Article:
Peiro, J.M., Nielsen, K., Latorre, F. et al. (2 more authors) (2020) Safety training for migrant workers in the construction industry: A systematic review and future research agenda. Journal of Occupational Health Psychology, 25 (4). pp. 275-295. ISSN 1076-8998

https://doi.org/10.1037/ocp0000178

Title page with All Author Information

Safety Training for Migrant Workers in the Construction Industry: A Systematic Review and Future Research Agenda.

José María Peiró

University of Valencia, & Ivie, Valencia, Spain.

Karina Nielsen

The University of Sheffield, Sheffield, UK.

Felisa Latorre

University of Valencia, Spain.

Rose Shepherd

The University of Sheffield, Sheffield, UK.

Michela Vignoli

University of Trento, Rovereto, Italy.

Safety Training for Migrant Workers in the Construction Industry: A Systematic Review and Future Research Agenda.

Abstract

The construction sector is high risk for accidents, injuries, and fatalities, particularly for migrant workers who comprise a large proportion of the workforce. This paper presents a systematic literature review of current safety training provision for migrant construction workers. In the interests of rigor, we draw on the learning, training transfer, and training effectiveness literatures, exploring not only the extent to which training brings about the intended outcomes, in terms of enhanced safety behaviors, and reduced accidents and injuries, but also the factors which influence learning and transfer of training back to the working environment. The literature search revealed only 18 peer-reviewed articles have been published since 2000, which is particularly surprising given the disproportionate accident and fatality rates for migrant workers. Consequently, we propose a research agenda to enhance safety training for low skilled, migrant and native construction workers, drawing on cognitive and social constructivist instructional design models, which view training as a dynamic process involving active participation of trainees. We advocate the importance of attending to the situational context in which workers are embedded, including labor market conditions, social relations, and cultural differences. Finally, we propose the need for further longitudinal, multi-dimensional research to evaluate the impact of safety training on learning, transfer of training, and individual and organizational level outcomes, such as behavior change, and accident and fatality rates.

Keywords: safety, training, evaluation, systematic literature review, migrant workers, construction workers

Safety Training for Migrant Workers in the Construction Industry: A Systematic Review and Future Research Agenda

In spite of efforts to protect the health and safety of workers, there are still 374 million nonfatal work-related accidents or illnesses every year and more than 2.78 million workplace fatalities (International Labour Organization [ILO], 2018). This means every 15 seconds, 150 workers have a work-related accident and one worker dies. The construction sector has a particularly poor safety record, with workers at increased risk of accidents and injuries (e.g., Buckley, Zendel, Biggar, Frederiksen, & Wells, 2016). The Statistical Office of the European Union report more than 1 in 5 (20.9%) fatalities at work in European Union Member States (EU-28) in 2015 took place within construction (Eurostat, 2018). According to the United Kingdom (U.K.) Health and Safety Executive (HSE), there were 1.64 fatal injuries per 100,000 full-time construction workers in the U.K. in 2018; a 27% increase over the previous year (HSE, 2018). This figure is around 4 times as high as the average rate across all other industries. Likewise, the United States (U.S.) Bureau of Labor Statistics (BLS) reported 9.5 fatalities per 100,000 full-time construction workers in the U.S. in 2017, compared with an average of 3.5 fatalities per 100,000 full-time workers across all industries (BLS, 2017).

The complex and ever-changing nature of the construction industry, with its focus on productivity and efficiency, makes safety particularly challenging (e.g., Brunette, 2005; Buckley et al., 2016; Choudhry & Fang, 2008; Dutta, 2016). Workers rarely have stable employment with one employer, typically moving from one building project to another (Brunette, 2005). Many subcontractors, of varying size, typically work on the same site, following different safety values, rules, regulations, and practices (Choudhry & Fang, 2008). Depending on the construction project (e.g., residential, roads, bridges), workers are exposed to varying hazards, such as working at height or operating complex machinery (Buckley et al., 2016), and often have to work in close proximity to one another, performing different

tasks (Choudhry & Fang, 2008). There is also immense pressure to complete tasks quickly, to deliver projects on time and within budget (Dutta, 2016). As a result, risks differ from site to site, trade to trade, job to job, and even day to day (Brunette, 2004, 2005).

Migrant Workers in the Construction Industry: A Vulnerable Group

The construction industry relies heavily on migrant workers, defined as persons who are engaged or have been engaged in remunerated activity in a State of which they are not national (United Nations [UN], 1990). During their first year in a new country, male migrants are predominantly employed in the construction sector, and are 1.4 times more likely to work in construction than native-born men (Eurostat, 2011). A recent report from the Office for National Statistics (ONS) estimates around 10% of all construction workers in the U.K. between 2014 and 2016, were non-national (ONS, 2018). Migrant workers, with low levels of skill, are particularly vulnerable, with higher reported rates of accidents and fatalities compared with native workers (e.g., Dong, Choi, Borchardt, Wang, & Largay, 2013; Dong, Fujimoto, Ringen, & Men, 2009; Dong, Men, & Ringen, 2010). For example, nearly 1 in 4 migrant workers who died on the job in the U.S. between 1996 and 2001 were employed in construction (Loh & Richardson, 2004). In the U.K. in 2007/2008, 66% of migrant worker deaths were in the construction industry (Centre for Corporate Accountability [CCA], 2009).

Existing research points to several contributory factors behind these shocking statistics. First, labor market conditions present a major challenge. Migrant workers often work in smaller companies, have poor quality jobs, low levels of pay, and are allocated the riskiest tasks without appropriate protective equipment (Moyce & Schenker, 2018); however, they accept these conditions to provide financial support to their families (Dutta, 2017; Menzel & Gutierrez, 2010). Relatedly, migrant workers may not be trained in construction but accept construction work because jobs are not available in their preferred field (Buckley et al., 2016). They may also have different attitudes and values towards safety than native

workers, influenced by work-related experiences, and safety practices in their countries of origin (Brunette, 2004). In addition, malnourishment and cramped living conditions contribute to sleep deprivation, increased fatigue and poor concentration, reducing safety-related behaviors on site and enhancing the risk of accident and injury (Brossoit et al., 2018; Dutta, 2017; Kao, Spitzmueller, Cigularov, & Wu, 2016). The situation is particularly dire for migrants who have entered the country illegally, as they fear losing their jobs or being deported (Menzel & Gutierrez, 2010; Moyce & Schenker, 2018).

Second, social relations present a challenge. Migrant workers are reported to have poor relationships with supervisors, experiencing language barriers (Donaghy, 2009), abuse (Dutta, 2017), and pressure to prioritize performance over safety (Choudhry & Fang, 2008; Menzel & Gutierrez, 2010). Other studies have found migrant workers typically work in close-knit teams with family members and friends, and thus do not learn the host country's safety values, rules, and regulations, from their native peers (Al-Bayati, Abudayyeh, Fredericks, & Butt, 2017; Hallowell & Yugar-Arias, 2016). These issues become more problematic in large construction sites with diverse labor forces (Oswald, Sherratt, Smith, & Hallowell, 2018). Santoso (2009) analyzed discrimination problems in a large, multicultural construction site and found issues with communication, wage segmentation, task assignment, trust, scapegoatism, beliefs, and religion, all played a role in working relations potentially causing tension. Diverse, multicultural workforces are particularly prominent in Europe (Eurostat, 2019), while in the U.S. the majority of migrant workers are Hispanic (Brunette, 2004).

Third, related to the above, research has indicated that cultural differences, at a national level, impact on training effectiveness and safety outcomes for migrant workers (e.g., Burke, Chan-Serafin, Salvador, Smith, & Sarpy, 2008; Choudhry & Fang, 2008; Hallowell & Yugar-Arias, 2016; Menzel & Gutierrez, 2010), although research of this nature

remains scarce (Hoffmann, Burke, & Zohar, 2017; Starren, Hornikx, & Luijters, 2013). A study of 68 organizations from 14 countries found a moderating effect of uncertainty avoidance on the transfer of safety training, and reduction of accidents and injuries (Burke et al., 2008). Other studies have highlighted how cultural differences impact upon migrant workers' willingness to wear personal protective equipment (PPE) compared with native workers (Chan, Javed, Wong, Hon, & Lyu, 2017a; Choudhry & Fang, 2008; Hallowell & Yugar-Arias, 2016). Cultural factors also influence perceptions of organizational safety climate, which is reported to be poorer among migrant workers compared with native workers (Arcury et al., 2012; Chan, Wong, Hon, Lyu, & Javed, 2017b).

A Need for Better Safety Training

Following calls from Donaghy (2009), it is crucial to develop our understanding of how accidents and injuries occur, and how they can be prevented through safety training, a primary mechanism for enhancing workplace safety by encouraging behavior change (e.g., Burke et al., 2006; Burke et al., 2011; Cunningham et al., 2018; Dong, Entzel, Men, Chowdhury, & Schneider, 2004; Moyce & Schenker, 2018; Robson et al., 2012; Tutt, Daunty, Gibb, & Pink, 2011). In their systematic review of safety management studies in construction, Zhou, Goh, and Li (2015) found safety training to be one of the key safety management processes aimed at reducing accidents. Similarly, a meta-analysis by Ricci, Chiesi, Bisio, Panari, and Pelosi (2016) found occupational health and safety (OHS) training had a strong effect on workers' OHS attitudes, beliefs and knowledge. Recently, Lee, Huang, Cheung, Chen, and Shaw (2019) found safety training to be a central part of workplace interventions aimed at enhancing safety climate, a factor widely reported to have a positive impact on workers' safety performance (see Clarke, 2006, 2010, 2013 for meta-analyses).

Aksorn and Hadikusumo (2008) identified four factors influencing the effectiveness of safety training in construction: workers' involvement, safety prevention and control

systems, safety arrangements, and management commitments. In most countries, governments have introduced compulsory training to ensure safety training of construction workers, e.g., the Construction Industry Training Board (CITB) in the U.K., the Occupational Safety and Health Administration (OSHA) in the U.S., or the Spanish regulations established in the National Collective Agreement. Limited attention has been paid to developing and implementing training tailored to the particular challenges and vulnerabilities faced by migrant construction workers. For instance, safety training may only be offered at induction and may not be easily understood if workers' language skills are rudimentary (Mckay, Craw, & Chopra, 2006). More alarmingly, safety training may not be undertaken at all; studies report between two-thirds and three-quarters of migrant workers sampled had received some form of safety training (O'Connor, Loomis, Runyan, Abboud Dal Santo, & Shulman, 2005; Trajkovski & Loosemore, 2006).

These specific risks and challenges also highlight the need to formulate tailored criteria to evaluate the effectiveness of safety training for migrant construction workers. Previous systematic literature reviews on OHS training have primarily focused on the outcomes of training, i.e., knowledge, attitudes and beliefs, behaviors, and health (Ricci et al., 2016; Robson et al., 2012). Asari and Leman (2015) reviewed current approaches to evaluating safety training using Kirkpatrick's (1994) 4-level training evaluation model, and concluded it is rarely evaluated systematically. Safety training is most often evaluated only at the first level of Kirkpatrick's model (reactions to training) and, as a result, evaluation provides little knowledge on how to design future safety training (Asari & Leman, 2015). Although not tested or used in systematic reviews, models have been developed for the evaluation of safety training that capture the transfer of training, e.g., whether knowledge and skills acquired during training are generalized into workplace behaviors and whether such

changes in behaviors are maintained over time (Pedersen, Nielsen, & Kines, 2012; Vignoli, Punnett, & Depolo, 2014).

