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The importance of training transfer of non-technical skills safety training of construction workers

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ABSTRACT
Safety training of migrant workers in construction has focused on technical skills with limited attention to non-technical skills, which support safety training transfer to the worksite, both immediately after training and in the long term. Using realist evaluation as our theoretical framework, this study explores the transfer of two key non-technical skills to construction sites: communication and decision-making. Trained workers completed questionnaires post-training and after six months. A moderated mediation model found an indirect link through training transfer between communication and decision-making skills immediately post-training and six months later. The results also revealed that high levels of safety self-efficacy moderated the relationship between communication, but not decision-making, safety skills post-training and the extent to which trained workers reported transferring these skills. The study has important practical implications, showing the significance of training transfer of non-technical skills, such as communication and decision-making, to the worksite.

KEYWORDS
safety; training; realist evaluation; non-technical skills; training transfer

1. Introduction

The construction industry is a high-risk sector [1]. Recent data from Eurostat revealed that one in five fatalities in the European Union happened in the construction sector [2]. A particular challenge in the construction sector is the reliance on migrant workers [3]: people engaged in remunerated activity in a state of which they are not a citizen [4]. In Italy, accidents and fatalities are on the increase among migrant workers, but decreasing for native workers [5]. In 2019, 16.90% of accidents could be ascribed to migrant workers and 18.80% of fatalities at work occurred among migrant workers [5]. In Spain, 11.80% of work accidents were reported by migrant workers, and 13% of work fatalities occurred among migrant workers in 2019 [6]. In 2018 to 2019, construction was the sector with the third highest rate of work accidents, an 11% increase compared to the previous year [6].

Migrant workers are particularly vulnerable as they are often low-skilled and face language barriers and different safety cultures [7–9]. Safety training is widely acknowledged as an effective way of improving safety at work [10]; however, a recent systematic literature review concluded that transfer of safety training of migrant construction workers remains under-researched [11]. Transfer of training refers to the extent to which learning is translated into changes in behaviour and maintained over time [12]. The systematic literature review by Peiró et al. [11] revealed two main limitations of current state-of-the-art of safety training of migrant workers in construction. First, there has been little focus on training competencies to support safety application on the construction site (i.e., non-technical skills). Second, evaluation of such training has failed to consider transfer of learned skills to the construction site and long-term application of such skills. The lack of consideration of training transfer is a general issue in the safety training literature [13].

In the present study, we employ a post-training and follow-up design to explore the extent to which safety behaviours were transferred to the construction site. As a case study we use the Construction Training Safety Package (CSTP) [14], which is tailored to the needs of migrant workers in construction. Employing realist evaluation as our framework [15], we explore training transfer as the working mechanism explaining the sustainability of changes, and the conditions in which training transfer can be observed. We focus on the period after training as this is when transfer would occur.

The main contributions of the present study are threefold. First, we evaluate the training transfer ability of a recently developed training programme, the CSTP, which integrates technical and non-technical skills (NTS) training. NTS can be defined as 'the cognitive, social and personal resource skills that complement technical skills, and contribute to safe and effective task performance' [16, p.1]. It has been estimated that at least 80% of incidents and accidents are due to human behaviour [17], and it is therefore important to train workers in *when* to apply safety skills (specifically, NTS) rather than just *how* to work safely (technical skills). We focus in particular on two NTS, communication and decision-making, as these are crucial to safety in the construction sector. NTS training teaches workers how to communicate about safety and how to make decisions about safe behaviours at work [14]. Traditional approaches to safety have focused on normative regulations (the prescription of safety regulations) and error management (identification of the correct way of performing a task safely), but have neglected the complex processes that influence how workers enact safety behaviours in the construction site [18].

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Moving from concrete thinking (e.g., how to use a safety harness) to higher level thinking (e.g., making decisions about when to use a harness) is challenging for low-skilled workers and in particular migrant workers [19]. We therefore need training that focuses not only on the transmission of technical skills, but also on NTS to facilitate workers applying technical skills in the construction site [16]. To the best of our knowledge, CSTP has yet to be evaluated for its effectiveness.

Second, we explore whether learned communication and decision-making NTS safety skills are transferred and whether such transfer leads to an increase in these skills, i.e., whether learning is generalised into behaviours in the workplace and maintained over time [20]. Although training is recommended to improve safety behaviours, there has to date been little attention paid to whether skills and knowledge about safety are translated into actual changes in safety behaviours in the long term [13]. Training transfer refers to the extent to which trained workers apply the skills and knowledge acquired during training once they return to the work setting [20]. Enhancing knowledge of the training transfer process is extremely important as survey results have suggested that 40% of trained workers fail to transfer their learning to behaviours immediately after training [21], and thus training transfer may be an important explanatory mechanism for changes in training outcomes. In the present study, we test whether the use of skills and knowledge explains any increases in our two NTS over time.

