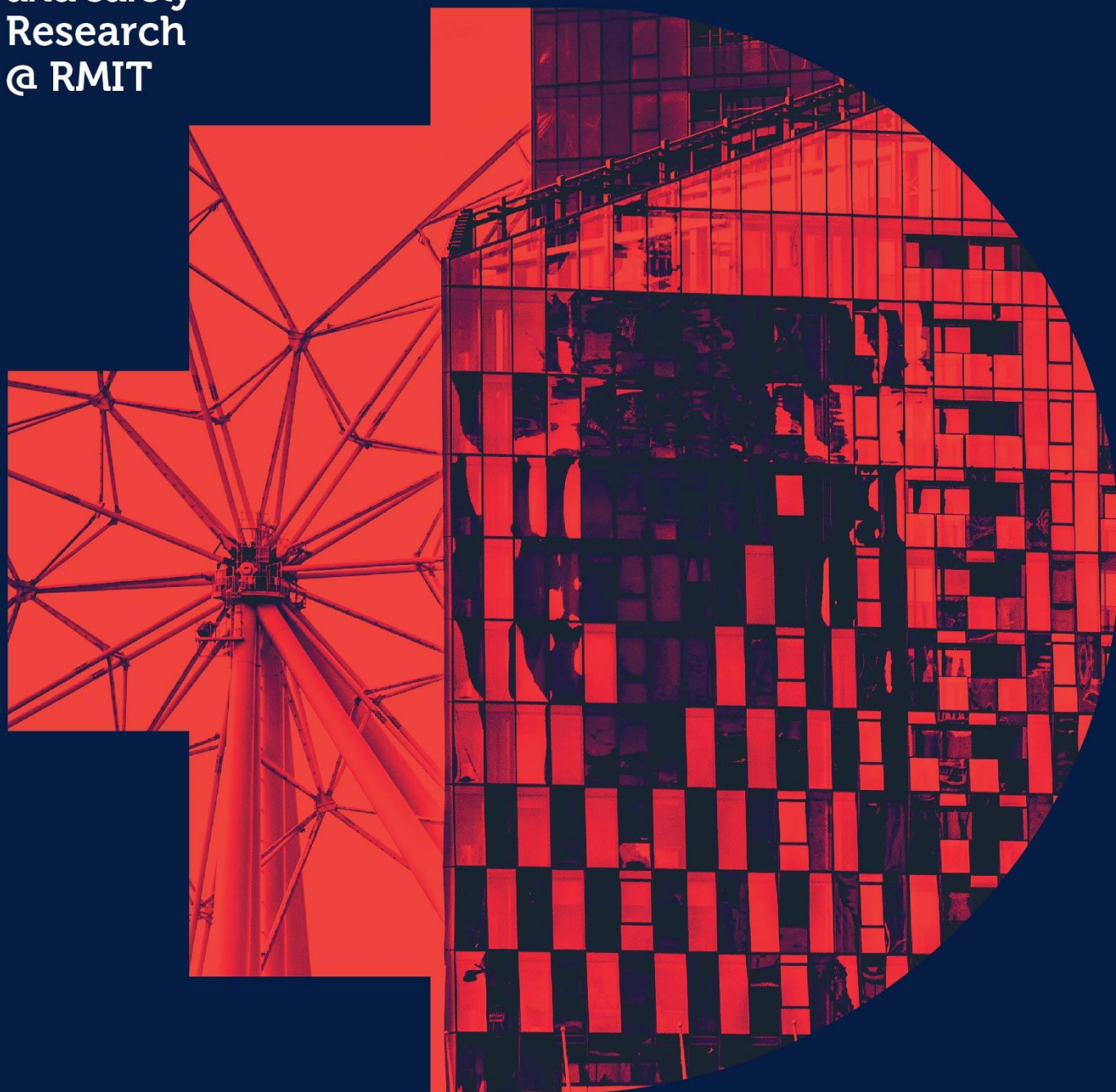


Construction  
Work Health  
and Safety  
Research  
@ RMIT



Conversations about life, health, and  
safety: Social supports for young  
construction workers' health and safety  
Final report

Published by  
Construction Work Health and Safety Research @ RMIT

**Copyright © RMIT University**

Except external referenced documents and images

All rights reserved. Apart from any use permitted under the Copyright Act 1968 no part may be reproduced, stored in a retrieval system or transmitted by any means or process whatsoever without the prior written permission of the publisher.

This report was commissioned by icare NSW.

**Authors**

Construction Work Health and Safety Research @ RMIT  
Helen Lingard, Rita Peihua Zhang, Jack Clarke

Research School of Population Health, College of Health and Medicine, Australian National University  
Lyndall Strazdins, Christine LaBond, Tinh Doan

**Suggested citation**

Construction Work Health and Safety @ RMIT (2024). Conversations about life, health and safety, Social supports for young construction workers' health and safety: Final Report. RMIT University, Melbourne.

---

**About Construction Work Health and Safety Research @ RMIT**

Construction Work Health and Safety Research @ RMIT provides leading-edge, applied research to the construction and property industries. Our members are able to work with organisations to analyse health and safety (H&S) performance and identify opportunities for improvement. We can develop and evaluate innovative solutions, provide specialised H&S programs or undertake other research-based consulting activities. Our work addresses real-world H&S challenges and our strong international linkages provide a global perspective to our research.

Construction Work Health and Safety Research @ RMIT  
Building 8, Level 8, Reception  
360 Swanston Street  
Melbourne VIC 3000  
Phone: +61 3 9925 2230  
Fax: + 61 3 9925 1939  
Email: [constructionwhs@rmit.edu.au](mailto:constructionwhs@rmit.edu.au)  
[www.rmit.edu.au/research/health-safety-research](http://www.rmit.edu.au/research/health-safety-research)

---

# Conversations about life, health and safety: Social supports for young construction workers' health and safety

Final report

## **Authors**

Construction Work Health and Safety Research @ RMIT  
Helen Lingard, Rita Peihua Zhang, Jack Clarke

Research School of Population Health, College of Health and Medicine,  
Australian National University  
Lyndall Strazdins, Christine LaBond, Tinh Doan

## **Acknowledgements**

We would like to thank our project partners:

icare NSW

The Australian National University

The Master Builders Association of NSW

The Centre for Work Health and Safety

Deakin Motion Lab

RMIT TAFE

TAFE NSW

And a special thanks to the project consultative committee members:

Candace Spence

Aaron Veldman

Jess Gillman

Mal Dorn

Mitch Sutcliffe

This research was funded by icare NSW.

---

Published by Construction Work Health and Safety Research @ RMIT

# Contents

<b>Part 1: Executive summary</b>	<b>5</b>
<b>Part 2: Introduction</b>	<b>8</b>
2.1 Background	8
2.2 Young workers' health and safety experiences	8
2.3 The importance of communication between supervisors and young workers	10
2.4 Social cognitive theory	11
2.5 Project objectives	13
<b>Part 3: Intervention design</b>	<b>14</b>
3.1 Role-playing games	14
3.2 Participatory design approach	15
Preliminary interview results (identify and define)	16
Framing the intervention (position)	17
Content design and consultation (concept)	18
Motion capture and digitisation (create)	21
<b>Part 4: Methodology</b>	<b>23</b>
4.1 The evaluation design	23
Pre-test/post-test design	23
Intervention session structure and protocol	23
Measures and variables	24
Sampling strategy	26
Response rate	26
Description of the final sample	27
Data analysis	27
4.2 In-game data	28
4.3 Supervisor focus group	29
<b>Part 5: Results</b>	<b>31</b>
5.1 Intervention survey results	31
Predominance of a ceiling effect	31
Paired t-test and mixed-effect model results	33
5.2 In-game data	38
5.3 Supervisor focus group	39
Value	40
Game design	41
Implementation in industry	43
Inductions	43
Suggested improvements	45
<b>Part 6: Discussion and recommendations</b>	<b>47</b>
6.1 Participatory development of the RPG	47

6.2	Effect of the intervention	47
6.3	In-game evaluation data	49
6.4	Supervisors' focus group	50
6.5	Conclusions and recommendations	50
<b>Part 7: References</b>		<b>52</b>
<b>Part 8: Appendices</b>		<b>61</b>
8.1	Appendix 1: Intervention facilitator's guide	61
8.2	Appendix 2: Baseline survey & follow-up survey questions	66
8.3	Appendix 2: Paired-samples t-test	69

# Part 1: Executive summary

The “Conversations about life, health and safety: Social supports for young construction workers' health and safety” project aimed to develop, trial and evaluate the effectiveness of a training & learning intervention to improve communication between construction apprentices and others in the workplace, such as supervisors and co-workers, with a specific focus on work health and safety (WHS) and general wellbeing.

This report describes the development and evaluation of an intervention (a digital role-play game) to improve the quality of communication between construction apprentices and their supervisors and outlines the intervention results. The work was undertaken in the Australian construction industry.

The project was undertaken in two stages.

Stage 1 involved interviewing 30 apprentices and 11 supervisors to understand the behaviours and characteristics required for effective communication between apprentices and supervisors, as well as the potential causes of conversation failure. This interview data collection and analysis was reported in a Stage 1 qualitative report and is not described in detail again in this report.

Stage 2 utilised data collected from Stage 1 to inform the development of a communication training/learning intervention. This training/learning intervention was scenario-based, drawing on construction apprentices' stories of lived experiences shared during the Stage 1 interviews. The scenario-based communication training/learning intervention was delivered in the form of a digital role-playing game.

In addition to drawing on Stage 1 interview data in the development of the role-playing game (RPG), the participatory design process utilised in the project involved the formation of a consultative committee comprising apprentices as end-user representatives. This consultative committee was engaged at key decision-points in the intervention design process (e.g. scenario selection, script development, review of animated scenarios etc) to comment on technical content, language etc. This consultation process helped to ensure that the intervention content was realistic and relatable to apprentices.

Once developed, the RPG intervention was delivered to construction apprentices in three different locations/training environments: The Master Builders Association – New South Wales training facility, TAFE New South Wales, and RMIT TAFE (Melbourne). A matched pre-test/post-test evaluation design was utilised.

A baseline survey was conducted before participants (construction apprentices) played the RPG. The game-playing session, lasting approximately 25 minutes, allowed time for participants to play through each scenario once. Participants played the game and subsequently engaged in a short, facilitated discussion (lasting 10-15 minutes) about what choices participants made in the RPG and what happened to the characters as a consequence of these choices.

One month after the intervention, participants were requested to complete a follow-up survey.

A total of 294 apprentices completed the baseline survey and 189 (64%) completed the follow-up survey.

The data revealed a pronounced ceiling effect within the baseline and follow-up survey data, which meant that it was difficult to detect significant improvements in absolute levels of communication skills, confidence or behaviour between the pre- and post-test surveys.

Unsurprisingly, given the pronounced ceiling effect, paired-samples t-tests only revealed one significant change in apprentices' communication confidence and skills and/or their work health and safety-related behaviour between the baseline and follow-up surveys (relating to confidence in talking with supervisors about work tasks).

However, an alternative data analysis strategy was subsequently implemented to test whether exposure to the RPG significantly changed (strengthened) a pre-existing relationship between young workers' communication confidence and/or self-reported capability and their workplace behaviour in relation to communicating about issues that could affect their health or safety.

To test this more complicated relationship, our pre- and post-test survey data was analysed using a mixed-effects modelling technique to identify whether the intervention significantly impacted young workers' translation of pre-existing communication skills and confidence into workplace behaviour (e.g. speaking up about safety in the workplace).

Despite the presence of a ceiling effect in the baseline data, the mixed-effects models indicated that playing the RPG significantly strengthened the relationship between apprentices' confidence in communication (e.g. feeling comfortable talking about health and safety-related issues) and their workplace WHS behaviours (e.g. speaking up about safety in the workplace). Additionally, playing the RPG also strengthened the association between apprentices feeling comfortable talking with their supervisors about WHS-related issues (e.g. safety at work and taking time off) and the apprentices' self-reported mental health.

In addition to the pre-test/post-test evaluation, all participants were asked three in-game questions upon completing each of the three scenarios within the RPG. These questions related to the relevance of the RPG content (Have similar situations ever happened to you or a mate?); learning (Did you learn anything new about handling situations like this?); and usefulness (Would you use what you learned from this?).

Between 36% and 55% of participants indicated that they had experienced something similar to the situation depicted in the game scenarios while working in the construction industry. Given the limited time that apprentice participants have spent working in the industry, these responses indicate a substantially high degree of relevance. Moreover, scenario 2 (All due respect) contains elements of bullying and sexual harassment and it is therefore concerning that 36% of participants indicated they have experienced or witnessed situations like this. Scores for learning and useability were very high. For example, between 80% and 83% of apprentices indicated they would use the content across the three scenarios.

To test the usefulness of the RPG for supervisors/managers of apprentices a focus group was conducted. 14 supervisors/managers participated in the focus group and were asked to play through the RPG before being asked questions about their views on the RPG. Participants



indicated they saw considerable value in the RPG as a training/learning tool for apprentices, as well as people who supervise young workers. In particular, participants described how the RPG is more engaging than traditional training approaches and how it enables supervisory trainees to see situations from the perspective on an apprentice. The development of empathy in supervisor-apprentice communication was a key learning objective of the RPG.

The in-game data and supervisor/manager focus group results suggest that the RPG is relevant, useful and can produce behavioural changes and improved wellbeing through facilitating apprentices to transform their confidence in communication into practices.

It is recommended that future trials examine how the RPG can be embedded into training activities within construction organisations and workplaces. Additionally, evaluating the impact of modifying the delivery mode, such as allocating additional time for RPG gameplay and incorporating more comprehensive debriefing sessions, on the outcomes is recommended. We would also recommend the use of scenario-based measures where apprentices are presented with a description of a situation and asked about their confidence and capability in dealing with difficult conversations related to a specific work-based situation or event. It is anticipated that this would yield a wider distribution of responses as participants will better be able to imagine the level of difficulty in having such conversations.

# Part 2: Introduction

## 2.1 Background

This report describes the development and results of an evaluation of a digital role-play game (RPG) intervention designed to improve the quality of communication between construction apprentices and their supervisors. The evaluation results include a pre-post survey evaluation, in-game evaluation responses and a supervisor focus group. The work was undertaken in the Australian construction industry.

The project was undertaken in two stages. However, before the project commenced a comprehensive literature review was undertaken. This literature review identified risk factors for poor health and safety among young workers and interventions that have been implemented to improve the work-related health, safety and wellbeing among young workers (Lingard & Zhang, 2019). Key findings from this literature review are summarised in parts 2.2 and 2.3 of this report but a more detailed literature report was also published.

Stage 1 of the project involved the collection and analysis of interview data from Australian apprentices and supervisors to:

- understand how apprentices engage in communication about life, health and safety with their work supervisors, and
- identify the work environment barriers to positive communication between apprentices and supervisors with regard to health, safety and wellbeing.

This interview data analysis was reported in a comprehensive Conversations about Life, Health and Safety: Social Supports for Young Construction Workers' Health and Safety Qualitative Report (Lingard et al., 2021).

Stage 2 of the project involved the development and evaluation of an intervention (a digital role-playing game) designed to improve the health, safety and wellbeing of construction apprentices by addressing the issue of supervisor-apprentice communication.

## 2.2 Young workers' health and safety experiences

International research consistently shows that young workers (frequently defined as workers under the age of 25) experience disproportionately high rates of workplace incidents and injuries compared to older workers. This is particularly the case for young male workers (Salminen, 2004; Breslin & Smith, 2006). In Australia, young workers constituted 17% of Australian workforce but accounted for 20% of all workplace injuries (Safe Work Australia, 2013). This equates to an injury rate of 66.1 (i.e. 66.1 work-related injuries per 1,000 workers), which was 18% higher than the rate for workers aged 25 years and over (Safe Work Australia, 2013). The risk of workplace injuries for young workers is further elevated if they enter high-risk industries,

such as the construction industry. Australian statistics show that during 2009-2010, an injury rate of 67.3 was recorded for young construction workers, which was 1.2 higher than the injury rate for all young workers across industries and 8.1 higher than the average rate for construction workers of all ages (Safe Work Australia, 2015).

In addition to this, Pidd et al. (2017) report that construction apprentices in Australia experience a substantially higher level of psychological distress than that of general Australian young men. Evidence suggests that suicide rates among young construction workers are also high. For example, Heller et al. (2007) report that young construction workers (15-24 years) in Australia are more than twice as likely to die by suicide than other Australian people in the same age group.

In Australia, the number of young workers commencing apprenticeships and those currently in training are reported to be the lowest for a decade (Australian Industry Group, 2016). The Australian Bureau of Statistics data also shows completion rates for apprentices in construction steadily declined between 2012- 2017 (ABS, 2018).

On commencement, apprentices usually hold positive expectations towards the apprenticeship, with a strong focus on learning and professional development (Dagsland et al., 2011). However, in the three-way partnership between the apprentice, a training organisation and training employer, apprentices' expectations towards their learning and development are sometimes unmet. This can occur if apprentices' learning expectations are not respected, if apprentices are insufficiently supported, and if they are not provided with enough time to develop and try out new skills in the workplace.

Breslin et al. (2007) describe young workers as feeling powerless to change their situation and being reluctant to raise work health and safety concerns with their employer, given their insecure/precarious employment conditions. Precarious employment is a risk factor for poor work health and safety (Quinlan et al., 2001), and particularly affects people in unskilled jobs (Blewett et al., 2013). When young workers feel that they are easily replaced at work, they are more likely to feel the need to 'earn' their jobs, which can result in them taking unnecessary risks (Blewett et al., 2013). Young workers in precarious work are also likely to experience elevated levels of stress (Nielsen et al., 2017).

These findings suggest that the workplace social context plays an important role in the experience of apprentices. While a lack of social support can be damaging and can negatively impact apprentices' completion rates, the availability of social support in the workplace can have positive benefits for apprentices' mental health and wellbeing (Buchanan et al., 2016). Effective support for apprentices includes the provision of both formal support (e.g., mentoring arrangements), as well as informal support that is embedded in daily interactions between apprentices, supervisors and co-workers (Buchanan et al., 2016). Importantly, informal support was identified by Buchanan et al. (2016) as being a stronger determinant of the health, wellbeing and satisfaction of Australian construction apprentices than formal support.

## 2.3 The importance of communication between supervisors and young workers

Supportive supervision and effective communication between supervisors and workers are particularly well-documented determinants of workers' health, safety and wellbeing (Sparks et al., 2001). Research also suggests supervisors may not always be supportive of the work health and safety of young workers. Being able to talk about work health and safety with others in the workplace is an important part of learning a craft. However, Breslin et al. (2007) report that, even when young workers raise questions or concerns about work health and safety these may be 'systematically silenced' by supervisors whose focus is on getting the job done.

