures for working around…

	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
Overhead power lines	1	2	3	4	5	6	7
Underground power lines	1	2	3	4	5	6	7
Fixed wiring	1	2	3	4	5	6	7

Perceived behavioural control

Please provide a response for each context. **Assume you will be working around these types of electrical areas when answering the following questions.**

1. In the next 2 weeks, I have **complete control** over whether I follow electrical safety procedures for working around....

	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
Overhead power lines	1	2	3	4	5	6	7
Underground power lines	1	2	3	4	5	6	7
Fixed wiring	1	2	3	4	5	6	7

2. In the next 2 weeks, it will be **easy** for me to follow electrical safety procedures for working around....

	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
Overhead power lines	1	2	3	4	5	6	7
Underground power lines	1	2	3	4	5	6	7
Fixed wiring	1	2	3	4	5	6	7

Moral norms

Please provide a response for each context. **Assume you will be working around these types of electrical areas when answering the following questions.**

1. In the next 2 weeks, it would be **against my principles** to follow electrical safety procedures for working around....

	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
Overhead power lines	1	2	3	4	5	6	7
Underground power lines	1	2	3	4	5	6	7
Fixed wiring	1	2	3	4	5	6	7

2. In the next 2 weeks, it would be **morally wrong** for me to follow electrical safety procedures for working around….

	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
Overhead power lines	1	2	3	4	5	6	7
Underground power lines	1	2	3	4	5	6	7
Fixed wiring	1	2	3	4	5	6	7

<u>Intentions and willingness</u>

Please provide a response for each context. **Assume you will be working around these types of electrical areas when answering the following questions.**

1. In the next 2 weeks, I am **willing** to follow electrical safety procedures for working around….

	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
Overhead power lines	1	2	3	4	5	6	7
Underground power lines	1	2	3	4	5	6	7
Fixed wiring	1	2	3	4	5	6	7

2. In the next 2 weeks, I **intend** to follow electrical safety procedures for working around….

	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree

Overhead power lines	1	2	3	4	5	6	7
Underground power lines	1	2	3	4	5	6	7
Fixed wiring	1	2	3	4	5	6	7

3. In the **next** 2 weeks, it is **likely** that I will follow electrical safety procedures for working around....

	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
Overhead power lines	1	2	3	4	5	6	7
Underground power lines	1	2	3	4	5	6	7
Fixed wiring	1	2	3	4	5	6	7

<u>Descriptive norms</u>

Please provide a response for each context. **Assume you will be working around these types of electrical areas when answering the following questions.**

1. In the next 2 weeks, most of my **friends and peers** would approve of me following electrical safety procedures for working around....

	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
Overhead power lines	1	2	3	4	5	6	7
Underground power lines	1	2	3	4	5	6	7
Fixed wiring	1	2	3	4	5	6	7

2. In the next 2 weeks, my **parents/guardians** would approve of me following electrical safety procedures for working around....

	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
Overhead power lines	1	2	3	4	5	6	7
Underground power lines	1	2	3	4	5	6	7

Fixed wiring	1	2	3	4	5	6	7

3. In the next 2 weeks, my **co-workers** would approve of me following electrical safety procedures for working around....

	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
Overhead power lines	1	2	3	4	5	6	7
Underground power lines	1	2	3	4	5	6	7
Fixed wiring	1	2	3	4	5	6	7

4. To what extent do you agree that **everybody in your age group** would approve of you following electrical safety procedures for working around...

	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
Overhead power lines	1	2	3	4	5	6	7
Underground power lines	1	2	3	4	5	6	7
Fixed wiring	1	2	3	4	5	6	7

Section 4. About Your Typical Behaviour

Please select the response next to each item that best describes you.