An important aspect of training transfer is the context within which transfer happens [20]. One important part of context is trainees' characteristics [20,22]. We explore whether safety self-efficacy beliefs (i.e., whether workers feel they can successfully manage safety challenges in the workplace [23]) are an important precondition for transfer to happen.

Third, we apply realist evaluation [15] as our underlying theoretical framework. The lack of theory-based evaluation is a general issue in safety research [24]. Drawing from the public health domain, it has been suggested that realist evaluation [15] may be a suitable theoretical framework for evaluating safety training to capture how skills acquired during training develop over time and the factors that influence such development [25]. The key question that realist evaluations seek to answer is: 'What works for whom in which circumstances?' This question is answered by exploring how the mechanisms of an intervention work (what makes it work?) in a certain context (what are the circumstances that trigger mechanisms?) to bring about intended outcomes, in what is termed context–mechanism–outcome (CMO) configurations [15,26]. CMO configurations enable the development and testing of coherent theories regarding context, mechanisms and outcomes. These configurations cannot be tested in separate hypotheses, but need to be understood in terms of how they relate to each other [26]. In the present study, we test two CMO configurations to answer the questions of what works for whom in which circumstances – one for each of our NTS outcomes.

1.1. The importance of NTS training

Safety training remains a widely acknowledged means of improving safety in the workplace [27]. Up to 80% of accidents in the workplace can be ascribed to workers' behaviours [28], and research has found that workers perceive training to be the most important factor in making workplaces safer [29]. In line with normative and error management perspectives on safety, safety training has primarily focused on training technical skills (e.g., chemical, electrical and physical risks and hazards; use of personal protective equipment (PPE) [30]); however, these perspectives fail to consider the active role of workers in safety management.

According to the cognitive systems engineering (CSE) perspective [31], a team's work practices shape what situations the teams find themselves in and how they react to these situations. The construction sector is loosely structured, which allows for high degrees of freedom in determining work practices in terms of allocation and sequencing of tasks, workload, pace, coordination and communication, and therefore the team's work practices to manage safety are crucial to prevent accidents and injuries [32]. From this perspective, training in communication and decision-making skills is crucial to improving safety at work [14].

Focusing on safety training of migrant workers in construction, Peiró et al. [11] concluded that few training studies focused on NTS, and none focused on developing communication and decision-making skills. As noted above, the present study evaluates the ability of a training programme (CSTP) to train workers in applying NTS (i.e., communication and decision-making skills) in the construction site. Working in the construction sector is a social process whereby communication between workers plays a key role in safety management [18,32,33]. Communication skills describe the extent to which workers communicate effectively about safety with supervisors and peers, raise concerns about safety, and actively seek information about how to perform work procedures safely [34], so it is important to focus on training safety communication skills to prevent accidents and injuries, paying special attention to migrant workers, who may face language barriers [9].

One important implication of viewing construction work as a social process is that training must follow active learning and participatory principles, where workers interact to develop a shared understanding of preventive safety management [14]. In the CSTP, native and migrant workers were trained together to break down barriers between them [35,36] and to facilitate communication and cooperation once workers returned to the construction site [14].

Workers' decision-making skills regarding how to engage in safe working practices are equally important. In a study by Fung et al. [37], safety professionals reported that the key contributors to accidents were poor judgement of risk and unrealistic risk assessment and hazard analysis. As safety prevention often relies on immediate decision-making, workers must be able to assess and act quickly in response to risks as they emerge onsite [32]. It is therefore an important safety management strategy to train workers to anticipate unsafe behaviours and quickly decide what course of action to take to minimise risks [38]. Decision-making skills are especially relevant in the case of migrant workers, who are often allocated the riskiest jobs [39]. Moreover, in the construction industry, work demands are high [32] and piecemeal work is prevalent [40], so workers are often pressured to prioritise performance over safety [41,42]; therefore, it is crucial that workers are trained in making decisions that consider both performance and safety.

To the best of our knowledge, no studies have focused on these two NTS, communication and decision-making, as outcomes of safety training in the construction sector [11]. Vignoli et al. [43] tested the antecedents of training transfer in an NTS

training; however, they did not evaluate the actual training transfer and how this explained outcomes of training.

