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Mikko Nykänen

Enhancing Safety Competencies of Young People

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ABSTRACT

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Young workers are vulnerable to occupational hazards and are at a greater risk of being injured at work. Inexperience, lack of safety training and inadequate skills for dealing with work-related hazards undermine the occupational safety of young people. In addition, young individuals often work in low-skilled and manual jobs that involve a higher risk of accidents. Prior research has shown that the majority of accidents at work are caused by factors related to human behavior. By enhancing safety preparedness, increasing safety motivation and modifying the safety locus of control and safety attitudes, it is possible to influence young individual's abilities of protecting themselves from occupational hazards. The main purpose of this study was to extend our understanding of effective methods that help young people play active role in occupational safety. The efficacy and implementation process of a student-centered safety training program was investigated in a school-based randomized controlled trial carried out in eight Finnish vocational schools. The safety training program was based on social-cognitive theories and utilized a peer learning process. The study comprised three sub-studies. The results of Sub-study I indicate that the safety training program enhanced safety preparedness, increased internal safety locus of control and reduced risk attitudes among students. Sub-study II detected a significant increase in safety motivation. Furthermore, the effect of safety training on internal safety locus of control was associated with motivational outcomes. These results provide practical implications for designing school-based safety training and increase our understanding of the antecedents of safety motivation. The efficacy evaluation was complemented by analysis of the implementation process in Sub-study III. The results showed that adherence to the intervention program and quality of delivery were associated with student outcomes. The target group perspective of the intervention fidelity assessment provided new insights into the evaluation of the implementation process of school-based preventive interventions. Furthermore, the identification of the key active ingredients of the safety training program helped determine specific practices that facilitate the desired change among students. Overall, this study suggests that a student-centered safety training approach has a positive impact on the antecedents of safety behaviors. The results provide practical suggestions for school-based safety training and help equip young people with readiness to promote occupational safety and resilience to overcome barriers to safe work.

Keywords: Adolescents, young adults, young workers, vocational education, occupational safety, safety training, accident prevention

TIIVISTELMÄ (FINNISH ABSTRACT)

Nykänen, Mikko
Nuorten turvallisuusvalmiuksien vahvistaminen: Koulupohjaisen työturvallisuuskoulutus menetelmän vaikutukset
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Nuoret työntekijät ovat haavoittuvaisia työhön liittyville vaaroille ja heillä on suurempi riski joutua työtapaturmiin. Vähäinen turvallisuuskoulutus, kokemattomuus ja puutteelliset taidot työhön liittyvien vaarojen torjumiseen heikentävät nuorten työturvallisuutta. Lisäksi nuoret tekevät usein tapaturmille alttiimpia fyysisiä työtehtäviä. Aiemmat tutkimukset ovat osoittaneet, että ihmisen omalla turvallisuuskäyttäytymisellä on merkittävä rooli työturvallisuudessa. Vahvistamalla valmistautuneisuutta työturvallisuuteen, lisäämällä motivaatiota turvalliseen työskentelyyn sekä muokkaamalla turvallisuuteen kohdistuvaa hallinnan tunnetta ja turvallisuusasenteita on mahdollista vahvistaa nuorten työntekijöiden kykyä suojella itseään työhön liittyviltä vaaroilta. Tämän tutkimuksen tarkoituksena on lisätä tietoa keinoista nuorten työturvallisuuden edistämiseen. Tutkimuksessa arvioidaan opiskelijakeskeisen ja vertaisoppimiseen perustuvan turvallisuuskoulutuksen vaikutuksia käyttäen satunnaistettua kenttäkoeasetelmaa (8 ammatillista oppilaitosta). Tutkimus sisältää kolme osatutkimusta. Ensimmäinen osatutkimus osoitti, että turvallisuuskoulutus vahvisti työturvallisuuteen kohdistuvaa valmistautuneisuutta ja sisäistä hallinnan tunnetta sekä vähensi riskiasenteita. Toinen osatutkimus osoitti, että koulutuksella oli positiivinen vaikutus motivaatioon edistää työturvallisuutta. Lisäksi havaittiin, että turvallisuuskoulutuksen vaikutukset sisäiseen hallinnan tunteeseen olivat yhteydessä motivaation vahvistumiseen. Tämä tulos lisää tietoa turvallisuusmotivaatiota ennustavista tekijöistä ja auttaa kehittämään turvallisuuskoulutuksesta tehokkaampaa. Kolmannen osatutkimuksen tulokset osoittivat, että koulutusohjelman toteuttamisen täsmällisyydellä ja laadulla oli yhteyksiä positiivisiin vaikutuksiin. Implementaatioprosessin tutkiminen opiskelijoiden näkökulmasta tarjoaa uuden lähestymistavan kouluympäristössä toteutettavien interventioiden arviointiin. Yhteenvetona voidaan todeta, että sosiaalis-kognitiviisiin teorioihin pohjautuva ja osallistava lähestymistapa turvallisuuskoulutukseen vaikuttaa turvallisuuskäyttäytymistä ennustaviin tekijöihin. Tutkimus tarjoaa suuntaviivoja turvallisuuskoulutuksen kehittämiseen kouluissa ja auttaa vahvistamaan nuorten valmiuksia turvalliseen työskentelyyn.

Avainsanat: Nuoret, nuoret aikuiset, nuoret työntekijät, ammatillinen koulutus, työturvallisuus, turvallisuuskoulutus, tapaturmien ennaltaehkäisy

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I wrote this dissertation during the worldwide health crisis due to the rapid spread of coronavirus. People across the world are fighting the epidemic. This has led me to reflect on how multiple approaches are needed to promote human

safety and health in the world. First, we need top-down policies and regulations. This requires the actions of skilled policy-makers, the utilization of scientific knowledge, collaboration with experts, and monitoring of the implementation of measures found to be appropriate. However, top-down approaches are not effective if people do not act. This requires effort and will from all of us. I sincerely hope that this dissertation gives rise to ideas for empowering people to be active in promoting safety and health.

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LIST OF ORIGINAL PUBLICATIONS

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Taking into account the instructions given and comments made by the co-authors, the author of the thesis collected the data, conducted the analyses, and was the main author in the three publications.

FIGURES

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1 INTRODUCTION

Work is an essential part of human life. It is important that each individual has the opportunity and ability to work safely. In a broad sense, occupational safety means the state of being safe from harm at the workplace (Hanvold et al., 2016). Occupational hazards have the potential to cause harm, injuries or illness at work (Kines et al., 2013). They come in many forms, such as physical hazards (e.g. handling heavy loads), exposure to biological and chemical hazards, psychological hazards (e.g. threat of violence), and hazards related to using tools and machines at work (see International Labor Organization, 2015). One of the most used indicators of occupational safety is the occurrence of accidents at work (Wallace, Paul, Landis, & Vodanovich, 2012). An occupational accident is defined as "a workplace event that results in physical harm to persons" (Beus, McCord, & Zohar, 2016, p. 354). Occupational accidents are a major problem and every year cause serious health-related harm, lost working days, financial costs, and in the worst cases, fatalities (Concha-Barrientos, Nelson, Fingerhut, Driscoll, & Leigh, 2005). Occupational accidents also have psychological consequences such as anxiety and post-traumatic symptoms (Ghisi et al., 2013).

Young people are especially vulnerable to occupational hazards. A previous international review study showed that young workers (aged under 24) are at a higher risk of accidents at work (Salminen, 2004). More recently, a Nordic study by Hanvold et al. (2019) found that young workers (aged under 29 years) are at almost twice the risk of occupational accidents and more often face potentially harmful exposures (e.g. chemicals) in comparison to older workers. Inexperience, lack of safety training and inadequate skills for dealing with occupational hazards undermine the occupational safety of young workers (Guerin & Toland, 2020). Moreover, vulnerability to occupational hazards is context dependent, and young people often work in manual jobs with higher risks of accidents (Rodrigues, Vale, & Silva, 2008).

It is generally recognized that occupational accidents and their precipitating events are largely preventable (Davis & Pless, 2001; Gielen & Sleet, 2003). The most effective way to prevent occupational accidents and other harmful events is to remove and entirely eliminate occupational hazards from the work

environment (see NIOSH, 2015). However, due to the nature of work or the characteristics of the working environment, this is not always possible. Additional preventive approaches are needed, such as increasing individuals' competencies and knowledge regarding how to protect themselves through safety training (Robson et al., 2012) and modifying their safety-related behaviors at work (Dejoy, 1996). The main purpose of this study was to extend our understanding of effective methods to help young people play an active role in protecting themselves from occupational hazards.

This dissertation is structured as follows. First, I review the key factors that affect the occupational safety of young people. Thereafter, I define a framework to illustrate the associations between personal safety competencies, safety behaviors and occupational accidents. Next, I discuss different approaches for promoting occupational safety among young people, with a particular focus on school-based safety training. This is followed by a description of a student-centered safety training approach for enhancing personal safety competencies during vocational education. I also discuss the role of peer learning in safety training. Finally, the theoretical chapter ends with a summary of aims and the research questions of the current study. The second chapter provides a synopsis of the study methods, including its randomized controlled study design, research setting and data analysis procedures. The study results are presented in the third chapter and discussed in the fourth chapter.