The main aims of our paper are threefold. First, to review systematically the literature on safety training for migrant construction workers, highlighting its strengths and weaknesses, and gaps in our current knowledge and understanding. Second, to identify key challenges for both researchers and practitioners in the design, implementation, and evaluation of safety training activities, with a view to understanding how these can be overcome. In particular, we look to investigate factors which influence learning and transfer of training back to the working environment. Third, to develop a research agenda, explaining how the effectiveness of safety training in the construction industry can be improved, not only for low-skilled, migrant workers but also low-skilled, native workers.

In the interests of rigor, our review integrates the learning, training transfer, and training effectiveness literatures. First, following Kirkpatrick's (1994) model, we consider trainees' reactions (e.g., satisfaction) and learning as outputs of training effectiveness, at the individual level. Moreover, in line with Kraiger, Ford, and Salas (1993), we distinguish between learning of cognitive, affective, and skills capacities. These three types of learning outcomes are essential given the specificities of migrant workers' risks. Second, in line with Baldwin and Ford's (1988) dominant training transfer model, we consider the extent to which knowledge, attitudes, and skills learned during training are retained, transferred to the work setting, translated into behavioral change, and maintained over time (Blume, Ford, Baldwin, & Huang, 2010; Burke & Hutchins, 2007; Hussain Pedro, Lee, Pham, & Park, 2018). Third, to understand whether training brings about its intended outcomes, we also consider the organizational level, again following the training effectiveness model (Kirkpatrick, 1994). In utilizing an integration of these three models, we move beyond traditional methods for evaluating the outcomes of safety training (Lee et al., 2019) and formulate an integrative

model, at both the individual and organizational level. This model aims to develop practice-oriented guidance on how to design, implement, and evaluate safety training.

Effectiveness of Training: Learning, Transfer and Outcomes

As outlined above, the effectiveness of training can be measured at different levels. Learning is one such level, which is included in all three training evaluation models (Kirkpatrick, 1994; Kraiger et al., 1993; Baldwin & Ford, 1988). We therefore explore whether studies of safety training for migrant construction workers report learning as an outcome of training. Furthermore, based on Kraiger et al. (1993), we distinguish between cognitive, affective, and skills components of learning.

Research Question 1: To what extent do migrant construction workers report new cognitive, affective and skills learning as a result of safety training?

Learning in itself, however, is not sufficient to realize good safety outcomes; learning needs to be transferred to the workplace in order for changes in behavior to occur and, subsequently, better safety outcomes to be achieved. Indeed, the training transfer literature has recently been criticized for failing to consider whether training transfer leads to intended outcomes (Blume, Ford, Surface, & Olenick, 2019). Translation of learning into the workplace setting and subsequent maintenance of new behaviors are key elements of Baldwin and Ford's (1988) training transfer concept. We therefore review whether learning has been transferred to the construction site and whether skills and knowledge have been maintained over time.

Research Question 2: To what extent do migrant construction workers successfully transfer the new knowledge, attitudes, and skills learned during safety training back to the construction site?

Building on this, we also review whether training transferred to the construction site actually leads to better safety outcomes. Although Kirkpatrick's (1994) training evaluation model has been criticized for its lack of consideration of context (Holton, Bates, Seyler, & Carvalho, 1997), it is widely used for training evaluation (Lacerenza, Reyes, Marlow, Joseph, & Salas, 2017; Salas, Tannenbaum, Kraiger, & Smith-Jentsch, 2012), and for safety training (Asari & Leman, 2015). We find it useful to explore the impact on higher level outcomes such as safety climate, accidents, and injuries which are not captured by Kraiger et al.'s (1993) learning outcomes. Thus, we focus on the effectiveness of training in terms of impact/results, in line with level four of Kirkpatrick's (1994) model.

Research Question 3: To what extent is safety training for migrant construction workers effective, in relation to the outcomes achieved for individuals and organizations?

Predictors of Learning and Training Transfer

Baldwin and Ford (1988) identified three input factors, which together may influence whether learning, and ultimately transfer, takes place: individual characteristics, training design, and work environment. Reviews and meta-analyses have found support for these three factors (Burke & Hutchins, 2007; Blume et al., 2010), and recent studies have applied the model in safety training (Hussain et al., 2018). On the basis of the model, we therefore propose three further research questions.

First, individual trainee characteristics may play an important role in migrant workers' learning and training transfer. Limited language ability may mean learning is minimal (Donaghy, 2009), while not prioritizing safety may reduce workers' motivation to engage with, and apply, their training (Chan et al., 2017a; Menzel & Gutierrez, 2010).

Research Question 4: Which characteristics of migrant construction workers influence their ability to learn during safety training and transfer this learning back to the construction site?

Second, the training literature emphasizes the need to analyze carefully training content and methods of delivery, to understand whether the needs of trainees are addressed (Baldwin & Ford, 1988). This is particularly important when training migrant workers, given the language barriers they face. Baldwin and Ford (1988) suggest central elements of training design include actual training content, sequencing (phased learning), and principles of learning (e.g., different ways of learning, such as role-play and case studies). Recent studies have explored the role of video (Edirisinghe & Lingard, 2016), participatory video (Lingard, Harley & Edirisinghe, 2015), e-learning (Ho & Dzeng, 2010), immersive virtual reality (Sacks, Perlman, & Barak, 2013), and a combination of methods (safety training 4.0, Ricci, Pelosi, Panari, & Chiesi, 2018) in safety training in the construction industry. We therefore explore how safety training has been tailored for migrant construction workers.

Research Question 5: To what extent is safety training designed and delivered to address the needs of migrant construction workers?

Based on the third factor proposed by Baldwin and Ford (1988), we also review the barriers and facilitators of training transfer in the work environment, e.g., peer and supervisor support, and opportunity to use learning. With regards to migrant construction workers, it is possible that despite training, they may not be motivated to transfer their learning to the workplace due to performance pressure (Choudhry & Fang, 2008; Menzel & Gutierrez, 2010), or lack of support from their supervisors (Donaghy, 2009; Dutta, 2017). Conversely, there may be factors that support training transfer, e.g., strong relationships with national peers. We therefore formulate our final research question:

> *Research Question 6:* What are the factors which facilitate or hinder learning and training transfer among migrant workers in construction?

Method

A systematic literature review offers a critical exploration, evaluation, and synthesis of papers relating to a research question, with a view to finding gaps in up-to-date knowledge (Suri & Clarke, 2009). We applied broad search criteria to extract empirical studies focused on understanding the safety training of low-skilled, migrant workers in the construction sector.

Search Strategy

We searched for empirical papers published in English, in peer-reviewed journals, between January 2000 and November 2017 (date of our search), in the major databases PsycINFO, PubPsych, and Scopus, and the Web of Science platform (searching Medline, Current Contents Connect, Web of Science Core Collection, SciELO Citation Index, Korean Journal Database, and Derwent Innovations Index). Search terms were identified through discussion among the study team, liaison with subject matter experts, and prior knowledge of

the subject area. To maximize inclusivity, we applied *safety* and *training* as generic search terms.

In relation to migrant construction workers, we searched specifically for *migrant, construction, roofer* and *builder*, recognizing that different terms are often applied to low-skilled, construction workers.

With respect to safety, we followed Halbesleben and Bellairs (2015), to view adverse safety outcomes broadly as physical harm to employees, which may have arisen due to accidents or similar events. Our specific search terms included *health, well being, accident, prevention of accidents, incident, injury*, and *physical harm*.

Finally, with respect to training, we searched for terms related broadly to effectiveness of learning in organizations, such as *training methods, training program(me)s, training tools, trainers, effectiveness of training, transfer of training, skills, competences, competencies, certification, norms*, and *regulation*.

Selection of Relevant Papers

A total of 2681 papers with titles broadly related to safety training for migrant construction workers were identified from our search. Once duplicates had been removed, 890 papers remained. The abstracts of these were reviewed and 850 papers were eliminated due to a lack of focus on safety training. The first and second authors then read the remaining 40 papers in detail and independently decided which should be included in the final review, based on a set of inclusion criteria (see Table 1).

Insert Table 1 about here

Twenty-two of these 40 papers focused on safety among construction workers in general, but had no explicit focus on training so were excluded. In total, therefore, 18 papers

were included in our systematic review. Figure 1 provides an overview of our paper sift process.

Insert Figure 1 about here.

Systematic Review

The final 18 papers were reviewed in detail and the following information extracted:

Type of work and aims of the study. Any study related to safety training or safety evaluation for low-skilled, migrant construction workers was considered.

Characteristics of study's sample and work setting. Information about study sample, such as size, occupational level, sector, nationality, country of the study, or characteristics of trainer (if applicable) was extracted.

Research design. All information about methodology and variables applied to the study was extracted if the study was an intervention: specific contents and administrative information, focus on construction sites, target (low-skilled, migrant workers), and timeframe (frequency and duration). Methodology and information about measures of evaluation were also extracted.

Results. Information about key safety outcomes assessed after training or predictors of training transfer were extracted.

Results

Our systematic literature review revealed only 18 papers focused on safety training for migrant construction workers (see Table 2 for details). No studies were published before 2005, and only one study was published since 2013 (in 2016). Given the high rates of accidents and fatalities suffered by migrant construction workers compared with native

workers, this lack of contemporary research into safety training for this vulnerable group is surprising.

Of these papers, 14 studies were conducted in the U.S. targeting Hispanic and Latino migrant workers, and two studies were conducted in Korea with workers from Vietnam, China, the Philippines and Thailand. One study was conducted in China with Chinese and non-Chinese workers (the nationalities of the latter were not reported), and one study was conducted in Australia, with workers from over ten different nationalities, speaking languages including Arabic, Italian, and Portuguese. Thus, while the studies cover an array of migrant groups, a large portion of the migrant population in the construction sector is not represented in these articles, particularly in terms of Europe. This highlights a significant gap in our knowledge and understanding.

In terms of focus, seven studies were concerned with migrant workers' previous experiences with safety training, whereas 11 tested specific training initiatives. These initiatives ranged in length from 4 hours to 5 days, and were delivered either by professional trainers or by peers. In relation to methodology, the majority of studies employed a mixed methods approach (nine studies), four studies used a cross-sectional survey design, three a qualitative design, and two employed longitudinal quantitative methods. Sample sizes varied substantially across the studies, ranging from seven workers and five supervisors, who participated in interviews, through to 1525 workers, who participated in a training intervention. Eleven studies included a sample of between 100 and 500 participants.

Insert Table 2 about here.

Effectiveness of Training: Learning, Transfer and Outcomes

In answer to our first research question—*To what extent do migrant construction workers report cognitive, affective and skills learning as a result of safety training?*—we identified nine studies reporting learning. Building on Kraiger et al. (1993), we further distinguished between cognitive, affective and skills learning.