1.2. Hypotheses and CMO configuration development

In the previous section, we discussed the importance of training NTS. An overlooked area in safety management training is whether trained workers apply learned skills in their workplaces [11]. Training transfer relates to the extent to which workers use the skills they have acquired during training in their everyday job [44] and aims to lessen the gap between learning and sustainable changes in behaviours in the workplace [45]. In order to understand the gap between learning the two NTS (communication and decision-making) and sustained application of these skills, we focus on the levels of communication and decision-making immediately after workers complete training (as a proxy for learning), and how these NTS develop over time, i.e., whether the use of these skills increases over time and becomes an integrated method of safety management in the construction site.

It is important to consider training transfer of NTS as compared to technical skills. NTS are less salient and less immediate, and require a higher degree of translation as they describe more abstract concepts [38]. The dynamic training transfer model [46] suggests that attempts to transfer skills are crucial for sustainable behavioural change. In other words, workers must be able to engage in training transfer by having opportunities to apply learned skills.

The greater need for translation of NTS into actual behavioural change means that mastery of such skills is challenging to achieve [39]. The more workers engage in behaviours to apply NTS they have learned during training, the more likely they are to increase the use of these skills later – i.e., if they transfer learned skills, we will see increases six months post-training in (a) communication and (b) decision-making. Applying a relist evaluation perspective, training transfer may therefore be a key mechanism in explaining increases in the application of NTS over time. H_1 can therefore be stated as follows:

> H_{1a}: There will be an indirect path between communication skills Time 1 (T1) and communication skills Time 2 (T2) through training transfer (T2).
>
> H_{1b}: There will be an indirect path between decision-making skills (T1) and decision-making skills (T2) through training transfer (T2).

1.3. Self-efficacy and training transfer

There is strong evidence to suggest that trained workers' belief about their own competence to manage the challenges they face at work, i.e., self-efficacy, is related to training transfer [22,40]. Safety self-efficacy refers to workers' confidence that they can adhere to safety procedures and manage and prevent hazards in their work team [23]. According to Bandura [47], people's beliefs in their efficacy can have diverse effects: beliefs influence the choices individuals make about their behaviours and the resources individuals will employ to engage in these behaviours. Individuals engage in tasks in which they feel competent and avoid those they do not feel competent about. Laker and Powell [38] argued that NTS training may not increase self-efficacy to the same extent as technical skills training as there are no prescribed ways of translating these skills to the workplace setting. Safety self-efficacy may be an important contextual factor (precondition) that influences the extent to which trained workers apply their newly learned skills once they return to the construction site. Trained workers who have a strong belief that they can successfully adhere to safety procedures and have sufficient control to prevent hazards in the workplace are more likely to engage in training transfer – i.e., they are more likely to apply NTS once they are back at the construction site.

From a realist evaluation perspective, we propose that workers who report high levels of learning NTS (communication and decision-making) and who score high on safety self-efficacy post-training are more likely to apply acquired skills and knowledge in their daily work (transfer training) – i.e., that workers' self-efficacy is an important contextual factor that triggers the mechanism of training transfer.

> H_2 can therefore be stated as follows:
>
> H_{2a}: The association between communication skills (T1) and training transfer (T2) will be moderated by safety self-efficacy (T1). We propose that the higher the levels of safety self-efficacy, the more trained workers will engage in transferring their learned communication skills.
>
> H_{2b}: The association between decision-making skills (T1) and training transfer (T2) will be moderated by safety self-efficacy (T1). We propose that the higher the levels of safety self-efficacy, the more trained workers will engage in transferring their learned decision-making skills.

1.4. CMO configuration

Central to realist evaluation is the synthesis of hypotheses into CMO configurations, which can be tested [26]. Based on our hypotheses, we can formulate two CMOs, one for each of our NTS outcomes. As outlined above safety self-efficacy is an important contextual factor. Equally, the level of NTS acquired during training is an important precondition. Together safety self-efficacy and the level of acquired NTS immediately after training will trigger the mechanism of training transfer, i.e., the extent to which trained workers engage in transfer behaviours. If the mechanism of training transfer is triggered, we would expect to see an increase in our NTS outcomes over time as trained workers develop their NTS and apply them in more situations and settings. Translating our hypotheses into a testable CMO configuration, we propose the following CMO configuration:

> CMO Configuration 1: If trained workers report high levels of safety self-efficacy and have learned communication skills (context), then they will transfer these skills to the construction site (mechanism), and as a result these skills will increase over time (outcome).
>
> CMO Configuration 2: If trained workers report high levels of safety self-efficacy and have learned decision-making skills (context), then they will transfer these skills to the construction site (mechanism), and as a result these skills will increase over time (outcome).