1.1 Occupational safety of young people

According to the statistics of the Finnish Workers Compensation Center, in 2018, a total of 16 042 accidents occurred at work among young workers aged under 25. The highest accident rates among young workers were in the construction sector, the manufacturing industry (e.g. manufacture of wood and metal products, food industry) and the municipal sector. In 2017, 4501 young people's accidents at work resulted in more than four days of absence from work (Finnish Workers Compensation Center, 2020). Previous studies in other countries indicate that young people's occupational accidents may cause a cumulative morbidity burden over the life course. Using a retrospective cohort study (years 1991–2001) of young workers and a total of 268 238 workers' compensation claims in Canada, Koehoorn, Breslin and Xu (2008) found that the magnitude of health care use was higher among injured workers (aged under 24 years at the time of the accident) after the accident in the long term (9 years). Similarly, using cohort data on 12 686 individuals in the US, and an average of a 10-year follow-up period, Dong, Wang, Largay and Sokas (2015) found that early-career occupational accidents were related to adverse health status several years after injury. Thus, the occupational safety of young workers is also fundamental in terms of the sustainability of working careers.

The type of work and workplace characteristics are a major factor in the higher risk of occupational accidents among young workers. Young people often

work in low-skilled, manual jobs that involve hazardous physical work and a higher risk of accidents (e.g. work in the construction sector and the retail industry) (Breslin et al., 2007). Moreover, young people are often employed in temporary and part-time work (Breslin & Smith, 2005), which in turn is associated with fewer opportunities for training (Aronsson, Gustafsson, & Dallner, 2002) and negative safety indicators such as occupational accidents (Quinlan, Mayhew, & Bohle, 2001). In addition to work-related and contextual factors, it has been highlighted that inexperience, lack of safety training and inadequate skills for dealing with occupational hazards undermine the occupational safety of young workers (Hanvold et al., 2019; Guerin & Toland, 2020). Furthermore, a limited amount of work experience and a "newcomer" status may affect how young workers perceive occupational hazards. According to a study by Breslin, Polzer, MacEachen, and Shannon (2007), young workers may even feel that accidents are a normal part of their work and perceive a lack of control over improving the conditions of their work, resulting in unsafe work. Tucker and Turner (2013) found that young workers may lack the self-confidence to raise concerns about their safety. This behavior was related to fear of losing one's job and feelings of powerlessness. Moreover, an Australian study by Clarkson, Blewett, Rainbird, Paterson, and Etherton (2018) highlighted that young workers are less likely to report hazards or injuries at the workplace and had limited information on how to seek safety-related guidance. Thus, safety-related perceptions and lack of confidence in their ability to influence safety may also play an important role in young people's vulnerability to occupational hazards.

Due to the nature of certain work tasks, it is not usually possible to entirely eliminate hazards from the work environment. For example, construction and manufacturing industry work usually requires the use of equipment that involves a risk of accidents. Another example is healthcare work in the municipal sector, where it is difficult to completely eliminate work-related biological hazards, chemical hazards and the use of hazardous equipment. In general, many occupations involve work tasks and the use of tools and equipment that involve risks of accidents or other harmful events. Therefore, personal competencies to work safely and self-protective behaviors in relation to hazards play a fundamental role in the occupational safety of young people. This study focuses on methods to enhance personal competencies that help young people play an active role in protecting themselves at work. The next section presents a framework for understanding how personal safety competencies affect safety-related behaviors and occupational accidents.

1.2 Theoretical model of workplace safety behavior

Previous studies (Reese, 2012) have estimated that approximately 80% of accidents at work are caused by factors related to human behavior. Hence, individual safety behavior is a major concern in occupational safety. The concept

of safety performance refers to positive and preventive safety behaviors at workplaces. According to Neal, Griffin and Hart (2000), safety performance can be roughly divided into two categories: Safety compliance refers to basic safety activities that need to be carried out by individuals (e.g. adhering to safety procedures, using personal protective equipment) and safety participation refers to demonstrating initiative and putting effort into improving safety at the workplace (e.g., offering suggestions to improve occupational safety, voicing safety concerns) (Christian, Bradley, Wallace, & Burke, 2009; Neal et al., 2000;). Safety behavior can also take more negative forms such as remaining silent about safety issues, neglecting errors that weaken safety, underreporting safety-related development needs, or taking risks or shortcuts in safety procedures (see Manapragada & Bruk-Lee, 2016; Pek, Turner, Tucker, Kelloway, & Morrish, 2017).

Grounded in Campbell et al.'s (1993) theory of performance, a model of workplace safety by Christian et al. (2009) defines personal abilities, attitudes and beliefs as distal antecedents, and safety-related knowledge and motivation to work safely as proximal antecedents of safety performance at work. According to the model, personal abilities, attitudes and beliefs are associated with motivation to work safely. Furthermore, safety compliance and safety participation are negatively associated with accidents. Building on their proposed theoretical model, Christian et al. (2009) conducted a meta-analysis of 90 empirical studies. Their results showed that increasing safety knowledge alone is not enough to influence safety performance at work. Both safety knowledge and motivation to work safely demonstrated positive associations with safety behaviors. However, motivation to work safely had a stronger effect on safety participation. More recently, a comprehensive research synthesis (including 697 research articles) by Beus et al. (2016) examined the linkages defined by the model of workplace safety. Their results provided evidence that motivation to work safely contributes to safety performance and that safety performance is associated with accidents. However, they also pointed out that more empirical studies are needed to explore the individual-level antecedents of motivation to work safely. The model of workplace safety also determines that contextual factors affect safety performance indirectly through individual-level antecedents of safety behaviors. These contextual factors include safety training processes and safety culture at workplaces. Based on the workplace safety model by Christian et al. (2009) and the modified version by Beus et al. (2016), Figure 1 provides a theoretical model of the antecedents of safety behaviors at work.

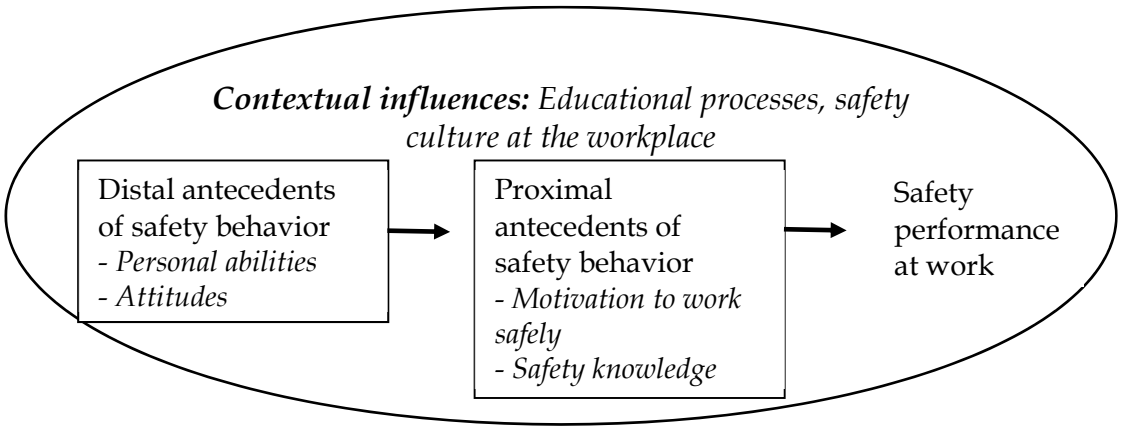

FIGURE 1 Theoretical model of workplace safety behavior (adapted from Christian et al., 2009; Beus et al., 2016)

The earlier theoretical models of workplace safety by Christian et al. (2009) and Beus et al. (2016) provide an illustrative overview of the associations between personal abilities, motivation to work safely and safety behaviors. However, they lack a more thorough understanding of the factors and processes underlying safety motivation and safety behaviors. As a result, three important questions emerge: Which personal competencies influence whether young individuals choose to engage in preventive safety behaviors? How can motivation to work safely be increased among young individuals? How can this knowledge be used to design effective safety interventions? Seeking answers to these questions requires a deeper understanding of psychological theories. In this study, the conceptual basis for finding such solutions is based on the social-cognitive theories of Bandura (1997) and Rotter (1966) and the expectancy theory of Vroom (1964). These theories address factors underlying human motivation and behavior and provide a framework for identifying key personal safety competencies for young people entering working life.

1.3 Social-cognitive framework for personal safety competencies

The purpose of the following sections is to present a synopsis of key personal competencies that contribute to self-protective behaviors among young people. They also review the associations between different personal competencies. This study defines personal safety competencies as safety motivation, safety preparedness, internal safety locus of control, and safety attitudes.