	Questions	Strongly disagree	Disagree	Agree	Strongly agree
1	If I think something unpleasant is going to happen I usually get pretty "worked up".	1	2	3	4
2	I worry about making mistakes.	1	2	3	4
3	Criticism or scolding hurts me quite a bit.	1	2	3	4
4	I feel pretty worried or upset when I think or know somebody is angry at me.	1	2	3	4
5	Even if something bad is about to happen to me, I rarely experience fear or nervousness.	1	2	3	4

	Questions	Strongly disagree	Disagree	Agree	Strongly agree
6	I feel worried when I think I have done poorly at something.	1	2	3	4
7	I have very few fears compared to my friends.	1	2	3	4
8	When I get something I want, I feel excited and energized.	1	2	3	4
9	When I'm doing well at something, I love to keep at it.	1	2	3	4
10	When good things happen to me, it affects me strongly.	1	2	3	4
11	It would excite me to win a contest.	1	2	3	4
12	When I see an opportunity for something I like, I get excited right away.	1	2	3	4
13	When I want something, I usually go all-out to get it.	1	2	3	4
14	I go out of my way to get things I want.	1	2	3	4
15	If I see a chance to get something that I want, I move on it right away.	1	2	3	4
16	When I go after something I use a "no holds barred" (i.e., no rules apply) approach.	1	2	3	4
17	I will often do things for no other reason than that they might be fun.	1	2	3	4
18	I crave excitement and new sensations.	1	2	3	4
19	I'm always willing to try something new if I think it will be fun.	1	2	3	4
20	I often act on the spur of the moment.	1	2	3	4

Appendix C: Immediate post survey (post computerised tasks)

The following items/sections will be repeated in the immediate post survey:

1. Section 2 items
2. Section 3 items
3. Please note below if you experienced any technical problems with completing your session today or any other comments that you may have about your participation today.

____

____

____

____

[Participants will then be directed to a separate page to leave their email address to be provided with a link to the follow-up survey in 2 weeks' time, and also be sent the first $30 gift-card of their choice]

Please enter in your email address below to receive the link to the follow-up survey in 2 weeks' time and to receive your first $30 e-gift card (which will be emailed to you in one week). The contact information that you provide will NOT be stored with your survey responses but put into a separate folder to be sent the link to the follow-up survey and e-gift card. This means that your responses will remain anonymous.

Email: ____

Please indicate below which $30 e-gift card you would like?

- Bunnings e-gift card
- WISH e-gift card

Thanks for your participation in our study! You will receive the link to the e-gift card of your choice in one week. Please also keep an eye out for an email with the link to the follow-up survey (which will be sent to you in two weeks). Participants who complete the follow-up survey will be offered an additional $30 e-gift card (Bunnings or WISH).

Appendix D: 2-Week follow-up survey

The following items/sections will be repeated in the 2-week follow-up survey:

1. Personal ID generation
2. Section 3 items

[Participants will also be asked to complete the following items]

Section 5. Risk perception

In your opinion, what will be the expected frequency of each injury type (classified based on injury severity) depicted in each scenario [each of the test scenarios from Time 1 will be repeated above the response grid below]? For example, if you think that discomfort/pain is experienced each week from the injury presented in the following scenarios please check once every week. If you think that lost work time from the injury presented in the following scenarios occurs once every year, please check once every year. Please see below for the definitions of the injury types.

		Injury Frequency			
		Once every week (40 worker hours)	Once every month (167 worker hours)	Once every year (2000 worker hours)	Once every 10 years (20000 worker hours
Injury outcome/ Severity	Discomfort/Pain				
	First aid				
	Medical case				
	Lost work time				
	Permanent disablement or fatality				

<u>Definitions:</u>

Discomfort/Pain: Incidents that result in temporary or persistent pain, but do not prevent workers from performing work in normal capacity.

First Aid: Incidents that require treatments for cases such as minor cutes, scratches, or sprains; where the worker is able to return to work immediately after treatment.

Medical Case: Injuries or illnesses that require care or treatment from medical professional beyond first aid; where the worker is able to return to regular work under normal capacity.

Lost work time: Injuries or illnesses that restrict workers from returning to work on the following day.

Permanent disability or fatality: Injuries or illnesses that result in permanent disablement or death of worker.