2. Method

2.1. Design and participants

We employed a two-wave evaluation design, with surveys distributed immediately after training (T1) and a follow-up six months later (T2). The study took place in the construction industry in Italy and Spain. Ethics approval (no. 026475) was obtained from the departmental ethics board of the principal investigator. All participants received an information sheet with information about the study and their right to withdraw from the study at any time. All participants signed a consent

Table 1. Worker characteristics.

Variable	Results
Gender	Male (93%)
Age	40.78 (SD = 13.56)
Organisational tenure (years)	5.41 (SD = 8.07)
Country of training	51.20% Spain, 48.80% Italy
Migrant workers	41.9%
Non-EU, non-native speaker workers	16.3%
EU, non-native speaker workers	14%
Non-EU, native speaker workers	11.6%
Migrant workers: Spain (seven countries)	–
Colombia	13.6%
Ecuador	9%
Brazil	4.5%
Migrant workers: Italy (six countries)	–
Romania	19%
Moldova	9.5%
Pakistan	4.8%

form. The surveys were distributed to all workers who completed training. A total of 107 native and migrant workers completed training and they all completed the T1 survey. Six months after completing training, 57 workers completed the questionnaire (response rate = 47.90%). In the present study, we include these 57 workers; however, not all of these completed all questions, so the sample sizes in some cases is lower. (See Table 1 for an overview of participants.) We conducted dropout analyses to explore attrition from T1 to T2. Analyses revealed no significant differences between those who only responded at T1 to those who responded both times in terms of gender, migrant worker status, decision-making or communication.

2.2. The CSTP training

We evaluated the training transfer potential of the CSTP [14]. The CSTP is designed to accommodate the learning needs of low-skilled and migrant workers in the construction industry; however, to break down barriers between migrant and native workers, all construction workers are training together. The CSTP consists of 20 h of face-to-face training supplemented by 4 h of online training. The CSTP employs training methods drawing upon cognitive and social constructivist approaches, i.e., active learning and participatory [48] and training transfer principles [44]. The training content comprises both technical skills (as required by the national regulations on safety training) and NTS, which aimed to facilitate the transfer of technical skills to the workplace [16,19].

Face-to-face classroom safety training has been criticised for taking place away from the workplace and being focused on passive learning, in which workers listen without participating [27]. In response to this, the CSTP's face-to-face sessions utilises active learning and participatory principles, such behavioural modelling, feedback and dialogue [49], together with exercises closely aligned with the daily experiences of workers [44]. To encourage transfer of training, workers also developed action plans encouraging them to practice technical skills and NTS as part of face-to-face training [44].

An example of a group exercise practicing both technical skills (repairs of electrical systems and hydraulic hoses in compliance with safety rules) and NTS (communication skills) is a layout exercise aimed at enhancing signalising and non-verbal communication [9]. The exercise consists of three parts and requires three volunteers. One volunteer, with their back to the other trainees, must describe an apartment layout and the location of safety risks inside it, such as a broken pipe or a sagging hallway ceiling. Trainees must then draw the apartment layout and indicate the safety risk sources, following the volunteer's instructions. In the first part of the exercise, trainees are not allowed to ask the volunteer additional questions. In the second part, trainees are allowed to ask the second volunteer additional questions for clarification. In the third part, the volunteer is a migrant worker who is allowed to face the other trainees and can describe the apartment layout in their native language and use non-verbal communication (e.g., gestures) as well. Trainees are allowed to ask further questions. At the end of the exercise, the trainer goes over the differences between the actual layout and the trainees' drawings in each of the three exercise parts. Trainees then discuss the pros and cons of each communication style and how each may affect safety behaviours.

An example of an exercise aiming to integrate technical skills (using excavators safely) with NTS (decision-making skills) is a role-playing exercise. In this exercise, six volunteers were given a card describing a scenario in which an accident occurs and allocated a specific role to play:

> In the middle of the work, Adam notices that the actual position of the pit and the adjacent construction basement do not correspond exactly with the technical drawing reporting the position of the largest gas pipe. First, he talks with the foreman, who replies that Adam must keep on working. Next, Adam tries to talk with Danny, but he is in a hurry and must leave. Adam then asks Alex, who does not understand the reasons behind Adam's concerns. Adam goes back to complete the task of digging the pit. A few minutes later, he hits something hard and hears a sudden high-pressure gas discharge: it is evident that he broke the main gas pipe!. The activity ends with a plenary session where trainers and trainees discuss the elements contributing to the accident, with a particular focus on NTS enacted by the different characters. An example of a discussion question is: 'By evaluating the different options, was Adam able to make appropriate decisions to ensure safety in the situation?'