1.3.1 Safety motivation

Occupational safety is undermined if an individual adopts a passive tendency in terms of accident prevention or is not motivated to carry out preventive behaviors (Ford & Tetrick, 2008: Hedlund, Åteg, Andersson, & Rosen, 2010; Tucker & Turner, 2013). Motivation to engage in preventive behaviors and willingness to promote safety at work plays a key role in accident prevention. In order to understand the concept of motivation, it is important to investigate both general and domain-specific definitions. Klein (1989) defined motivation as "the set of psychological processes that cause the initiation, direction, intensity, and persistence of behavior" (p. 150). Motivation activates behavioral choices, guides individual effort and predicts behavior (Mitchel 1982). In the field of safety research, Neal and Griffin (2006) defined safety motivation as "an individual's willingness to exert effort to enact safety behaviors and the valence associated with those behaviors" (p. 947). If workers are highly motivated to work safely, they are also more likely to actively prevent accidents (see Griffin & Neal, 2000). Accordingly, motivation is the driving force that underlies safety performance and it is possible to direct behavior in the desired direction through reinforcing safety motivation. The more inspired and motivated young people are to work safely, the more likely they are to execute positive safety behaviors in their future workplaces. Thus, the key question concerns the factors that affect safety motivation. Previous research on safety motivation has mostly focused on organizational factors such as safety leadership (e.g. Jiang & Probst, 2016), and more empirical studies are needed to explore the individual-level antecedents of safety motivation (Beus et al., 2016). Furthermore, to the best of the author's knowledge, no prior studies have investigated methods to enhance safety motivation among young people.

1.3.2 Expectancy theory and safety motivation

Expectancy theory (Vroom, 1964) offers a perspective of the cognitive processes that potentially influence safety motivation. It defines motivation as a process that is shaped by individual beliefs and perceptions. The key factors underlying motivation include expectancy, instrumentality and valence. Basically, expectancy reflects the perceived likelihood that effort will lead to effective performance, instrumentality is related to how the individual assesses their performance as contributing to the achievement of benefits, and valence is related to how much one personally appreciates the particular outcomes (Van Eerde & Thierry, 1996). Based on this conceptualization, an individual is motivated to exercise safety behaviors if they perceive a clear link between effort (e.g. implementing a preventive measure) and effective safety performance, if they expect safety performance to lead to a beneficial outcome (e.g. prevention of an accident) and if they see the outcome as attractive (e.g. the person identifies health-related personal value). In sum, individual perceptions of the effort-

performance-outcome association may play an important role in safety motivation.

1.3.3 Safety preparedness

During the school-to-work transition, young people encounter a new environment at the workplace. The process of entering working life is characterized by facing unfamiliar situations and feelings of uncertainty (Kowtha, 2011; Louis, 1980). The school-to-work transition phase also involves a need for competencies to handle new safety-related situations. It is important that young individuals have the readiness to carry out safety-related actions in their new jobs and that they are prepared to respond effectively to the barriers to safe work that may emerge early in their careers. Vinokur and Vuori (2005) conceptualized preparedness as a cognitive construct comprising confidence in one's ability to effectively organize and perform activities in a given context and resilience related to possible setbacks or barriers. The concept of preparedness has since been used in intervention studies in relation to various educational and occupational transitions such as job search and organizational socialization processes among upper secondary-level vocational school graduates (Koivisto, Vuori, & Nykyri, 2007; Koivisto, Vuori, & Vinkokur, 2010) and career transitions later in working life (Vuori, Toppinen-Tanner, Mutanen, 2012). These previous studies have shown that preparedness supports wellbeing and helps individuals successfully cross educational and work-related transition phases.

This study introduces safety preparedness as an adaptation of the original preparedness construct, to assess young individuals' readiness to adopt an active role in occupational safety and resilience in order to overcome barriers to safe work. Safety preparedness comprises safety self-efficacy and preparation for safety barriers, defined as safety inoculation. Next, these elements of safety preparedness are examined in more detail.

Safety self-efficacy

Self-efficacy refers to the degree of confidence in one's ability to effectively organize and perform activities in a given context (Bandura, 1997). Self-efficacy has often been defined as a domain-specific construct (Bandura, 2012) and has been used in previous intervention studies in relation to a wide variety of health-promoting behaviors such as physical activity (Olander et al., 2013), healthy nutrition (Kreausukon et al., 2012) and hygiene behavior in health care (Zhou et al., 2015). The self-efficacy construct has also been identified as playing an important role in occupational safety. DeJoy (1996) proposed that self-efficacy is a possible determinant of safety behaviors at the workplace. Furthermore, Blackman (2012) stated that if workers have confidence in their abilities to prevent hazards at work, they are more likely to engage in positive safety

behaviors (e.g. using protective equipment). Previous empirical studies provide support for these assumptions. For example, a study by Newnam, Griffin and Mason (2008) showed that safety-related self-efficacies increase public sector employees' motivation to safely drive work vehicles, and Brown, Willis and Prussia (2000) found that safety-related self-efficacies influenced the extent to which steel industry workers engaged in safe work behaviors. Moreover, according to the study results of Kim, Oh, Suh, & Seo (2014) self-efficacy is associated with self-protective behavior against injuries among Korean nurses. Thus, prior research provides evidence that self-efficacy is related to motivation to work safely and to practice safety behaviors at the workplace. This study defines safety self-efficacy as the degree of confidence in one's ability to successfully perform safety-related activities, such as identifying hazards, voicing safety concerns or acquiring instructions or guidelines at work to work safely. According to Bandura (1977), mastery experience in which an individual successfully practices a behavior, verbal persuasion, emotional arousal, and vicarious learning that is derived through observing the performance of others are a key mechanisms for influencing self-efficacy.

Safety inoculation

At the beginning of their working careers, young workers may be confronted with various situations that make it difficult to work safely. Barriers to safe work may include receiving unfamiliar work tasks, uncertainty about asking for further guidance, encountering coworker risk-taking and pressure to perform at too fast a pace in relation to one's own skill level, or encountering a situation in which equipment does not work properly. Previous studies have pointed out that perceived barriers to safe work may result in unsafe work behaviors (Dejoy, 1996; Seo, 2005). Young individuals in particular may lack skills and behavioral strategies for appropriately responding to work-related situations that are unexpected and unsafe (Laberge et al., 2016; see Kincl, Anton, Hess, & Weeks, 2016). Tucker and Turner (2013) found that young workers may take a "wait-and-see" approach when they face safety concerns. Such passive orientation undermines their ability to protect themselves from risks. Furthermore, unexpected barriers to safe work can create stress that may result in the inability to make rational decisions in terms of occupational safety. Psychological distress and anxiety have also been found to increase the risk of accidents at work (Hilton & Whiteford, 2010).

Okun, Guerin and Schulte (2016) stated that young people need confidence to overcome barriers for safe work. However, previous research has not yet provided the definition of a personal resource that supports a young worker's ability to respond effectively to safety related barriers or setbacks. Building on earlier research by Vuori and Vinokur (2005) and on the principles of stress inoculation theory by Meichenbaum (1985), this study presents the concept of safety inoculation. Safety inoculation involves learning to anticipate safety-

related barriers and identifying effective behavioral skills to respond to related situations. This preparation helps young individuals maintain an active role in occupational safety when they face barriers to safe work (see Koivisto, Vuori, & Vinokur, 2010). In the process of preparing for possible safety barriers, a young person develops a sense of mastery and "learned resourcefulness". Safety inoculation may have an impact on how young workers respond to barriers to safe work and potentially lead to self-protective behaviors. If an individual acknowledges the appropriate behavioral strategy involved (e.g. asking for instructions, voicing safety concerns or refusing unsafe work) and is encouraged to execute the required preventive actions, an accident may be prevented.

1.3.4 Safety locus of control

Human behavior is affected by individuals' beliefs regarding the controllability of the events in their lives (Shapiro, Schwartz, & Austin, 1996). People also have beliefs regarding the causes of accidents at the workplace. Explanations for accidents are an important part of understanding safety behavior (Kouabenan, 2009). These perceptions may concern external factors over which the people involved have less control (e.g. bad luck, low-quality safety management) or internal factors that emphasize the role of the individual worker (e.g. using safe working methods, paying attention to hazards) (Gyekye, 2010). The concept of locus of control (Rotter, 1966) offers an analytical viewpoint to how these personal perceptions are related to safety motivation and behaviors. Locus of control refers to the perception of personal control over events and the degree to which outcomes are attributed to one's own ability to alter a situation, as opposed to external factors such as other people or luck (Rotter, 1966; 1982). The construct is divided into two parts: internal and external locus of control. Internal locus of control involves the perception that events in a person's life derive primarily from their own actions, whereas external locus of control involves the perception that events are a result of external factors such as luck or the actions of other people. The concept of locus of control has been extensively studied in work-related contexts. A meta-analysis by Ng, Sorensen and Eby (2006) showed that internal locus of control is associated with one's motivation to exert effort in work-related settings. In contrast, a lack of belief in one's ability to exert control over events attenuates achievement efforts. Moreover, a study by de Vos, Buyens and Schalk (2005) showed a positive association between internal locus of control and information-seeking behavior in a new employment relationship. Originally, the locus of control construct was developed to measure generalized expectancies of personal control. However, previous research has also treated locus of control as a domain-specific construct (Furnham & Steele, 1993; see Lefcourt, 1982). Like self-efficacy, internal locus of control has been conceptualized as a changeable psychological characteristic (see Nowicki & Duke, 2016; You, Ji, & Han, 2013). For example, Huang & Ford (2012) found that an

individual's driving locus of control can be modified using attributional retraining.