Section 6. Final feedback and e-voucher

1. We welcome any final comments that you may have about any aspect of this research. Please feel free to share your comments in the space provided. As all data is to remain non-identifiable, please ensure that you do not record your name or any other information that could identify you in this section.

____

____

____

____

2. Would you be interested in taking part in the follow-up telephone interview (for an additional $20 e-gift card)?

☐ Yes *(redirected to separate page to leave phone number or email address)*

☐ No *(proceed to question 3)*

3. Are you interested in being invited to participate in future research which may follow from this study? Selecting "yes" does not give informed consent, only that you would be interested in receiving information about participating in future research which may follow from this study.

☐ Yes *(redirected to separate page to leave phone number or email address)*

☐ No *(proceed to question 4)*

4. Would you like to receive a brief summary of these findings from this research?

☐ Yes *(redirected to separate page to leave phone number or email address)*

☐ No *(proceed to question e-voucher page)*

[The following page will not be linked to any participant data]

5. Please enter your email address below to receive your $30 e-gift card (which will be emailed to you within one week). The contact information that you provide will NOT be stored with your survey responses but put into a separate folder to be sent your e-gift card. This means that your responses will remain anonymous. Once your e-voucher has been sent these contact details will be destroyed.

Email: ____

Please indicate below which $30 e-gift card you would like?

- Bunnings e-gift card
- WISH e-gift card

Thank you for your participation in this study. You will receive the link to the e-gift card of your choice within one week.

Appendix E: Cognitive tasks (scenarios and accompanying written material)

Imagery Exercise Instructions (adapted from Lothmann et al., 2011)

Pre-training

Before you begin this task, please engage in a 1 minute mental imagery exercise.

"Imagine that you have come home after a long day at work. Your feet are aching and you are feeling exhausted. You walk through your front door, take off your shoes, drop your keys on the table and lay on the couch with your feet up.

You then get a strong scent of your favourite meal being cooked by your partner/housemate. You are happy to be home."

Please try to imagine this scenario as vividly as you can.

Using your keyboard, please write with as much description as you can, what you can HEAR [space provided on screen], SEE [space provided on screen], TASTE [space provided on screen], SMELL [space provided on screen] and FEEL [space provided on screen]."

Please apply this imagery technique when completing the following task. When you can vividly imagine this experience, press c to continue.

Pre-assessment

Before you begin, please take a moment to engage in another short imagery exercise.

"Imagine that you are biting into a lemon."

Again, please write what you can HEAR, SEE, TASTE, SMELL and FEEL, on the screen in front of you.

When you can vividly imagine this experience, press c to begin.

Training scenarios - condition 1

Overhead powerlines:

1. You are guiding the person who is operating a mobile crane on the worksite. You notice that there are overhead powerlines near where he is moving the crane, and that moving the boom of the crane causes the chains to swing outwards near the lines. You realise that he needs to maintain relevant approach distance to the electric lines and so you call out to the guy that he needs to back up. You can tell from his response that he is feeling [relieved].

2. You are going to install an antenna on the roof of a commercial development. You are working near the roadside, and you see there are overhead powerlines nearby, pretty close to where you will be working. One of the guys is supposed to be the safety observer for the job, but you can't see him anywhere, and everybody else is busy. You tell the guys you'll wait until you have somebody to act as a safety observer, and one of them shouts out to you, 'That's [great]'.

3. You are loading pipes onto a ute at work. You notice that the ute is parked directly under overhead high voltage powerlines. You see that the pipes are probably a bit too close to the powerlines, but you keep loading them in. One of the other guys walks past and calls out "That's a sure way to have an [accident]!"

4. You are watching a guy drive the concrete pumping truck and trying to guide him to the right place. He pulls up at the spot you indicated, and begins to extend the hydraulic boom. However, you can see that the boom is encroaching on the no go zone, and he may be too close to the power lines. You think it will probably be fine, and so you don't say anything. One of the guys runs over, and calls out to him in [fear].

Underground powerlines:

1. You are digging trenches at the worksite and come across an electric cover mat. At this stage, the trench is about 600-800mm deep, and you are using a jackhammer to dig through the hard ground. You recall a previous week on site when you'd come across a wire while digging in this way. You joke about it to the guy working besides you, and continue to dig. The other guy gives a forced smile, looking [uneasy].