The CSTP online training platform contains interactive games that test trainees' knowledge. Guo et al. [27] recommended gaming as an effective safety training method. The CSTP games provide immediate, explanatory feedback to workers in order to facilitate learning and are structured around the face-to-face training such that workers can further explore the topics they have found challenging in classroom sessions. To ensure consistency of training across the two countries, a training manual for trainers was developed and the research team delivered a train-the-trainer session. To ensure active engagement, we delivered training in smaller groups, in total three in each country (Italy and Spain).

2.3. Measures

The two NTS measures were taken from the Mariani et al. [34] NTS questionnaire. Each dimension contains four items: *Decision-making skills* (example item 'When required, I make quick decisions to ensure safe working') (T1 $\alpha = 0.778$, T2 $\alpha = 0.703$) and *Communication skills* (example item 'I communicate effectively about safety with colleagues') (T1 $\alpha = 0.753$, T2 $\alpha = 0.810$).

Training transfer was captured with three items inspired by Grohmann and Kauffeld's [45] application to practice and explored the extent to which trained workers use the skills they have acquired during CSTP training. An example of an item is 'In my everyday work, I often use the knowledge I gained in the training' (T2 $\alpha = 0.865$).

Safety self-efficacy was measured by three items from Katz-Navon et al. [23]. This measure captures whether workers are confident they can adhere to safety procedures and prevent safety incidents at work. An example item is 'I am confident in my ability to keep the safety procedures of my gang' (T1 $\alpha = 0.813$).

All measures used a 5-point Likert-type response scale ranging from 1 = *strongly disagree* to 5 = *strongly agree*.

2.4. Data analysis

We tested our hypotheses using Hayes's [50] PROCESS Macro version 3.4.1, a popular tool used with complex statistical models, in SPSS version 26.0, which enabled us to test our CMO configurations in two models, one for each of our outcomes. We specified 5000 bootstrap samples, in order to obtain more robust SE estimates and confidence intervals, and specified the moderator to show values at ±1 SD. We also covaried participant age, country of training and in which training pilot they participated, as correlation analyses indicated these were correlated with our outcomes.

In our analysis, we examined two models. Model 1 includes H_{1a} and H_{2a}: H_{1a} tested whether there is an indirect relationship between T1 and T2 communication, via T2 training transfer; H_{2a} tested the same mediation model but with T1 safety self-efficacy moderating path *a*. Model 2 includes H_{1b} and H_{2b}: H_{1b} tested the indirect relationship between T1 and T2 decision-making, mediated by T2 training transfer; H_{2b} tested the same mediation model but with T1 safety self-efficacy also moderating path *a*.

3. Results

Table 2 shows the scales, means, SD and intercorrelations of all variables in this study. Paired-sample *t*-tests between T1 and T2 were used to identify any significant increases in communication and decision-making in the sample as a whole, revealing only a small, but significant, decrease in decision-making skills (T1 $M = 4.42$ vs. T2 $M = 4.17$), $t(42) = 2.51$, $p < 0.050$). These results showed that without considering within-intervention group variability in reports of training transfer, we would have concluded that the CSTP has no effect. The exploration of training transfer allows us to explore whether effects can be detected if the mechanism of training transfer is activated and if the context is supportive of transfer (Table 3).

3.1. Model 1 (communication skills)

Analyses showed a significant indirect effect between T1 and T2 communication skills, via T2 training transfer ($b = 0.17$, 95% CI [0.01, 0.38]), supporting H_{1a}. However, moderation analyses indicated that T1 safety self-efficacy did not significantly moderate the relationship between T1 and T2 communication skills ($b = 0.31$, 95% CI [−0.13, 0.74]), rejecting H_{2a}. The overall model, with all variables, showed a non-significant index of moderated mediation (index = 0.27, 95% CI [−0.07, 0.59]), which means there was no conditional indirect effect between T1 and T2 communication skills, via T2 training transfer and moderated by T1 safety self-efficacy. This means that we are unable to answer the 'for whom' question in our CMO, as safety self-efficacy is not a moderator (Figure 1).