The likelihood that young workers' will talk to their supervisors about health and safety is influenced by supervisors' willingness to listen (Breslin et al., 2007). Supervisor-worker communication also affects young workers' safety-related behaviour. Research shows that when supervisors are seen as unapproachable or unhelpful or they do not listen well, young workers are substantially more likely to engage in unsafe work practices (Zierold, 2017). Importantly, Zierold (2017) found that young male workers are particularly susceptible to social pressure from supervisors and are significantly more likely to perform unsafe work if requested to do so by a supervisor than young female workers (Zierold, 2017).

Good interpersonal relationships at work are also an important determinant of apprentices' successful completion. For example, Australian research by Gow et al. (2008) showed that poor quality relationships with supervisors and co-workers are the most significant predictors of apprentices' intention to quit their apprenticeship. Gow et al. (2008) also found that apprentices' intention to quit is significantly associated with motivational factors, including the extent to which they are motivated by the recognition and positive reinforcement they receive from others. Supervisors and co-workers are the main sources of recognition for apprentices at the workplace and social support in the work environment is likely to be an important factor shaping apprentices' self-efficacy, as well as their mental health and wellbeing (Buchanan et al., 2016). Conversely, poor relationships at work are likely to be damaging to mental health and wellbeing (Cortina et al., 2001).

An Australian study reports that interpersonal and generic skills, such as emotional intelligence, self-awareness and teamwork, are a critical success factors in apprenticeship training (Pagnoccolo & Bertone, 2021). Emotional intelligence influences various aspects of people's everyday life, including their cognitive abilities, mental health and wellbeing, social functioning, academic performance and workplace performance (Brackett et al., 2011). In the workplace, workers with higher levels of emotional intelligence are believed to be more capable of maintaining positive affective states, using their emotions to cope with workplace challenges, enhancing their own and others' moods, and managing emotions while motivating others to work towards meeting an intended goal (Wan et al., 2014). However, workers with low levels of emotional intelligence are likely to experience work as being more stressful, challenging and less fulfilling (Nikolaou et al., 2002).

The following highly valued leadership capabilities are also connected to emotional intelligence:

- the ability to put employees at ease with a good sense of humour

- the ability to build and mend relationships without alienating others
- the ability to maintain composure during crises and recovering from mistakes/difficulties in a calm and straightforward manner, and
- being centred and grounded (Ruderman et al., 2001).

The literature review also revealed several workplace health and safety interventions focused on improving work health and safety by directly addressing the relationship between supervisors and workers, including:

- a leader-based verbal safety communication intervention (Kines et al., 2010)
- a youth leadership intervention (Delp et al., 2005)
- a safety and health improvement program (Hammer et al., 2015), and
- a discourse-based intervention for modifying supervisory communication (Zohar & Polachek, 2014).

Given the documented importance of effective communication in keeping young workers safe and healthy at work, targeted education and training programs have also focused on promoting effective communication among people who will supervise young workers (Zierold, 2017). Programs designed to develop work health and safety-related communication capability in young workers have also been developed, including the *Youth @ Work: Talking Safety* program developed by the National Institute for Safety and Health (NIOSH) in the United States of America (CDC, 2021). Moreover, due to the ubiquitous ownership and use of cell phones and portable gaming devices, technology-based means of delivering work-related health and safety training to young workers have been recommended (Rohlman et al., 2013).

Consistent with these recommendations, a targeted intervention focused on improving communication effectiveness (specifically in relation to work health and safety) between apprentices and their supervisors was developed, implemented and evaluated in Stage 2 of the project.

## 2.4 Social cognitive theory

Chin et al. (2010) suggest that work health and safety (WHS) training for young people should move from being informational to instructional, to promote self-advocacy and develop young workers' ability to apply learned knowledge and skills into practice within their workplaces. They argue that "*youth need to be engaged in safety learning that questions their beliefs, rights, and knowledge of self, and teaches them how to communicate with colleagues, employers, unions, and compensation agencies, as well as with their family and friends*" and that WHS training programs should increase young workers' "*ability to advocate*" (Chin et al., 2010, p. 572).

Social cognitive theory (SCT) was used to establish the rationale for the data analysis described and presented in this report.

SCT suggests that human functioning is determined by the interaction of: *cognitive and other personal factors, environmental influences, and behaviour* (Bandura, 1986; Wood & Bandura, 1989). SCT emphasises the mechanism of human agency, which is exercised through cognitive, vicarious, self-reflective and self-regulatory processes (Bandura, 1989, 2001). Central to the

human agentic perspective of SCT is the concept of self-efficacy, which is defined as “*people’s beliefs about their capabilities to exercise control over events that affect their lives*” and is a key proximal determinant of human motivation, affect and action (Bandura, 1989, p. 1175). According to SCT, self-efficacy shapes people’s actions through a variety of cognitive and motivational processes (Bandura, 1989, 1993).

SCT has previously been applied in WHS research to understand the effects of intervention programs on individuals’ WHS-related skills and competencies, motivational processes, and behavioural changes. For example, Nykänen et al. (2018) used SCT to guide the design and impact evaluation of the *Attitude to Work Program* intervention, which aimed to increase the occupational safety preparedness of young people entering working life, strengthen young workers’ internal safety locus of control and reduce their risk-taking attitudes. Cheung and Chan (2000) used SCT to examine the impact of promotional activities that were initiated by the Hong Kong Occupational Safety and Health Council to target WHS. Their study showed that exposure to and learning from the promotional activities improved workers’ WHS efficacy, collective efficacy (i.e. perceived confidence in the Council’s performance) and WHS outcome expectancy, which subsequently increased their WHS behavioural intention and actual WHS behaviours. In the construction industry, Nykänen et al. (2020) applied SCT to compare the outcomes of different safety training programs among construction workers. Their study revealed that participants who received virtual reality (VR) based safety training showed a greater increase their safety knowledge, safety self-efficacy, internal safety locus of control, safety motivation and safety performance expectancy, compared to participants who received lecture-based safety training.

In the context of WHS, self-efficacy refers to the level of confidence an individual has in their ability to successfully perform WHS-related activities, such as raising WHS concerns in the workplace, acquiring instructions or guidance to work safely (Nykänen et al., 2019). Aligned with the cognitive and motivational functioning of self-efficacy, previous research has consistently reported the positive effect of self-efficacy on WHS behavioural intentions and/or behaviour. For example, Sun et al. (2022) found that an individual’s perceived confidence in their WHS communication competence positively affects their safety voice behaviour, i.e., the extent to which they actually speak up about WHS issues and concerns in the workplace (Tucker & Turner, 2015). Guerin and Toland (2020) reported that adolescents’ perceived confidence in their ability to apply specific job safety skills predict their intention to apply these safety skills in workplaces.

Apprentices’ WHS-related communication efficacy reflects their perceived confidence in effectively communicating with their supervisors and co-workers about issues that could potentially impact their H&S. Curcuruto et al. (2020) suggest that safety voice (or speaking up about WHS) is shaped by a dual process of proactive behaviour which involves safety envisioning (i.e. a goal generating process involving mental simulations of safety relevant situations) and safety voice (i.e. a goal striving phase in which individuals engage in proactive behaviours to maintain and improve workplace safety).

While most previous studies have examined the direct influence of training intervention programs on young workers’ levels of WHS efficacy (Guerin et al., 2019; Nykänen et al., 2019; Nykänen et al., 2018), research also indicates an alternative mechanism of influence. For example, Guerin

and Toland (2020) examined the relationships between WHS knowledge, attitudes, self-efficacy and behavioural intention among adolescents who received the *Youth @ Work - Talking Safety* program. A comparison between the before- and after-intervention data showed a stronger association between WHS-efficacy and behavioural intention after receiving the intervention compared to before receiving the intervention. That is, in addition to improving young workers WHS self-efficacy, it can also strengthen the translation of skills and confidence into workplace behaviour. This is consistent with SCT which suggests that exposure to environmental stimuli (including training interventions) can create significant behavioural changes through translating self-efficacy into action.

We wanted to test whether a similar effect was produced by our role-playing game (RPG) intervention. It was expected that there would be a significant relationship between apprentices' communication self-efficacy (their self-appraised skills and confidence) and their self-reported WHS behaviour. We hypothesised that the RPG intervention would strengthen the significant positive relationships between communication self-efficacy and apprentices' WHS communication behaviour in their workplaces. The results of our testing of this hypothesis are presented in part 5 of this report.

## **2.5 Project objectives**

The objectives of the project were:

1. to understand the way that supervisors and workers talk about life, health and safety,
2. to identify the characteristics of supportive interaction and supervision of young workers,
3. to identify organisational or context-related drivers of conversation failure (e.g. time pressure, lack of top-level support, lack of WHS knowledge, etc.), and
4. to develop and evaluate an intervention related to improving supportive supervision and/or the health and safety preparedness of young construction workers.

Objectives 1-3 are addressed in the previous literature review and qualitative interview analysis reports. This report describes the development of the intervention as well as the evaluation results (pre-post survey evaluation, in-game evaluation responses and supervisor focus group).

Part 3 of this report describes the intervention development and explains how the intervention was based upon lived experiences of construction apprentices elicited during the Stage 1 interviews. Part 4 describes the methods used in the trial and evaluation of the intervention and Part 5 presents the evaluation findings. Part 6 contains the discussion of the intervention results as well as recommendations for future research.

# Part 3: Intervention design

## 3.1 Role-playing games

A digital role-playing game (RPG) delivery approach was selected for the intervention. This decision was initially made by necessity, i.e., due to restrictions implemented during the COVID-19 pandemic a face-to-face delivery approach was not feasible at the time of the intervention development. However, the selection of a role-play game delivery approach was based upon a robust body of evidence for the effectiveness of digital RPGs in communication skills training.

Role play is a well-established approach to developing inter-personal skills, such as how to best communicate in particular situations and to develop empathy between roles. It is widely used in the training of medical professionals (Lane et al., 2007) and has also been used to teach engineering students about the social aspects of engineering practice (Martin et al., 2019). Role-playing involves taking on a role in a specific situation or scenario. The role played by a participant can reflect a participant's own role, or the role of another person. Role-playing enhances learning because the roles are played in a safe environment permitting participants to experiment and learn, without the risk of irreversible consequences (Ladousse, 1987). Greco (2009) defines an RPG as "a game where each player takes on the role of a character. The character's story takes shape and evolves depending on the player's decisions and choices. Role play can involve a complex interaction among the players (social interaction) or among a player and computer-controlled characters" (p.159). Digital RPGs are increasingly used to help users improve interpersonal skills (e.g., communication, negotiation, leadership) and/or to improve knowledge about a given topic. For example, digital RPGs have been used to promote empathy in trainee nurses (Ma, 2021) and familiarise new students with life at a university campus (Wang, 2020).

The benefits of using digital game-based training over traditional training approaches have been documented. For example, Oblinger (2004) claims that digital games provide powerful learning environments for young, digitally literate learners, who are accustomed to a digital media-rich environment for communication and information processing. Learners are likely to develop a sense of motivation through digital game-facilitated learning in which stories, meaningful contexts and non-verbal cues are provided (Oblinger, 2004; Terzidou et al., 2012). Moreover, digital game-based learning creates stronger emotional, cognitive and behavioural connections between users and learning materials, increasing engagement attention, immersion, involvement, and feeling of presence (Bouvier et al., 2014).

To date, the application of digital game-based training in the construction industry has been limited. Applying this approach to training may improve learning outcomes relating to communication and work health and safety in the construction industry.



## 3.2 Participatory design approach

The value of involving participants in the design and development of work health and safety-related interventions is well-recognised (e.g., Williams et al., 2010; Robertson et al., 2015; Peters et al., 2020). Involving young workers in the design of work health and safety programs is important to develop interventions that reflect the workplace social context and young workers' experiences (Sámano-Ríos et al., 2019). However, many work health and safety interventions are designed and implemented with little input from those they seek to help. Participatory design is also advocated in the development of health interventions targeting young people (Ospina-Pinillos, et al., 2018). A participatory approach keeps young people's needs, experiences, and knowledge at the centre of intervention development and uses knowledge collected from end-users to design interventions that are effective, relevant, and appealing to young people (Hagen et al., 2012).

Participatory design is user-centric and engages participants as co-designers of the intervention (Ehn, 2008; Bjögvinsson et al., 2012). Spinuzzi (2005) argues that participatory design:

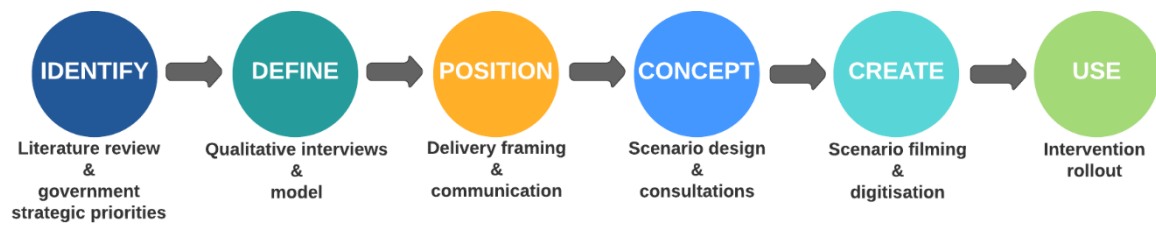
- seeks to understand tacit, invisible aspects of human activity,
- assumes these aspects can be ethically examined through design partnership with user participants, in which researcher-designers and participants collaboratively design artefacts, systems, and prototypes, and
- involves an iterative partnership so researcher-designers and participants can verify and refine interpretations of relevant human activity represented in the intervention. In this way, intervention design and research are closely intertwined (Spinuzzi, 2005).

Spinuzzi (2005) also observes different research methods (e.g., interviews, focus groups, etc.) can be used in participatory design to develop an initial evidence base and iteratively shape the emerging design. The resulting intervention subsequently reflects content that has been co-interpreted by researcher-designers and user participants (Spinuzzi, 2005). Participatory design is underpinned by two types of value:

- value relating to the social and rational idea of democracy that leads to consideration of appropriate and legitimate user participation, and
- value relating to the importance of eliciting and using participants' tacit knowledge as a design input (Ehn, 2008; Bjögvinsson et al., 2012).

Thus, participatory design combines end-users' tacit knowledge with researchers' analytical knowledge as inputs into intervention design (Spinuzzi, 2005).

Hagen et al. (2012) proposed a framework for the participatory design of health interventions for young people, which was adopted in the development of the digital RPG in the present project. Project activities closely followed the process depicted in Figure 1.



**Figure 1. The participatory design process (adapted from Hagen et al., 2012)**

The literature review (Identify) and qualitative interviews (Define) stages of the participatory design process are documented in previously referenced reports.

The present report describes the “Position”, “Concept,” “Create” and “Use” stages of the participatory process.

An explanation of the intervention design and development process with reference to these process stages is provided in the remainder of Part 3 of this report.

### **Preliminary interview results (identify and define)**

Stage 1 of the project consisted of semi-structured interviews with 30 construction apprentices and 11 construction supervisors. The purpose of these interviews was to explore the following:

- the ways that supervisors and apprentices talk about life, health, and safety, and the nature of supervisor-apprentice communication about these topics
- the characteristics of supportive interaction with supervisors and young workers, and
- the organisational or context-related drivers of conversation failure and success for apprentices and supervisors.

Interviews were conducted in partnership with the Master Builders Association of New South Wales (MBA-NSW). Interviews were audio-recorded and transcribed before transcripts were analysed using an inductive, grounded approach.

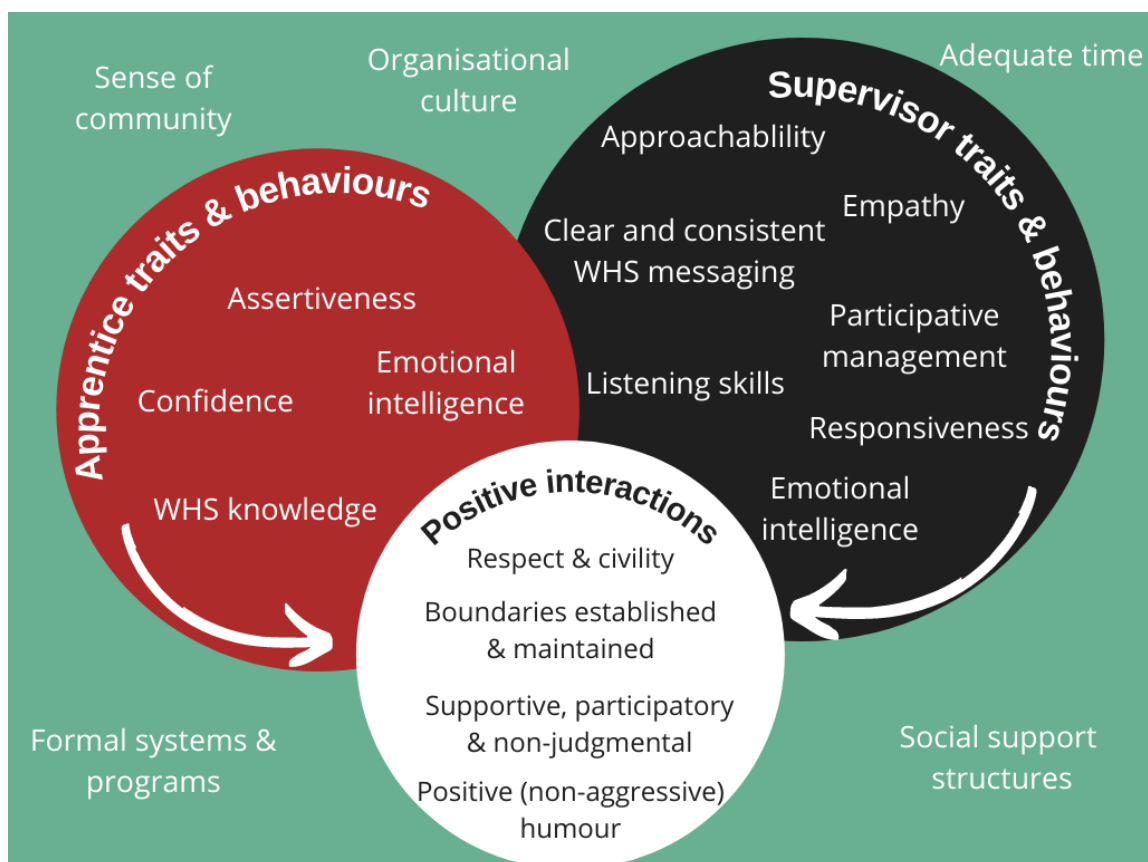
The findings of the interviews identified traits and behaviours (of both apprentices and supervisors) that are associated with effective communication and supportive interactions (Figure 2).