2. You are working in a carpark, putting up signs and fencing. All of the holes have been dug, and all that is left to do is place the metal poles in the ground. You remember that news story last week, of the guy who got electrocuted setting up metal fencing on site. You ask one of the guys for the utility plan of the site, and carefully go over where it indicates wiring below the surface. You do some exploratory potholing before preparing to put the poles in. Your supervisor walks by and nods at you, looking [impressed].

3. You and the team are working on a new building site, excavating at the corner of the building to make footings for piling. You've got a Dial before you Dig site map, and it looks like there is no wiring in the vicinity. The excavator has been used to move a lot of the top layer of earth out of the way, and now it's just down to shovels. Just in case, you finish the task by hand digging as you get further below the surface, making sure to use non-conductive tools and pothole any potential assets. Just as well you do, because you soon come across a gas pipe – you and the other guys look up at each other in [relief].

4. You and the guys are asked to dig out a kerbside at a site. You are shown the kerb that you need to work on, and one of the guys throws you a crowbar to start guttering with. You wonder how close the site is to electric cables under the surface. You expect this has all been cleared, if you're being given metal tools to work with. You start digging, noticing as you do that a couple of the guys are taking up their crowbars with some [reluctance].

Fixed wiring:

1. You are up a 6' step ladder, drilling a hole in the ceiling in order to install a security alarm system. You reach into the hole to grab the socket in the ceiling space. As you go to connect the socket to the lead, you wonder whether the circuits have been isolated/de-energised. You figure it was probably checked already. As you connect the socket, you think about your workmate – if he'd been watching you, he would have been [disappointed].

2. You are working on an air conditioning unit, and get out your voltstick to test whether the unit is turned on (receiving electricity). When you test the unit, the indicator on the voltstick doesn't light up. You make sure to 'double-test' the unit, testing that when the unit is on, it lights up, and when the unit is off, it doesn't light up. You remember back to your days as an apprentice and know your supervisor would [approve].

3. You are on a roofing job with one of the guys, where you have been tasked with replacing the roof tiles with metal sheets. You have installed metal battens and are about to start screwing the sheets down to the battens. You assume that the electricity has been turned off, or that safety switches will be set off in any case. You hand the drill to your workmate and as he starts to drill into the battens you realise you're putting him at [risk].

4. You and another worker are using a jack hammer to remove tiles on the wall of a unit bathroom. You accidentally cut through an electrical cable. You see some spare cables lying around, and consider

replacing it yourself. You decide to wait until the electrician comes on site the next day and explain what happened then. When you say this to your fellow worker, he looks [contented].

Training scenarios - condition 2

Overhead powerlines:

1. I was operating a crane onsite, where there were 132,000 volt overhead powerlines nearby. I slewed the boom of the crane towards the overhead electric lines resulting in the lifting chains swinging outwards, making contact with the electric line. The crane sustained extensive damage to the tyres, lifting rope and its electrical system. I was hospitalised for severe burns and was in a world of [pain].

2. I received an electric shock when I was installing an antenna on the roof of a commercial development. I was working near the roadside, and there were overhead power lines nearby. Nobody was free at that point to act as safety observer, so I did the job anyway. The antenna came into close proximity with the 415V overhead line, causing a [flashover].

3. My name's Steve and I work in construction. I watched 2 guys loading pipes onto a ute, which was parked underneath some high voltage powerlines. One of the pipes made contact with the overhead line. Both of the guys [died] from the electric shocks they received.

4. I watched a mate die while standing next to a concrete pumping truck. The hydraulic boom of the truck had been extended to the end of the 1st stage, around 10 metres high and 10 metres wide. As the boom retracted, my mate was standing at the side of the truck on the grass working the slurry. The boom touched overhead power lines causing an electrical shock, leaving burn marks to his left arm and hand and [killing] him.