3.2. Model 2 (decision-making skills)

Analyses showed a significant indirect effect between T1 and T2 decision-making skills, via T2 training transfer ($b = 0.13$, 95% CI [0.02, 0.29]), supporting H_{1b}. Moderation analyses suggested that there was no significant moderating effect of T1 safety self-efficacy between T1 and T2 decision-making skills (b = 0.13, 95% CI [−0.39, 0.66]); however, the overall model showed a significant index of moderated mediation (index = 0.22, 95% CI [0.00, 0.51]). The relationship between T1 decision-making and T2 training transfer was significantly moderated when T1 safety self-efficacy was at moderate (4.31) and high (+1 SD = 4.91) levels, thus supporting H_{2b}. As shown in Figure 2, moderate levels of safety self-efficacy led to greater training transfer when T1 communication skills were high (effect = 0.67, 95% CI [I9.19, 1.17]), while high levels of safety self-efficacy showed the highest amount of training transfer (effect = 1.20, 95% CI [0.42, 2.0]. Therefore, we find support for our CMO configuration.

Synthesising these results into our hypothesised CMO configuration, we can conclude that if trained workers report high or moderate levels of safety self-efficacy and have learned decision-making skills (context), then they apply these skills (training transfer as the mechanism) and, as a result, decision-making skills increase over time (outcomes). We were unable to formulate a similar CMO for communication skills.

Table 2. Means, SD, and intercorrelations of study measures and control variables (N = 43).

Variables	Mean	SD	1	2	3	4	5	6	7	8
1) Age	40.78	13.56	–	–	–	–	–	–	–	–
2) Country	1.51	0.51	0.136	–	–	–	–	–	–	–
3) Training session	4.09	2.15	0.197	0.898**	–	–	–	–	–	–
4) Communication T1	4.36	0.74	−0.042	0.111	0.185	–	–	–	–	–
5) Communication T2	4.29	0.58	−0.150	0.582**	0.576**	0.116	–	–	–	–
6) Decision-making T1	4.42	0.57	−0.134	0.085	0.161	0.766**	0.200	–	–	–
7) Decision-making T2	4.17	0.48	−0.039	0.425**	0.480**	0.207	0.765**	0.237	–	–
8) Training transfer T2	4.20	0.74	−0.055	−0.006	0.008	0.441**	0.415**	0.405**	0.399**	–
9) Safety self-efficacy T1	4.31	0.60	0.090	−0.016	0.067	0.566**	0.081	0.523**	0.043	0.112

*$p < 0.050$; **$p < 0.010$.
Note: Country: 1 = Italy; 2 = Spain.

Table 3. Results of the moderated-mediation model for decision-making.

	T2 Training transfer (M) model		T2 Decision-making skills (Y) model	
Variable	Coefficient	SE	Coefficient	SE
Age	−0.001	0.009	−0.005	0.005
Country of training	0.373	0.527	−0.128	0.279
Training session	−0.109	0.133	0.146	0.072
T1 Decision-making skills (X)	−3.045	1.761	−0.056	0.119
Safety self-efficacy (W)	−0.3912	1.845	–	–
T1 Decision-making skills ∗ T1 Safety self-efficacy	0.863	0.417	–	–
T2 Training transfer (M)	–	–	0.258	0.090
M Model summary	$R^2 = 0.258$	∗	–	–
Y Model summary	–	–	$R^2 = 0.377$∗	–
	Conditional indirect effect of T2 decision-making skills (X) on T4 decision-making skills (Y) through training transfer (M) at values of workers' safety self-efficacy (W)			
Safety self-efficacy	Effect	Boot SE	Boot 95% CI	
Low (3.70)	0.039	0.070	[−0.08, 0.20]	
Middle (4.31)	0.174	0.086	[0.02, 0.36]	
High (4.91)	0.309	0.149	[0.04, 0.64]	

$*p < 0.050$; $**p < 0.010$; $***p < 0.001$.
Note: $N = 39$. CI = Confidence Interval.

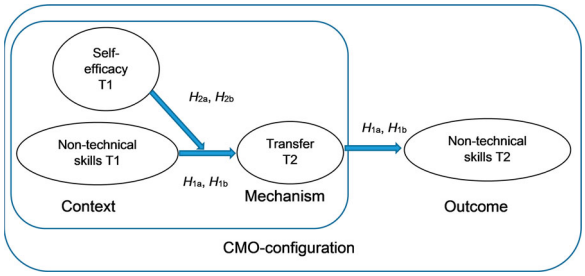

Figure 1. CMO configuration framework.
Note: CMO = context, mechanism, outcome; H 1a –H 2b = hypothesis 1a–2b; T1 = Time 1; T2 = Time 2.