Traits and behaviours identified as being important for apprentices included being assertive, having self-confidence, possession of work health and safety knowledge and having emotional intelligence.

Traits and behaviours identified as being important for supervisors included approachability, empathy, demonstrating clear and consistent messaging in relation to work health and safety, being a good listener, being responsive, using a participative management style and having emotional intelligence.

Characteristics of effective communication and supportive interpersonal interactions between apprentices and supervisors included engaging in civil and respectful communication, using positive (non-aggressive) humour, understanding and maintaining appropriate boundaries when communicating about work and personal life, and engaging in communication in a supportive, participatory and non-judgmental way.

The findings of the Stage 1 analysis also identified important workplace/organisational factors that act as environmental barriers to effective apprentice-supervisor communication, including formal systems and programs, social support structures and having sufficient time for conversation. While these organisational factors were not targeted directly by the intervention, they provide important context that informed the development of the RPG scenarios.



**Figure 2. Model of factors facilitating effective communication and social support**

### **Framing the intervention (position)**

The aim of the intervention was to improve the quality of communication between construction apprentices and their supervisors in ways that better protect apprentices' health and safety at work and in life outside work. The intervention was designed to benefit both apprentices and supervisors and incorporates characteristics, traits and behaviours relevant to both groups.

The digital RPG comprised of three scenarios developed in the project included three separate scenarios which were designed to support the learning of communication characteristics and

interaction styles identified as being important from the Stage 1 interviews. Stories shared by apprentices during the interviews informed branching narratives of the RPG scenarios, ensuring the content reflected realistic events drawn from lived experiences of end-user representatives.

Each scenario depicts a complex and challenging situation to be navigated by the characters (including a supervisor and up to three apprentices). Players are asked to decide how the characters should respond to each unfolding situation. Players' select responses to events and interactions between characters that occur within each scenario. The choices they make determine what happens next and the outcome of the sequence of events. The scenarios run between five and eight minutes and involve sequential, inter-related communication decisions. When players complete a scenario, the outcome of their choices can be either undesirable or positive. Players are then provided with information about the facets of communication covered in the scenario and an explanation of how their communication decisions contributed to the outcome that occurred. Players are then encouraged to replay the scenario to make different choices and experience alternative outcomes to reinforce learning.

Example situations from one scenario are outlined in the following section to illustrate the development process.

### **Content design and consultation (concept)**

#### ***Example: Assertiveness and approachability***

Assertiveness and confidence were frequently mentioned in the Stage 1 interviews as important enabling characteristics for young workers to engage in effective work health and safety-related communication with their supervisors. For example, one apprentice explained:

- *“I was pretty nervous starting because everyone else was a bit older than me, and I didn't even know anyone, but, I suppose you've just got to ask as many questions as you can. Not be afraid to ask questions – that's the biggest thing.”* (Bryce, plumbing apprentice)

Apprentices felt that they were more assertive in raising work health and safety concerns or asking questions when their supervisors talked frequently about the importance of work health and safety. However, supervisory messages about work health and safety can sometimes be ambiguous, especially under time pressure, which can make apprentices uncertain about what behaviour is expected of them. One apprentice described a situation in which this ambiguity is evident:

- *“If someone asked me to run over and do something, like grind up some rod or any other material, I would say, I would have to quickly run to my tool bag over at the shed to get my safety glasses. And he said, “Oh, it's only one cut. You'll be alright.”* (Alexis, female plumbing apprentice).

Many apprentices also indicated that being able to communicate with confidence and assertiveness depends upon the approachability of their supervisor. Most apprentices emphasised that they feel more comfortable and confident if their supervisors are receptive,

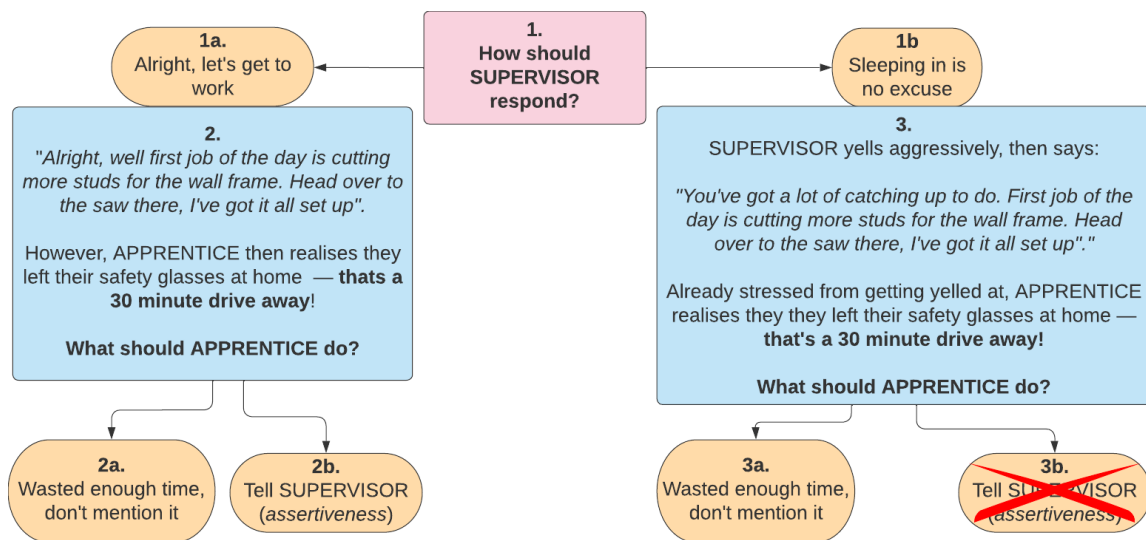
friendly and 'easy to talk to'. Approachability was identified as an important communication characteristic for supervisors:

- *“He’s pretty easy to talk to and pretty approachable sort of a man. A couple of times, when I got confused on, like, safety or just, like, general stuff...he just explains it again, nice and thoroughly.”* (Noah, carpentry and joinery apprentice)
- *“If I make a mistake, he doesn't blow his lid. He's very understanding... he'll come along and say, "Oh, look, like, that's - that's not right. This is the way to do it" and coaches me through it...he's pretty calm.”* (Zach, male carpentry and joinery apprentice)

Both quotes above are also good examples of respectful interactions. Interviewees recognised that aggressive communication or yelling can create psychological distress in the workplace. Aggressive communication from a supervisor is also likely to act as an impediment to apprentices feeling comfortable raising concerns or asking for help. The following comment from an apprentice illustrates how this can lead to shutting down communication between apprentices and supervisors:

- *“There’s some situations obviously, you know, you can’t speak up or ask...Because a lot of people (are) scared to ask questions. And like some people get really bad bosses, like really bad.”* (Joshua, male carpentry apprentice)

The first scenario (“Against the Grain”) was designed to address the apprentice communication characteristic of assertiveness. This scenario was based on the experience recounted by the apprentice, Alexis, who explained (above) that she had been asked to do a cutting job without her glasses. The scenario also demonstrates how an apprentice’s assertiveness can be affected by the way that their supervisor communicates. Decisions 1 and 2 of this scenario are shown in Figure 3. The basic premise of the scenario was devised first: an apprentice arrives late to work and is reprimanded by his supervisor for being late. After the apprentice apologises, the player’s first decision determines how the supervisor reacts to the apprentice’s late arrival at the worksite. The player, taking on the role of the supervisor, can either accept the apprentice’s apology, or they can double-down on their admonishment by yelling at the apprentice and blaming him for the project being behind schedule. This initial decision shapes what will happen in the remainder of the scenario.



**Figure 3. Scenario “Against the Grain” decision flowchart**

Following his late arrival, and then his supervisors’ reaction, the apprentice realises that he has forgotten to bring his safety glasses with him. He has been tasked with cutting wood using a circular saw. The player is now faced with a second decision: they can either use a saw without safety glasses, or they can tell their supervisor about the missing glasses. However, the second option is only available if the player chose the more respectful/approachable supervisor reaction in the previous decision. If the supervisor yelled aggressively at the apprentice, telling the supervisor about the missing safety glasses is not provided as an option – if the player attempts to choose it, the game narrator explains that due to getting yelled at, the apprentice does not feel comfortable or confident enough to be assertive. From here, the scenario can play out in multiple ways, with different endings based on the choices made by the player. These endings range from positive to undesirable (i.e. an injury occurs), showcasing the potential impact of supervisor approachability and apprentice assertiveness for effective health and safety-related communication and outcomes in the workplace.

By giving players the ability to make decisions from the perspective of the apprentice as well as the supervisor players are encouraged to see the situation from the other person’s point of view. The RPG format also allows players to experiment with different decisions and test out the consequences of their choices in a way that standard video-based training programs are not able to do.

### **Consultation**

Throughout the development of the RPG, frequent consultation was undertaken with members of a consultative committee, comprised of three apprentices and two supervisors. The members of the consultative committee provided feedback and advised on the development of the RPG scenarios. During the consultation committee members played out each scenario were asked about whether the situations and consequences were realistic and logical, as well as whether the scenario content was educational and helpful. Scenarios were modified based upon the detailed feedback received from consultative committee members.

The consultation also revealed that the scenarios would help players to see situations from the perspective of the other party. For example, in one scenario a supervisor receives an urgent call from the client at the same time as the apprentice is looking uncertain about how to perform a work task. Players were asked whether the supervisor should take the call. At this point, an apprentice member of the consultative committee commented: *“geez, it’s pretty hard being the supervisor”*.

Once the decision sequences were finalised, these were scripts in preparation for the filming and development of the RPG.

### **Motion capture and digitisation (create)**

After consulting with the apprentices and supervisors for feedback on the three scenarios, they were further revised into more detailed scripts and then motion captured in which actors’ voices, movements and facial expressions are simultaneously captured by the Deakin Motion Lab. The motion capture process is shown in Figure 4. The animation team created digital characters using Unreal MetaHuman (Fang et al., 2021) and virtual sets and transferred the motion captured animation to the virtual characters. The resulting animation was rendered in Unreal Engine. The animation is then edited and uploaded to an interactive online interactive video platform. An example of the digitised output is provided in Figure 5.



**Figure 4. Scenario filming with motion capture technology**





Figure 5. Example of digitised character models and gameplay



# Part 4: Methodology

## 4.1 The evaluation design

### Pre-test/post-test design

The project utilised a “before-after” or “pre-post” evaluation design (comparing measurement in ‘outcome’ variables of relevance to a study before and after the delivery of an intervention). This is a widely used approach to evaluating the impact of an intervention in the social sciences. In the construction research discipline, the before-after design has been used to evaluate interventions designed in the construction industry for injury prevention (van der Molen et al., 2007), safety training using virtual reality (Jeelani et al., 2020), suicide prevention (Ross et al., 2020), a safety and health improvement program (Hammer et al., 2015), as well as a discourse-based intervention for modifying supervisory communication (Zohar & Polachek, 2014).

We acknowledge that this strategy is not able to eliminate the effect of external factors on the outcome over the program/intervention period (Marsden & Torgerson, 2012; Shadish et al., 2002; Cook & Campbell, 1979). For example, the improvement in apprentice-supervisor communication during the intervention period may also be attributable to the increasing on-site experience and maturation of apprentices over time, which is not controlled by the before-after design.

### Intervention session structure and protocol

In this project, apprentices were invited to participate in the intervention session which lasted about 45 minutes. Within the intervention session, apprentices first completed a baseline survey, played through the RPG for about 25 minutes, and then took part in a facilitated discussion. The survey asked the apprentices questions about their:

1. experiences with their supervisor/s
2. interactions with others in the workplace
3. workplace WHS behaviours
4. experiences of safety, health and wellbeing, and
5. overall job satisfaction

Four weeks later, all participating apprentices were given the opportunity to take part in a short follow-up survey, nearly identical to the first, to determine whether there had been any changes in apprentices’ perceptions of these five areas. Apprentices were provided an incentive for completing each survey (\$30 for the baseline/intervention session and \$20 for the follow-up). See Appendix 2 for the full list of baseline and follow-up survey questions.

All intervention sessions were delivered in-person by a facilitator, who first guided apprentices through the baseline survey. Following the completion of the survey, the facilitator introduced the RPG intervention before providing a QR code and link to the RPG itself. Apprentices then played

through all three scenarios on their phones, laptops or on a tablet provided by the facilitator. The facilitator provided headphones and headphone input adapters to all apprentices to ensure they could focus on their own experience of the scenarios. Once every apprentice had completed all three scenarios, the facilitator would then lead a guided discussion, unpacking the main themes and learning objectives of the three scenarios. Following this, the apprentices would then be given a Woolworths gift card and a handout which enabled them to access the RPG again if they would like to.

The facilitator role was assumed by a member of the research team for the RMIT TAFE and TAFE NSW cohorts, and by an MBA staff member for the MBA cohort. Consistency in the intervention delivery was assured due to the creation of a facilitators guide which outlined the structure and protocol of the sessions in great detail.

### **Measures and variables**

Measures, variables, and their response options are presented in Table 1. The measures were primarily adapted from existing validated measures in the literature. Variables for *confidence and skills in communication with supervisor* were adapted from the measures of safety communication by Cigularov et al. (2010) and daily verbal safety communications by Kines et al. (2010). The measure of *safety voice* behaviour was adapted from Tucker and Turner (2015). *Supervisor's attitude to apprentices* was assessed with variables adapted from the measure of supervisor openness to safety concerns developed in Tucker and Turner (2015). The variables included in *workplace safety citizenship behaviours* were adapted from Hofmann et al. (2003). Variables for *emotional intelligence* were adapted from Schutte et al. (1998), Wong and Law (2002) and Brackett et al. (2006). *Mental health* was measured with the WHO-5 Wellbeing Index (WHO, 1998). *Safety incidents* were assessed with variables relating to three commonly reported workplace incidents. *Job satisfaction* and *work engagement* was each assessed with a single variable capturing the general level of perceived satisfaction or engagement. Variables included in *work engagement* and *career intention* were adapted from Cook et al. (1981) and Blau (1985).

Table 1: Measures and variables

Measures	Response options
<b>Confidence and skills: Communication with supervisor</b>	
<i>How comfortable are you talking (or texting) with your supervisor about the following things?</i>	
Work tasks	Very comfortable [1]
Safety at work	Comfortable [2]
Health and mental wellbeing	Neutral [3]
Your hours of work	Uncomfortable [4]
The level of over time you're expected to do	Very uncomfortable [5]
Taking time off	
<b>Safety voice behaviour</b>	
<i>How often do the following apply to you?</i>	
I take safety concerns to my supervisor.	Always [1]
I tell my supervisor about dangerous situations.	Often [2]
	Sometimes [3]
	Rarely [4]
	Never [5]
<b>Supervisor's attitude to apprentices</b>	
<i>Thinking about the communication with your supervisor, does your supervisor:</i>	
Care about your opinion	Always [1]
Listen to your ideas	Often [2]
	Sometimes [3]
Respond caringly if you share your concerns	Rarely [4]
	Never [5]
<b>Workplace safety citizenship behaviours</b>	
<i>When the need arises, I am confident that I can:</i>	
Protect co-workers from safety hazards	Strongly agree [1]
Look out for the safety of co-workers	Agree [2]
Protect co-workers from risky situations	Neutral [3]
Prevent co-workers from being injured on the job	Disagree [4]
Stop safety violations in order to protect the wellbeing of co-workers	Strongly disagree [5]
<b>Emotional intelligence</b>	
<i>What is your level of agreement with the following statements?</i>	
I am generally comfortable sharing my view or feelings on an issue with others.	Strongly agree [1]
I am generally good at noticing how others are feeling.	Agree [2]
I am able to control my temper.	Neutral [3]
I am willing to support others when they are upset about something at work.	Disagree [4]
I am able to ask for help when I need it.	Strongly disagree [5]
<b>Mental health</b>	
<i>Over the last 2 weeks:</i>	
I have felt cheerful and in good spirits	All the time [1]
I have felt calm and relaxed	Most of the time [2]
I have felt active and vigorous	More than half of the time [3]
I woke up feeling fresh and rested	Less than half of the time [4]
My daily life has been filled with things that interest me	Some of the time or at no time [5]
<b>Safety incidents</b>	

<i>Over the past three months, have you experienced any of the following incidents at work?</i>	
Near misses	Yes [1] No [0]
Minor injuries	
Injuries resulting in time off work	
<b>Job satisfaction</b>	
<i>What is your overall current job satisfaction?</i>	1 totally dissatisfied – 10 totally satisfied
<b>Work engagement</b>	
<i>How engaged do you feel in your work?</i>	1 extremely engaged – 5 not at all engaged
<b>Career intention</b>	
<i>I will probably look for a new job in the next year.</i>	Strongly agree [1] Agree [2] Neutral [3] Disagree [4] Strongly disagree [5]
<i>I definitely want a career in construction.</i>	

### Sampling strategy

The initial sampling strategy was to collect data from apprentices enrolled in the apprenticeship training program of the Master Builders Association of NSW (MBA NSW), which was a research partner on this project. As apprentices receive on-the-job training on different sites, it was planned that intervention sessions would be delivered to apprentices on the days when they attended the in-person classes in MBA NSW's training centre. Due to scheduling conflicts, MBA NSW apprentices could only be accessed after their classes had concluded at 3pm. A total of six intervention sessions were delivered at the MBA NSW training centre. A couple of intervention sessions showed a low number of participants, as many apprentices were either unable or unwilling to stay at the training centre beyond their 3pm finish time. As such, we expanded the sample to include apprentices enrolled with RMIT TAFE (VIC) and TAFE NSW. Similarly, apprentices were accessed when they returned to campus for in-person classes. Six sessions were delivered at RMIT TAFE, and another nine sessions were delivered at TAFE NSW.

### Response rate

The initial response rate at RMIT TAFE and TAFE NSW was 100%, as all students who were given the opportunity to take part in the baseline survey and intervention elected to do so (123 at RMIT TAFE, 97 at TAFE NSW). At MBA NSW, approximately 132 apprentices were given the opportunity to take part in the study (this number is approximate, as some classes may not have been informed of the study if they were taking a practical learning class). Of these 132 apprentices, 75 completed the baseline survey and intervention, resulting in an initial response rate of 57%. In total, approximately 352 apprentices were given the opportunity to participate in the study and 294 of these took part in the baseline survey and intervention, resulting in an initial response rate of 84%.

Of the initial 294 participants, 189 went on to complete the study by completing the follow-up survey, resulting in an attrition rate of 36% between the baseline survey and the follow-up survey, and a follow-up response rate of 64% across all three cohorts (53% at MBA NSW, 48% at RMIT TAFE, and 93% at TAFE NSW). In total, 189 out of 352 apprentices who were invited to

participate in the experiment completed the whole study, resulting in an overall response rate of 54%.