Six studies explored cognitive capacities or knowledge. Studies employing pre- and post-test measures showed gains in technical safety knowledge (Ahonen et al., 2013; Del Puerto, Fontan-Pagan, Molina-Bas, & Mrozowski, 2016; Sokas, Jorgensen, Nickels, Gao, & Gittleman, 2009; Williams, Ochsner, Marshall, Kimmel, & Martino, 2010), while Harrington, Materna, Vannoy, and Sholz (2009) reported improved knowledge about regulations. Two studies focused on affective learning outcomes and found improved attitudes and motivation to work safely post-training (Harrington et al., 2009; Sokas et al., 2009). Finally, three studies evaluated skills-based learning. Hazard awareness increased (Ahonen et al., 2013; Menzel & Shrestha, 2012), with levels retained 3 years after training (Ahonen et al., 2013). Following language training, site supervisors were also more confident talking in the native language of their workers (Jaselskis, Strong, Aveiga, Canales, & Jahren, 2008).

In summary, studies presented positive results in terms of learning outcomes, although predominantly focused on learning cognitive content, i.e., technical safety skills; few studies focused on nontechnical skills, such as changing attitudes, motivation, and hazard awareness.

In response to our second research question—*To what extent do migrant construction workers successfully transfer the new knowledge, attitudes, and skills learned during safety training back to the construction site?*—only two studies explored training transfer explicitly. Both Ahonen et al. (2013) and Williams et al. (2010) reported migrant workers were able to use their training in their daily work; again, these findings were maintained in a 3-year follow-up (Ahonen et al., 2013).

Six studies evaluated level three of Kirkpatrick's (1994) model, focusing on post-training behavioral changes on the construction site. Migrant workers' use of PPE and safety equipment increased (Forst et al., 2013; Menzel & Shrestha, 2012; Williams et al., 2010), as did their participation in safety activities (Forst et al., 2013; Harrington et al., 2009; Menzel & Shrestha, 2012). Migrant workers also reported being more proactive in identifying and acting on hazardous situations (Harrington et al., 2009; Ochsner, Marshall, Martino, Pabelón, Kimmel, & Rostran, 2012; Williams et al., 2010). In relation to assertiveness, Forst et al. (2013) found migrant workers became more assertive and demanded safer working conditions, whereas Williams et al. (2010) found only a few workers became more forceful, and Menzel and Shrestha (2012) failed to find any change. In terms of social behavioral change, migrant workers began looking after each other (Forst et al., 2013), shared safety-related information (Williams et al., 2010), networked more (Ochsner et al., 2012), and communicated better with supervisors (Jaselskis et al., 2009).

In addressing our third research question—*To what extent is safety training for migrant construction workers effective, in relation to the outcomes achieved for individuals and organizations?* —three studies focused on the results/impact of training, following level four of Kirkpatrick's (1994) model. According to Harrington et al. (2009), contractors reported training to be more effective than before, although there were no improvements in safety climate post-training. Williams et al. (2010) reported a reduction in injuries to migrant workers, and Forst et al. (2013), more specifically, reported a reduction in falls and electrical shocks. No studies focused explicitly on traditional outcomes, such as accidents and fatalities. This limited focus on results is consistent with the wider safety training literature, which reports evaluation to be primarily at the reactional level (Asari & Leman, 2015).

Predictors of Learning and Training Transfer

In response to our fourth research question—*Which characteristics of migrant construction workers influence their ability to learn during safety training and transfer this learning back to the construction site?* —four studies identified one major individual characteristic specific to migrant workers: language abilities. In two cases, materials were translated into the migrant workers' language (Menzel & Gutierrez, 2010; O'Connor et al., 2005), although translation was reported to be poor, which reduced understanding. Similarly, when training was delivered in the host country's language, migrant workers struggled to understand the content and pass the subsequent exam (Trajkovski & Loosemore, 2006). Another individual characteristic was the ability to engage in abstract thinking: De Souza, Hecker, de Castro, Stern, Hernandez, and Seixas (2012) reported challenges when moving from teaching technical skills to nontechnical skills. This characteristic may not be unique to migrant workers, but low-skilled workers in general.

In response to our fifth research question—*To what extent is safety training designed and delivered to address the needs of migrant construction workers?*—13 studies reported details of training design and delivery. In four studies, training was based on existing courses translated into the migrant workers' native language of Spanish (Brunette, 2005; Evia, 2011; Jaselskis et al., 2008; Menzel & Shrestha, 2012). In seven studies, new training material was developed (De Souza et al., 2012; Menzel & Shrestha, 2012; Ochsner et al., 2012), using methods including literature reviews (Harrington et al., 2009), expert input (Harrington et al., 2009), results of previous surveys (Brunette, 2005), interviews or focus groups with workers (Brunette, 2005; Ahonen et al., 2013), and workplace risk exposure and work situations (Williams et al., 2010).

Training content ranged from legal aspects (Forst et al., 2013; Harrington et al., 2009), to cross-cultural differences between Hispanic workers and their supervisors (Jaselskis et al., 2008), to existing training materials (e.g. Day Laborers' Health and Safety Workbook

[DLH&SW], Ahonen et al., 2013; the OSHA Smart Mark training course, Jaselskis et al., 2008). Two studies focused on technical skills, namely ladder safety and electrical safety (Forst et al., 2013) and falls (Menzel & Shrestha, 2012), whereas two studies included soft skills, namely assertiveness (Jaselskis et al., 2008) and empowerment (De Souza et al., 2012). Two studies focused on aspects of the host country's culture and legislation aiming to enable migrant workers to understand their rights (Ahonen et al., 2013; Harrington et al., 2009). One study focused on organization-specific policies and practices (Choudhry & Fang, 2008) and another on safety culture (De Souza et al., 2012).

In relation to how safety training should be designed to maximize learning, four key principles were identified. First, training in migrant workers' native tongue; Spanish in these studies (Ahonen et al., 2013; Brunette, 2005; Evia, 2011; Harrington et al., 2009; Jaselskis et al, 2009; Menzel & Shrestha, 2012). Second, engaging and involving migrant workers through a participatory approach, using teambuilding and small group methods (Ahonen et al., 2013), and role-play, hands-on practice, and multimedia interactive material in the form of videos (Jaselskis et al., 2009). Third, using both peers and supervisors as trainers. Migrant workers were trained to train their peers in safety (Ahonen et al. 2013; De Souza et al., 2012; Ochsner et al., 2012), in addition to supervisors conducting training on the construction site (Harrington et al., 2009). Fourth, tailoring training materials to meet migrant workers' needs. Audiovisual materials were used to facilitate learning in a low-skilled workforce with limited host country language abilities (Evia, 2011; Shin, Nam, Kim, & Kim, 2013; Won, Kwon, Jung, Kim & Shin, 2013). Harrington et al. (2009) reported interactive, practical activities, such as group discussions and tailgate training, were perceived as useful.

In terms of training delivery, no papers focused directly on sequencing, but 11 studies considered the duration of training. A contrast was found between the amount of safety training migrant workers felt they needed (30 minutes, Won et al., 2013; 1 hour, O'Connor et

al., 2005) and the duration of the training evaluated. In three studies, training lasted 4-5 hours (De Souza et al., 2012; Harrington et al., 2009; Menzel & Shrestha, 2012) and in five studies training lasted 6-10 hours (Ahonen et al., 2013; Forst et al., 2013; Jaselskis et al., 2008; Sokas et al., 2009; Williams et al., 2010). The longest training duration was 5 days (Ochsner et al., 2012).

In summary, despite the use of tailored methods and some attempts to address the potentially limited language abilities of migrant workers, mostly though translation and use of audiovisual material, few studies addressed cultural issues and lack of knowledge of the host country's laws and regulations. The use of e-learning was scarce despite the increased awareness of its usefulness in the wider safety training literature (Ricci et al., 2018).

In answer to our sixth research question—*What are the factors which facilitate or hinder learning and training transfer among migrant workers in construction?*—two studies identified work environment factors that may play a role in whether learning and transfer are likely outcomes of safety training. To enhance the effectiveness of peer support, identified in the training transfer literature as a facilitating factor (Blume et al., 2010), Ochsner et al. (2012) found support from a national formal body to have a substantial impact, suggesting peers need to be empowered. Similarly, Ahonen et al. (2016) found collaboration with community centers, providing migrant workers with additional support, increased the uptake of safety training.

Discussion

The main aims of our paper were to: 1) systematically review the literature on safety training for migrant construction workers; 2) identify key challenges in the design, implementation, and evaluation of safety training, particularly in relation to learning, training transfer, and safety outcomes; and 3) develop a research agenda, outlining how safety training in the construction industry can be improved for low-skilled workers, both migrant

and native. We structured our review following an integrated training effectiveness model based on key indicators of: training evaluation, at the individual and organizational level (Kirkpatrick, 1994); cognitive, affective, and skills based learning (Kraiger et al. 1993); and transfer of training into the workplace, influenced by individual characteristics, training design, and the work environment (Baldwin & Ford, 1988; see also Hussain et al., 2018). Accordingly, we proposed six research questions: three concerned with the effectiveness of safety training for migrant construction workers, in terms of learning, transfer, and outcomes; and three concerned with the predictors of learning and transfer.

Somewhat alarmingly, given their increased vulnerability and high fatality rate, our systematic literature review revealed a dearth of contemporary research focused on safety training for migrant construction workers. In the following sections, we propose a research agenda to improve safety for low-skilled construction workers, both migrant and native, through training. This is summarized in Table 3.

Insert Table 3 about here.

Towards a Theory-Based Research Agenda

A limitation of the 18 studies we reviewed is the lack of reflection on how learning occurs, what content should be learned, or how content should be trained; also known as training instructional models (Kraiger, 2008). Kraiger (2008) distinguished three generations of instructional models: 1) first-generation instructional models, in which trainees are seen as passive recipients of content determined by the trainer; 2) second-generation cognitive constructivist models, the underlying assumption of which is that trainees need to make sense of content learned; and 3) third-generation social constructivist models, which suggest learning happens in a social context, where trainees share experiences and learn

collaboratively. These models of learning incorporate different methods of training and modes of delivery. Many studies included in our review primarily relied on first-generation instructional models, where migrant workers were seen as passive recipients of technical skills. There was limited consideration of the need for sensemaking or social interaction of trainees with diverse cultural values, communication constraints, and lack of knowledge of the host country's regulations.

The latter two generations of instructional model coexist, and a number of conditions (e.g., learners' capabilities in terms of skills and experience, the type of contents in terms of complexity, or the amount of control given to the learner) may mean added value of combining the two (Kraiger, 2008). In line with training transfer thinking, we argue training methods and content should support trainees making sense of the training, and rely on social exchanges and experience sharing in order for training transfer to occur and improvements in safety outcomes to be observed. Thus, we base our research agenda on second- and third-generation instructional models.