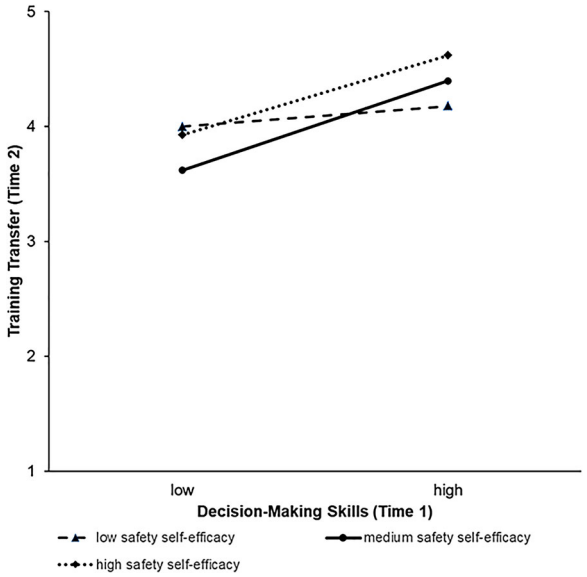

Figure 2. Form of interaction between decision-making skills (T1) and safety self-efficacy (T1) on training transfer (T2).

4. Discussion

In the present study, we evaluated the training transfer potential of an innovative safety training programme for low-skilled workers in construction, with a particular focus on migrant workers. Based on realist evaluation, we tested whether training in two NTS, communication and decision-making, led to increases in these skills over a six-month period post training. We suggested that increases would only be observed if trained workers transferred their skills and knowledge to the construction site, and that workers who were confident of their competence in addressing safety challenges in the workplace would show greater transfer. We found partial support for our hypotheses. Our analyses revealed an indirect link between communication and decision-making skills immediately post-training and six months later through training transfer (supporting our first hypothesis). Without the transfer of communication and decision-making skills, these learned skills may even decrease over time as they are not practiced [46]; this was the case for decision-making skills in our study.

In support of our second hypothesis, we found that high levels of safety self-efficacy moderated the relationship between decision-making skills post-training and the extent to which trained workers reported transferring these skills, such that the more safety efficacious workers reported being, the more they transferred skills. When safety self-efficacy was low, trained workers failed to transfer skills. We failed to find a similar result for communication skills.

Taken together the tests of these hypotheses enabled us to test our CMO configurations: our PROCESS models confirmed that the transfer of learned communication skills was the explanatory mechanism that led to increased use of these skills in a context where trained workers reported feeling self-efficacious about managing safety challenges at work and had learned communication skills during training.

We are unable to identify a similar CMO configuration for decision-making skills. Only the MO part of the configuration was confirmed: the mechanisms of training transfer led to the outcome of increased use of decision-making skills. Future studies should explore what contextual factors might trigger the decision-making skills mechanism.

4.1. Implications for research and practice

Our study has important implications for research on how to design and evaluate the safety training of migrant workers. In terms of the design of safety training, we found our training methods to be effective to transfer trained workers' communication and decision-making skills over time. Previous research on safety training of migrant workers has mainly focused on translating existing training into migrant workers' native language and has failed to examine the long-term effects of such training [11]. As migrant workers in Europe are not a homogeneous group [51], such a strategy is not feasible in the European context. Moreover, simply translating existing material fails to consider methods that might facilitate migrant worker learning [52]. Our results indicate that training that is based on cognitive and social constructivist and training transfer principles (e.g., relevance to the migrant worker context, and including development of a shared understanding of safety issues, behavioural modelling, feedback and dialogue) [44,48,49] and focuses on integrating NTS and technical skills [14] may encourage workers to transfer learned skills to the construction site, which in turn is related to increased use of NTS in the long term, regardless of whether they are migrant or native workers.

In terms of the evaluation of training, we found that a training course that focused on workers acquiring NTS to enhance their technical skills [16], employed active learning and participatory training methods, and supplemented face-to-face training with online serious games [14] successfully enhanced these skills over a period of six months, if trained workers applied these skills. Our study indicates the importance of studying training transfer. Without studying training transfer, we were unable to detect any improvements in NTS over time.