### Description of the final sample

Table 2 provides key characteristics of the 189 apprentices. The sample was male-dominated and 0.5% of the apprentices identified themselves as being of Aboriginal and/or Torres Strait Islander origin. 59% of the apprentices were under 25 years old, and the majority of the apprentices were either in Stage 1 (45%) or Stage 2 (28%) of their apprenticeship program. Approximately two thirds of the apprentices had worked for one training employer and the majority (61%) worked in the residential sector. 24% of the apprentices indicated they had participated in other WHS programs in the past 6 months.

**Table 2: Demographics of apprentices completed both surveys (n = 189)**

<b>Demographic variable</b>	<b>Response (%)</b>
<i>Aboriginal and/or Torres Strait Islander origin (%)</i>	0.5
<i>Male (%)</i>	92.1
<i>Age group (%)</i>	
15-19	20.6
20-24	38.1
25-29	27.5
30 and over	13.8
<i>Stage of apprenticeship (%)</i>	
Stage 1	45.0
Stage 2	28.0
Stage 3	23.3
Stage 4	3.7
<i>Number of training employers have worked for since apprenticeship (%)</i>	
One	66.7
Two	20.1
Three	7.9
More than three	4.8
<i>Sector(s) currently work (%)</i>	
Commercial construction only	18.5
Residential construction only	61.4
Civil construction only	0
Other	0
More than one sector	16.8
<i>Have participated in and work H&amp;S programs in the last 6 months (%)</i>	23.8

### Data analysis

Prior to conducting the analysis, the score for each variable was reversed for data analysis purposes, e.g., the original scoring direction was converted from 1 “strongly agree” to 5 “strongly disagree” to 1 “strongly disagree” to 5 “strongly agree”. This change in scoring direction would not affect the data analysis results.

Paired-samples t-tests were initially performed to determine whether there were any significant before-after intervention changes in apprentices’ communication confidence or skills or in their

self-reported WHS communication behaviours. However, due to a high ceiling effect by which apprentices reported their communication skills and confidence to be very high in the baseline (and follow-up) survey data, significant changes were identified for the mean of only one variable (relating to confidence in talking with supervisors about work tasks).

The RPG intervention was developed in line with calls for training programs that develop “*young workers’ efficacy by providing the knowledge and skills needed to increase his or her ability to feel confident about performing safety and health practices in the workplace*” (Okun et al. 2016, p. 47), and that promote self-advocacy and develop young workers’ ability to apply what they have learned in their workplaces (Chin, 2010).

Considering the purpose of the intervention, an alternative analytical strategy was implemented. This strategy tested whether the intervention had a moderation effect.

It was theoretically possible that the intervention, while not producing changes in the absolute levels of apprentices’ communication, confidence and skills or WHS-related behaviour, had a moderating effect. That is, exposure to the RPG could significantly change the relationship between apprentices’ communication skills and confidence and the extent to which they translate this skill and confidence into WHS-related communication behaviour in the workplace (e.g. speaking up about WHS).

To test for a moderation effect, mixed-effects models (or multilevel models) were applied to analyse the effect of the intervention (represented by a specially-created binary dummy variable) on the relationship between apprentices’ communication skills and confidence in relation to WHS and their WHS related behaviours and outcomes.

The mixed-effects models were appropriate because the repeated-measure design introduced dependency in observations owing to the fact that variables were measured twice within the same group of people. This violates the assumptions of traditional linear regression models. However, to overcome this, mixed-effects models are appropriate in the presence of model dependent observations and are suitable for analysing hierarchical data in repeated-measures designs (Field, 2013). The mixed-effects method has previously been applied and proved to be effective in dealing with before and after intervention data (Chen et al., 2022). With random effects for participants, mixed-effects models assume that the levels of WHS behaviours and outcomes vary between participants when their confidence in communication is zero and the relationship between confidence in communication and WHS behaviours and outcomes are different among participants. In preparation of data analysis, variables related to confidence in communication were standardised (z-scores).

## **4.2 In-game data**

In-game data was collected from apprentice participants at during the intervention sessions. At the conclusion of each of the three RPG scenarios, participants answered three anonymous Yes/No questions (delivered via Eko.com, the same platform on which the RPG is hosted). These three questions were:

- Have similar situations ever happened to you (or a mate)?
- Did you learn anything new about handling situations like this?
- Would you use what you learned from this?

These questions were answered by every participant who completed the baseline survey/intervention session (294 participants). The in-game data was collected and analysed using Google Analytics. These responses were completely anonymous and not linked to the survey responses. Due to the nature of Google Analytics, there were some minor discrepancies in the data. Google Analytics only enables users to filter data by date and broad location, therefore it is possible that some users may have answered the questions twice (participants were encouraged to replay the scenarios again in their own time). We mitigated this by including a question at the beginning of the RPG (“Have you played this scenario before?”) to help filter out returning players, but it is possible that some returning players answered “No” by mistake. Conversely, there were some participants who accidentally clicked “Yes” on their first playthrough of a scenario; the facilitator made note of these incidents when informed by participants so this could be accounted for in the Google Analytics analysis later. With all of our mitigation strategies in place, the in-game questions ultimately received 304 responses – just 10 more than we anticipated. As the average responses for each of the 14 dates across 21 intervention sessions were very similar (approximately 50% for question 1, 70% for question 2 and 80% for question 3), we are confident that this in-game data is an accurate representation of how the game was received by apprentice participants.

### 4.3 Supervisor focus group

In November 2022, a focus group was conducted with 14 participants who worked as a supervisory, safety and/or managerial role in the construction industry. In the focus group session, a facilitator from the research team briefly introduced the intervention/role-playing game (RPG) and provided all the necessary equipment for participants to access it on their own devices, or on a provided tablet if they preferred. Following a play session, participants were asked to give their thoughts and opinions on the RPG as a training tool. The purpose of this focus group was to assess the relatability, quality and usefulness of the intervention materials from the perspective of supervisors as well as to understand and explore the ways in which the intervention could be taken up by industry.

The focus group discussion was centred around three areas:

- What did you think of the game? Could you relate to it?
- What was good about it/what could be improved?
- Who do you think this would be useful for? How would you use it?

The focus group discussion was audio-recorded and transcribed by a member of the research team. This transcript was then coded by two members of the research team independently, who

then refined the codes and identified themes through review and discussion. The findings were then discussed and interpreted by the whole research team.



# Part 5: Results

## 5.1 Intervention survey results

### Predominance of a ceiling effect

Table 3 shows that most of the variables related to confidence and skills in communication had a mean value higher than 4 in the baseline survey, indicating that participants largely responded to the questions with the two most positive response options (i.e., with values of 4 and 5) on a five-point response scale. Participants also had mean scores greater than 4 at baseline for the following variables: safety voice behaviour, supervisors' attitude to apprentices, emotional intelligence, and workplace safety citizenship behaviours.

Mental health achieved a mean value higher than 4 on a six-point scale and job satisfaction had a mean score of 8 on a ten-point scale, suggesting that most apprentices responded positively to mental health questions and indicated high levels of job satisfaction in the baseline survey. High scores were also found at baseline for work engagement and career intention (>3.5) on a five-point scale. All the values of skewness were negative, reflecting an asymmetrical distribution favouring high scores. For most of the survey questions at baseline, over 70% of participants responded with the two most positive responses. These results indicate a profound 'ceiling effect' at baseline for both predictor and outcome variables.

The challenge with finding a ceiling effect in baseline data when utilising a pre-test/post-test research design is that this leaves little room to detect improvement following the exposure to an intervention. This characteristic of the baseline data severely limited our ability to demonstrate significant changes in the level of participants skill, confidence, behaviour or WHS outcomes in simple pre-test/post-test comparisons.

Although the survey questions were adapted from validated measures from the literature, they still produced a skewness to positive responses in this particular cohort. However, it is unlikely that the ceiling effect was due to the representativeness of the sample. The participants included apprentices from three organisations in two States, i.e., MBA (NSW), RMIT TAFE (VIC) and TAFE NSW. As such, the sample can be considered to be reasonably representative of apprentices undergoing work-based training in the Australian construction industry. The ceiling effect may be attributed to apprentices overestimating or overstating their own abilities in the survey (social desirability bias) or alternatively could potentially be due to genuinely high levels of communication skills, confidence and WHS behaviour at baseline.

Table 3: Ceiling effect of variables in the baseline survey

Variable	Mean	SD	Skewness <sup>a</sup>	% ceiling responses <sup>b</sup>
<b>Confidence and skills: Communications with supervisors</b>				
<i>How comfortable are you talking with your supervisors about</i>				
Work task	4.51	0.67	-1.23	92.0
Safety at work	4.28	0.88	-1.24	83.1
Health and mental wellbeing	3.93	1.04	-0.70	67.2
Personal life	3.95	1.01	-0.81	69.3
Your work hours	4.17	0.85	-0.82	77.8
Overtime work	4.16	0.90	-0.81	75.7
Taking time off	4.05	0.97	-0.92	74.6
<b>Safety voice behaviour</b>				
<i>How often do the following apply to you</i>				
I take safety concerns to the supervisor	4.06	1.01	-0.92	72.0
I tell my supervisor about dangerous situations	4.22	0.95	-1.15	77.3
<b>Supervisors' attitude to apprentices</b>				
<i>Does your supervisor</i>				
Care about your opinions	4.13	0.89	-0.81	75.1
Listen to your ideas	4.04	0.82	-0.32	73.0
Respond caringly if you share your concerns	4.09	0.95	-0.89	73.5
<b>Emotional intelligence</b>				
<i>What is your level of agreement</i>				
I am generally comfortable sharing my view or feelings on an issue with others	4.03	0.75	-0.36	77.8
I am generally good at noticing how others are feeling	4.16	0.73	-0.42	82.5
I am able to control my temper	4.09	0.89	-1.01	78.3
I am willing to support others when they are upset about something at work	4.28	0.63	-0.43	91.0
I am able to ask for help when I need it	4.26	0.74	-0.71	84.7
<b>Workplace safety citizenship behaviours</b>				
<i>When the need arises, I am confident that I can</i>				
Protect co-workers from safety hazards	4.36	0.62	-0.43	91.5
Look out for the safety of co-workers.	4.42	0.59	-0.43	94.2
Protect co-workers from risky situations	4.38	0.63	-0.51	91.0
Prevent co-workers from being injured on the job	4.33	0.71	-0.85	88.4
Stop safety violations in order to protect the wellbeing of co-workers.	4.20	0.78	-0.70	82.1
<b>Mental health</b>				
<i>Over the last two weeks</i>				
I have felt cheerful and in good spirits	4.72	0.98	-0.87	66.7
I have felt calm and relaxed	4.61	1.01	-0.68	61.9

I have felt active and vigorous	4.78	0.97	-0.76	66.3
I woke up feeling fresh and rested	4.25	1.29	-0.67	48.1
My daily life has been filled with things that interest me	4.73	0.98	-0.97	66.1
<b>Job satisfaction</b>	7.93	1.68	-0.90	39.1
<b>Work engagement</b>	3.99	0.77	-0.34	75.6
<b>Career intention</b>				
<i>How do you agree with the following statements</i>				
I will probably look for a new job in the next year (reversed).	3.71	1.12	-0.63	59.2
I definitely want a career in construction.	4.25	0.87	-1.40	84.6

**Note:** Mental health was measured by a six-point scale and job satisfaction was measured by a ten-point scale, the remaining variables were all measured by a five-point scale.

<sup>a</sup> Positive skewness means a pile-up of scores on the left of the distribution (i.e., low scores), whereas negative skewness means a pile-up on the right (i.e., high scores).

<sup>b</sup> The proportion of the first two most positive responses (i.e., 4 “agree” and 5 “strongly agree”).

### Paired t-test and mixed-effect model results

The results of paired-samples t-test (see Appendix 3) revealed a significant difference only in the mean of the variable relating to confidence in talking with supervisors about work tasks. No statistically significant differences were found for other variables related to apprentices' communication confidence and skills or WHS behaviours. The high ceiling effect in baseline data is likely to have contributed to this.

This led us to consider whether the intervention might have still produced an effect in moderating the relationship between hypothesised ‘predictor’ variables and hypothesised ‘outcome’ variables. In particular, we utilised mixed-effects modelling methods to test whether exposure to the intervention (i.e. playing the RPG) strengthened the relationship between apprentices' communication skills and confidence and their workplace WHS-related behaviour (shown below in Table 4).

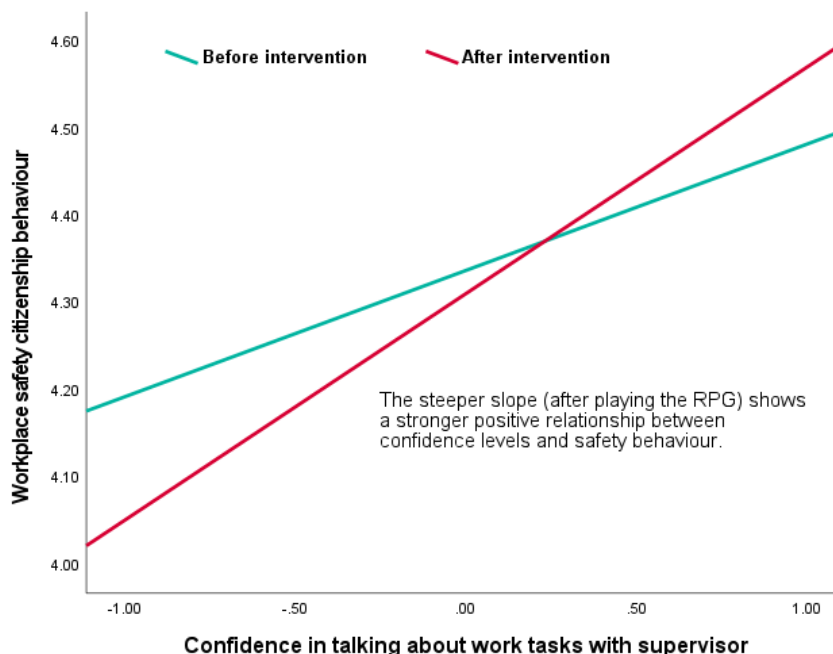
Table 4: The results of mixed-effects modelling analysis

	Safety voice behaviour				Workplace safety citizenship behaviours				Mental health			
	<i>b</i>	<i>SE b</i>	95% <i>CI</i>	<i>p</i>	<i>b</i>	<i>SE b</i>	95% <i>CI</i>	<i>p</i>	<i>b</i>	<i>SE b</i>	95% <i>CI</i>	<i>p</i>
<b>Confidence in talking about work tasks with supervisor (WT)</b>	0.33	0.07	0.20, 0.46	<0.001*	0.15	0.05	0.06, 0.24	0.002*	0.25	0.06	0.13, 0.36	<0.001*
Intervention	0.17	0.06	0.06, 0.29	0.003*	-0.02	0.04	-0.11, 0.06	0.554	0.13	0.06	0.02, 0.25	0.025*
WT x Intervention	0.07	0.07	-0.06, 0.21	0.275	0.11	0.05	0.02, 0.20	<b>0.016*</b>	0.08	0.07	-0.05, 0.21	0.230
<b>Confidence in talking about safety at work with supervisor (SW)</b>	0.46	0.06	0.35, 0.57	<0.001*	0.25	0.04	0.17, 0.33	<0.001*	0.28	0.05	0.17, 0.38	<0.001*
Intervention	0.12	0.06	0.00, 0.23	0.044*	-0.03	0.04	-0.11, 0.05	0.410	0.10	0.06	-0.02, 0.21	0.091
SW x Intervention	0.13	0.06	0.01, 0.25	<b>0.035*</b>	0.09	0.04	0.00, 0.18	<b>0.041*</b>	0.15	0.06	0.02, 0.27	<b>0.019*</b>
<b>Confidence in talking about health and mental wellbeing with supervisor (HMW)</b>	0.45	0.06	0.33, 0.56	<0.001*	0.22	0.04	0.14, 0.29	<0.001*	0.37	0.05	0.27, 0.48	<0.001*
Intervention	0.05	0.06	-0.07, 0.17	0.384	-0.06	0.04	-0.14, 0.03	0.171	0.06	0.06	-0.06, 0.17	0.344
HMW x Intervention	0.08	0.06	-0.05, 0.20	0.223	0.08	0.05	-0.01, 0.16	0.100	0.10	0.06	-0.02, 0.23	0.096
<b>Confidence in talking about personal life with supervisor (PL)</b>	0.32	0.06	0.20, 0.43	<0.001*	0.16	0.04	0.08, 0.24	<0.001*	0.33	0.05	0.23, 0.44	<0.001*
Intervention	0.12	0.06	0.00, 0.24	0.045*	-0.03	0.04	-0.11, 0.05	0.444	0.11	0.06	-0.01, 0.23	0.062
PL x Intervention	0.11	0.07	-0.02, 0.24	0.092	0.08	0.05	-0.01, 0.17	0.073	0.11	0.06	-0.02, 0.24	0.088
<b>Confidence in talking about hours of work with supervisor (HW)</b>	0.34	0.06	0.21, 0.46	<0.001*	0.18	0.04	0.10, 0.27	<0.001*	0.25	0.06	0.14, 0.35	<0.001*
Intervention	0.11	0.06	-0.00, 0.22	0.056	-0.05	0.04	-0.13, 0.04	0.257	0.07	0.06	-0.04, 0.18	0.230
HW x Intervention	0.16	0.06	0.03, 0.28	<b>0.015*</b>	0.12	0.05	0.03, 0.21	<b>0.013*</b>	0.12	0.06	-0.01, 0.24	0.064
<b>Confidence in talking about level of expected overtime with supervisor (LO)</b>	0.27	0.06	0.15, 0.39	<0.001*	0.20	0.04	0.12, 0.28	<0.001*	0.28	0.05	0.17, 0.38	<0.001*
Intervention	0.16	0.06	0.05, 0.27	0.006*	-0.01	0.04	-0.09, 0.07	0.817	0.13	0.06	0.02, 0.24	0.027*
LO x Intervention	0.20	0.06	0.08, 0.33	<b>0.001*</b>	0.10	0.05	0.01, 0.19	<b>0.030*</b>	0.12	0.06	-0.01, 0.24	0.070
<b>Confidence in talking about taking time off with supervisor (TTO)</b>	-	-	-	-	0.21	0.04	0.13, 0.29	<0.001*	0.35	0.06	0.24, 0.46	<0.001*
Intervention	-	-	-	-	-0.01	0.04	-0.09, 0.07	0.844	0.12	0.06	0.01, 0.23	0.030*
TTO x Intervention	-	-	-	-	0.15	0.04	0.06, 0.23	<b>0.001*</b>	0.13	0.06	0.02, 0.25	<b>0.028*</b>

\*  $p < 0.05$ . Statistically significant moderation effects are bold.