Underground powerlines:

1. We were digging trenches last week and came across an electrical cover mat. At that point, our trench was around 600-800mm deep. I was working with a jackhammer and hit an electric cable with it. I had an electric shock immediately and was rushed to hospital. It's not worth the [risk] – always dial before you dig… and if you don't know, don't dig.

2. My name's Jason and I work in construction. A few weeks ago, some of us were doing work in a carpark putting up signs and fencing. We'd dug holes to put in the metal poles, but when one of my mates went to wedge it into the ground, he was flung back a couple of metres and was killed – the pole had come into direct contact with a live wire. Don't forget the Ps of digging – plan, pothole, protect, proceed – and save yourself from [dying] like this.

3. Our team was doing an excavation the other week, making footings for new pilings at the corner of a building. We'd used an excavator to do most of the heavy lifting, but without us realising, it had struck a pipe that had not been identified on the Dial Before You Dig plan. One of the other workers then struck that pipe with a shovel, and he was electrocuted. If you're doing any hand digging, make sure to use non-conductive tools. Always use current Dial Before You Dig Plans, and cross-check them with site utility maps, to avoid [electrocution].

4. I saw a mate of mine get electrocuted last year. We were on site, digging under a kerb and guttering with some crow bars. His crowbar came into contact with a conduit. Never use a conductive tool when you're hand digging, and always check your site for exclusion zones. I'll never forget what I saw that day, or the [horrified] look on his parents' faces when they arrived.

Fixed wiring:

1. Last week I was drilling holes in the ceiling while up a 6' step ladder, so I could install a security alarm system. I reached into the ceiling to grab the socket and plugged the pre-prepared plug and lead into the socket. I didn't check the circuits were dead. The pre-prepared ends of the lead were left bare and un-isolated. As I was connecting the circuits, my hand brushed the live cable and I got an electric [shock] to my left pinkie finger. Always remember to isolate all electrical sources in the vicinity of your work.

2. My mate was a building and maintenance manager, but he was electrocuted while working on an air conditioning unit at work. He used a volt-tester to see if the unit was turned off – but while the indicator didn't light up, that was because it (the volt tester) wasn't working properly, not because the power was actually off. Don't forget to double-test – make sure your tester lights up when the power is on, and then make sure it doesn't light up when you've turned the power off. I'll never be able to erase from my mind the [devastated] looks on the guys' faces.

3. The other day I was replacing a tiled roof with a metal roof on a 2-storey house with a guy I've worked pretty closely with. We installed metal battens and screwed down the metal roofing sheets onto the metal battens. One of these roofing screws pierced an electrical conducting cable. The roofing material and parts of the structure became energised, probably including the metal guard rail – and I watched as my workmate was [killed] instantly.

4. My name is Jack and this is my story. I saw one of the lads killed last week. We were using a jack hammer to remove tiles on the wall of a unit bathroom, and we accidentally cut an electrical cable. We thought we'd replace the damaged cable with a new one ourselves, despite not being electricians. We forgot to disconnect the power before trying to connect the new cable to the switchboard. My mate touched a live wire in the roof cavity while trying to re-connect the new cable, and he was gone in seconds. If it's not your job, don't do it – it's too [dangerous], and not worth your life.

Training scenarios- condition 3 (i.e., Control Group)[1]

1	At the cinema.[a]	You are at the cinema with a friend. You are starving as you have not yet eaten lunch. Your friend goes to buy a treat. "Here's one for you", and he hands you a large...[popcorn]
2	Relaxing day.[a]	You have had a hard day. You really want to give yourself a treat for dinner so you call a mate and organise to eat out that night at your favourite...[restaurant]
3	Driving home.	You are driving home from work after a long day when a car suddenly cuts you off. You see the driver gesture to you as a sign of...[aggression].
4	Feeling restless.[a]	You are feeling very restless and finding it difficult to fall asleep. You try to think of what could relax you. You start imagining yourself lying on a tropical beach and soon you start to feel...[sleepy]
5	Hanging out.[a]	You and some mates are hanging out at your house, after finishing work early. You are trying to decide whether you should watch a movie or play some games. After a while, you decide on the...[movie]
6	Meeting a friend.[b]	You are about to meet up with your friend. Just before you leave, he phones to say that he can't make it. You think that this is because he is feeling...[unwell]
7	New	You bought a new Xbox. It does not work so you take it back to the shop. When the shop

[1] Items 1, 5, and 13 were used as 'Distractor Scenarios' in all three conditions during the training phase.