Jones and Wuebker (1985) developed the concept of *safety locus of control* to study safety behavior and occupational accidents. Safety locus of control refers to an individual's perception of the underlying causes of occupational accidents at work. People with a high internal safety locus of control tend to believe that accidents are largely determined by behaviors, effort and the initiative of individual workers. Consequently, they positively attempt to control work-related situations in terms of safety. In contrast, individuals with a high external safety locus of control view accidents as the result of external factors such as luck, fate or other factors beyond their personal control. This may result in passive tendencies in terms of preventive behaviors (Forcier, Walters, Brasher, & Jones, 2001). A study by Jones and Wuebker (1993) indicated that safety locus of control is associated with occupational accidents. According to their study, workers with a higher level of internal safety locus of control had fewer occupational accidents. More recently, a meta-analysis by Christian et al. (2009) found that locus of control was positively related to safety behaviors and negatively related to accidents. It is important to note that their meta-analysis included studies that utilized both safety locus of control and general locus of control concepts. Moreover, You, Ji and Han (2013) found that general locus of control influences safety behavior indirectly by affecting risk perception. According to their study, airplane pilots with a stronger sense of internal control rated flying risks higher and operated more safely in aviation. Furthermore, a study by Cigularov, Stallone and Stallones (2009) showed that internal safety locus of control was associated with safety-related error communication among young farm workers. From the perspective of the earlier research presented above, internal safety locus of control is an important personal competence among young people entering working life.

1.3.5 Relationships between internal safety locus of control, safety self-efficacy and safety motivation

Locus of control and self-efficacy are similar, closely related psychological constructs. Both are also regarded as important determinants of human behavior. The conceptualizations of Albert Bandura and Julian Rotter share many of the same principles in explaining how cognitions regarding human agency and perceptions of one's personal capabilities influence motivation and behavioral actions. However, there is a distinction between these two concepts. Both concepts investigate an individual's control beliefs, but each from a different perspective. Peterson and Stunkard (1992) pointed out that locus of control and self-efficacy refer to different levels of generality. The key difference is that locus of control is a more generalized construct. It refers to the extent to which individuals believe that outcomes are due to internal factors (e.g. one's own effort) or external factors (e.g. luck). In this regard, safety locus of control refers to perceptions of personal control over accidents. Self-efficacy in turn refers to one's perceived abilities to effectively organize and perform specific behavioral

activities. Thus, safety self-efficacy focuses on the degree of confidence in one's ability to effectively carry out safety related actions. The following example illustrates the difference between safety self-efficacy and safety locus of control: An individual may acknowledge that accidents are highly contingent on one's behavior (high internal safety locus of control) but may have low self-efficacy to execute specific preventive behaviors at the workplace.

Moreover, safety self-efficacy and internal safety locus of control are both cognitions that may have motivational consequences. According to Expectancy Theory (see Eccles & Wigfield, 2002; Vroom, 1964), motivation for a given behavior is influenced by the individual's expectations of success and sense of control over outcomes. Thus, in terms of safety motivation, it is important that individuals acknowledge their personal control over accidents and have the conviction that they can successfully perform the required preventive actions. If an individual does not perceive their personal ability to control safety events at work or is not confident in their ability to effectively carry out specified safety activities, they are not likely to actively engage in hazard prevention activities. Looking at the concepts of safety self-efficacy and internal safety locus of control in reference to expectancy theory, one can determine that both constructs are related to the effort-performance–outcome relationship. Despite similarities, these constructs may have unique motivational consequences. Figure 2 illustrates the potential impact of safety self-efficacy and internal safety locus of control on safety motivation among young individuals.

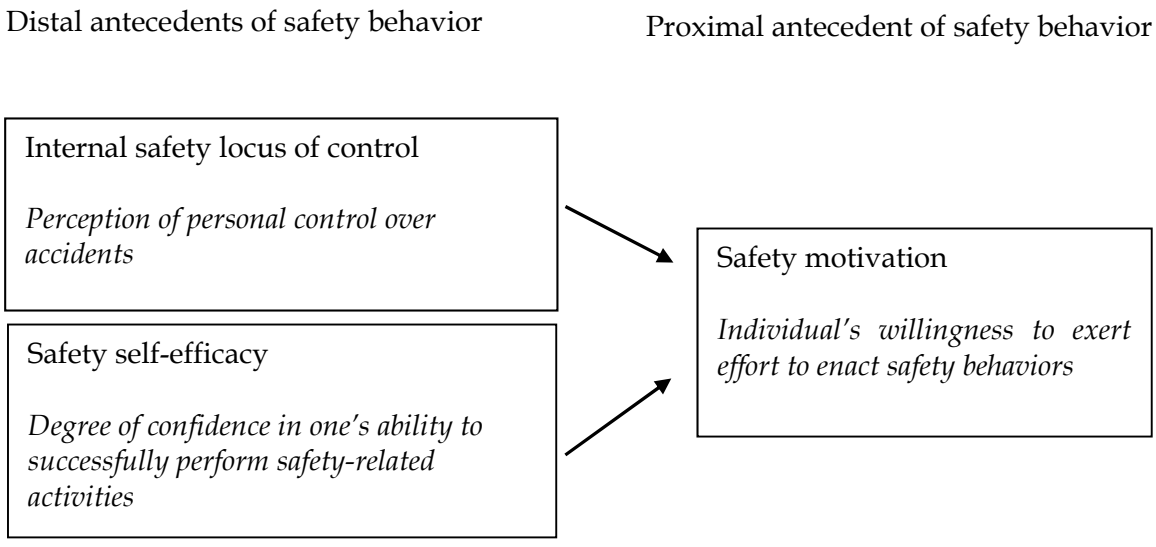

FIGURE 2 Cognitive processes related to safety motivation

1.4 Risk attitudes

As previously stated, occupational safety behavior can also occur in a negative sense. Unsafe work behavior subjects individuals to harm at workplaces and is associated with accidents (Beus, Dhanani McCord, 2015). Thus, it is also important to consider psychological factors that may contribute to negative safety behaviors such as risk-taking among young people. According to previous studies (Steinberg, 2008), adolescents and young adults have a heightened vulnerability to risk-taking in comparison to older age groups. The limited work experience of a young worker may also influence their perception of occupational hazards and the risks involved. Due to their inexperience, young workers may not be aware of the potential consequences of risk-taking or may underestimate the risks at work (see Loughling & Frone, 2004). A study by Lykke-Nielssen (2012) indicated that young workers may perceive working fast as the sign of a good worker, even if it implies risk-taking.

From a general perspective, attitude refers to "a person's degree of favorableness or unfavorableness with respect to a certain psychological object" (Ajzen & Fishbein, 2000). For the purposes of this study, risk attitude is defined as the extent to which an individual perceives occupational safety-related risk-taking as appropriate at the workplace. This definition is similar to the "risk-taking orientation" concept, which refers to a person's motivation to engage in risk-taking activities at work (Westaby & Lowe, 2005) and the "cavalier attitudes toward safety risk" concept, which refers to the individual's willingness to take risks at work (Brown et al., 2000). Westaby and Lowe (2005) found that risk-taking orientation predicted occupational accidents among young workers. Furthermore, Brown et al. (2000) found that a cavalier attitude toward safety risks resulted in unsafe behavior at work. Thus, it is important to reduce attitudes among young people that may result in risk-taking behaviors and accidents at the beginning of the working career.

1.5 Previous research on safety promotion

It is important to provide young people with the necessary competencies to perform work safely. As highlighted earlier, safety preparedness, internal safety locus of control, safety attitudes and safety motivation may influence young individuals' tendency to engage in positive and preventive safety behaviors at work. Moreover, these competencies are important for all young people entering working life, regardless of their occupational field. These individual resources may accompany a young worker from one workplace to another and support occupational safety across different situations and work-related contexts (see Okun et al., 2016). The key question is how to enhance these competencies. In order to determine solutions to this matter, it is first necessary to look more generally at research on promoting safety at work among young people.

In general, the same approaches are relevant when promoting occupational safety and health (OSH) among young workers and older age groups. Robson et al. (2001) defines an occupational safety intervention briefly "as an attempt to change how things are done in order to improve safety" (p. 1). A safety intervention can be initiated by workplaces, public authorities, schools or other stakeholders and can operate at various levels, such as societal, industry, organizational or individual levels (Dyreborg et al., 2015).