Table 4 presents the results of the mixed-effects model analysis. The results indicate that participation in the intervention significantly strengthened the following relationships:

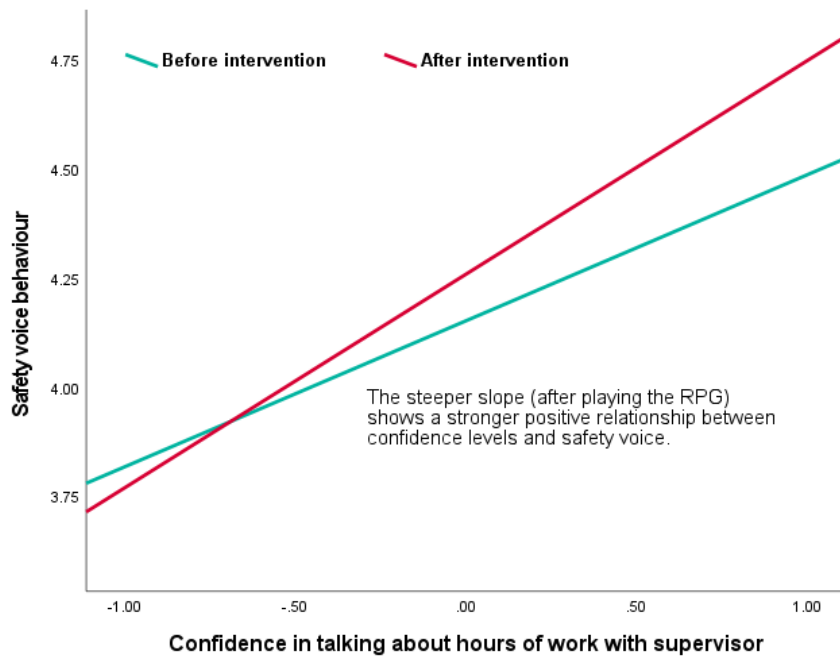
- the relationship between apprentices' confidence in talking with their supervisor about their work tasks and their safety citizenship behaviour (i.e, the extent to which they would intervene if they saw a co-worker doing something unsafe) ( $p = 0.016$ ), which is shown in Figure 6 below.
- the relationships between apprentices' confidence in talking to their supervisor about workplace safety and their safety voice behaviour (i.e, the extent to which they would proactively speak up about safety concerns in the workplace) ( $p = 0.035$ ), workplace safety citizenship behaviour ( $p = 0.041$ ) and their mental health ( $p = 0.019$ ), and one of the relationships is visually presented in Figure 7.
- the relationships between apprentices' confidence in talking to their supervisor about hours of work and their safety voice behaviour ( $p = 0.015$ ) and workplace safety citizenship behaviour ( $p = 0.013$ ), and Figure 8 illustrates one of the relationships,
- the relationships between apprentices' confidence in talking to their supervisor about overtime and their safety voice behaviour ( $p = 0.001$ ) and workplace safety citizenship behaviour ( $p = 0.030$ ), and Figure 9 displays one of the relationships,
- the relationships between apprentices' confidence in talking to their supervisor about taking time off work and their workplace safety citizenship behaviour ( $p = 0.001$ ) and mental health ( $p = 0.028$ ), and one of the relationships is demonstrated in Figure 10.



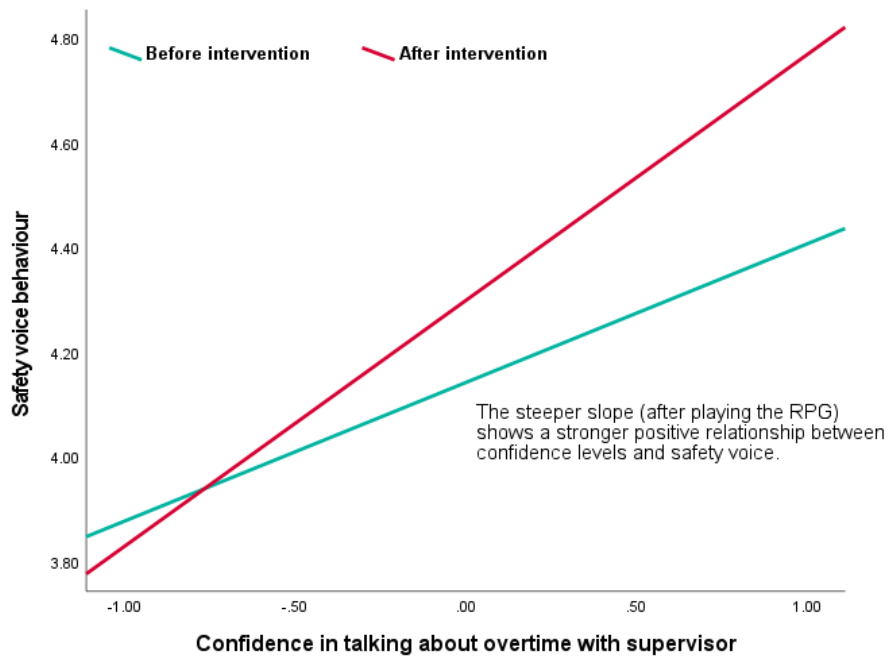
**Figure 6:** The relationship between confidence in talking about work tasks with supervisor and workplace safety citizenship behaviour before and after playing the RPG



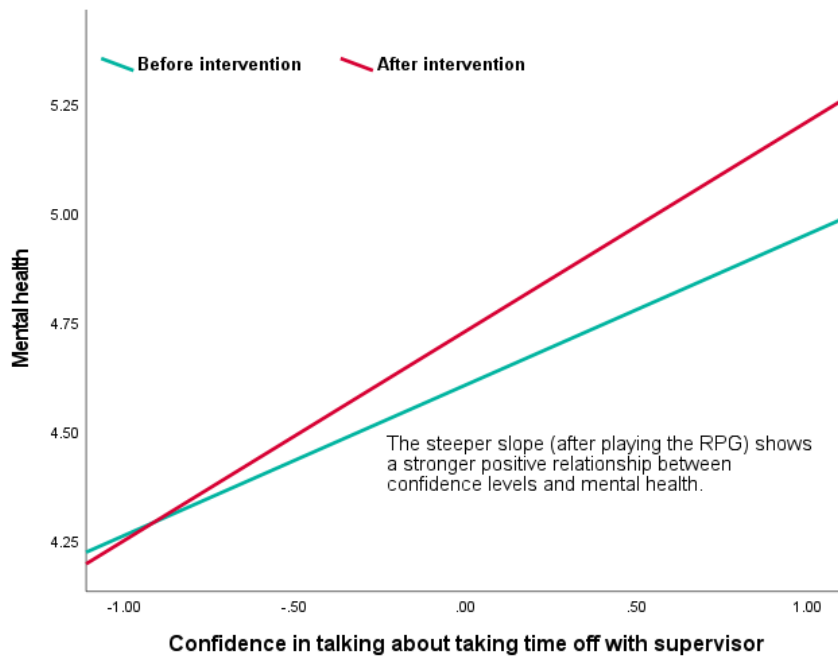
**Figure 7:** The relationship between confidence in talking about safety at work with supervisor and workplace safety citizenship behaviour before and after playing the RPG



**Figure 8:** The relationship between confidence in talking about hours of work with supervisor and safety voice behaviour before and after playing the RPG



**Figure 9:** The relationship between confidence in talking about overtime with supervisor and safety voice behaviour before and after playing the RPG



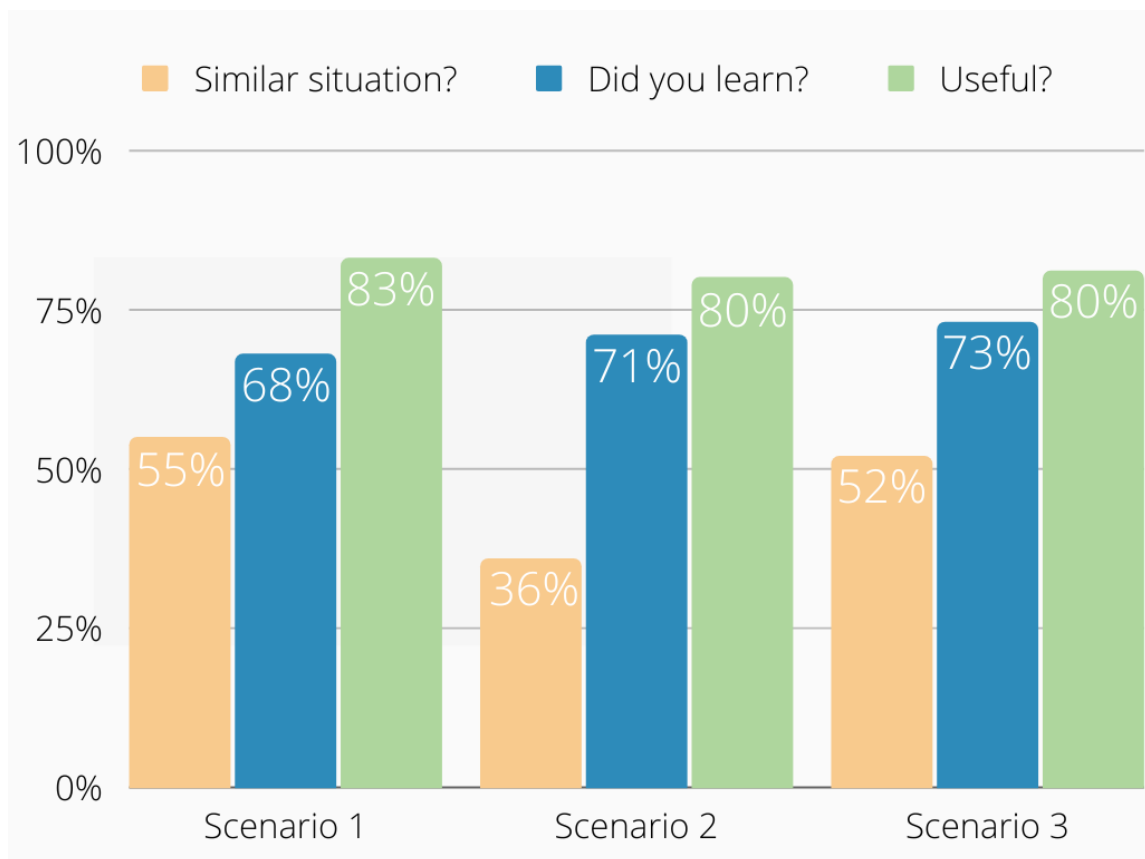
**Figure 10:** The relationship between confidence in talking about taking time off with supervisor and mental health before and after playing the RPG

## 5.2 In-game data

Data from the in-game questions featured at the end of each scenario featured very positive results. To recap, these three questions were:

1. Have similar situations ever happened to you (or a mate)?
2. Did you learn anything new about handling situations like this?
3. Would you use what you learned from this?

Data was gathered from participants who completed the baseline survey/intervention session (294 participants) and was collected and analysed using Google Analytics. The results are shown below in Figure 11.



**Figure 11. In-game question results**

The general pattern of responses to the three questions remained consistent across all scenarios; question 3 received the highest percentage of “Yes” responses, followed by question 2 and then question 1 with the lowest.

More than half of the apprentice participants had been in similar situations, or knew someone who had, to the events depicted in scenarios 1 and 3. These situations included:



- Being late for work
- Being unsure of a work task/asking for help
- Being yelled at by a supervisor
- Being uncomfortable working at heights/with ladders
- Discussing a personal issue at work (e.g. gambling addiction)
- Asking for time off
- Work-life balance conflicts

Over a third of apprentices reported that they, or someone they knew, had been in similar situations to the events of scenario 2. The events of scenario 2 included:

- Maintaining boundaries when discussing your personal life
- Pranking a new apprentice
- Escalating or de-escalating a conflict at work
- Standing up for someone being harassed
- Working as or with a female apprentice

Across all three scenarios, 36-55% of participants indicated either they or a co-worker they knew had experienced a situation similar to that depicted in the scenario. Given the relatively short amount of time the apprentices have worked in the construction industry these are high percentages and reflect the relevance of the scenarios to apprentices' real-world experiences. It is noteworthy that scenario 2 contains elements of sexual harassment and bullying and 36% of participants indicated they had experienced or witnessed something like this in the workplace. For scenarios 1 and 3, more than 50% of participants indicated they had experienced or witnessed something like this occurring in the workplace.

Positive answers for question 2 (did they learn anything new?) were consistently high (68-73%), indicating that the majority of participants believed they had learned something new from the scenarios. Apprentices also indicated the scenarios are useful, indicated by 80-83% of participants indicating they would use the scenario content in their workplaces. The relevance and usefulness of the scenario content reflects the adoption of a participatory design approach, whereby apprentices' lived experiences and knowledge were used in the development and scripting of the scenarios.

### **5.3 Supervisor focus group**

The data collected from the supervisor focus group was coded independently by two members of the research team, and the findings were then discussed and interpreted by the research team

as a whole. The results of the focus group have been grouped below into the following four categories: value, game design, implementation in industry and suggested improvements.

## **Value**

### ***Value for apprentices***

Participants in the focus group were positive about the game's value for apprentices. After the group had completed a play-through of the game's three scenarios, one participant commenced the discussion by praising its usefulness to young workers: *"I thought it was quite good...especially for the younger guys, I think there was really good aspects in there that people can take away from."*

Another participant expressed a similar sentiment, noting the value in young apprentices experiencing both the positive and negative outcomes in the game: *"Yeah, I enjoyed it. I thought it was good. I see a lot of value in it. I'm big with apprentices and young kids in the industry and I think they'd get a lot of value out of it, especially seeing both scenarios [outcomes]."*

One participant commented that the game will be especially useful to younger people, due to their emotional state and lack of experience when entering a potentially challenging industry:

---

*"It's really good. Like I mean, to some people who are emotionally involved in hormones like younger people...when you haven't been through as much and things are a bit harder and a bit more full-on. It's a hard, tough world out there for them...it's hard going. So, I think it's good on that level."*

---

### ***Value for supervisors***

Focus group participants expressed that the game's usefulness was not limited to young apprentices, with many participants pointing out that the game also held value for supervisors. One participant commended the game for demonstrating the importance of supervisors being perceptive of their workers' emotional state in relation to safety: *"Life's tough out there and obviously you bring it to work and being a supervisor, you need to be able to focus and see those changes within people. I think it's very important that sort of showed you how to deal with situations...obviously people become complacent, they cut corners, y'know their personality changes and they could be thinking bad things and if you can jump on that early it's a good thing."*

Another participant noted that the game can provide value to supervisors by enabling them to see things from the perspectives of young apprentices, reminding them of their own experiences: *"...to be like 'oh that is what it's still like to be a young person', y'know, and that's what they're processing. I kinda like that from an older person's point of view...this is what young people are still dealing with, cos you forget sometimes...I like it in that respect. I would use it."*

### **Value for the industry**

Speaking generally about the game's value to the construction industry, participants spoke positively about its contribution to an underdeveloped area of H&S training. One participant expressed that the game may fill a gap in apprentice training, stating that *"I don't have anything that we're using currently for apprentices or speak up programs other than, sort of, committees and...yeah so, I don't have anything to compare it to."*

Another participant echoed this sentiment, expressing a strong intention to use the game in their own organisation:

---

*"I think it's really good and I'd take it on tomorrow with where it sits...And where it sits now, I think it's better than nothing and its different right? It's stimulating."*

---

### **Game design**

#### **Design approach**

In terms of the game's general approach to design, participants were largely complimentary. One participant commended the design choice to position the player as an unseen, third party that makes decisions for both the supervisor and apprentice characters, noting the relatability of the in-game problems: *"Yeah, I thought it was great to stand back and look at it all as a third party...to see things unfold without actually being in that experience from an apprentice or a supervisor. It can gear them up for what could happen, 'cos a lot of those scenarios do happen...a lot... it's a good training tool."*

As the session only allowed time to play through each scenario once, several participants were curious to see what the other paths and outcomes would look like: *"I would be interested to see when you...look at all the... doing bad things, because I just went the way I'd go. But yeah, I'd like to have a look at the other scenarios, but I thought it was quite good."*

Another participant echoed this curiosity: *"I agree with my friend here; I'd like to see if you pressed the other what the outcome would be. And I'd be interested to see if they pressed the other side and just see what can happen and how things can play out ...so yeah, I think it's value, definitely."*

#### **Narrative design**

The narrative and character-based content of the game was also praised. One participant commented that the choices offered to the player were realistic and that the decisions that resulted in positive communication reflected his decision making at work: *"Cos the way I'd react is kinda how I did...some of the answers there it's like "Yeah that's probably how I'd handle that". So, I thought it was quite accurate in the positive responses that people could have. So yeah, it was good."*

Another participant commented that the third scenario is particularly relevant to the issues that supervisors face: *“At home making phone calls till 9 o’clock at night – if you’re lucky – trying to get people on the job. That’s probably very relatable for a supervisor. And then having to make the call at the last minute. And most apprentices would turn their phone off I’m sure...there’s no consequences for turning your phone off.”*

The game’s narratives were also praised for their complexity and realism. In particular, the handling of a harassment incident against a new female employee was commended for not placing the onus on the victim to fix the situation and not sugar-coating or presenting unrealistically easy solutions: *“I like that there wasn’t – when he made that sexist comment – there was no win-win, there was no win-loss, it was a lose-lose situation there. And I felt that was pretty accurate. “I like that there wasn’t – when he made that sexist comment – there was no win-win, there was no win-loss, it was a lose-lose situation there. And I felt that was pretty accurate...cos you can’t always win.”*

This participant also believed that the games’ handling of this issue is relevant and can successfully address both male and female players: *“It’s unfortunate, but it is something that young women especially will deal with at some point so, I thought that was, yeah, bang on. And I think there’s a lesson in there for the blokes as well, ‘cos they’ll see it like ‘you’ve just given her a really shitty situation by being a dickhead’... So, I think showing that lose-lose situation works really well from both points of view.”*

### **Emotional content**

Many participants agreed that the second scenario was their favourite, citing a balanced tone between humour and seriousness, as well as an increased emotional complexity. One participant explained: *“The one with the girl, Kate, that started...I thought that had a bit of humour a bit of kind of common firing back...and there was also that emotion at the start as well with the ‘I don’t want to talk about it’. But I felt like that whole scenario had a good tone, it had humour and it also had emotion.”*