Training and Transfer Outcomes and their Assessment

In relation to our first, second, and third research questions, concerning learning, transfer, and effectiveness of training, a number of contributions deserve attention. In the studies reviewed, learning was measured to test training outcomes. Improvements are noted on general outcomes, such as knowledge acquisition (Del Puerto et al., 2016; Ochsner et al., 2012), and on specific indicators, such as falls and electrical hazards (Sokas et al., 2009), and information about regulations and workers' rights (Williams et al., 2010). Learning has also been noted on content comprehension (Evia, 2011), safety awareness lasting over 3 years (Menzel & Shrestha, 2012), attitudes and motivation post-training (Sokas et al., 2009), and know-how to work safely (Ahonen et al., 2013; Williams et al., 2010). To progress the evaluation of learning, a systematic and multidimensional approach is needed, with more

precise measures and a more rigorous evaluation design, including cognitive, affective, and skills learning (Kraiger et al., 1993). Training methods promoted by the cognitive and socio-constructivist approaches may provide insights into the development and evaluation of design strategies towards achieving these aims.

In relation to transfer of training, studies generally found support for the first transfer component, namely generalization (e.g., using PPE and safety equipment, sharing information with coworkers, looking after colleagues, communicating with supervisors, participating in tailgate meetings, and proactively tackling hazardous situations). These correspond with the construct of transfer climate, advocating opportunities to practice new skills (Rouiller & Goldstein, 1993), and research highlighting the positive effect of peer support on transfer (Martin, 2010; see also Salas et al., 2012). Conversely, few studies explored the second component, maintenance of behaviors over time (Ahonen et al., 2013; Williams et al., 2010). Blume et al. (2019) proposed a dynamic training transfer model in which transfer attempts and subsequent learning are likely to influence maintenance. If migrant workers receive negative feedback when they attempt to change their safety behaviors, they are less likely to engage again. Future research should therefore consider how training could be designed to encourage continuous application of learning in low-skilled workers in the construction sector, specifically migrant workers, who operate in a potentially adverse environment where performance is prioritized over safety (Griffin & Curcuruto, 2016).

It is well-established that training in organizations may have important benefits for individuals, teams, organizations, and society (Aguinis & Kraiger, 2009). In our review, just three studies discussed the impact of training for individuals and organizations, in terms of accidents and injuries. A few studies explored the use of PPE (Forst et al., 2010; Menzel & Shrestha, 2012; Williams et al., 2010); in the wider safety literature, behaviors like this are

termed safety compliance (i.e., safety activities to maintain a minimum level of safety as required by formal work procedures) (Griffin & Curcuruto, 2016). In contrast, safety proactivity involves change-oriented behaviors, such as initiating safety-related changes, voicing safety issues, and providing suggestions for improvements (Griffin & Curcuruto, 2016). Using a post-training design, Harrington et al. (2010) found contractors perceived their workers raised safety concerns more often and were more involved in developing solutions. Ochsner et al. (2012) reported qualitative accounts of similar behaviors. Williams et al. (2010), using a pre-post evaluation design supplemented by qualitative data, found migrant workers took initiative to address safety concerns. None of these studies, however, employed a robust before and after design to identify actual increases in safety proactivity nor safety participation beyond safety compliance (Martínez-Córcoles, Gracia, & Peiró, 2018), despite their positive impacts (Zohar, 2008).

Individual Characteristics of Trainees

In relation to our fourth research question, the 18 studies in our review primarily examined language barriers as the key characteristic which may hamper learning and training effectiveness (De Souza et al., 2012; Menzel & Gutierrez, 2010; O'Connor et al., 2005; Trajkovski & Loosemore, 2006). Strategies to overcome these language barriers included training in the native language of the workers, translation of the materials provided, support from peers, and language facilitators. Simply translating training materials, however, may not ensure training transfer and outcomes, as sensemaking is likely to be influenced by the norms and values of workers from different cultures. Thus, from a cognitive constructivist perspective, future training designs need to consider the active role of individual learners, having first assessed their language proficiency to ensure learning takes place. Furthermore, from a social constructivist perspective, future training designs need to engage trainees in groupwork and interactive exercises to ensure a shared understanding of norms for working

safely.

As highlighted in the wider training transfer literature, individual differences in relation to cognitive ability, conscientiousness, neuroticism, self-efficacy, learning goal orientation, and motivation, also need to be considered when evaluating training (Blume et al., 2010). The low level of skill in the construction workers included in the studies we reviewed is likely to have affected the extent to which learning and training transfer occurred. Akin to the notion of positive gain spirals proposed by conservation of resources theory (see Hobfoll, 1989; Hobfoll, Halbesleben, Neveu, & Westman, 2018), suggesting initial resource gain begets further resource gain, it is likely that well-trained construction workers with higher levels of skill, will seek, receive, and benefit from increased opportunities for further training, thereby enhancing their learning and improving their training transfer and outcomes. Conversely, construction workers with lower levels of skill and education, who are in greater need of training, will actually seek and receive fewer opportunities, leading to poorer learning and outcomes. Thus, we need to understand better how such individual characteristics, beyond those specific to migrant workers, can promote effective safety in a population where safety may not be seen as a priority, i.e., where resources are low and individuals are vulnerable to loss (Hobfoll, 1989).

Similarly, different cultural values must be considered. Using Hofstede's cultural dimensions, Yang, Wang, and Drewry (2002) suggested how culture may influence learning and transfer. For instance, in collectivistic cultures, motivation to learn may be higher when training benefits the workgroup, while in individualistic cultures motivation may be higher when individual benefits are salient. Moreover, in high uncertainty avoidance cultures, a training approach that emphasizes well-established practices and rules would be more effective than in low uncertainty avoidance cultures. Integrating knowledge of trainees' cultural values will provide useful insights into how culture impacts transfer and outcomes.

The studies in our review were carried out in the U.S., Korea, China, and Australia, with predominantly Hispanic and Latino migrant workers, meaning many areas, such as Europe, are not represented. Furthermore, only the studies carried out in Korea and Australia explored multiple nationalities speaking different languages; yet migrant workers often originate from many different countries and cultures (Münz, 2007). For example, the latest figures from Eurostat report that as of 1st January 2018, 39.9 million people living the EU-28 were non-native, with 22.3 million of those having citizenship outside the EU-28 (including other European countries, Africa, Asia, and North and South America) and 17.6 million having citizenship in a different Member State (Eurostat, 2019). Specifically in terms of the construction industry, the ONS estimates that, for the period 2014 to 2016, 7% of all construction workers in the U.K. were from another Member State (predominantly Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Slovakia, Slovenia, Bulgaria and Romania), whilst 3% were from outside the EU-28 (ONS, 2018).

These data suggest there could be significant differences for migrant workers between their host and home countries, both in terms of language and culture. Thus, following Ford, Baldwin, and Prasad (2018), future research should investigate the extent to which cultural factors, and potential differences between host and home countries, need to be considered when planning, implementing and supporting training programs. In addition, more research is needed to understand the challenges of designing, delivering, and evaluating safety training for construction workers, both migrant and native, in countries characterized by high migration, such as those across Europe (Eurostat, 2019).

Training Design: Learning Principles, Contents and Sequencing

In answer to our fifth and sixth research questions, our review identified a number of learning principles used to support the safety training of migrant workers: a) training in migrant workers' mother tongue, b) engaging and involving migrant workers in the training

design, c) involving peers and supervisors as trainers (e.g., induction, tailgate, etc.), and d) using delivery tools that fit migrant workers' needs (e.g., audiovisual tools, participatory methods, or hands-on activities). Based on the training transfer literature, we propose three additional principles to guide the design of safety training for low-skilled migrant and native workers: a) assuring trainees understand the training purpose, objective, and intended outcomes; b) contextualizing training contents and activities to real-world construction; and c) using feedback (and errors) as part of the learning process (Noe & Colquitt, 2002). These principles could help motivate workers to attend training, and develop their shared understanding of why it is important to work safely.

A core point of training design concerns delivery methods. A few studies favored the use of participatory methods, work in small groups, role-play, and multimedia. New challenges appear as digitalization and information and communications technology (ICT) offer a wider array of options that, when properly designed, may be especially useful for the target population, offering trainees the opportunity to acquire learning at their own pace, potentially with less spoken language. Methods such as e-learning, gamification, behavioral modeling, simulation, practice in 'close to real context situations', social media, experiential learning, and communities of practice may support classroom teaching (Evia, 2011; Forst, et al. 2013; Shin et al., 2013; Won et al., 2013).

Concerning training contents, a few studies combined general contents for native workers (with or without adaptation to migrants) with those dealing with migrant specific needs, such as wage theft and national regulations. Given migrant workers are likely to hold different safety values and norms, training should also consider both technical and nontechnical (soft) skills. Developing a better safety climate through enhancing soft skills, such as understanding safety as a collective issue and the ability to identify and act on hazardous situations, should be prioritized. Soft skills may be challenging to train in migrant

workers; for example, Williams et al. (2010) and Menzel and Shrestha (2012) found disappointing results when trying to increase assertiveness. Social constructivist approaches where collective assertiveness is promoted may have more powerful results. The implications of cognitive and social constructivist approaches to develop these processes may be particularly fruitful avenues of research on soft skills.

Finally, no studies focused on the sequencing of training or other temporary facets, such as spaced versus massed practice (Donovan & Radosevich, 1999). Although studies reported training to last from 4-5 hours (e.g., Menzel & Shrestha, 2012) to 5 days (Ochsner et al., 2012), we know little about the optimal time frame. Training design needs to enable trainees to structure their sensemaking processes and practice safety behaviors at work between sessions, positively influence training transfer and effectiveness.

The Role of Context

The role of context in enhancing or hindering training has long been highlighted in the wider literature, e.g., Salas and Cannon-Bowers (2001) reviewed the characteristics of pre-training environment and climate, and post-training conditions. An important contribution of our review is the broader view of contextual factors. The actions of safety and health liaisons were more effective when empowered by official bodies (e.g., OSHA, Ochsner et al., 2012) and supported by work community centers (associations external to the company, Ahonen et al., 2013). The cooperation of social agents played a role in supporting migrant workers to defend their rights and avoid abusive practices (e.g., assigning them the riskier tasks with performance pressure). Although such support may also be helpful to low-skilled, native workers, migrant workers may benefit more, due to prejudice from supervisors or native workers, unsafe demands because of their (il)legal status, and their fear of dismissal if refusing hazardous work tasks (Dutta, 2017; Menzel & Gutierrez, 2010). Thus, safety training needs to be supported by interventions aimed at improving working conditions, supervision,

human resource practices, and industrial relations. In addition, an agentic role should be promoted for migrant workers, to strengthen their soft skills.

Post-training context is also relevant. Providing opportunities to apply training immediately on the job is important to enhance the use of new knowledge and skills (Blume et al., 2010), as is the support of supervisors (Ford et al., 2018). These contextual factors are likely to be important in training transfer for low-skilled construction workers in general, and in particular for migrant workers due to their often poor relationship with supervisors (Donaghy, 2009; Dutta, 2017). More systematic analysis of pre- and post-training contextual factors is needed to identify how to develop supportive interventions to ensure training transfer and effectiveness.