	Xbox.	assistant hears your story he seems very… [helpful]
8	House party.	You and your mates are organising a party. Everyone can invite 15 people each. You find that deciding on a guest list is very…[difficult]
9	Tidying up.	You just had a birthday party at your house. You begin to tidy up and put everything back in its place. You find that tidying your house is very…[boring]
10	Out for lunch.	You are out with a friend for lunch. You have still not received your meal after waiting for 45 minutes. You call over the waiter. After asking how far away your meals are, the waiter sounds very…[apologetic]
11	At the airport	You're flying out of town on holidays, and have arrived with just enough time to check in, so that you can board on-time. As you approach security, you see that the queue is very [long].
12	At the beach	You are at the beach for the day, and you take a walk along the boardwalk. The weather is perfect, without a cloud in sight, and only a slight breeze. Looking at the ocean, you can see that the waves are very [calm].
13	Making a pizza	You decide to make a pizza, and go to the store to buy some ingredients. You pick up a pizza base, tomato paste, and other toppings that you usually enjoy. As you go to the dairy section, you notice that they are completely out of [cheese].
14	At the doctor	You are at the doctor's office, sitting in the waiting room. The room is fairly full, with almost all of the chairs occupied. The door opens, and another patient arrives in the waiting room. She goes straight to the reception, looking [worried].
15	Out for a walk	You are walking up one of the streets in your neighbourhood. It's a quiet afternoon, and not many people are out. As you turn the corner, you see one of your neighbours walking toward you, with a large dog. As they pass, they call out [cheerfully].

[a] These scenario stems were adapted from scenarios used in Woud et al. (2012). [b] These scenarios and word continuations were taken from those detailed in Lothmann, Holmes, Chan, and Lau (2011).

Assessment scenarios

Overhead powerlines:

1. You are asked to help with setting up a mobile concrete pump on-site. You see that there were overhead powerlines in the area, and it looks as though the placement boom will be fairly close to the powerlines. You wonder whether the no go minimum clearance distance has been checked with the Electricity Supply Authority and the contractors. You assume this has all been checked and proceed to set up the pump. You notice that some of the guys are looking at you while talking to themselves – you think they must think you are being …

2. You are asked to help push an 8.9m high mobile aluminium scaffold out of the way so work can proceed on that part of the building. You scan the area and notice there are overhead powerlines adjacent to the site and the ground beneath you is soft and shifting from the movement in the area. You jump in and tell the guys to push together on the count of 3, and you start the count down. You catch the eyes of one of your workmates who looks …

3. You and one of the guys are working in a bucket of an elevating work platform (EWP, aka cherry picker) adjacent to the roof of a factory. The cherry picker is about 1-1.5m under 22kV overhead High Voltage power lines running parallel to the wall of the factory. You think the cherry picker is probably too close to the lines, but you don't say anything. You can tell from your mate's face that he is …

4. The building contractor is putting up a shed, and asks you and your fellow worker to pass him a long metal beam. You see that the contractor is standing on a metal ladder, leaning against metal construction frame, and there is an overhead line nearby. You think the pipe might be too long to avoid the no go clearance zone, and the contractor has overlooked this; but pass him the pipe anyway. Your co-worker starts to pick it up, and you notice he looks …

Underground powerlines:

1. You and some of the guys are excavating a site. You come across a hard concrete slab around a metre below the surface and you decide to cut through it using a wet saw. You wonder whether there are any live cables below the concrete slab, and decide it's fairly unlikely and would have been checked. Your mate who's holding the other end of the saw looks …