The same participant singled out the arc of a particular character from that scenario, as being emotionally realistic and in-depth: *“Yeah like (he said) I really don’t wanna talk about it. And then it came full circle at the end where like, he was cranky the whole day because he’d had that conversation at the start of the day...I suppose the supervisor could be sitting there going ‘what is going on with this guy?’. But the whole day he was cranky. So, I don’t know, that (scenario) felt a bit more involved, and there was more going on in the background.”*

Another participant adding: *“Layers. More layers to it.”*

### **Graphics/visual design**

When asked what they thought of the visual style of the game’s animation, the response was unanimously positive. One participant found the graphics of the animation so detailed that he initially wasn’t sure if it was animated or live-action:

## Implementation in industry

### *Intention to use*

Several participants were upfront in expressing their intention to use the game in their own organisations with comments such as: *“I’d take it on straight away, as it is.”*

The general consensus among participants was that young workers would get most value from the game earlier in their apprenticeships. One participant explained: *“I feel like probably it’d be best used in an apprentice scenarios preparing them for the workplace, in the earlier stages. So y’know they’ve come out of school their young adults, y’know they’re going into a different world so, probably be best used on their side for preparing for the workplace...earlier in the stage.”*

### Inductions

The conversation about delivering the game earlier in young workers’ apprenticeships led naturally to the topic of inductions. One participant commented that although the game is not as harsh as the reality of some construction jobs, it could help to prime apprentices for the culture shift from school to industry and perhaps even change the workplace culture for the better: *“It could be sort of implemented through the induction process...do that as part of the induction and try and change the culture a bit, ‘cos it’s got a good message...most of the kids, apprentices leaving school...school is pretty politically correct. Building sites aren’t, it’s a lot harsher in reality to what that was displaying.”*

There was a common sentiment among participants that many inductions are currently dull and non-interactive, and the inclusion of game could potentially increase engagement for apprentices attending induction. One participant commented: *“I like the idea of tying things into the induction, because at the moment inductions are boring, repetitive, and full of things that people don’t remember...And gamification is like huge when it comes to that engagement of a person, they remember that. So, I think there’s definite, like, credit there.”*

Another participant expanded upon this point describing her organisation’s current induction: *“So we have a just a person who runs apprentice inductions and all the content is vetted by myself and the construction manager...but there’s nothing interactive in it...I think it would be really nice to have a little bit of a taster of what’s about to happen, and I think that (the game) can potentially give that and I would do it in an induction.”*

The same participant expanded upon this point, pointing out that the game could serve a dual-purpose as an icebreaker activity and as a primer for confrontation:

---

*“I think if it’s used like an activity base of their induction as well as probably a bit of an icebreaker for them, they might be thinking ‘what’s it like? What’s it going to be like to have confrontation?’ And that might be a step up from just having a policy read to them.”*

---

One participant pointed out that their inductions are not just for new apprentices, but also for new employees. This participant felt that the game would be useful for everyone attending an induction: “...*the interactive-ness of it is quite good so, we always do an induction for new employees or apprentices or a construction manager, and I think that'd be the place for us to do it., before they went to site, for everyone.*”

A suggestion was made by one participant that, following induction, the game could be re-played every year to retain the lessons learned: “*And if you want a refresher every year, as practice, they've got quite a few years ahead of them and touch on it and see how they still pick up from it as well, and whether they have been through those scenarios now. I think it's worthwhile, it's got learning outcomes.*”

### **TAFE Training programs**

The focus group also discussed the value of rolling the game out via TAFE. One participant suggested that the game would be well suited to TAFE apprentices as it highlights the importance of speaking up about safety: “*And it's also good for an apprentice, let's say rolled out through TAFE or something, for them to see if they don't speak up about glasses or if they didn't hear the message, they just pretend they did so they don't get yelled at...it's good to speak up so they can speak up to their bosses and understand the repercussions if they don't, even if they think they're doing the right thing.*”

Another participant pointed out that the experience of construction culture is not universal and apprentices' experiences will vary between bigger and smaller organisations and from supervisor to supervisor. This participant suggested that the game could be a useful tool in increasing awareness of what communication in the workplace should look like across the board: “*Yeah, I think it would be good in TAFE because, a lot of the people in here all come from a big organisation...And then you'll have a guy in the back of the ute, who just takes his apprentice to a building site...they might think that's just the norm of...yelling at you and dadadada, that's just the norm...But this scenario becomes, 'oh wow, maybe that's not how I should be treated, maybe that's not the norm'.*”

One participant agreed that the game would be useful to apprentices enrolled in TAFE, but reiterated that its value extends to supervisors as well:

---

*“I think it will be useful on both ends: it's a refresher for the supervisor and through TAFE, it teaches them about what sort of situations you're going to go into and how you could... to act before it actually happens.*”

---

### **Other uses**

One participant suggested that the game could also function as a post-situation tool for supervisors who may have had a communication-related complaint levelled against them: “*...definitely as a tool, post-situation, post-where things have gone wrong, we've had a conflict or we've had HR complaints or issues, where you could use it as a tool like “I want you to sit down*”

*and go through a couple of these scenarios and do them differently and see how that might of worked differently. You could definitely use it for that.”*

Other comments made by this participant indicate that there are many supervisors who are lacking in the leadership and communication skills that the game is designed to develop:

---

*“Yeah, I definitely could see it from a supervisor perspective...I’ve worked with some that are completely emotionally unintelligent. Great supervisors, build beautiful buildings, fast and cheap but, Jesus, can’t talk to people.”*

---

## **Suggested improvements**

### ***Technical improvements***

The focus group participants suggested some minor improvements when prompted by the facilitators. On a technical level, one participant commented that, when compared to other games, playing the scenarios felt a little slow-paced: *“So from my perspective, and I don’t know if that’s just me, but games are often, a bit more fast-paced, and I found myself sitting there going ‘aaand ‘yes’ to the next question’...because life is a little bit more fast-paced and it wasn’t as fluid... but I enjoyed it, it was just a little bit slow for me.”*

### ***Emotional/tone design***

In terms of the emotional content and tone of the game, some participants suggested that the intensity of the conflicts could be increased. One participant commented: *“I think you definitely could push it up a notch or two and it would potentially be more engaging, particularly for people in this industry that probably don’t speak to each other as nicely as those people do.”*

Building upon this point, another participant added that stronger language would not be necessary, but then described a particular form of negative communication in the construction workplace that is not captured in the game: *“You don’t even need to have swearing. Yeah, there’s an emotion and kind of like a coldness when it gets to that point where it’s kind of ‘sorry, every man for himself out there’ and some of the stuff that comes out of people’s mouths can be quite cutting.”*

On the other hand, another participant suggested that the game could be more light-hearted: *“I was thinking whether you could make it uh, a bit more humorous? You know how young people are ‘ah it’s good but I actually get it?’”*

### ***Narrative design***

In terms of narrative improvements, one participant suggested that, although he thought highly of how harassment was handled in the second scenario, he would have liked to see an ending where the aggressor is reported to the supervisor and punished: *“There was kind of no justice with that comment from him, I think once she kind of laughed it off in a way it kind of got left behind a little bit. I think she felt awkward at the end, but still thought it was a decent day, but the*

*supervisor was none the wiser to that situation. So maybe that's something the younger guy could have mentioned...in the dilemma of "does he mention this to his supervisor that this comment was made?"*

Another participant expressed that she would like to see a female character in the game that is not part of a harassment plotline: *"And my only comment on the female part is, that the only addition in gender diversity was for a problem about sexual harassment or harassment. And it would have been nice to have females in the workplace – I know we're sparse but don't always...if you were going to add a female in, not always just for that reason. It could be...y'know, love to see some more female supervisors. There's not many but, y'know, there could be, in the digital world (laughs)."*



# Part 6: Discussion and recommendations

## 6.1 Participatory development of the RPG

In the present study, the RPG was developed utilising a process of participatory design. The value of involving participants in the design and development of WHS-related interventions is well-recognised (e.g., Williams et al., 2010; Robertson et al., 2015; Peters et al., 2020). However, many WHS interventions are still designed and implemented with little input from those they seek to help.

Participatory design has been advocated in the development of health and wellbeing interventions targeting young people (Ospina-Pinillos, et al., 2018; Hagen et al., 2012).

The use of a participatory approach in the design and development of the RPG intervention in the present study is likely to have substantially enhanced the relevance and authenticity of the intervention content. This is important because authenticity is a critical factor shaping the effectiveness of role-play-based communication skills training (Stokoe, 2013).

Participatory design also combines robust research activity with end-user representative knowledge in the design and development of interventions (Ehn, 2008; Björgvinsson et al., 2012). In Stage 1 of the study, interviews explored, in depth, the experiences and viewpoints of apprentices and supervisors in relation to communication in the workplace.

This information was used to develop scenarios based on apprentices lived experiences relating to WHS in construction worksites. Researchers and a group of end-user representatives then worked closely in the development of RPG scenarios, scripts and animated content. The content of the resulting RPG therefore combined end-users' tacit knowledge with research team members' analytical and technical subject matter knowledge in the fields of clinical psychology and construction WHS.

It is likely that the RPG would not have been as positively received by apprentices or supervisors/managers had this rigorous process of participatory design not been adopted in the development of the intervention.

## 6.2 Effect of the intervention

In the construction industry, communication has been identified as a characteristic of effective supervision (Hardison et al., 2014). Lingard et al. (2019) highlight the critical role played by supervisor-subordinate communication in shaping a shared understanding of the priority placed on safety within small, subcontracted work groups in the Australian construction industry.

Despite the importance of communication, the literature also reveals that communication between young workers and supervisors can fail for a variety of reasons (Tucker & Turner, 2015) and this has led to calls to implement training programs to improve the communication skills of young workers in relation to WHS (Chin et al., 2010).

The interviews that were undertaken in Stage 1 of the project revealed that supervisors in the Australian construction industry play a critical role in shaping how WHS is learned and practised in the workplace by apprentices (Lingard et al., 2022). Moreover, there is considerable variability in the supervisory leadership styles and behaviours experienced by apprentices. The interview results are reported in detail in the Stage 1 qualitative report.

Building on the literature and the evidence obtained from the Stage 1 interviews, Stage 2 of the project involved the development of a training/learning intervention to develop critical communication skills among construction apprentices (and also their supervisors).

The learning objectives underpinning this training/learning intervention were directly informed by the characteristics of effective communication identified during the Stage 1 interviews. The training/learning intervention involved the development of a digital and interactive role-playing game (RPG). Once developed, this RPG was evaluated in a before-after comparison trial of construction apprentices in New South Wales and Victoria.

Initially, paired sample t-tests were performed to assess the direct effect of the intervention on apprentices' communication confidence and skills and WHS-related behaviour. However, due to the presence of a high ceiling effect in the baseline survey data, the comparison of survey data collected before and after apprentices had participated in the intervention (i.e. played the RPG in a facilitated session) only revealed one significant change in apprentices' communication confidence and skills or WHS-related behaviour (relating to confidence in talking with supervisors about work tasks).

An alternative data analysis strategy using mixed-effects models was subsequently implemented to test whether exposure to the RPG significantly changed (strengthened) the relationship between young workers' communication confidence and their WHS-related behaviour and outcomes.

The alternative strategy was informed by the social cognitive theory (Bandura, 1986), which suggests that exposure to environmental stimuli (such as training and intervention programs) has the potential to facilitate the translation of individual efficacy into behaviours through the process of learning and the development of new knowledge and skills. This proposition has been empirically supported in the study of Guerin and Toland (2020).

The results from the mixed-effects models show that playing the game has significantly strengthened the relationships between apprentices' confidence in communication (e.g. feeling comfortable talking with their supervisors about health and safety) and their WHS-related behaviour, including:

- speaking up about health and safety concerns in the workplace; and
- actively intervening if they see a co-worker is in an unsafe situation.

Playing the game also significantly strengthened the association between feeling comfortable talking with supervisors about health and safety-related issues and the apprentices' mental health.

The role of the RPG intervention in enhancing the relationship between apprentices' communication confidence and WHS related behaviours can also be explained by the concept of perceived behaviour control (PBC), a key determinant of an individual's behaviour suggested in the Theory of Planned Behaviour (TPB) (Ajzen, 1991). PBC refers to "people's perception of the ease or difficulty of performing the behaviour of interest" (Ajzen, 1991, p.183). Generally, PBC is operationalised with two distinct dimensionalities: perceived self-efficacy (i.e. perceived confidence in one's ability to perform a behaviour) and perceived controllability (i.e. perceived control over the behaviour) (Ajzen, 2002; Armitage & Conner, 2001). Kidwell and Jewell (2003) further suggested that perceived self-efficacy is more related to internal control, whereas perceived controllability is more related to external control, such as the availability of resources and opportunities. Driven by various cognitive and motivational processes, an individual with higher self-efficacy or confidence should display a higher likelihood of performing a behaviour. However, the possibility to actually perform the behaviour is influenced by external control, which is claimed by Kidwell and Jewell (2003) as the facilitating conditions. Further, Kidwell and Jewell (2003) proposed that external control can potentially alter the relationship between internal control (e.g. self-efficacy or confidence) and behaviour through moderating influence.

Consistent with the claim of Kidwell and Jewell (2003), the evaluation results in our study show that participation in the RPG intervention empowers apprentices by providing them with access to external resources for practising their WHS communication related skills, which subsequently facilitate the process of translating their communication confidence into WHS related behaviour, increasing their sense of control over the workplace conditions, and improving their health and wellbeing.

### **6.3 In-game evaluation data**

In addition to the effect on behavioural outcome variables, perceived usefulness of knowledge, skills and abilities learned during communication skills training has been identified as an indicator of effectiveness (Wolderslund et al., 2021). This is because the perceived usefulness of new knowledge, skills and abilities is a significant predictor of whether someone will form an intent to transfer the content of a training intervention into behaviour change when they return to the workplace (Pham et al., 2023).

In our evaluation we included in-game questions that captured data about the relevance and perceived usefulness of the RPG content. The data (described in Part 5.2 of this report) reflected high levels of agreement in relation to relevance (Has something like this ever happened to you or a mate?) and very high levels of agreement for learning (Have you learned something new?) perceived usefulness (Would you use what you have learned in the workplace?). An average of 71% of apprentice participants indicated that they had learned something new as a result of playing the RPG and an average of 81% indicated they would use the content in their workplaces.

This data further indicates the potential of the RPG to deliver training that is relevant, valuable and useful to construction apprentices. The positive results shown in the in-game evaluation data are reflective of the participatory design approach utilised in the development of the RPG intervention – the initial Stage 1 interviews and later consultations and playtests with apprentices and supervisors ensured the relevance, educational value and usefulness of the final product.

## **6.4 Supervisors' focus group**

A focus group was held with a sample of supervisors and construction site managers. This focus group involved participants playing the RPG before engaging in a discussion exploring their reactions and views about the potential usefulness of the RPG in an industry context.

The results of the focus group (described in Part 5.3 of this report) were very positive. The supervisors and managers indicated they thought the RPG has considerable value in helping to develop critical communication skills and change behaviour among construction apprentices and supervisors.

In particular, the supervisors/manager described how the RPG helped them to take the perspective of young construction workers and better understand the challenges they may face in a construction workplace to better support them.

This is important because previous research examining the relationship between builders and young workers in small companies highlights critical differences between young workers and managers' perspectives about workplace risk and safety that, if not recognised and managed, can adversely affect WHS (Ozmec et al., 2015). Moreover, research investigating the experiences of Australian construction apprentices shows that receiving informal support (from supervisors and co-workers) is a key factor in influencing apprentices' health and wellbeing (Buchanan et al., 2016). Thus, the literature supports the potential benefits associated with delivering the RPG to workers who interact with apprentices (as well as the apprentices).

The positive responses of the supervisors/managers in the focus group also suggest that the RPG has considerable potential to assist in ensuring that construction workplaces in which apprentices engage in their on-the-job training are supportive and safe.

## **6.5 Conclusions and recommendations**

With the presence of a profound ceiling effect in the baseline survey, this study extends previous intervention evaluation research, where a before-after comparison is often used, by suggesting an alternative approach to examining the impact of the intervention. The alternative approach has been theoretically supported by social cognitive theory which posits that cognitive factors (e.g. efficacy and confidence), environmental stimuli (e.g. training and intervention) and behaviours interact to affect an individual's functioning.

The intervention evaluation results indicate that the RPG had a significant positive impact on assisting apprentices in translating their communication confidence into positive WHS

behaviours and improved WHS outcomes. The results highlight the value of the RPG intervention in providing construction apprentices with opportunities to learn and practice WHS related communication skills, which subsequently become the facilitating or enabling conditions for the transformation of communication confidence to WHS communication behaviour.

The in-game data indicates that the game was positively received by apprentices in terms of the extent to which content was perceived to be relevant, that the game stimulated learning and that the content could be used in the workplace. The perceived usefulness of content has previously been used as an indicator of effectiveness in role-play-based communication skills training programs and our findings in this regard suggest that apprentices believe there would be benefit in applying the knowledge, skills and abilities acquired through playing the RPG in the workplace. The results of the supervisor/manager focus group also support the potential usefulness and value of the RPG.

One of the key features of the RPG was the participatory design approach that was taken in its development stage. This approach combined the knowledge and experiences of end users (apprentices and supervisors) with the research team's analytical knowledge and subject matter expertise (e.g. in construction WHS and clinical psychology). Had we not used this approach it is unlikely that the RPG would have received such favourable responses in terms of its relevance, value and usefulness (from both apprentices and supervisors/managers).

The digitalisation of the RPG greatly enhances its scalability, enabling it to efficiently reach a broad audience in the construction industry. The digital RPG has been developed on an interactive online video platform and it can be easily accessed via any electronic devices such as a smartphone. The accessibility supports the ready adoption of the RPG by construction organisations to improve the communication competency of their workforce and foster a positive workplace culture. Additionally, the design approach underlying the digital RPG has proven effective and thus can be scaled up to develop interventions addressing other critical issues experienced by workers in construction workplaces.

The value of the RPG, demonstrated by the evaluation evidence, supports the dissemination and implementation of the game among broader construction apprentices to achieve wider benefits and contribute to the creation of a safer and healthier construction workplace environment.

It is also acknowledged that the evaluation of the RPG was undertaken in a TAFE classroom setting and the game was only delivered to apprentices using a single format. It is recommended that future trials and testing of the RPG be undertaken to assess whether the impact of the RPG will be further enhanced when delivered differently. It is recommended that future trials include:

- embedding the game in industry workplace contexts,
- trialling different delivery formats, including framing and debriefing, and
- delivering the RPG to apprentices and others (supervisors and co-workers) in the same workplace context.