Work-related safety legislation (e.g. legislation on the use of protective equipment) is widely acknowledged as an important societal and industry-level approach to safety promotion in working life. However, previous studies have pointed out that legislation alone is not sufficient to promote occupational safety (Lehtola et al., 2008; Teufer et al., 2019). Additional strategies are needed to increase compliance with the safety practices defined by law (Ricci, Chiesi, Bisio, Panari, & Pelosi, 2016). Organizational-level intervention approaches include measures such as modification of the physical work environment and making work processes safer at workplaces (e.g. organizational policies concerning protective equipment, replacing hazardous work equipment with safer equipment), developing safety leadership and safety management systems and reinforcing a safety culture at work. Individual-level approaches focus on enhancing the individual's personal competencies to work safely and modifying safety attitudes and behaviors. (Dyreborg et al., 2015). Safety training is regarded as one of the most important approaches for influencing individual-level abilities to work safely. Previous meta-analyses have shown that safety training plays a fundamental role in individual knowledge and skills for working safely (Burke et al., 2006; Ricci et al., 2016; Robson et al., 2012).

Although research on occupational safety promotion has been extensive in general, the amount of intervention studies focusing on young people in working life is limited. According to a recent international scoping review by Sámano-Ríos et al. (2019), more randomized controlled trials and non-randomized intervention studies with a concurrent control group are needed. Most previous studies have been cross-sectional or uncontrolled before-and-after studies. A Nordic review by Hanvold et al. (2019) had similar results and found a lack of intervention studies focusing on young workers.

Currently, only a few studies have investigated the impact of societal-level safety interventions on young-workers' OSH. Using a cross-sectional study design and a sample of 296 high school students, Delp et al. (2002) investigated the effectiveness of a work permit system among young workers (under 18 years of age) in the US. They found that young individuals without work permits were more likely to perform hazardous tasks and received less safety training than those with permits. Furthermore, it has been suggested (Jennifer, Purewal, Macpherson, & Pike, 2018) that altering the work environment and work processes protects young workers by replacing hazardous work methods with safer ones or developing a protective workplace safety culture. For example, using a quasi-experimental study of nine superstores, Banco, Lapidus, Monopoli and Zakowski (1997) found that the introduction of a safer case-cutting tool

accompanied by an educational intervention reduced the frequency of cutting accidents among young workers in superstores during a one-year follow-up period. However, due to the limited number of studies, evidence of the impact of organizational level safety interventions, particularly among young workers, is insufficient. Nevertheless, organizational-level intervention approaches are widely considered important for promoting occupational safety in general. Recent reviews (Hanvold et al., 2019; Jennifer et al., 2018; Sámano-Ríos et al., 2019) have shown that previous occupational safety intervention studies focusing on young individuals have mostly been conducted in educational settings and schools. The next section reviews earlier research on school-based safety interventions.

1.6 School-based safety training

Many young people can be reached in educational settings. Thus, schools provide an essential context for delivering safety interventions and enhancing young individuals' personal abilities to work safely. Moreover, it should be borne in mind that the amount of safety training provided at the workplace may vary (Cunningham et al., 2018; Rodrigues et al., 2018; see Smith & Mustard, 2007;) and that the level of supervision of young workers may sometimes be low (Lewko, Runyan, Tremblay, Staley, & Volpe, 2010; see Runyan et al., 2007). These possible shortcomings emphasize the role of school-based safety training. Guerin, Toland, Okun, Rojas-Guyler, and Bernard (2018) suggested that the integration of an occupational safety curriculum into the school context builds a foundation that affects the safety of young people in the long term by enhancing personal competence to deal with occupational hazards at workplaces. This argument also has empirical support. A recent French prospective study by Boini, Colin and Grzebyk (2017) with a two-year follow-up period (n=755) showed that young people who reported having received OSH education during vocational education had two times fewer occupational accidents than those who had not received OSH education.

The impact of school-based safety training comes from the effort to modify safety attitudes and to increase the knowledge and skills of young people to help them work safely. Based on a single-group pretest-posttest study among high school students in the US (n=200), Linker, Miller, Freeman and Burbacher (2005) found that a school-based safety training program had a positive effect on young people's knowledge of occupational safety. Similarly, a one-group pretest–posttest study with a large sample (n=2503) by Guerin et al. (2018) showed that an OSH curriculum had a beneficial impact on safety knowledge and safety attitudes among eighth-grade students in US schools. In addition, a quasi-experimental study by Rodrigues et al. (2018) showed that participatory safety training methods had a positive impact on intended safety behaviors among students in vocational education. It is important to note that earlier international research on occupational safety among young people has been characterized by

a lack of randomized controlled trials, which are essential for establishing causal relationships between intervention efforts and outcomes (see Cowen, Virk, Mascarenhas-Keyes, & Cartwright, 2017; see Deaton & Cartwright, 2018). Thus, more research is needed to determine effective methods for promoting occupational safety among young people.

It is also noteworthy that there has been relatively little systematic research on safety training in Finnish vocational schools. A recent Nordic survey, which also included Finland, indicated that the quality and quantity of OSH education in Finnish vocational schools is often dependent on school-related factors (e.g. available resources) and individual teachers' experience and skills (Hanvold et al., 2016). Earlier Finnish studies (Salminen & Palukka, 2007) have found that typical safety learning methods in vocational education include lecturing, written material and discussions with students. Furthermore, safety has been taught at the same time as work skills: for example using protective equipment when a student is practicing using work equipment or handling potentially harmful chemicals. A study by Salminen and Palukka (2007) also showed that the implementation of safety training depends on the initiative of the teacher. However, the effects of different safety training approaches have not been previously studied in Finnish schools.

1.6.1 Implementation of school-based safety interventions

The investigation of implementation processes plays an important role in school-based intervention studies. According to Durlak and Dupre (2008) "Implementation refers to what an intervention program consists of when it is delivered in a particular setting" (p. 329). A typical shortcoming in intervention studies is the lack of implementation process evaluation and underreporting of the intervention delivery process (Montgomery et al., 2018). The so-called "Black-box problem" in intervention studies refers to a limited and simplified approach that explores intervention programs only in terms of effects, without paying attention to how these effects are associated with the actual implementation (Astbury & Leeuw, 2010). Thus, an essential part of an evaluation of a school-based intervention is making the implementation process transparent and measurable. This involves operationalizing the mechanism through which the intervention program is expected to have an impact on outcomes. A key to opening this black box is to determine the active ingredients of the intervention program. An intervention's active ingredients are defined as the components of the intervention designed to contribute to the positive impact. Active ingredients specify a "recipe" for intervention efficacy (Abry, Hulleman, & Rimm-Kauffman, 2015).

It is important to monitor an intervention's active ingredients, as they occur during the implementation process. This is related to the concept of intervention fidelity, which refers to how well an intervention program has been implemented as intended in a school (Carroll, Patterson, Wood, Booth, & Balain, 2007). The intervention fidelity evaluation provides evidence that the positive effects are the result of the intervention program, adds explanatory value to the efficacy

evaluation and offers insights into how different active ingredients relate to intervention outcomes (see Abry, Rimm-Kaufman, & Curby, 2017; Astbury & Leeuw, 2010; see Wolery, 2011). For example, parts of an intervention program may be poorly implemented or not implemented at all. In such a situation, it is more difficult to draw conclusions from the links between the intervention and the positive effects. Moreover, looking at the role of the individual active ingredients provides information about which one acts as the strongest component for improving outcomes and helps distinguish essential from nonessential ingredients (O'Donnell, 2008). This information will help prioritize different aspects of the intervention program in the future (see Abry et al., 2015). Exploring the implementation of interventions' active ingredients also facilitates the replication of the intervention process in other settings (Espada, Griffin, Pereira, Orgilés, & García-Fernández, 2012) and supports the determination of practical implications for practitioners (Abry et al., 2015). For example, identifying the active ingredients in an educational safety intervention program provides guidance for teachers and trainers on what to prioritize in school-based safety training activities. Moreover, a review by Durlak and Dupre (2008) showed that intervention fidelity is an important determinant of school-based intervention program outcomes. Hence, the aim should be a high level of intervention fidelity.

A distinction can be made between the "content" of interventions and the way in which they are delivered (Michie, West, Sheals, & Godinho, 2018). The important aspects of intervention fidelity have been specifically defined as adherence to the intervention program and quality of delivery (Abry et al., 2017). Basically, the difference between these two is that adherence refers to the extent to which the pre-planned intervention content and activities are implemented, and quality of delivery reflects the manner in which an intervention provider delivers the program (Carroll et al., 2007). In educational interventions, active ingredients often include factors such as the curriculum content delivered and the instructional techniques utilized (Abry et al., 2017; Berkel, Mauricio, Schoenfelder, & Sandler, 2011).