Strengths and Limitations

The main strength of our paper is the systematic review of empirical evidence related to safety training for migrant workers in the construction industry, highlighting strengths and weaknesses of the current state of the art. In doing so, we have integrated learning, training transfer and effectiveness models, to develop an in-depth understanding of how and why safety training for migrant construction workers succeeds or fails.

There are also some limitations to our review which have to be considered. First, although we searched widely by hand (e.g., searching publications of key safety researchers) and via multiple databases, we may not have captured all published studies about safety training for migrant construction workers. Second, we focused on peer-reviewed, published papers. This poses a risk of publication bias, as there may be a large body of grey literature which has explored safety training for migrant construction workers; however, as part of a larger project, we did review the grey literature and did not find any relevant evaluations of safety training (reference to website summarizing grey literature withheld for anonymity). Third, the papers varied substantially in terms of evaluation methods and the measurement of

training transfer and outcomes, making it difficult to draw firm conclusions about the effectiveness of different designs for training migrant workers. We hope our review, with its recommendations for future research, provides inspiration for how the field may develop.

Conclusion

This paper presents a systematic literature review of safety training for low-skilled, migrant workers in the construction industry, integrating: Kirkpatrick's (1994) 4-level training effectiveness model; Kraiger et al.'s (1993) cognitive, affective, and skills-based learning outcomes; and Baldwin and Ford's (1988) seminal training transfer model. Our study develops understanding of the state of the art of research and professional practice in this field. Specifically, it highlights the paucity of contemporary academic research on safety training for migrant workers, with only 18 studies published since 2000 and only one in the past 6 years. There were no studies in Europe; 78% of the papers were based in the U.S. and focused on Hispanic and Latino migrant workers. Thus, a large percentage of the migrant population in the construction sector is not represented. This is surprising given the disproportionate accident and fatality rates for this vulnerable group. Moreover, it is particularly problematic for understanding safety training in a European context, due to the heterogeneity of migrant workers who originate from numerous countries and speak many different languages.

Based on the literature review, we propose a research agenda for safety training for low skilled, migrant and native construction workers. In developing our research agenda, we draw on cognitive and social constructivist instructional design models in extension of the dominant objectivist model. These models view training as a dynamic process with an agentic trainee role, involving active participation and co-elaboration of meaning and learning processes. Relatedly, we highlight the need to pay particular attention to the situational context in which these workers are embedded, including labor market conditions, social

relations (and how language, values, attitudes, and so forth, impact upon this), and cultural differences. Finally, we argue there is a pressing need for robust, longitudinal, multi-dimensional research designs to evaluate how safety training impacts upon workers' learning, training transfer, behavioral change, and outcomes including accident and fatality rates.

References

References marked with an asterisk indicate papers included in the systematic review.

Aguinis, H., & Kraiger, K. (2009). Benefits of training and development for individuals and teams, organizations, and society. *Annual Review of Psychology, 60,* 451–74. https://doi.org/10.1146/annurev.psych.60.110707.163505

*Ahonen, E. Q., Zanoni, J., Forst, L., Ochsner, M., Kimmel, L., Martino, C., … Sokas, R. (2013). Evaluating goals in worker health protection using a participatory design and an evaluation checklist. *New Solutions: A Journal of Environmental and Occupational Health Policy, 23,* 537-560. https://doi.org/10.2190/NS.23.4.b

Aksorn, T., & Hadikusumo, B. H. (2008). Critical success factors influencing safety program performance in Thai construction projects. *Safety Science, 46*, 709-727. https://doi.org/10.1016/j.ssci.2007.06.006

Al-Bayati, A. J., Abudayyeh, O., Fredericks, T., & Butt, S. E. (2017). Managing cultural diversity at US construction sites: Hispanic workers' perspectives. *Journal of Construction Engineering and Management, 143,* 04017064. https://doi.org/10.1061/(asce)co.1943-7862.0001359

Arcury, T. A., Mills, T., Marín, A. J., Summers, P., Quandt, S. A., Rushing, J., ... Grzywacz, J. G. (2012). Work safety climate and safety practices among immigrant Latino residential construction workers. *American Journal of Industrial Medicine, 55,* 736-745. https://doi.org/10.1002/ajim.22058

Asari, M. S., & Leman, A. M. (2015). Safety Training Evaluation: Approaches and Practices. *Journal of Occupational Safety and Health, 12*, 23-30. Retrieved from http://www.niosh.com.my/images/Journal/2015/CONTENT-JOSH-DEC-2015-pg1-48.pdf

Baldwin, T. T., & Ford, J. K. (1988). Transfer of training: A review and directions for future research. *Personnel Psychology, 41,* 63-105. https://doi.org/10.1111/j.1744-6570.1988.tb00632.x

Blume, B. D., Ford, J. K., Baldwin, T. T., & Huang, J. L. (2010). Transfer of training: A meta-analytic review. *Journal of Management, 36,* 1065-1105. https://doi.org/10.1177/0149206309352880

Blume, B. D., Ford, K. J., Surface, E. A., & Olenick, J. (2019). A dynamic model of training transfer. *Human Resource Management Review, 29,* 270-283. https://doi.org/10.1016/j.hrmr.2017.11.004

Brossoit, R. M., Crain, T. L., Leslie, J. J., Hammer, L. B., Truxillo, D. M., & Bodner, T. E. (2018). The effects of sleep on workplace cognitive failure and safety. *Journal of Occupational Health Psychology*. Advance online publication. http://dx.doi.org/10.1037/ocp0000139

Brunette, M. J. (2004). Construction safety research in the United States: Targeting the Hispanic workforce. *Injury Prevention*, *10*, 244-248. https://doi.org/10.1136/ip.2004.005389

*Brunette, M. J. (2005). Development of educational and training materials on safety and health: Targeting Hispanic workers in the construction industry. *Family and Community Health, 28*, 253-266. https://doi.org/10.1097/00003727-200507000-00006

Buckley, M., Zendel, A., Biggar, J., Frederiksen, L., & Wells, J. (2016). *Migrant work & employment in the construction sector*. (Technical report for the International Labour Organization). Retrieved from https://www.ilo.org/global/topics/labour-migration/publications/WCMS_538487/lang--en/index.htm.

Bureau of Labor Statistics (BLS). (2017). *National census of fatal occupational injuries in 2017*. Retrieved from https://www.bls.gov/news.release/pdf/cfoi.pdf

Burke, M. J., Chan-Serafin, S., Salvador, R., Smith, A., & Sarpy, S. A. (2008). The role of national culture and organizational climate in safety training effectiveness. *European Journal of Work and Organizational Psychology, 17*, 133-152. https://doi.org/10.1080/13594320701307503

Burke, L. A., & Hutchins, H. M. (2007). Training transfer: An integrative literature review. *Human Resource Development Review, 6*, 263-296. https://doi.org/10.1177/1534484307303035

Burke, M. J., Salvador, R. O., Smith-Crowe, K., Chan-Serafin, S., Smith, A., & Sonesh, S. (2011). The dread factor: How hazards and safety training influence learning and performance. *Journal of Applied Psychology*, *96*, 46-70. http://dx.doi.org/10.1037/a0021838

Burke, M. J., Sarpy, S. A., Smith-Crowe, K., Chan-Serafin, S., Salvador, R. O., & Islam, G. (2006). Relative effectiveness of worker safety and health training methods. *American Journal of Public Health, 96,* 315-324. https://doi.org/10.2105/ajph.2004.059840

Centre for Corporate Accountability (CCA). (2009). *Migrants' Workplace Deaths in Britain.* Retrieved from http://www.corporateaccountability.org.uk/dl/HSE/migrant/cca_irwinmitchell.pdf

Chan, A. P., Javed, A. A., Wong, F. K., Hon, C. K., & Lyu, S. (2017a). Evaluating the safety climate of ethnic minority construction workers in Hong Kong. *Journal of Professional Issues in Engineering Education and Practice, 143*, 04017006. https://doi.org/10.1061/(ASCE)EI.1943-5541.0000333

Chan, A. P., Wong, F. K., Hon, C. K., Lyu, S., & Javed, A. A. (2017b). Investigating ethnic minorities' perceptions of safety climate in the construction industry. *Journal of Safety Research, 63,* 9-19. https://doi.org/10.1016/j.jsr.2017.08.006

*Choudhry, R. M., & Fang, D. (2008). Why operatives engage in unsafe work behavior: Investigating factors on construction sites. *Safety Science, 46*, 566-584. https://doi.org/10.1016/j.ssci.2007.06.027

Clarke, S. (2006). The relationship between safety climate and safety performance: A meta-analytic review. *Journal of Occupational Health Psychology*, *11*, 315–327. https://doi:10.1037/1076-8998.11.4.315

Clarke, S. (2010). An integrative model of safety climate: Linking psychological climate and work attitudes to individual safety outcomes using meta-analysis. *Journal of Occupational and Organizational Psychology*, *83*, 553-578. https://doi.org/10.1348/096317909X452122

Clarke, S. (2013). Safety leadership: A meta-analytic review of transformational and transactional leadership styles as antecedents of safety behaviours. *Journal of Occupational and Organizational Psychology*, *86*, 22-49. https://doi.org/10.1111/j.2044-8325.2012.02064.x

Cunningham, T. R., Guerin, R. J., Keller, B. M., Flynn, M. A., Salgado, C., & Hudson, D. (2018). Differences in safety training among smaller and larger construction firms with non-native workers: Evidence of overlapping vulnerabilities. *Safety Science*, *103*, 62-69. https://doi.org/10.1016/j.ssci.2017.11.011.

*Del Puerto, C. L., Fontan-Pagan, J. J., Molina-Bas, O. I., Mrozowski, T. L. (2016). Safety training on warehouse worker hazards for structural steel Latino Workers: Phase 2 implementation and assessment. *ASEE Annual Conference and Exposition, Conference Proceedings.* https://doi.org/10.18260/p.26130

*De Souza, R. A., Hecker, S., de Castro, A. B., Stern, H., Hernandez, A., & Seixas, N. (2012). Novel approaches to development, delivery and evaluation of a peer-led occupational safety training for Latino day laborers. *New Solutions: A Journal of*

Environmental and Occupational Health Policy, 22, 387–405. http://doi.org/10.2190/NS.22.3.i

Donaghy, R. (2009). *One death is too many: Inquiry into the underlying causes of construction fatal accidents* (Report to the Secretary of State for Work and Pensions, Vol. 7657). Retrieved from https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/228876/7657.pdf

Dong, X. S., Choi, S. D., Borchardt, J. G., Wang, X., & Largay, J. A. (2013). Fatal falls from roofs among US construction workers. *Journal of Safety Research, 44*, 17-24. https://doi.org/10.1016/j.jsr.2012.08.024

Dong, X., Entzel, P., Men, Y., Chowdhury, R., & Schneider, S. (2004). Effects of safety and health training on work-related injury among construction laborers. *Journal of Occupational and Environmental Medicine, 46*, 1222-1228. https://doi.org/10.1097/01.jom.0000147268.42094.de

Dong, X. S., Fujimoto, A., Ringen, K., & Men, Y. (2009). Fatal falls among Hispanic construction workers. *Accident Analysis & Prevention, 41*, 1047-1052. https://doi.org/10.1016/j.aap.2009.06.012

Dong, X. S., Men, Y., & Ringen, K. (2010). Work-related injuries among Hispanic construction workers - Evidence from the Medical Expenditure Panel Survey. *American Journal of Industrial Medicine, 53,* 561-569. https://doi.org/10.1002/ajim.20799

Donovan, J. J., & Radosevich D. J. (1999). A meta-analytic review of the distribution of practice effect: Now you see it, now you don't. *Journal of Applied Psychology, 84,* 795–805. https://doi.org/10.1037/0021-9010.84.5.795

Dutta, M. J. (2017). Negotiating health on dirty jobs: Culture-centered constructions of health among migrant construction workers in Singapore. In M. Yuping, & A. Rukhsana (Eds.), *Culture, migration, and health communication in a global context* (pp. 45-59). London, UK: Routledge.