# Part 7: References

Ajzen, I. (1991). The theory of planned behavior. *Organizational behavior and human decision processes*, 50(2), 179-211.

Ajzen, I. (2002). Perceived behavioral control, self - efficacy, locus of control, and the theory of planned behavior 1. *Journal of applied social psychology*, 32(4), 665-683.

Armitage, C. J., & Conner, M. (2001). Efficacy of the theory of planned behaviour: A meta - analytic review. *British journal of social psychology*, 40(4), 471-499.

Australian Bureau of Statistics (ABS). (2018). Completion-and-attrition-rates-for-apprentices-and-trainees-2018-data-tables, retrieved 04. June 2020.

Australian Industry Group. (2016). Making Apprenticeships Work, retrieved 12. September 2018, [http://cdn.aigroup.com.au/Reports/2016/15160\\_apprenticeships\\_policy\\_full.pdf](http://cdn.aigroup.com.au/Reports/2016/15160_apprenticeships_policy_full.pdf)

Bandura, A. (1986). *Social foundations of thought and action: a social cognitive theory*. Englewood Cliffs, N.J: Prentice-Hall.

Bandura, A. (1989). Human agency in social cognitive theory. *American Psychologist*, 44(9), 1175-1184. doi: <https://doi.org/10.1037/0003-066X.44.9.1175>

Bandura, A. (1993). Perceived self-efficacy in cognitive development and functioning. *Educational psychologist*, 28(2), 117-148.

Bandura, A. (2001). Social cognitive theory: An agentic perspective. *Annual review of psychology*, 52(1), 1-26.

Bjögvinsson, E., Ehn, P., & Hillgren, P.-A. (2012). Design things and design thinking: Contemporary participatory design challenges. *Design issues*, 28(3), 101-116.

Blau, G. J. (1985). The measurement and prediction of career commitment. *Journal of Occupational Psychology*, 58(4), 277-288.

Blewett, V., Rainbird, S., Clarkson, L., Paterson, J., & Etherton, H. (2013). *Developing the youth health and safety strategy for South Australia*. Appleton Institute, Central Queensland University.

Blume, B. D., Ford, J. K., Baldwin, T. T., & Huang, J. L. (2010). Transfer of training: A meta-analytic review. *Journal of Management*, 36(4), 1065–1105.

Bouvier, P., Lavoué, E., & Sehaba, K. (2014). Defining engagement and characterizing engaged-behaviors in digital gaming. *Simulation & Gaming*, 45(4-5), 491-507.

Brackett, M. A., Rivers, S. E., & Salovey, P. (2011). Emotional intelligence: Implications for personal, social, academic, and workplace success. *Social and personality psychology compass*, 5(1), 88-103.

Brackett, M. A., Rivers, S. E., Shiffman, S., Lerner, N., & Salovey, P. (2006). Relating emotional abilities to social functioning: a comparison of self-report and performance measures of emotional intelligence. *Journal of personality and social psychology*, 91(4), 780.

Breslin, F. C., & Smith, P. (2006). Trial by fire: a multivariate examination of the relation between job tenure and work injuries. *Occupational and Environmental Medicine*, 63(1), 27-32.

Breslin, F. C., Polzer, J., MacEachen, E., Morrongiello, B., & Shannon, H. (2007). Workplace injury or "part of the job"? Towards a gendered understanding of injuries and complaints among young workers. *Social Science & Medicine*, 64(4), 782-793.

Buchanan, J., Raffaele, C., Glozier, N., & Kanagaratnam, A. (2016). *Beyond Mentoring: Social Support Structures for Young Australian Carpentry Apprentices. Research Report*. National Centre for Vocational Education Research Ltd. PO Box 8288, Stational Arcade, Adelaide, SA 5000, Australia.

Burke, L. A., & Hutchins, H. M. (2007). Training transfer: An integrative literature review. *Human Resource Development Review*, 6(3), 263–296.

Chen, X., Lin, F., Gao, H., & Zou, Y. (2022). Stratified changes in emotional distress during the COVID-19 pandemic: Evidence from a longitudinal survey of residents in Hubei province, China. *Journal of Psychosomatic Research*, 160, 110959.

Cheung, C.-K., & Chan, C.-M. (2000). Learning to work safely with reference to a social-cognitive model. *Social Behavior and Personality*, 28(3), 293. doi: <https://doi.org/10.2224/sbp.2000.28.3.293>

Chin, P., DeLuca, C., Poth, C., Chadwick, I., Hutchinson, N., & Munby, H. (2010). Enabling youth to advocate for workplace safety. *Safety science*, 48(5), 570-579.

Cigularov, K. P., Chen, P. Y., & Rosecrance, J. (2010). The effects of error management climate and safety communication on safety: A multi-level study. *Accident analysis & prevention*, 42(5), 1498-1506.

Conchie, S. M., & Burns, C. (2008). Trust and risk communication in high-risk organizations: A test of principles from social risk research. *Risk Analysis: An International Journal*, 28(1), 141-149.

Cook, D., & Campbell, T. (1979). *Quasi-experimentation: design and analysis issues for field settings*. Boston, MA, Houghton Mifflin.

Cook, D., & Campbell, T. (1979). *Quasi-experimentation: design and analysis issues for field settings*. Boston, MA, Houghton Mifflin.

Cook, J.D., Hepworth, S.J., Wall, T.D., & Warr, P.B. (1981). The experience of Work: A compendium and review of 249 measures and their use.

Cortina, L. M., Magley, V. J., Williams, J. H., & Langhout, R. D. (2001). Incivility in the workplace: incidence and impact. *Journal of occupational health psychology*, 6(1), 64.

Curcuruto, M., Strauss, K., Axtell, C., & Griffin, M. A. (2020). Voicing for safety in the workplace: A proactive goal-regulation perspective. *Safety Science*, 131, 104902. doi: <https://doi.org/10.1016/j.ssci.2020.104902>

Dagsland, Å. H. B., Mykletun, R., & Einarsen, S. (2011). Apprentices' Expectations and Experiences in the Socialisation Process in their Meeting with the Hospitality Industry. *Scandinavian Journal of Hospitality and Tourism*, 11(4), 395-415.

Delp, L., Brown, M., & Domenzain, A. (2005). Fostering youth leadership to address workplace and community environmental health issues: A university-school-community partnership. *Health Promotion Practice*, 6(3), 270-285.

Ehn, P. (2008). *Participation in design things*. Participatory Design Conference (PDC), Bloomington, Indiana, USA (2008).

Field, A. (2013). *Discovering statistics using IBM SPSS statistics* (C. Michael, Ed.). SAGE Publications.

Fuller, A., & Unwin, L. (2008). *Towards Expansive Apprenticeships: A commentary by the teaching and learning research programme*. Teaching and Learning Research Programme.

Gordon, E., & Schirra, S. (2011, June). Playing with empathy: digital role-playing games in public meetings. In *Proceedings of the 5th International Conference on Communities and Technologies* (pp. 179-185).

Gow, K., Hinschen, C., Anthony, D., & Warren, C. (2008). Work expectations and other factors influencing male apprentices' intentions to quit their trade. *Asia Pacific Journal of Human Resources*, 46(1), 99-121.

Greco, M. (2009). The use of role-playing in learning. Games-based learning advancements for multi-Sensory human computer interfaces: techniques and effective practices (pp. 157-173). IGI Global.

Guerin, R. J., & Toland, M. D. (2020). An application of a modified theory of planned behavior model to investigate adolescents' job safety knowledge, norms, attitude and intention to enact workplace safety and health skills. *Journal of Safety Research*, 72, 189-198. doi: <https://doi.org/10.1016/j.jsr.2019.12.002>

Guerin, R. J., Okun, A. H., Barile, J. P., Emshoff, J. G., Ediger, M. D., & Baker, D. S. (2019). Preparing Teens to Stay Safe and Healthy on the Job: a Multilevel Evaluation of the Talking Safety Curriculum for Middle Schools and High Schools. *Prevention Science*, 20(4), 510-520. doi: 10.1007/s11121-019-01008-2



- Hagen, P., Collin, P., Metcalf, A., Nicholas, M., Rahilly, K., & Swainston, N. (2012). Participatory Design of evidence-based online youth mental health promotion, intervention and treatment. Young and Well Cooperative Research Centre, Melbourne, Australia.
- Hammer, L. B., Truxillo, D. M., Bodner, T., Rineer, J., Pytlovany, A. C., & Richman, A. (2015). Effects of a Workplace Intervention Targeting Psychosocial Risk Factors on Safety and Health Outcomes. *BioMed research international*, 2015, 836967.
- Hardin, J. W., & Hilbe, J. M. (2002). *Generalized estimating equations*. Chapman and Hall/CRC.
- Hardison, D., Behm, M., Hallowell, M. R., & Fonooni, H. (2014). Identifying construction supervisor competencies for effective site safety. *Safety science*, 65, 45-53.
- Heaven, C., Clegg, J., & Maguire, P. (2006). Transfer of communication skills training from workshop to workplace: the impact of clinical supervision. *Patient education and counseling*, 60(3), 313-325.
- Heller, T. S., Hawgood, J. L., & Leo, D. D. (2007). Correlates of suicide in building industry workers. *Archives of Suicide Research*, 11(1), 105-117.
- Hofmann, D. A., & Morgeson, F. P. (1999). Safety-related behavior as a social exchange: The role of perceived organizational support and leader–member exchange. *Journal of applied psychology*, 84(2), 286.
- Hofmann, D. A., Morgeson, F. P., & Gerras, S. J. (2003). Climate as a moderator of the relationship between leader-member exchange and content specific citizenship: safety climate as an exemplar. *Journal of applied psychology*, 88(1), 170.
- Israel, G. D. (1992). *Determining sample size*. University of Florida, Nov 1992.
- Jeelani, I., Han, K. and Albert, A. (2020), "Development of virtual reality and stereo-panoramic environments for construction safety training", *Engineering, Construction and Architectural Management*, Vol. 27 No. 8, pp. 1853-1876. <https://doi.org/10.1108/ECAM-07-2019-0391>
- Kath, L. M., Marks, K. M., & Ranney, J. (2010). Safety climate dimensions, leader–member exchange, and organizational support as predictors of upward safety communication in a sample of rail industry workers. *Safety Science*, 48(5), 643-650.
- Kidwell, B., & Jewell, R. D. (2003). An examination of perceived behavioral control: Internal and external influences on intention. *Psychology & Marketing*, 20(7), 625-642.
- Kines, P, Andersen, L., Spangenberg, S., Mikkelsen, K., Dyreborg, K., Zohar, D. (2010). Improving construction site safety through leader-based verbal safety communication. *Journal of Safety Research*, 41(5), 399-406.
- Ladousse, G. P. (1987). Role-play. Oxford, UK: Oxford University Press.

Lane, C., & Rollnick, S. (2007). The use of simulated patients and role-play in communication skills training: a review of the literature to August 2005. *Patient Education and Counseling*, 67(1-2), 13-20.

Lingard, H. & Zhang, R. P. (2019), *Young and Older Construction Workers' Work Health and Safety*, Construction Work Health and Safety @ RMIT, RMIT University, Melbourne, Australia.

Lingard, H., Pirzadeh, P., & Oswald, D. (2019). Talking safety: Health and safety communication and safety climate in subcontracted construction workgroups. *Journal of construction engineering and management*, 145(5), 04019029.

Lingard, H., Zhang, R. P., LaBond, C., Clarke, J., & Doan, T. (2022). Situated Learning: How Interactions with Supervisors Shape Construction Apprentices' Safety Learning and Practice. *Journal of Construction Engineering and Management*, 148(10), 04022107.

Lingard, H., Zhang, R.P., LaBonde, C., Strazdins, L., Clarke, J & Doan, T., (2021). *Conversations about Life, Health and Safety: Social Supports for Young Construction Workers' Health and Safety Qualitative Report*, Construction Work Health and Safety @ RMIT, RMIT University, Melbourne, Australia.

Ma, Z., Huang, K. T., & Yao, L. (2021). Feasibility of a Computer Role-Playing Game to Promote Empathy in Nursing Students: The Role of Immersiveness and Perspective. *Cyberpsychology, Behavior, and Social Networking*, 24(11), 750-755.

Marsden, E., & Torgerson, C. J. (2012). Single group, pre-and post-test research designs: Some methodological concerns. *Oxford Review of Education*, 38(5), 583-616.

Martin, D., Conlon, E. & Bowe, B. (2019). The role of role-play in student awareness of the social dimension of the engineering profession, *European Journal of Engineering Education*, 44:6, 882-905.

Michael, J. H., Guo, Z. G., Wiedenbeck, J. K., & Ray, C. D. (2006). Production supervisor impacts on subordinates' safety outcomes: An investigation of leader-member exchange and safety communication. *Journal of safety Research*, 37(5), 469-477.

Nielsen, K., Ng, K., Vignoli, M., Lorente, L., & Peiró, J. M. (2023). A mixed methods study of the training transfer and outcomes of safety training for low-skilled workers in construction. *Work & Stress*, 37(2), 127-147.

Nielsen, M. L., Görlich, A., Grytnes, R., & Dyreborg, J. (2017). Without a safety net: precarisation among young Danish employees. *Nordic Journal of Working Life Studies*, 7(3).3-22.

Nikolaou, I., & Tsaousis, I. (2002). Emotional intelligence in the workplace: Exploring its effects on occupational stress and organisational commitment. *The International Journal of Organisational Analysis*, 10(4), 327-342.

Nørgaard, B., Ammentorp, J., Ohm Kyvik, K., & Kofoed, P. E. (2012). Communication skills training increases self-efficacy of health care professionals. *Journal of Continuing Education in the health professions*, 32(2), 90-97.

Nykänen, M., Puro, V., Tiikkaja, M., Kannisto, H., Lantto, E., Simpura, F., . . . Teperi, A.-M. (2020). Implementing and evaluating novel safety training methods for construction sector workers: Results of a randomized controlled trial. *Journal of Safety Research*, 75, 205-221. doi: <https://doi.org/10.1016/j.jsr.2020.09.015>

Nykänen, M., Salmela-Aro, K., Tolvanen, A., & Vuori, J. (2019). Safety self-efficacy and internal locus of control as mediators of safety motivation – Randomized controlled trial (RCT) study. *Safety Science*, 117, 330-338. doi: <https://doi.org/10.1016/j.ssci.2019.04.037>

Nykänen, M., Sund, R., & Vuori, J. (2018). Enhancing safety competencies of young adults: A randomized field trial (RCT). *Journal of Safety Research*, 67, 45-56. doi: <https://doi.org/10.1016/j.jsr.2018.09.012>

Oblinger, D. (2004). The next generation of educational engagement. *Journal of interactive media in education*, 2004(8), 1-18.

Okun, A. H., Guerin, R. J., & Schulte, P. A. (2016). Foundational workplace safety and health competencies for the emerging workforce. *Journal of Safety Research*, 59, 43-51.

Ospina-Pinillos, L., Davenport, T. A., Ricci, C. S., Milton, A. C., Scott, E. M., & Hickie, I. B. (2018). Developing a mental health eClinic to improve access to and quality of mental health care for young people: using participatory design as research methodologies. *Journal of medical internet research*, 20(5), e9716.

Ozmeç, M. N., Karlsen, I. L., Kines, P., Andersen, L. P. S., & Nielsen, K. J. (2015). Negotiating safety practice in small construction companies. *Safety Science*, 71, 275-281.

Pagnoccolo, J., & Bertone, S. (2021). The apprentice experience: the role of interpersonal attributes and people-related generic skills. *Education+ Training*.

Parker, S. K., Axtell, C. M., & Turner, N. (2001). Designing a safer workplace: importance of job autonomy, communication quality, and supportive supervisors. *Journal of occupational health psychology*, 6(3), 211.

Peters, S. E., Trieu, H. D., Manjourides, J., Katz, J. N., & Dennerlein, J. T. (2020). Designing a Participatory Total Worker Health® Organizational Intervention for Commercial Construction Subcontractors to Improve Worker Safety, Health, and Well-Being: The “ARM for Subs” Trial. *International Journal of Environmental Research and Public Health*, 17(14), 5093.

Pham, T. T., Lingard, H., & Zhang, R. P. (2023). Factors influencing construction workers' intention to transfer occupational health and safety training. *Safety Science*, 167, 106288.

Pidd, K., Duraisingam, V., Roche, A., & Trifonoff, A. (2017). Young construction workers: substance use, mental health, and workplace psychosocial factors. *Advances in Dual Diagnosis, 10*(4), 155-168.

Quinlan, M., Mayhew, C., & Bohle, P. (2001). The Global Expansion of Precarious Employment, Work Disorganisation, and Consequences for Occupational Health: A Review of Recent Research. *International Journal of Health Services, 31*(2), 335-414.

Robertson, M. M., Henning, R. A., Warren, N., Nobrega, S., Dove-Steinkamp, M., TibiriÁ § Áj, L., & Bizarro, A. (2015). Participatory design of integrated safety and health interventions in the workplace: A case study using the Intervention Design and Analysis Scorecard (IDEAS) Tool. *International journal of human factors and ergonomics, 3*(3-4), 303-326.

Rohlman, D. S., Parish, M., Elliot, D. L., Montgomery, D., & Hanson, G. (2013). Characterizing the needs of a young working population: making the case for total worker health in an emerging workforce. *Journal of occupational and environmental medicine, 55*, S69-S72.

Rollnick, S., Kinnersley, P., & Butler, C. (2002). Context-bound communication skills training: development of a new method. *Medical education, 36*(4), 377-383.

Ross, V. R., Wardhani, K, Kolves. (2020). The Impact of Workplace Bullying on Mental Health and Suicidality in Queensland Construction Industry Apprentices. *Mates in Construction*.

Ruderman, M. N., Hannum, K., Leslie, J. B., & Steed, J. L. (2001). Making the Connection. *Leadership in Action, 21*(5), 3-7.

Safe Work Australia (2013). *Work-related injuries experienced by young workers in Australia, 2009–10*. Canberra: Safe Work Australia.

Salminen, S. (2004). Have young workers more injuries than older ones? An international literature review. *Journal of Safety Research, 35*(5), 513-521.

Sámano-Ríos, M. L., Ijaz, S., Ruotsalainen, J., Breslin, F. C., Gummesson, K., & Verbeek, J. (2019). Occupational safety and health interventions to protect young workers from hazardous work – A scoping review. *Safety Science, 113*, 389-403.

Schutte, N. S., Malouff, J. M., Hall, L. E., Haggerty, D. J., Cooper, J. T., Golden, C. J., & Dornheim, L. (1998). Development and validation of a measure of emotional intelligence. *Personality and individual differences, 25*(2), 167-177.

Shadish, W.R., Cook, T.D. & Campbell, D.T. (2002). *Experimental and quasi-experimental designs for generalized causal inference*. Boston, Houghton Mifflin.