Despite increased attention to the assessment of intervention fidelity in the field of psychology (see Gearing et al., 2011) and school-based prevention research (Durlak & Dupre, 2008), the number of empirical studies that have measured fidelity from the perspective of the target group is limited. Usually, evaluation has been based on provider self-reports or independent behavioral observations (Durlak & Dupre, 2008). The perceptions of the target group may provide more reliable information because the self-reported ratings of intervention providers are subject to a social desirability bias (Berkel et al., 2011; Lillehoj, Griffin, & Spoth, 2004). In addition, intervention fidelity has often been measured in a unidimensional way and has not been disassembled into multiple sub-dimensions from the perspective of separate active ingredients (Abry et al., 2015). This typical and rather simplified approach excludes much of the information on the relevance of the intervention process' different aspects to the results. For example, it is possible that some aspects of the intervention program

are not implemented very well during the implementation process or that some aspects are not even relevant to the impact (Dusenbury, Brannigan, Falco, & Hansen, 2003). Based on the research presented above, it seems there is a need to develop new approaches to measuring intervention fidelity and the delivery of an intervention's active ingredients using a target group perspective.

1.6.2 Individual differences on safety training outcomes

An important question concerns the subgroup differences in school-based safety intervention impact. Previous studies have highlighted that personality traits have the potential to affect training efficacy because they can influence the level of attention to training and how individuals process information during training (Gully & Chen, 2010). Therefore, it is important to consider how individual differences may affect how a person responds to school-based safety training.

Conscientiousness is an individual trait that is characterized by being responsible and achievement oriented (Clarke & Robertson, 2005). According to previous studies, conscientiousness is associated with educational achievement (Gully, Payne, Koles, & Whiteman, 2002) and positive attitudes toward occupational safety (Henning et al., 2009). These associations may also be reflected in the way in which a person responds to a safety training program in vocational education. Students with a higher conscientiousness level may be more receptive to safety training, which in turn may result in a stronger positive training effect.

Sensation-seeking is "a trait defined by the seeking of varied, novel, complex, and intense sensations and experiences, and the willingness to take physical, social, legal, and financial risks for the sake of such experience" (Zuckerman, 1994, p. 27). It has been linked to health-related risk-taking among adolescents and young adults (Raverta et al., 2009; Steinberg, 2008). Moreover, prior research has shown associations between sensation-seeking and unsafe work behaviors (Beus et al., 2015) and between sensation-seeking and traffic accidents (Wang, Shi, & Schwebel, 2019). Previous studies (Greene et al., 2000; Donohew, Lorch, & Palmgreen, 1998; Donohew et al., 2000) suggest that adolescents' sensation-seeking level influences their information processing in terms of health-related messages and that high-level sensation-seekers may need intervention efforts that are more suspenseful, fast-paced, and emotionally arousing. This suggestion is based on the activation model of information exposure (Donohew et al., 1998). According to this model, sensation-seeking affects individuals' optimum level of activation and stimulation regarding health-related messages. To attract and hold the attention of the target group, this level should be reached in health-related intervention efforts (Donohew et al., 1998). The activation model of information exposure provides a perspective that may increase our understanding of the relationship between sensation-seeking and the impact of school-based safety training. It is possible that for high-level sensation seekers, the impact of a school-based safety training program is weaker. High-level sensation seekers may need specially targeted and more intensive intervention approaches.

There is a lack of empirical studies exploring how conscientiousness and sensation-seeking influence the way in which young people respond to school-based safety training. Understanding how individual differences impact safety training outcomes informs the further development of school-based safety training approaches and intervention efforts. For example, it is possible to identify subgroups that need additional support or different training approaches to achieve positive outcomes. In this study, both conscientiousness and sensation-seeking are explored as potential moderators of the impact of school-based safety training.

1.6.3 Participatory vs. passive approach to safety learning

It is important to acknowledge how a training approach may contribute to learning outcomes in school-based safety training. In the domain of occupational safety research, safety training approaches have been distinguished on the basis of learners' participation in the training process. The level of engagement refers to the extent to which safety training approaches involve active participation on the part of the learners as a means of skills development and incorporate elements of dialogue and reflection (Burke et al., 2006; Burke et al., 2011; Burke & Sockbeson, 2016). In highly engaging safety training, the learners themselves participate actively in the execution of the training process and the learning activities are characterized by social interaction. In a less engaging and passive approach to safety training, the learners are more passive recipients of information, knowledge is transferred from trainers to trainees and trainers control the learning process (Burke et al., 2006; Burke et al., 2011).

Highly engaging training methods utilize active learning methods such as hands-on exercises, simulations, behavioral modelling, problem-solving, small-group activities, and role-plays. The passive training approach is typically based on lectures, videos and reading materials and offers no opportunity to engage in reflection and dialogue (Burke et al., 2006; Burke et al., 2011). Previous meta-analyses (Burke et al., 2006; Burke et al., 2011) have shown that safety training approaches based on the active participation of learners are more effective than passive safety training approaches in terms of safety-related knowledge acquisition and attitudinal effects on safety training at workplaces. In addition, a study by Hedlund, Gummesson, Rydell and Andersson (2016) showed that in comparison to passive learning approaches, safety training methods that were based on a high degree of participation led to more positive effects on safety motivation at workplaces. Similarly, using a quasi-experimental research design, Rodrigues et al. (2018) found that in comparison to a theoretical training approach, participatory safety training methods had stronger effects on risk acceptance and intended safety behaviors among students in vocational education.

When investigating the concept of "level of engagement" used in the field of safety research, it is important to acknowledge its similarity to the concept of "student-centered learning", which is used in the broader educational literature. Student-centered learning is defined as "ways of thinking about teaching and

learning that emphasize student responsibility and activity in learning rather than content or what the teachers are doing" (Cannon & Nebwle 2000, p. 16). Smit, Brabander, and Martens (2014) have outlined the key principles of student-centered learning. Their study defines the key features of student-centered learning as students being challenged through problem-solving processes and self-directed learning and being guided to link new information to their prior knowledge and experiences. This involves also adopting knowledge and skills from other students through peer learning. Teachers take the role of facilitator during the student-centered learning process. Educational studies have shown that student-centered learning is associated with positive learning outcomes in various fields such as math and science (Cornelius-White, 2007; see Dong, Wu, Wang, & Peng, 2019; Fraser, Wahlberg, Welch, & Hattie, 1987).

Earlier definitions of student-centered learning stress the role of a reciprocal peer-learning process. Boud (2001) defined peer learning broadly as "students learning from and with each other in both formal and informal ways" (p.10). It involves students working together to accomplish a common learning goal, peer reinforcement, sharing ideas and experiences, and support between learners (Hanson, Trolian, Paulsen, & Pascarella 2016; Topping, 2005). Previous studies (Wessel, 2015) have suggested that in the peer learning process, students may feel more comfortable presenting their own ideas and they also help clarify the thinking of their peers. Furthermore, previous studies indicate that peer learning promotes learners' self-agency (Trede & Jackson 2019) and supports the development of self-efficacy (Pålsson, Mårtensson, Swenne, Ädel, & Engström, 2017).

If the goal is to strengthen young people's perceptions of their personal control over safety and their beliefs about their abilities to plan and execute safety-related actions, a student-centered approach and peer learning process seem more promising in terms of safety learning than a passive and teacher-driven form of safety training. Despite previous research findings regarding the potential of a student-centered learning approach and peer learning, more studies are needed to determine their efficacy in school-based safety training.

1.7 Safety training approach of the study

For a school-based safety intervention to have an impact on targeted outcomes, it is crucial to determine a mechanism through which the intervention program can achieve the desired outcomes. Next, I provide an overview of the safety training approach investigated in this study.

1.7.1 "Attitude to work" safety training program

The Attitude to Work safety training method (Nykänen, Klemola, & Vuori, 2016a; Nykänen, Klemola, & Vuori, 2016b) was developed at the Finnish Institute of Occupational Health in collaboration with upper secondary-level vocational

schools and workplaces. The method is free and publicly available online. The specific pedagogical principles are based on social-cognitive theories (Bandura, 1997; Rotter 1966) and partly on the peer learning model previously developed by the Finnish Institute of Occupational Health (Koivisto, Vuori, & Nykyri, 2007; Vuori, Price, Mutanen, & Malmberg-Heimonen, 2005). The program is also consistent with the definitions of student-centered learning.

The safety training program involves active participation on the part of learners. Students are guided to play an active role in the safety learning process rather than be passive recipients of information from the teacher. Teachers act as a facilitators. The facilitator role includes promoting self-directed learning among students, keeping the student group focused on the learning subject of discussions, promoting collaboration between students, providing positive feedback, and sharing safety-related knowledge with students during learning activities.