Edirisinghe, R., & Lingard, H. (2016). Exploring the potential for the use of video to communicate safety information to construction workers: Case studies of organizational use. *Construction Management and Economics*, *34*, 366-376. https://doi.org/10.1080/01446193.2016.1200736

Eurostat (2011). *Migrants in Europe. A statistical portrait of the first and second generation*. Retrieved from https://ec.europa.eu/eurostat/web/products-statistical-books/-/KS-31-10-539

Eurostat. (2018). *Accidents at work statistics*. Retrieved from https://ec.europa.eu/eurostat/statistics-explained/index.php/Accidents_at_work_statistics

Eurostat. (2019). *Migration and migrant population statistics*. Retrieved from https://ec.europa.eu/eurostat/statistics-explained/index.php/Migration_and_migrant_population_statistics

*Evia, C. (2011). Localizing and designing computer-based safety training solutions for Hispanic construction workers. *Journal of Construction Engineering and Management, 137,* 452-459. https://doi.org/10.1061/(asce)co.1943-7862.0000313

Ford, J. K., Baldwin, T. P. & Prasad, J. (2018). Transfer of training: The known and the unknown. *Annual Review of Organizational Psychology and Organizational Behavior, 5,* 201-225. https://doi.org/10.1146/annurev-orgpsych-032117-104443

*Forst, L., Ahonen, E., Zanoni, J., Holloway-Beth, A., Oschner, M., Kimmel, L., . . . Sokas, R. (2013). More than training: Community-based participatory research to reduce

injuries among Hispanic construction workers. *American Journal of Industrial Medicine, 56*, 827-837. https://doi.org/10.1002/ajim.22187

Griffin, M. A., & Curcuruto, M. (2016). Safety climate in organizations. *Annual Review of Organizational Psychology and Organizational Behavior*, *3*, 191-212. https://doi: 10.1146/annurev-orgpsych-041015-062414

Halbesleben, J. R., & Bellairs, T. (2015). Employee well-being and safety behaviors. In S. Clarke, T. M. Probst, F. Guldenmund, & J. Passmore (Eds.), *The Wiley Blackwell handbook of the psychology of occupational safety and workplace health* (pp. 251–271). Chichester: Wiley

Hallowell, M. R., & Yugar-Arias, I. F. (2016). Exploring fundamental causes of safety challenges faced by Hispanic construction workers in the US using photovoice. *Safety Science, 82,* 199-211. https://doi.org/10.1016/j.ssci.2015.09.010

*Harrington, D., Materna, B., Vannoy, J., & Sholz, P. (2009). Conducting effective tailgate trainings. *Health Promotion Practice, 10,* 359-369. https://doi.org/10.1177/152483990730788

Health & Safety Executive (HSE). (2018). *Construction statistics in Great Britain, 2018*. Retrieved from: http://www.hse.gov.uk/statistics/industry/construction.pdf

Ho, C. L., & Dzeng, R. J. (2010). Construction safety training via e-learning: Learning effectiveness and user satisfaction. *Computers & Education*, *55,* 858-867. https://doi.org/10.1016/j.compedu.2010.03.017

Hobfoll, S. E. (1989). Conservation of resources: A new attempt at conceptualizing stress. *American Psychologist, 44*, 513–524. https://doi.org/10.1037//0003-066x.44.3.513

Hobfoll, S. E., Halbesleben, J., Neveu, J. P., & Westman, M. (2018). Conservation of resources in the organizational context: The reality of resources and their

consequences. *Annual Review of Organizational Psychology and Organizational Behavior, 5,* 103-128. https://doi.org/10.1146/annurev-orgpsych-032117-104640

Hofmann, D. A., Burke, M. J., & Zohar, D. (2017). 100 years of occupational safety research: From basic protections and work analysis to a multilevel view of workplace safety and risk. *Journal of Applied Psychology, 102*, 375-388. http://dx.doi.org/10.1037/apl0000114

Holton, E. F., Bates, R. A., Seyler, D. L., & Carvalho, M. B. (1997). Toward construct validation of a transfer climate instrument. *Human Resource Development Quarterly, 8,* 95-113. https://doi.org/10.1002/hrdq.3920080203

Hussain, R., Pedro, A., Lee, D. Y., Pham, H. C., & Park, C. S. (2018). Impact of safety training and interventions on training-transfer: targeting migrant construction workers. *International Journal of Occupational Safety and Ergonomics*. Advance online publication. https://doi.org/10.1080/10803548.2018.1465671

International Labour Organization (ILO). (2018). *Safety and health at work*. Retrieved from: http://ilo.org/global/topics/safety-and-health-at-work/lang--en/index.htm

*Jaselskis, E. J., Strong, K. C., Aveiga, F., Canales, A. R., & Jahren, C. (2008). Successful multi-national workforce integration program to improve construction site performance. *Safety Science, 46,* 603-618. https://doi.org/10.1016/j.ssci.2007.06.023

Kao, K-Y., Spitzmueller, C., Cigularov, K., & Wu, H. (2016). Linking insomnia to workplace injuries: A moderated mediation model of supervisor safety priority and safety behavior. *Journal of Occupational Health Psychology*, *21*, 91-104. http://dx.doi.org/10.1037/a0039144

Kirkpatrick, D. L. (1994). *Evaluating training programs: The four levels.* San Francisco, CA: Berret-Koehler.

Kraiger, K. (2008). Transforming our models of learning and development: Web-based instruction as enabler of third-generation instruction. *Industrial and Organizational Psychology, 1*, 454-467. https://doi.org/10.1111/j.1754-9434.2008.00086.x

Kraiger, K., Ford, J. K., & Salas, E. (1993). Application of cognitive, skill-based, and affective theories of learning outcomes to new methods of training evaluation. *Journal of Applied Psychology, 78,* 311–328. https://doi.org/10.1037/0021-9010.78.2.311

Lacerenza, C. N., Reyes, D. L., Marlow, S. L., Joseph, D. L., & Salas, E. (2017). Leadership training design, delivery, and implementation: A meta-analysis. *Journal of Applied Psychology*, *102*, 1686-1718. http://dx.doi.org/10.1037/apl0000241

Lee, J., Huang, Y. H., Cheung, J. H., Chen, Z., & Shaw, W. S. (2019). A systematic review of the safety climate intervention literature: Past trends and future directions. *Journal of Occupational Health Psychology, 24,* 66-91. https://doi.org/10.1037/ocp0000113

Lingard, H., Pink, S., Harley, J., & Edirisinghe, R. (2015). Looking and learning: using participatory video to improve health and safety in the construction industry. *Construction Management and Economics*, 33(9), 740-751. https://doi.org/10.1080/01446193.2015.1102301

Loh, K., & Richardson, S. (2004). Foreign-born workers: Trends in fatal occupational injuries, 1996-2001. *Monthly Labour Review, 127*, 42-53. Retrieved from https://www.bls.gov/opub/mlr/2004/article/foreign-born-workers-trends-in-fatal-occupational-injuries-1996-2001.htm

Martin, H. J. (2010). Workplace climate and peer support as determinants of training transfer. *Human Resource Development Quarterly, 21,* 87–104. https://doi.org/10.1002/hrdq.20038

Martínez-Córcoles, M., Gracia, F. J., & Peiró, J. M. (2018). Human safety performance in high reliability organizations: The case of the nuclear industry. *Papeles del Psicólogo*, *39,* 183-190. https://doi.org/10.23923/pap.psicol2018.2869

McKay, S., Craw, M. & Chopra, D. (2006). *Migrant workers in England and Wales: An assessment of migrant worker health and safety risks.* (Report for HSE by Working Lives Research Institute, London Metropolitan University, London). Retrieved from http://www.hse.gov.uk/research/rrpdf/rr502.pdf

*Menzel, N. N., & Gutierrez, A. P. (2010). Latino worker perceptions of construction risks. *American Journal of Industrial Medicine, 53,* 179-187. https://doi.org/10.1002/ajim.20735

*Menzel, N. N., & Shrestha, P. P. (2012). Social marketing to plan a fall prevention program for Latino construction workers. *American Journal of Industrial Medicine, 55,* 729-735. https://doi.org/10.1002/ajim.22038

Moyce, S. C., & Schenker, M. (2018). Migrant workers and their occupational health and safety. *Annual Review of Public Health*, *39*, 351-365. https://doi.org/10.1146/annurev-publhealth-040617-013714

Münz, R. (2007). *Migration, labor markets, and integration of migrants: An overview for Europe.* (HWWI policy paper, No. 3-6). Retrieved from https://www.econstor.eu/handle/10419/47671

Noe, R. A., & Colquitt, J. A. (2002). Planning for training impact: Principles of training effectiveness. In K. Kraiger (Ed.), *Creating, implementing, and maintaining effective training and development: State-of-the-art lessons for practice* (pp. 53–79). San Francisco, CA: Jossey-Bass.

*O'Connor, T., Loomis, D., Runyan, C., Abboud Dal Santo, J., & Schulman, M. (2005). Adequacy of health and safety training among young Latino construction

workers. *Journal of Occupational and Environmental Medicine, 47*, 272-277. https://doi.org/10.1097/01.jom.0000150204.12937.f5

*Ochsner, M., Marshall, E. G., Martino, C., Pabelón, M. C., Kimmel, L., & Rostran, D. (2012). Beyond the classroom: A case study of immigrant safety liaisons in residential construction. New Solutions: *A Journal of Environmental and Occupational Health Policy, 22,* 365-386. https://doi.org/10.2190/ns.22.3.h

Office for National Statistics (ONS). (2018). *Migrant labour force within the UK's construction industry: August 2018*. Retrieved from https://www.ons.gov.uk/peoplepopulationandcommunity/populationandmigration/internationalmigration/articles/migrantlabourforcewithintheconstructionindustry/august2018

Oswald, D., Sherratt, F., Smith, S. D., & Hallowell, M. R. (2018). Exploring safety management challenges for multi-national construction workforces: a UK case study. *Construction Management and Economics*, *36*, 291-301. https://doi.org/10.1080/01446193.2017.1390242

Pedersen, L. M., Nielsen, K. J., & Kines, P. (2012). Realistic evaluation as a new way to design and evaluate occupational safety interventions. *Safety Science*, *50*, 48-54. https://doi.org/10.1016/j.ssci.2011.06.010

Ricci, F., Chiesi, A., Bisio, C., Panari, C., & Pelosi, A. (2016). Effectiveness of occupational health and safety training: A systematic review with meta-analysis. *Journal of Workplace Learning*, *28*, 355-377. https://doi.org/10.1108/JWL-11-2015-0087

Ricci, F., Pelosi, A., Panari, C., & Chiesi, A. (2018, September). Safety training 4.0: Active, collaborative, human-focused practices, to improve health at work. In M. Peruzzini, M. Pellicciari, C. Bil, J. Stjepandic, and N. Wognum (Eds.), *Advances in Transdisciplinary Engineering Series: Vol. 7. Transdisciplinary Engineering Methods*

for Social Innovation of Industry 4.0: Proceedings of the 25th ISPE Inc. International Conference on Transdisciplinary Engineering, July 3–6, 2018 (pp.310-319). Amsterdam, Netherlands: IOS Press.