Sparks, K., Faragher, B., & Cooper, C. L. (2001). Well-being and occupational health in the 21st century workplace. *Journal of occupational and organisational psychology, 74*(4), 489-509.

Spinuzzi, C. (2005). The methodology of participatory design. *Technical communication, 52*(2), 163-174.

- Stokoe, E. (2013). The (in) authenticity of simulated talk: Comparing role-played and actual interaction and the implications for communication training. *Research on Language & Social Interaction*, 46(2), 165-185.
- Sun, Y., Chen, J., Qian, C., Luo, X., & Wu, X. (2022). The Influence Mechanism of Political Skill on Safety Voice Behavior in High-Risk Industries: The Mediating Role of Voice Efficacy. *International Journal of Environmental Research and Public Health*, 19(23). Retrieved from doi:10.3390/ijerph192316162
- Taherdoost, H. (2017). Determining sample size; how to calculate survey sample size. *International Journal of Economics and Management Systems*, 2.
- Tucker, S., & Turner, N. (2015). Sometimes it hurts when supervisors don't listen: The antecedents and consequences of safety voice among young workers. *Journal of occupational health psychology*, 20(1), 72.
- van der Molen, H., Mol, E. Kuijer, P., Frings-Dresen, M. (2007). The evaluation of smaller plasterboards on productivity, work demands and workload in construction workers. *Applied Ergonomics*, 38(5),
- Wan, H. C., Downey, L. A., & Stough, C. (2014). Understanding non-work presenteeism: Relationships between emotional intelligence, boredom, procrastination and job stress. *Personality and Individual Differences*, 65, 86-90.
- Wang, Y. H. (2020). Exploring the effects of designing a role-playing game with single and peer mode for campus learning. *Educational Technology Research and Development*, 68(3), 1275-1299.
- Weiss, C. H. (1995). Nothing as practical as good theory: Exploring theory-based evaluation for comprehensive community initiatives for children and families. In J. Connell, A. Kubisch, L. Schorr & C. Weiss (Eds.), *New approaches to evaluating comprehensive community initiatives* (pp. 65-92). New York: The Aspen Roundtable Institute.
- Westborg, J. (2023). The Educational Role-Playing Game Design Matrix: Mapping Design Components onto Types of Education. *International Journal of Role-Playing*, (13), 18-30.
- Wheeler, S. M. (2006). Role-playing games and simulations for international issues courses. *Journal of Political Science Education*, 2(3), 331-347.
- WHO. (1998). *Wellbeing Measures in Primary Health Care/The Depcare Project*. WHO Regional Office for Europe: Copenhagen.
- Williams Jr, Q., Ochsner, M., Marshall, E., Kimmel, L., & Martino, C. (2010). The impact of a peer-led participatory health and safety training program for Latino day laborers in construction. *Journal of safety research*, 41(3), 253-261.

Wolderslund, M., Kofoed, P. E., & Ammentorp, J. (2021). The effectiveness of a person-centred communication skills training programme for the health care professionals of a large hospital in Denmark. *Patient education and counseling*, 104(6), 1423-1430.

Wong, C. S., & Law, K. S. (2002). Wong and law emotional intelligence scale. *The leadership quarterly*.

Wood, R., & Bandura, A. (1989). Social cognitive theory of organizational management. *Academy of management Review*, 14(3), 361-384.

Zierold, K. M. (2017). Youth doing dangerous tasks: Supervision matters. *American Journal of Industrial Medicine*, 60(9), 789-797.

Zohar, D., & Polachek, T. (2014). Discourse-based intervention for modifying supervisory communication as leverage for safety climate and performance improvement: A randomized field study. *Journal of Applied Psychology*, 99(1): 113-124.

# Part 8: Appendices

## 8.1 Appendix 1: Intervention facilitator's guide

### **PREPARATION**

You should have:

- Survey QR codes
- Headphones
- Lightning adapters
- Usb-c adapters
- QR code handouts
- Scenario 1 QR codes

Before people arrive, have the survey ready on the projector, on the front page. As people walk in, ask them who has headphones to get a sense of how many will be needed. They won't be necessary till after the survey but good to know.

### **GENERAL INTRODUCTION (2 minutes)**

"Welcome everyone, my name is xxx, thanks for taking part in this session. It will run for about an hour maximum. We're offering a \$30 gift card to everyone who stays till the end that you can spend at Woolworths, BIG W, BWS, Dan Murphy's and participating EG and Caltex Woolworths fuel sites. We have them printed out and at the end of the session you'll leave with it in your hand. So please stick around for the whole session, it will be worth it, and the training we have for you today is pretty fun."

"The purpose of this session to try out a new type of training that is designed to teach good communication skills in the construction workplace."

"Research has found that **apprentices** are more likely to sustain an injury at work, and are also at greater risk of mental health issues."

"Studies have also shown that good communication with your workmates, particularly between apprentices and supervisors, is a critical part of reducing both safety and mental health risks."

"The training that you'll be given today will be a game with three interactive scenarios that you can play through on your phone or tablet. These scenarios will have lessons in them, which show the positive outcomes of making good communication choices, and the unsafe consequences that poor communication can lead to."

### ***SURVEY INTRODUCTION (3 minutes)***

“However, first of all, we’re going to get each of you to complete **a short survey** about your experiences as an apprentice. The idea is, today we’ll survey you, and then you’ll play through the game... and then about a month from now we’ll survey you again — this second survey is just another short 7-10-minute survey and if you complete it you’ll receive an **extra \$20 gift card**, on top of the \$30 you’ll walk out of here with today.”

“You’ll have to enter your email address and phone number at the beginning so we can send you the link to the follow-up survey, so please make sure you use the **email address you check the most.**”

“In a second I’m going to walk around and hand out QR codes for the survey. Go ahead and scan it when you have it. We’re going to go through the survey together, so **don’t answer each question until I’ve finished reading it out.** Take your time but don’t overthink it, there are no ‘right’ answers. It should only take us between 7-10 minutes.”

“If anyone’s phone is either broken or about to die, let me know now, we have some back-up tablets that you can use instead.”

“If there are any questions you don’t understand, let me know and I can explain it.”

“Okay, here come the QR codes.” (pass out the survey QR codes)

### ***BASELINE SURVEY (10 minutes)***

Before starting survey ask if anyone is having trouble scanning the QR code. If it’s not working for anyone, Survey shortlink.

“Okay has everyone entered their phone and email? Make sure you do or you won’t be able to get that extra \$20 on the gift card. Okay let’s start, question 1...” (When **you** start the survey type “Test” into both the email and phone number boxes...Read through question clearly, pause for 5-10 secs, then move on to next question till survey is done).

### ***SCENARIOS INTRODUCTION (5 minutes)***

“Thanks everyone for completing the survey. Now we can get to the more exciting bit. So in a minute we’re going to get you all to play through **three scenarios** that are based on **real stories from apprentices.**”

“When you’re playing through them, first you’ll be shown some construction workers doing something, then everything will stop and you get to make a decision for them. You’ll always be given **two options**. For example, someone’s phone could be ringing and you have the options “Answer the phone” or “Don’t answer the phone”. Based on your choices; you will each get a very different ending.”

“Now, don’t worry, this isn’t a test, so don’t worry about choosing ‘right’ or ‘wrong’ answers. Sometimes you may choose something and it will turn out very differently from what you thought might happen. No matter what you choose, there are lessons to be learned.”



“There is some mild bullying and harassment shown in the game, so if anyone is getting uncomfortable and wants to take a break, just let me know.”

“Before we get started, you’ll need headphones for this. Hands up if you still need headphones.”  
(should now hand out to anyone who still needs them)

“Okay I’m going to replace the survey QR codes with the Scenario one, go ahead and scan it and you can get started.” (replace the survey QR codes with the Scenario ones).

“Let me know if you’re having any problems getting it going. Make sure your phone isn’t on silent and you turn your phone sideways to make it full-screen. Getting it to stay full-screen can be a little tricky but as long as you can hear it and see it, that’s the main thing. First thing you’ll want to do is hit the “x” on that white box that pops up about cookies.”

“The video quality might be a little fuzzy at first but it should catch up in a minute or so.”

“When you get the end of a scenario, click continue and you’ll be shown a quick highlights reel of what that story was about and then you’ll have to answer three quick questions to progress through to the next one. Just click continue whenever it comes up to keep moving through it.”

“We’re going to allocate about 30 minutes to play through all three Scenarios. Make it clear when you’re finished by putting your phone down, and Alan will come round to collect any equipment you’ve borrowed”.

### ***SCENARIOS PLAYTHROUGH (30 minutes)***

Move around room and check that everyone is playing and can hear it properly.

After about 20 minutes say “let me know if you finish early”. If they do, they can relax for 5 mins/go to the bathroom (insist that they come right back or they won’t get the gift card). Alan can collect any equipment they’ve borrowed. Do not start discussion until all iPads/cables are returned.

### ***DEBRIEF/DISCUSSION (10 minutes)***

“Okay has everybody finished all three scenarios?”

If possible, refer apprentices to summary of scenarios on the whiteboard:

Scenario 1: Late apprentice and the saw

Scenario 2: New apprentice’s first day/banter going too far

Scenario 3: Scared of heights and asking for time off

If there’s no whiteboard, just read the above out loud to remind them which is which.

### **General show of hands**

“Which scenario did you think was the trickiest?”

- Hands up for Number 1 – the one with the late apprentice
- Hands up if you think Number 2 was the trickiest - the one with the new female apprentice joining the team
- Hands up if you think Number 3 was the trickiest - the one with the guy scared of heights.

### Scenario 1 Discussion

“Okay let's start with the first one – in the first scenario did anyone see the apprentice get injured on the saw?”

(Some hands should go up, pick someone, and ask questions below)

(If no hands go up, ask if they got a positive ending and ask why. If no one responsive can skip straight to the explain paragraph).

- Why did he get injured?  
(**common answer:** because he wasn't wearing safety glasses)
- But why wasn't he wearing safety glasses?  
(**two possibilities:** either the player decided that there was no time to ask for them OR they chose to yell at the apprentice when he was late).

*Explain to them:*

So, to avoid bad outcomes, apprentices need to be **assertive** – raising issues as they see them and asking for help. However, it's hard to be assertive if you're not comfortable around your supervisor. In this scenario, if the supervisor was too hard on the apprentice, he loses his confidence and is no longer comfortable asking for help, no matter what you choose. So basically when **supervisors are approachable AND apprentices are assertive** things will go well. If just one of those things is missing, it can often lead to trouble.

### Scenario 2 discussion

“How did you all handle the second scenario with the new apprentice joining the team? Chances are at least one of the three apprentices was unhappy at the end of it. Hands up if at the end of Scenario 2, you had at least one apprentice who was unhappy.”

(some hands should go up, pick one and ask questions below. If not, say “wow, so everyone got a positive ending?” and skip to explain paragraph)

“Do you remember which apprentice was unhappy? Why were they?”

**If Kate (the new girl)** = either because Dev offended her after prank and/or Jacob didn't stick up for her.

**If Jacob (skinny guy with faint moustache)** = because Dev bullied him.

**If Dev (stronger guy)** = either because supervisor pressed in with personal issues/Jacob mentioned his family problems during fight.

*Explain to them:*

The main lesson from this one is putting yourself in other people's shoes, that's what **empathy** is. To get a good ending in this one you really have to think about it from each character's point of view, and treat everyone with respect.

A big part of that is judging when banter goes too far. Everyone likes to have a laugh at work, but what is funny to one person may not be funny to someone else. Everyone draws the line somewhere different. For instance, if anyone pranked Kate – the actual prank goes alright, but when Dev makes his joke about "typical women" afterwards, that's where the line was crossed for Kate.

### **Scenario 3 discussion**

And finally, how'd you go with Scenario 3? Did anyone get a good ending?

(If yes, ask them what happened and why – the best ending is when the supervisor and apprentice negotiate so that he comes to work after footy. If no, can ask about negative endings or jump straight to the explain paragraph).

*Explain to them:*

The tricky thing about the third scenario is that everyone's **commitments are clashing with each other**: Ed has to play footy, Liam has to see his Mum and the supervisor has to get the job done. However, the best possible ending comes about if everyone is **honest and upfront** about their needs and commitments from the beginning. However, Ed is only comfortable being honest about his footy commitments if he's able to overcome his fears of heights. Just like the first scenario, it's much easier for apprentices to be assertive if they feel comfortable and respected at work.

"One last question, which of the three scenarios was your favourite/did you find the most interesting? Hands up for Number 1...2...3."

### **Wrap up**

"Okay great. Along with your gift card, I'm going to give everyone a handout to take home with a QR code to each scenario on it – if you're interested in playing it again anytime at home, give it a try, you might find it interesting to see what happens if you choose differently next time."

"Thanks again for participating today everyone. Don't leave without your gift card and keep an eye out for the follow-up survey in about a month".

## 8.2 Appendix 2: Baseline survey & follow-up survey questions

### 1. Demographic information

#### Apprentice characteristics

No	Apprentice characteristics	Responses
1	Are you of Aboriginal and/or Torres Strait Islander origin?	1 = Yes 2 = No
2	How do you identify yourself?	1 = Male 2 = Female 3 = Non-binary 4 = Different identity 5 = Prefer not to say
3	What is your age group?	1 = 15-19 2 = 20-24 3 = 25-29 4 = 30 and over

#### Workplace and job characteristics

No	Work and workplace characteristics	Responses
4	At what stage are you in your apprenticeship?	1 = Stage One 2 = Stage Two 3 = Stage Three 4 = Stage Four
5	How many training employers have you worked for since starting your apprenticeship?	1 = One 2 = Two 3 = Three 4 = More than three
6	In which sector do you currently work? ( <b>You can choose more than one</b> )	1 = Commercial construction 2 = Residential construction 3 = Civil construction 4 = Other
7	Have you participated in any work health and safety programs (including mental health programs) in the last 6 months?	1 = Yes 2 = No

### 2. Communication between young workers and supervisors

No	Communication about health, safety, work and life	Responses
8	<i>How comfortable are you talking (or texting) with your supervisor about each of the following?</i>	

	Work tasks	1 = Very comfortable 2 = Comfortable 3 = Neutral 4 = Uncomfortable 5 = Very uncomfortable
	Safety at work	
	Health and mental wellbeing	
	Your personal life	
9	<i>Thinking about communication with your supervisor, does your supervisor:</i>	
	Care about your opinions?	1 = Always 2 = Often 3 = Sometimes 4 = Rarely 5 = Never
	Listen to your ideas?	
	Respond caringly if you share your concerns?	
10	Is there anything you wish you could talk about more with your supervisor? Choose all that apply.	<input type="radio"/> Work tasks <input type="radio"/> Safety at work <input type="radio"/> Health and mental wellbeing <input type="radio"/> Personal life <input type="radio"/> None <input type="radio"/> Other, please specify _____

No	Communication about health, safety, work and life	Responses
11	<i>How comfortable are you having conversations with your supervisor about the following?</i>	
	Your hours of work	1 = Very comfortable 2 = Comfortable 3 = Neutral 4 = Uncomfortable 5 = Very uncomfortable
	The level of overtime you're expected to do	
	Taking time off	

### 3. Young workers' safety voice

No	Speak up about safety	Responses
12	<i>How often do the following apply to you?</i>	
	I take safety concerns to my supervisor.	1 = Always 2 = Often 3 = Sometimes 4 = Rarely 5 = Never
	I tell my supervisor about dangerous situations.	

### 4. Emotional intelligence

13	<i>What is your level of agreement with the following statements?</i>	
	I am generally comfortable sharing my view or feelings on an issue with others.	1 = Strongly agree 2 = Agree 3 = Neutral 4 = Disagree 5 = Strongly disagree
	I am generally good at noticing how others are feeling.	
	I am able to control my temper.	

	I am willing to support others when they are upset about something at work.	
	I am able to ask for help when I need it.	

### 5. Experience of health, safety and wellbeing

14	<i>Over the last two weeks:</i>	
	I have felt cheerful and in good spirits	1 = All the time 2 = Most of the time 3 = More than half of the time 4 = Less than half of the time 5 = Some of the time 6 = At no time
	I have felt calm and relaxed	
	I have felt active and vigorous	
	I woke up feeling fresh and rested	
	My daily life has been filled with things that interest me	

15	<i>Over the past three months, have you experienced any of the following incidents at work (please tick as many as applicable)?</i>	
	Near misses	1 = Yes 2 = No
	Minor injuries (e.g., first aid injury)	
	Injuries resulting in time off work	

16	When the need arises, I am confident that I can:	
	Protect co-workers from safety hazards	1 = Strongly agree 2 = Agree 3 = Neutral 4 = Disagree 5 = Strongly disagree
	Look out for the safety of co-workers.	
	Protect co-workers from risky situations	
	Prevent co-workers from being injured on the job	
	Stop safety violations in order to protect the wellbeing of co-workers.	

### 6. Job satisfaction, work engagement and career intention

17	Overall job satisfaction	Responses
	What is your overall current job satisfaction?	0 totally dissatisfied – 10 totally satisfied
	How engaged do you feel in your work?	1 = Extremely engaged 2 = Very engaged 3 = Moderately engaged 4 = Slightly engaged 5 = Not at all engaged
	I will probably look for a new job in the next year.	1 = Strongly agree 2 = Agree 3 = Neutral 4 = Disagree 5 = Strongly disagree
	I definitely want a career in construction.	

### 8.3 Appendix 2: Paired-samples t-test

Variable	<i>t</i>	<i>p</i>
Confidence and skills in communication with supervisor		
<i>Comfortable to talk about work tasks</i>	2.292	0.023*
<i>Comfortable to talk about safety at work</i>	0.461	0.645
<i>Comfortable to talk about health and mental wellbeing</i>	-1.549	0.123
<i>Comfortable to talk about your personal life</i>	0.589	0.557
<i>Comfortable to talk about your hours of work</i>	-0.717	0.474
<i>Comfortable to talk about the level of overtime you're expected to do</i>	1.641	0.103
<i>Comfortable to talk about taking time off</i>	1.343	0.181
Safety voice behaviour	-1.251	0.212
Supervisors' attitude to apprentices	-0.290	0.772
Emotional intelligence	0.086	0.932
Safety citizenship behaviour	0.910	0.364
Mental health	-1.536	0.126
Safety incidents		
<i>Near misses</i>	-4.340	<0.001*
<i>Minor injuries</i>	-3.357	<0.001*
<i>Injuries resulting in time off work</i>	-1.092	0.276
Job satisfaction	1.166	0.245
Work engagement	2.128	0.035*
Career intention	2.975	0.003*

\*  $p < 0.05$