The training program complements other safety training methods in vocational education by addressing the readiness to adopt an active role in occupational safety, resilience to overcome barriers to safe work, and perceptions of personal control over accidents. In accordance with the social learning theory (Bandura, 1977) the training process utilizes the following learning mechanisms: mastery experiences during safety-related exercises, emotional arousal through fostering a positive learning atmosphere, and vicarious learning through observing the performance of other students during peer learning. In this way, the intervention process is linked to key mechanisms for reinforcing self-efficacy. The content of the training program includes topics such as identifying and practicing behavioral strategies for preventing accidents at work and promoting safety, seeking safety-related information, and voicing safety concerns. In addition, students initiate a sequence of problem-solving processes and are guided towards identifying behavioral strategies that help overcome barriers to safe work. These learning activities are designed to enhance safety preparedness. Students are also guided towards acknowledging the relationship between unsafe behavior and work-related accidents, identifying controllable causes of accidents, and recognizing personal control over safety and accidents. These learning activities are designed to specifically address safety locus of control and risk attitudes. The final part of the training program involves setting personal occupational safety goals.

The Attitude to work method applies a similar peer learning process to a model previously developed at the Finnish Institute of Occupational Health (Koivisto, Vuori, & Nykyri, 2007; Vuori et al., 2005). The program promotes interaction and dialogue between students. The students share their safety-related experiences, knowledge and skills during the training and initiate problem-solving activities during group exercises. In the peer learning process, the understanding of occupational safety is shaped through the interactions between the students. The students help each other learn, share ideas and define ways in which to promote occupational safety. These activities encourage the students to recognize the significance of their own ideas and the impact of their

personal effort on promoting safety and build a perception of personal responsibility for safety.

The operationalization of the active ingredients of the Attitude to work safety training program is based on an approach developed by Vuori et al. (2005). Intervention fidelity in terms of adherence to the program and quality of delivery are divided into four measurable active ingredients:

1) Adherence related to the acquisition of safety skills training. The Attitude to work program involves identifying hazards at the workplace, practicing behavioral strategies for preventing accidents, and addressing the role of individual workers' safety behaviors and how to seek safety-related information and speak about safety issues.

2) Adherence related to the acquisition of safety inoculation training. The key content of this active ingredient involves practicing how to act when encountering coworkers' risky behavior at the workplace, unexpected safety-related events or unfamiliar work tasks.

3) Quality of delivery in terms of fostering a positive atmosphere for safety learning. An essential part of the intervention plan was to create an inspiring atmosphere in which students feel comfortable talking about their own ideas for promoting safety and sharing their experiences of occupational safety.

4) Quality of delivery in terms of utilizing active learning techniques. In line with the principles of student-centered learning, the instructional techniques are based on the learner's own active participation. The intervention program consists of behavioral modeling using role-play exercises and promoting dialogue between students in small group exercises. The intervention plan involves the teacher acting as a facilitator who presents questions that guide the students' further investigation of the learning topics. Furthermore, the teacher's role is to help the students develop and express their own ideas for promoting occupational safety.

1.8 Aims of the research

1.8.1 Current research gaps

Current research gaps can be summarized into seven points.

1. Previous studies (e.g. Salminen, 2004) have shown that young workers experience a higher rate of occupational accidents than older workers Nevertheless, there is a lack of knowledge on effective ways to promote occupational safety among young people.
2. Human behavior plays an important role in accident processes at workplaces (Christian et al., 2009). However, there is little knowledge on how to influence the individual-level antecedents of safety behaviors.
3. Previous studies conducted at workplaces (Christian et al., 2009) and among young people in vocational education (Lecours & Therriault 2018)

have found a link between safety motivation and preventive work behavior. Nevertheless, evidence of effective training methods that influence safety motivation is limited.
4. More knowledge is needed on the individual-level antecedents of safety motivation (Beus et al., 2016).
5. Although the importance of school-based safety training has been emphasized (e.g. Okun et al., 2016), there is little research evidence on effective safety training methods. In particular, more randomized controlled trials are needed.
6. Previous studies have addressed the moderating role of personality traits in learning and educational processes (Gully & Chen, 2010). Nevertheless, this has not been investigated in the context of school-based safety training.
7. Despite general agreement that fidelity assessment is a critical factor in school-based intervention studies (Durlak & DuPre, 2008), it is rarely based on the identification of the intervention process' active ingredients. Moreover, fidelity analyses based on target group perceptions are lacking.

The following section presents the current study's aims to address these research gaps.

1.8.2 Study aims

The broad aim of this study was to extend our understanding of effective methods for enhancing the safety competencies of young people entering working life. The study is structured around five aims, investigated in three sub-studies based on the same study setting, data set and intervention process. The sub-studies are based on a randomized controlled trial, carried out in eight upper secondary-level vocational schools in Finland during the school year 2015–2016. The first aim of the study was to evaluate the short-term effects of the Attitude to work safety training program on safety preparedness, safety locus of control and risk attitudes (Sub-study I). The second aim was related to the generalizability of the safety training effects across subgroups (Sub-study I). In intervention studies, a moderator is a factor that affects the direction or strength of the relation between an intervention and an outcome variable (see Baron & Kenny, 1986). In this regard, the second aim was to explore conscientiousness and sensation-seeking as potential moderators of safety training effects. Specifically, it was expected that a high sensation-seeking level would reduce the intervention effects and a high conscientiousness level would be related to a stronger intervention impact. The third aim of the study was to explore the motivational outcomes of the Attitude to work safety training program (Sub-study II). The fourth aim focused on the cognitive process underlying safety motivation (Sub-study II). In the context of intervention studies, a mediator is defined as a variable that provides an explanation for the causal relationship between an intervention process and an outcome (see MacKinnon, Fairchild, & Fritz (2007). Based on

social-cognitive theories (Bandura, 1997; Rotter, 1966) and the expectancy theory (Vroom, 1964), this study investigated safety self-efficacy and internal safety locus of control as potential mediators of the effects of the safety training intervention on safety motivation. The fifth study aim was to develop a new approach for exploring the links between separate active ingredients and school-based safety training program outcomes of the intervention (Sub-study III). This included the investigation of the implementation of the intervention's active ingredients from the student perspective. The purpose was to explore the associations between different active ingredients and intervention outcomes, to identify essential elements in terms of the impact of safety training and to provide knowledge for the scale-up of the intervention program. Table 1 presents the research questions by sub-study and Figure 3 presents a model of the key constructs and associations of the current study based on social-cognitive theories (Bandura, 1997; Rotter, 1966), expectancy theory (Vroom, 1964) and earlier models of workplace safety (Beus et al., 2016; Christian et al., 2009).

TABLE 1 Research questions and study hypotheses

STUDY	Research questions	Study hypotheses
I	Does a student-centered safety training program have positive effects on safety preparedness, safety locus of control and risk attitudes among young people in vocational education?	Student-centered safety training increases: 1.1 safety preparedness 1.2 internal locus of control Student-centered safety training reduces: 1.3 risk attitudes 1.4 external locus of control
I	Do personality factors moderate the effects of the safety training program?	1.5 A high sensation-seeking level reduces positive effects on risk-taking attitudes, internal safety locus of control, external safety locus of control, and safety preparedness 1.6 A high conscientiousness level is related to a stronger reduction in risk attitudes and external locus of control and a stronger increase in safety preparedness and internal locus of control
II	Does a student-centered safety training program have motivational outcomes among students in vocational education?	2.1 Student-centered safety training increases safety motivation
II	What is the cognitive process through which a safety training program influences safety motivation?	2.2. Safety self-efficacies and internal safety locus of control mediates the intervention effect on safety motivation
III	How did the intervention's active ingredients affect the intervention outcomes?	3.1 Student perceptions of the implementation fidelity are associated with training outcomes.

FIGURE 3 Integrated study model

2 STUDY METHODS

This study investigated the efficacy of a student-centered safety training program in a randomized field trial involving a total of eight upper secondary-level Finnish vocational schools. Ethical approval was obtained from the Ethics committee of the Finnish Institute of Occupational Health. The study was conducted during the school year 2015–2016. In Finland, young people either start an academic track in general upper secondary education which focuses on preparation for higher education, or enter the vocational upper secondary education track, which provides a vocational qualification in certain occupational field. Approximately 40% of young people completing compulsory education continue the educational track of upper secondary-level vocational education (Finnish National Agency for Education, 2019). Vocational education plays a key role in developing young people's work-related skills, including safety-related competencies. Vocational upper secondary-level education in Finland usually lasts three to four years and offers students qualified entry into working life. Training is organized in schools with on-the-job learning periods at workplaces or as apprenticeship training carried out at workplaces. In Finnish upper secondary-level vocational education, students must complete at least one-sixth of their studies at workplaces during on-the-job training (Virtanen, Tynjälä and Collin, 2009). As vocational education offers a context to reach a large number of young individuals and the majority of graduates enter the labor market, this level of education provides an essential setting for enhancing the personal safety competencies of young people.

2.1 Study design and procedure

The randomized controlled trial had two time points (baseline and short-term follow-up) and the study data were collected using paper-format questionnaires. A cluster-level pairwise randomization method was chosen to achieve balanced allocation into intervention and control conditions. In accordance with the

guidelines of Donner and Klar (2004), if a cluster (student group) did not provide data at baseline or at follow-up (T2), the matched cluster was discarded in order to preserve the integrity of the study design. The baseline measurements of all study participants were conducted approximately two weeks before the intervention program. A total of 580 students from 46 student groups were included in the randomization process after baseline measurements. Student groups were first paired within schools by vocational track. Next, half of the student groups in each school were randomized into the intervention condition (who underwent the Attitude to work safety training program) and the other half into the control condition (who received written educational OSH material).