2. You are asked to dig holes for a fence, using a drill with an auger attachment. As you survey the site, you consider how deep the holes will be and how close the proposed fence will be to any live underground wires. You assume that these checks have already been put in place, and get ready to start drilling. You recall a similar situation occurring when you were an apprentice, and that if your previous supervisor had been watching you today, he would think your decision was …

3. You are asked to drill holes into the floor in a new building. As you set the drill up, you notice a lot of temporary wiring around, and it reminds you of all the underground power that could be there. You assume none of that work should be interfering in the part of the building you're working on, and that safety switches would probably be set off if you do come across anything dicey. You start to drill down, when a worker passing by grabs you by the shoulder with …

4. You're watching one of the guys excavate a trench, in a 5 tonne excavator. He is lowering the bucket down to the earth, and calls out to you, asking if you think there would be any wiring under the surface where he is about to dig. It's a new construction site and you can't think of any permanent wiring that would be anywhere near the trenches, so you shout back in reassurance to your mate. He continues to lower the bucket, looking …

Fixed wiring:

1. You are working with a tradesman on a house being renovated. You are shown the area around an architrave switch that needs plastering, a job usually done by a painter. The tradesman unscrews the switch plate and removes it from the wall, leaving the live parts exposed. You start to plaster around the switch, trying to avoid the wires. Some of the other guys are looking on as you work, and you can tell they are feeling …

2. You are tasked with cleaning out the roof space. You begin to climb up into the roof space (through the manhole) to do this. As you do so, you wonder whether the power has been isolated. You assume it has been done and keep going with the job. You notice that the guy you're working with looks …

3. You and some of the guys are asked to assist with repairing a solar heating system that has been retaining rain water. You see that there are a number of electrical wires exposed, and wonder if they are isolated or live. You assume that the wires are not live, tell the guys you're ready to start, and head up the ladder to the roof. You catch the eyes of your workmate who has just welcomed a baby into his family and you instantly realise you're being …

4. You are using a pneumatic nail gun to panel timber to the outside of a building. You are aware that the part of the building you are working on is located close to the building's electrical power box. You assume that any wiring to do with the power box will be far enough away from where you are nailing, and place the gun against the nail ready to start. You can see from the face of the guy working next to you that he is feeling…

Appendix F: Follow-up phone interview question guide

Personal ID Generation The following set of questions is only to create a confidential code for you. You will need this code for the other questionnaires and tasks. By filling in this code your confidential responses can be matched with future surveys. Using a code like *this maintains your anonymity* as only you know the code. Filling out this code is voluntary and your participation is greatly appreciated. <u>This information is confidential.</u>	
What are the <u>first</u> two letters of your first name: e.g., your name is Alan = A L	
What are the <u>first</u> two letters of your mother's first name?	
What day were you were born: e.g., 5th day of the month= 0 5	

1. What were your impressions of the questionnaires and scenario tasks that you completed?

2. What do you think about the instructions of the questionnaires and scenario (word/sentence completion) tasks?
   - Were they helpful or unhelpful?
   - Were they easy or difficult to understand?
   - If unhelpful or difficult, in what ways can the instructions be improved?

3. When you were completing the word and sentence tasks, what were your thoughts on the scenarios on the screen?
   - Do they accurately reflect what happens in your workplace?
   - Which scenarios do you remember the most?
   - Are there any aspects of these scenarios that you would suggest remain as is? If so, what aspects?
   - In what ways can these scenarios be improved?

4. Has your awareness of electrical risks related to overhead power lines, underground power lines, and fixed wiring changed after completing this study?
   - If yes, in what ways has your awareness changed?
   - If no, why not?

5. Do you think that the awareness of electrical risks related to these three areas would change in others who work in the construction industry, if they completed this study?
   - Why/Why not?

6. Has your behaviour on the worksite changed since participating in this study? If yes, in what ways? What do you do differently?
   - If no, why not?

7. Can you see this type of training [scenario-based word completion task] being used in the construction industry? Why/ why not?

8. Do you have any comments about your participation in this study?

Thank you for taking part in this interview.

Appendix G: Images used in cognitive tasks

Overhead powerlines

Underground powerlines

Fixed wiring