Robson, L. S., Stephenson, C. M., Schulte, P. A., Amick III, B. C., Irvin, E. L., Eggerth, D. E., ... Grubb, P. L. (2012). A systematic review of the effectiveness of occupational health and safety training. *Scandinavian Journal of Work, Environment & Health, 38*, 193-208. https://doi.org/10.5271/sjweh.3259

Rouiller, J. Z., & Goldstein, I. L. (1993). The relationship between organizational transfer climate and positive transfer of training. *Human Resource Development Quarterly, 4,* 377–390. https://doi.org/10.1002/hrdq.3920040408

Sacks, R., Perlman, A., & Barak, R. (2013). Construction safety training using immersive virtual reality. *Construction Management and Economics, 31*, 1005-1017. https://doi.org/10.1080/01446193.2013.828844

Salas, E., & Cannon-Bowers, J. A. (2001). The science of training: A decade of progress. *Annual Review of Psychology, 52,* 471-499. https://doi.org/10.1037/e597432010-181

Salas, E., Tannenbaum, S., Kraiger, K., & Smith-Jentsch, K. A. (2012). The science of training and development in organizations: What matters in practice. *Psychological Science in the Public Interest, 13,* 74 –101. https://doi.org/10.1177/1529100612436661

Santoso, D. S. (2009). The construction site as a multicultural workplace: A perspective of minority migrant workers in Brunei. *Construction Management and Economics*, *27*, 529-537. https://doi.org/10.1080/01446190902960482

*Shin, Y., Nam, S., Kim., T. Y., & Kim, G. H. (2013). An analysis of the Safety Education for Foreign Laborer in Construction Site. *Advanced Materials Research, 671,* 3083-3086. https://doi.org/10.4028/www.scientific.net/amr.671-674.3083

*Sokas, R. K., Jorgensen, E., Nickels, L., Gao, W., & Gittleman, J. L. (2009). An intervention effectiveness study of hazard awareness Training in the construction building trades. *Public Health Reports, 124,* 161–168. https://doi.org/10.1177/00333549091244S118

Starren, A., Hornikx, J., & Luijters, K. (2013). Occupational safety in multicultural teams and organizations: A research agenda. *Safety Science, 52,* 43-49. https://doi.org/10.1016/j.ssci.2012.03.013

Suri, H., & Clarke, D. (2009). Advancements in research synthesis methods: From a methodologically inclusive perspective. *Review of Educational Research, 79*, 395-430. https://doi.org/10.3102/0034654308326349

*Trajkovski, S., & Loosemore, M. (2006). Safety implications of low-english proficiency among migrant construction site operatives. *International Journal of Project Management, 24*, 446-452. https://doi.org/10.1016/j.ijproman.2005.11.004

Tutt, D., Dainty, A., Gibb, A., & Pink, S. (2011). *Migrant construction workers and health & safety communication.* (Report for the Construction Industry Training Board). Retrieved from https://citb-constructionskills.preprod-cskills.org/documents/research/migrant-construction-workers-health-safety-communication_tcm17-25018.pdf

United Nations (UN). (1990). *International convention on the protection of the rights of all migrant workers and members of their families*. Retrieved from http://www.un.org/documents/ga/res/45/a45r158.htm

Vignoli, M., Punnett, L., & Depolo, M. (2014). How to measure safety training effectiveness? Towards a more reliable model to overcome evaluation issues in safety training. *Chemical Engineering Transactions, 36*, 67-72. https://doi.org/10.3303/CET1436012

*Williams Q. Jr., 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*, 253-261. https://doi.org/10.1016/j.jsr.2010.02.009

*Won, D., Kwon, K., Jung, K. H., Kim, G. H., & Shin, Y. (2013). A comparative analysis of the safety education awareness between site managers and foreign laborers in construction site. *Advanced Materials Research, 671*, 3069-3072. https://doi.org/10.4028/www.scientific.net/amr.671-674.3069

Yang, B., Wang, Y., & Drewry, A. W. (2009). Does it matter where to conduct training? Accounting for cultural factors. *Human Resource Management Review, 19,* 324–333. https://doi.org/10.1016/j.hrmr.2009.03.002

Zhou, Z., Goh, Y. M., & Li, Q. (2015). Overview and analysis of safety management studies in the construction industry. *Safety Science, 72*, 337–350. https://doi.org/10.1016/j.ssci.2014.10.006

Zohar, D. (2008). Safety climate and beyond: A multi-level multi-climate framework. *Safety Science*, *46,* 376–387. https://doi.org/10.1016/j.ssci.2007.03.006

Table 1

Inclusion and Exclusion Criteria for Literature Search

Category	Inclusion criteria	Exclusion criteria
Year	2000-2017	
Keywords	Safety and training and related terms[1]	Patient safety
Research setting	Construction	Other sector (healthcare, agriculture, etc.)
Sample characteristics	Migrant workers	Not migrant workers or not low skilled workers
Research design	Based on a quasi – experimental and experimental design Between- subject design Within-subject design Mixed design Cross-sectional design	No safety training
Training	Time scheme: Frequency and duration Method: Training modalities Focus: Construction workplaces Target: Migrant workers	
Outcome variable	Any safety related outcome	
Others	Published in English Full text available	

Note. [1]Related terms to select articles by title are described in the *Search Strategy* section

Table 2

Eighteen Articles on Safety Training Interventions (2002–2017) for Systematic Review

Study	Sample/design	Training duration	Target	Country	Training method	Outcomes
Ahonen et al. (2013)/ published in *New Solutions: A Journal of Environmental and Occupational Health Policy*	Sample 444 migrant workers trained, 84 included in survey. 32 worker leaders trained Design Mixed methods quasi-experimental design with pre- and post knowledge test. Meeting notes, observations, interviews, attendance logs, pre-and post-training trainee survey. Three months follow-up	2 full days	Hispanic workers in construction	U.S.	The Day Laborers' Health and Safety Workbook (DLHSW) was developed based on the OSHA 10 hours program and covering all of its topics. The workbook is based on the Small Group Activity Method and it involves 3 learning pathways: a) facilitator to facilitator, facilitator to trainee and trainee to facilitator. Training was led by facilitators. Every activity of the workbook was about a specific	Positive reactions to the training Knowledge gain about workplace safety Limited but positive evidence for application knowledge

Study	Sample/design	Training duration	Target	Country	Training method	Outcomes
					workplace safety topic and proviedd both information and problem solving activities. Worker leaders were identified as facilitators and trained about the DLHSW content	
Brunette (2005)/ published in *Family & Community Health*	Sample 175 Hispanic speaking construction workers trained Design Mixed method sequential design. Cross-sectional survey and focus groups	10 hours	Hispanic migrant workers in construction	U.S.	13 modules (6 mandatory and 7 elective), organized using a participatory approach: introduction (1 hr) fall protection (2 hr) electrical safety (1 hr) personal protective equipment and life-saving equipment (1 hr) tools-hand and power (1 hr) materials handling (1 hr) ergonomics (1 hr)	Development of Occupational safety and Health administration tool Development of educational materials on construction safety

Study	Sample/design	Training duration	Target	Country	Training method	Outcomes
					lead and asbestos hazards (1 hr) scaffolds confined spaces (1 hr) stairways and ladders (1 hr) fire protection (1 hr) hazard communication (1 hr)	
Choudhry and Fang (2008)/ published in *Safety Science*	Sample Seven construction workers and five supervisors Design Semi-structured interviews	*na*	Chinese and non Chinese workers in construction	China	Interviews of Chinese and non-Chinese workers	Identification of 11 factors correlated to workplace safety
De Souza et al. (2012)/ published in *New Solutions: A Journal of Environmental and Occupational Health Policy*	Sample 125 migrant workers trained, 96 workers included in analysis Design Mixed methods. Knowledge test, pre- and post-training, semi-	4 hours	Day laborers Latino immigrants in construction	U.S.	Training intervention based on a train-the-trainer approach. Identification of 8 priorities in the curriculum. 4 hours of training allotted to 4 themes: Personal protective	Knowledge gain in terms of workplace safety Increased attitudes and behaviors toward safety in the workplace Difficulties and obstacles correlated to the application of

Study	Sample/design	Training duration	Target	Country	Training method	Outcomes
	structured interviews, large group discussion, trainer and work centre staff interviews				equipment (PPE) familiarity Correct PPE Hazard identification - Workers rights	the knowledge gained to the workplace reported
Del Puerto et al. (2016)/ *Conference Proceedings*	Sample 104 migrant workers trained with 95 returning useable data. Design Cross-sectional design. Knowledge pre and post test with post-test sruvey about perceptions of training.	4 training sessions	Workers in steel industry related to construction	U.S.	Implementation of the Susan Harwood training program, consisting in 2 phases: Phase 1 (curriculum development on safety): 6 contact hours on safety educational material (10 modules), about: program overview 2 hazards overview 3 material handling and storage 4 material handling and storage equipment continuation 5 preventing musculoskeletal	Moderate knowledge increase about workplace safety Intention to apply knowledge gained Perceived utility and satisfaction about the attended training

Study	Sample/design	Training duration	Target	Country	Training method	Outcomes
					injuries 6 electrical safety 7 respiratory safety and personal protective equipment 8 worker's rights 9 secondary training Phase 2: conduction and assessment of the training. Training structured in 4 sessions (30 participants in the first, the second and the third one, and 14 in the fourth)	
Evia (2011)/published in *Journal of Construction Engineering and Management*	Sample 20 workers Design Mixed methods: Pre- and post knowledge test, interviews and focus groups	*na*	Latin workers in residential construction	U.S.	Localization of an online course on workplace safety	Ineffective on Hispanic workers Low levels of interactivity with computers
Forst et al. (2013)/ published in *American*	Sample 446 migrant workers	10 hours	Hispanic workers in	U.S.	Modified version of the OSHA 10	Increase in knowledge about prevention of