To overcome the limitations of previous research evaluating the effects of safety training research [24], we employed a theoretical evaluation model to evaluate the effectiveness of our training. We found that the use of realist evaluation [15] enabled us to establish what works for whom in which circumstances. Our research calls for the use of sophisticated evaluation designs that consider the mechanisms that make training work (training transfer) and the circumstances in which these mechanisms operate (workers' self-efficacy). In line with Blume et al.'s [46] dynamic training transfer model, we need to employ long-term follow-ups to understand the sustainable effects of safety training transfer.

It is equally important to consider the implications of our study for practice. Our results indicate that once trained workers return to the construction site, they should be encouraged to apply learned skills. There are multiple forms such encouragement could take. Occupational safety and health professionals could hold toolbox talks [53], where trained and non-trained workers meet and discuss safety issues and trained workers are encouraged to share their acquired skills. Supervisors can also play an important role in supporting training transfer. They could discuss learning with workers once they return to the construction site and allocate specific tasks to trained workers that allow them to apply their learned skills. For example, supervisors could place trained workers in situations where they need to communicate about PPE. They could also allocate them responsibility for safety at work, e.g., making sure that the necessary PPE is available to all and is not out of date.

This study supports the evidence presented by Bandura and Locke [54] and shows that efficacy beliefs predict the behavioural functioning between individuals at different levels of perceived self-efficacy, corroborating that high levels of efficacy beliefs lead NTS to have a stronger effect on training transfer, making training more effective. Therefore, it is highly recommended that trainers and supervisors promote efficacy beliefs of workers, both during training courses and on the construction site. They should particularly focus on promoting the beliefs of migrant workers, who often come from cultures where safety is less of a priority [41,42] and migrant workers may thus present lower levels of safety-related self-efficacy. Supervisor support is an important job resource [55] and triggers workers' personal resources [56]. Workers seek support and guidance from their supervisors, who can help them to increase their safety self-efficacy beliefs, mainly though verbal persuasion and vicarious experience, which are two of the main sources of self-efficacy (together with mastery experiences and positive emotional states) [47]. Future studies could focus on how to foster the efficacy beliefs of construction workers both in safety training programmes and in their daily work on site.

4.2. Strengths and limitations

The strengths of the study are the evaluation of whether NTS can be trained and whether these skills are transferred, thus leading to sustainable effects; however, our study is not without its limitations, which must be taken into account when drawing conclusions about our results.

First, we did not include a control group. Our design allowed us to investigate what happened after the training had been completed, but we do not know whether NTS might have improved without our training. The aim of our study, however, is to focus on the role of training transfer in bringing about intervention outcomes post-training, and we could not explore the transfer of training in workers who have not been trained. A control group that had not undergone training would add little understanding of the factors that promote training transfer and the actual transfer of training. Future research could focus on experimentally varying the transfer factors, thereby providing more rigorous tests of the relationships proposed in this study.

Second, our response rate at T2 was low, and attrition presents a challenge. The follow-up took place during the pandemic of 2020, and as the construction sector in both countries was affected by lockdown, this is likely to have influenced our response rates. Nevertheless, we were able to detect an indirect effect between NTS through training transfer, which suggests training was effective, despite the small sample size.

Third, we measured NTS by asking trained workers to self-report their NTS immediately after training and six months later. Self-reporting may present a bias, and it could be argued that observations would be a better method to capture NTS. Our workers came from different construction sites and we did not have the necessary resources to visit these sites to observe trained workers' behaviours at two time points. It could be argued that we could have chosen to observe only a few workers; however, we prioritised collecting the self-reported behaviours of all who participated in training to obtain a representative view of changes in NTS. Future studies should consider observations of NTS.

Finally, the sample of workers who responded both times were slightly younger than those workers who responded only at T1. We primarily collected follow-up data online and it is possible that younger workers had better access to computers, smartphones and tablets and may also be more information technology literate [57].

5. Conclusions

This study adds to the current literature on the safety training of low-skilled and migrant workers in the construction industry in three ways. First, this study highlights the importance of NTS (i.e., communication and decision-making), as a complement to technical skills in safety training programmes in the construction sector. We found support that NTS can be trained and transferred to the work site, leading to sustainable effects and expanding the effectiveness of safety training, thus improving safety performance of native and migrant workers. Second, we found safety self-efficacy beliefs to be a key precondition for training transfer, therefore representing a lever that should be considered in safety training courses, for both workers and supervisors, to ensure the transfer of acquired expertise to the work site. Finally, our study employed a theoretical evaluation approach, realist evaluation, which enabled us to test what worked for whom in which circumstances, namely that workers who report communication and NTS after training and who are safety self-efficacious are more likely to apply these skills, and as a result we see long-term effects of training.

Disclosure statement

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