Study	Sample/design	Training duration	Target	Country	Training method	Outcomes
Journal of Industrial Medicine	Design Mixed methods. Pre- and post-test post-test knowledge test Semi-structured interviews with work centre leaders, open discussions with migrant work leaders (trainers), Three month follow-up		construction		hours training (16 hours).	falls and electrocution Increase in initiative taking by workers to self-protection through communication with co-workers and supervisors
Harrington et al. (2009)/ published in *Health Promotion Practice*	Sample 1525 migrant workers trained, 972 included in analyses Design Structured interviews and follow-up survey six months post-training	15 half-days training of trainer programs	Hispanic workers in construction	U.S.	4-hour training curriculum developed as it follows: introduction pairing off (self-presentation of the participants and discussion about barriers and challenges they encounter in tailgate trainings) contractor's	86% of the participants found the training helpful. The most useful thing learned was about how to conduct tailgate trainings and the resourced provided After 6 months, 71% of the attendees reported to use tailgate trainings every ten days and

Study	Sample/design	Training duration	Target	Country	Training method	Outcomes
					perspective: a) motivational pitch about tailgate training; b) 2 videotapes about tailgate training; c) lessons about effective adult learning techniques and best practices; d) distribution of resource folder, discussion of how Safety Break materials were designed to be used, and review of other resources provided; e) small group exercises; f) discussions about tailgate training programs carried out; g) summary of previous phases	the frequency and the efficency of these trainings was higher Increase in safety concern and attention to company rules, as well as problem solving in terms of safety Training reported as useful.
Jaselskis et al. (2008)/ published in *Safety Science*	Sample Phase 1: 98 Hispanic workers. Phase 2:	Variable: 8 hours	Hispanic workers in construction	U.S.	Assessment of needs and interest of American	Training considered as useful Improved

Study	Sample/design	Training duration	Target	Country	Training method	Outcomes
	38 supervisors. Phase 3: 23 supervisors and 69 Hispanic workers Design Three cross-sectional surveys	for course 2; 11 sessions for course 4.			construction companies utilizing Hispanic craft workers with the objective of developing an effective tool to improve communication between workers (American supervisors and Hispanic workers). 4 different courses: 1) English as a Second Language; 2) Spanish as a Second Language; 3) Concrete Pavement Construction Basics; 4) Toolbox Integration Course for Hispanic Workers and American Supervisors (TICHA)	communication between workers Improved confidence on jobsite Lost fear of speaking in another language

Study	Sample/design	Training duration	Target	Country	Training method	Outcomes
Menzel and Gutierrez (2010)/ published in *American Journal of Industrial Medicine*	Sample 30 workers Design Four focus groups	*na*	Hispanic workers in construction	U.S.	Four 90 minutes focus groups to determine perceived risks of injury using a convenience sample	Difficulty in reading and understanding safety training perceived as the most prominent risks Workers in lower skilled trades perceived poor quality or Absence of safety training or equipment as risks. The third perceived risk-affecting safety was traditional Latino values that were extensively mentioned, in particular Machismo (hypermasculinity) and Respeto (respect for authority)
Menzel and Shrestha (2012)/ published in *American Journal of*	Sample 773 construction workers attended	5 hours	English and Hispanic construction	U.S.	A multidisciplinary team used a social marketing	Latinos did not attend in the Same proportion as their

Study	Sample/design	Training duration	Target	Country	Training method	Outcomes
Industrial Medicine	training of which 180 attended Spanish language course Design Post-training course evaluation and structured telephone interviews eight weeks post-training		workers		approach, based on the "4 P's" (Product, Price, Placement, Promotion) to plan the training program. Teaching techniques included: role playing; hands-on practice and competency testing with fall prevention equipment in a laboratory; multimedia, interactive classroom format; native Spanish-speaking assistant and interpreters.	representation in the Las Vegas population. 71% of Latino participants reported that in the 8 weeks after the training they had used their knowledge to avoid a fall on the job, but only 45% of those attending The English language training reported the same. 87% of Latino trainees made at least one change in safety behavior after the training, compared to 83% of English language trainees.
O'Connor et al. (2005)/ published in *Journal of Occupational and Environmental Health*	Sample 50 migrant workers Design Cross-sectional	*na*	Latino workers in construction (under 21	U.S.	In-person structured interview, with questions covering construction work	A high proportion of participants performed Tasks that can pose

Study	Sample/design	Training duration	Target	Country	Training method	Outcomes
	structured interviews		years old)		experience, tasks performed, tool use, exposure to specific hazards, injury experience, attitudes toward safety, use of personal protective equipment, safety-related knowledge, training received, and how the respondent learned about job safety.	significant health and safety hazards. Most participants received some type of health and safety training, but the median training time was 1 hour. Training was commonly a supervisor demonstrating how to perform a task; only 24% of the participants received written information. Only 8% of all respondents had been through an apprenticeship program. Participants with very limited English was less likely to receive any safety training tan those with better English

Study	Sample/design	Training duration	Target	Country	Training method	Outcomes
						ability. Many participants reported co-workers as sources of information about safety.
Ochsner et al. (2012)/published in *New Solutions: A Journal of Environmental and Occupational Health Policy*	Sample 10 migrant workers trained as liaison workers, 13 trained in OSHA 10 Design Mixed methods Cross-sectional baseline survey, meeting minutes and observations, interviews, focus groups	5 days	Hispanic day laborers in construction	U.S.	Safety Liasons Training with the following activities: OSHA 10 hour curriculum Quarterly meetings Worker council Safety audits Development of communication about hazards and possible risks	Development of a communication system about safety Improvements in safety behaviors
Shin et al. (2013)/ published in *Advanced Materials Research*	Sample 172 migrant workers Design Cross-sectional survey	*na*	Mainly Vietnamese and Chinese	Korea	A survey to analyze the current status of safety education for foreign construction workers	70% of participants responded positively about the preventive effect of the safety education. 76% of respondents

Study	Sample/design	Training duration	Target	Country	Training method	Outcomes
						understood most of the education. Those who did not understand the education reported massive education, linguistic barriers and difficulty of the training as the principal reasons why they cannot understand safety education. For the majority of respondents an education improvement was needed. The most effective method of education was the audio-visual one. In order to improve safety education, participants asked in particular for programs tailored to work type,

Study	Sample/design	Training duration	Target	Country	Training method	Outcomes
						clearly delivered.
Sokas et al. (2009)/published in *Public Health Reports*	Sample 158 migrant workers Design Mixed methods. Survey pre-and post-training on knowledge and attitude Follow-up interviews three months after baseline.	10 hours	Latin workers in residential construction	U.S.	Apprenticeship programs vary in length and content by trade, but in general alternate classroom, hands-on controlled workshop activities, and actual on-the-job experience in work settings.	Measurable improvements in knowledge and attitudes were demonstrated three months after a one-hour Hazard awareness training session provided in The context of a union-based apprenticeship or journeyman training program.
Trajkovski and Loosemore (2006)/ published in *International Journal of Project Management*	Sample 400 migrant workers Design Cross-sectional survey	*na*	Migrant workers	Australia	Survey of migranrt workers in the Sydney metropolitan area in Australia. Questionnaires about: language prevalently spoken on jobsite; difficulties experiences communicating	The majority of workers do not use English as primary language at work. Interest in improvement in the use of English language Difficulties in communication about safety on jobsite

Study	Sample/design	Training duration	Target	Country	Training method	Outcomes
					with colleagues; importance of mandatory safety training; language support to migrant workers from supervisors in terms of safety	Lack of knowledge about safety procedures in migrant workers Higher exposure to health or safety risks for migrant workers Strong support for safety training Discrete level of mandatory safety training received
Williams et al. (2010)/ published in *Journal of Safety Research*	Sample 300 workers trained, 70 completed follow-up survey Design Mixed methods. Pre-andpost survey with 2-6 months follow-up. Focus groups conducted prior to training. Interviews and focus goups post-training.	1 day	Hispanic day laborers	U.S.	One day Spanish language health and safety training class. The classes, led by trained worker trainers, engaged participants in a series of tasks requiring teamwork and active problem solving focused on applying safe practices to	Decrease in self-reported injuries Information sharing about safety workbooks between collegues

Study	Sample/design	Training duration	Target	Country	Training method	Outcomes
					situations they encounter at their worksites.	
Won et al (2013)/ published in *Advanced Materials Research*	Sample 207 migrant workers and 105 site managers Design Cross-sectional survey	*na*	Vietnamese, Chinese, Filipino and Thai workers	Korea	Survey of migrant workers from 4 countries. The questionnaire was made to include 16 questions about awareness of construction safety and analyzing differences between site managers and foreign workers	Lack of support for a safety education system for foreign laborers was reported. Meaning differences between awareness of construction safety between the groups reported

Table 3

Cognitive and Social Constructivist Research Agenda for Training Low-Skilled Workers in Construction and in particular Migrant Workers

Antecedents	Training design	Training transfer	Outcomes
Individual characteristics Cultural values* Language proficiency* Knowledge of host country*	Learning methods Learning principles Clarifying objectives and potential outcomes of training	Dynamic transfer attempts Opportunities to practice	Improvements in skills, knowledge (soft and technical) and attitudes (e.g. change of macho values)

Antecedents	Training design	Training transfer	Outcomes
Cognitive abilities Self-efficacy Learning goal orientation Motivation Conscientiousness Neuroticism Context Policy making bodies * Community centres * Financial compensation Organizational safety culture Culture of the home and host countries. *	Linking training content to the job Feedback (also on errors) Interaction and groupwork to promote collective learning and development of shared norms * Mixed classroom teaching * Peers and supervisors as trainers and role models * Practical exercises that facilitate the acquisition of skills and makes sure people gain confidence speaking up. Supportive ICT and online material. Sequencing to facilitate sensemaking Training content Focus on nontechnical skills such as assertiveness, conflict management, communications, and proactivity. Pay attention to team factors and taking care of others'		Safety climate Accidents Injuries Fatalities Safety proactivity Safety compliance as these are central to injuries, near misses and acicdents

Antecedents	Training design	Training transfer	Outcomes
	safety and protection Awareness of cultural values in host country * Awareness of host country regulations and legislation *		

Note. * = Factors specific to migrant workers

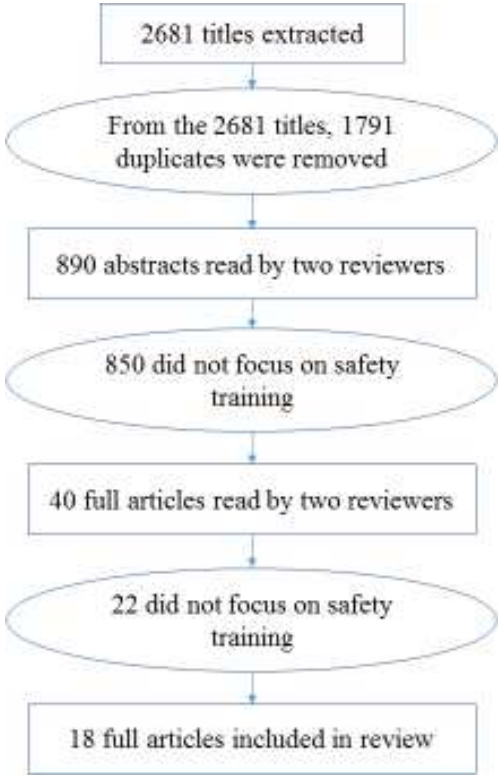

Figure 1. Scientific literature search procedure