All the teachers whose student groups were randomized into the intervention condition received teacher training in the Attitude to work training method. During the training, the teachers became acquainted with the content, training principles, and practical implementation of the intervention. After the training workshop, the teachers implemented the Attitude to Work training program in their schools. The student groups that were allocated into the intervention condition participated in the 12-hour Attitude to Work intervention program within approximately two weeks of baseline measurements. The implementation process was supported by a student workbook and a teacher's manual. The teacher's manual contains practical guidelines on how to conduct group activities, examples of questions that the teacher can ask students, and tips for different group situations. The approach was implemented in the same pedagogical format and the training program followed the same exercise structure across the different occupational fields, but the information on the hazards was occupation specific. Depending on the student group, vocational track and their typical work environments, the training addressed physical hazards (slippery floors, sharp objects, using tools and work machinery etc.) electrical hazards, chemical or biological hazards, or other hazards (e.g. heat, noise, ergonomic hazards). Table 2 provides an overview of educational topics and presents practical examples of the training activities. The student groups that were allocated into the control condition received written safety learning material. Thus, the students allocated into the control condition completed an intervention process that included some of the content of the intervention provided to the intervention condition, but not the student-centered safety training process.

The safety training process (student-centered safety training program or written educational material) was implemented as part of the curriculum at school, whereas participation in the study and filling in the study questionnaires was voluntary. The follow-up measures were conducted immediately after the intervention. The follow-up measurements of the controls were conducted during the same week as those of the intervention group. One student group was excluded at follow-up due to a lack of matched-pair data. The sample size in the follow-up measures was 464 students. Of these, 229 (in 22 student groups) were in the intervention condition, and 235 students (in 22 student groups) in the control condition.

The outcome analysis included study participants, regardless of whether they had participated full time in the intervention program or had familiarized themselves with the written material. Eighty percent of the participants in the intervention condition reported full participation in the safety training program, 15% reported that they had participated most of the time, and 5% reported that they had participated half of the time. Respectively, sixty-two percent of the students in the control condition had read all the written material, 13% had read half of the material, and 25% had read less than half. The age range of the study participants was 17–29 years (M=19.7) and 22.5% also had a part-time job. The study participants had an average of 4.8 months of work experience in their occupational field, and 36.6% were male and 63.4% female. A total of 26% of the students had experienced an accident at work or during their vocational studies and most of the study participants were second-year students (mean length in current studies 16.3 months). Moreover, a total of 47% of the study participants were studying for a vocational qualification in social and health care, 40% for a vocational qualification in technology and transport, and 13% for a vocational qualification in business or tourism. Thus, different occupational fields were well represented in the study sample.

TABLE 2 Overview of the intervention program

Day 1	Educational topic	Practical examples of training activities
	Introduction to behavioral actions that support occupational safety	The teacher introduces a question to the students: "How much influence do you think you have on occupational safety?" The teacher then asks the students to line up according to their opinion: One end of the classroom represents "I have a lot of influence," the opposite end represents "I have no influence at all". Students can also choose a place in the middle if their opinion is in between. Next, a whole-group discussion is held on the reasons why the students chose their location, after which the teacher initiates a discussion on personal control over accidents and how people can influence occupational safety.
	Identifying hazards at the workplace	Students work in small groups and draw a visual representation and a map that illustrates their potential future workplace. They draw potential hazards on the map using symbols and different colors. The hazards may be associated with work tasks, using work equipment or machines, using chemicals, and so forth. In addition, appropriate preventive measures and behavioral strategies are written next to each hazard. Finally, the small group reports back to the student group as a whole and the trainer facilitates the discussion and provides supplementary safety knowledge for students.
	Analyzing the factors preceding accidents, identifying behavioral strategies for preventing accidents	Whole group discussions on case stories of occupational accidents at the workplace. Students are guided to analyze the behavioral and motivational factors that precede accidents. The teacher presents questions that provide a basis for investigating how workers' preventive behaviors reduce the risk of accidents or other harmful events at the workplace and how unsafe work behavior contributes to accidents.
Day 2	Negative consequences of staying silent about safety issues and positive consequences of information-seeking and speaking about safety at work	Using a case example, the teacher illustrates how not reporting an occupational safety issue has resulted in an accident. Next, the students practice in pairs how to suggest a safety-related improvement. One of the students acts as a supervisor and the other as an employee. The interaction exercise is supported by an easy-to-use model for proposing the improvement (1. make contact 2. share the observation from a work safety perspective 3. suggest an improvement).

(continues)

TABLE 2 continues

Day 2	Educational topic	Practical examples of training activities
	Safety inoculation training	Students work in small groups. They are given case descriptions of different situations that involve barriers to safe work. These barriers include coworker risk-taking, work equipment malfunctions, and new tasks in which the employee is uncertain about safety instructions. The students reflect on possible solutions to challenges, how to implement them in practice, and how to overcome obstacles. The teacher facilitates the small group discussions and guides the students toward identifying effective behavioral strategies. Finally, solutions for overcoming barriers are shared with the whole group.
	Personal safety goals	The teacher puts twenty different cards on the table which contain ways of influencing occupational safety and preventing accidents (e.g. I will seek safety-related information and guidance at the workplace). Each student chooses three cards and students take turns in sharing their thoughts about why these are important to them.

2.2 Study measures

The intervention condition was measured as a dichotomous variable (student-centered safety training program vs. control condition). Standard survey questions gathered information on the study participants' age, gender, previous work experience and school grade. Outcome measures were included in the questionnaires at baseline and at short-term follow-up.

2.2.1 Outcome measures

Safety locus of control was measured using a scale adapted from a study by Mazaheri, Hidarnia, and Ghofranipour (2012). This six-item scale assessed the students' beliefs regarding accident causation and included two subdimensions: 1. internal safety locus of control (example item: *People can avoid injury if they are careful and aware of potential dangers* and 2. external safety locus of control (example item: *Most injuries are caused by accidental events outside people's control*. The scale ranged from 1 (strongly disagree) to 5 (strongly agree). The items for the safety preparedness scale were developed for this study and the measurement technique (response format and two-dimension structure) was adapted from previous intervention studies (Koivisto, Vuori, & Vinokur, 2010). The safety preparedness measure included two subdimensions 1. Safety self-efficacy and 2. Safety inoculation. In the six self-efficacy items, study participants were asked about their confidence in safety-related activities such as *acquiring instructions or guidelines at work in order to work safely*. The scale ranged from 1 (very low) to 5 (very high). Three five-point safety inoculation items measured

the extent to which participants had ideas or plans for situations in which they may encounter various safety-related barriers or problematic situations at the workplace (sample item: *Coworkers' attitudes and behavior are harmful to occupational safety*). The scale ranged from 1 (very few) to 5 (very many). The risk attitude scale was adapted from the measure developed by Henning et al. (2009). The five-point scale (1=strongly disagree 5=strongly agree) included three items that measured the extent to which participants viewed occupational safety-related risk-taking as appropriate at the workplace (sample item: *Sometimes it is necessary to take risks to get a job done*). Safety motivation was measured using a three-item five-point scale (1=strongly disagree 5=strongly agree) previously developed by Neal, Griffin, & Hart (2000). The safety motivation scale assessed study participants' willingness to put effort into promoting safety (sample item: *I feel that it is worthwhile to put effort into maintaining or improving my personal safety*).

2.2.2 Moderators of intervention outcomes

The study participants' sensation-seeking and conscientiousness level was measured at baseline using an eight-item five-point scale developed by Hoyle et al. (2002), and a nine-item five-point scale adapted from the Big Five scale developed by John, Naumann and Soto (2008).

2.2.3 Intervention's active ingredients

The delivery of the intervention's prespecified active ingredients was evaluated at follow-up using a revised version of a measurement technique developed by Vuori et al. (2005). The students rated four dimensions of the implementation process using a five-point scale, ranging from (1) not at all to (5) very well. Student-level responses to their perceptions of teachers' implementation of four different active ingredients were aggregated to form collective, group-level variables. Aggregated variables were considered to better reflect the shared perception of learning activities in a given student group (see Lüdtke, Robitzsch, Trautwein, & Kunter, 2009). Adherence related to the acquisition of safety skills training included five items and the following question: *How much did you practice…*? (sample item: *How to prevent occupational hazards or incidents).* Adherence related to the acquisition of safety inoculation training included three items with the following question: *How much did you discuss solutions to the following situations…*? (sample item: *Negative attitudes towards occupational safety at the workplace).* Quality of delivery in terms of fostering a positive learning atmosphere included three items with the following question: *To what extent…*? (sample item: *as it easy for to talk about your own ideas or experiences?*), and quality of delivery in terms of utilizing active learning methods was measured using five items with the following question: *How much…?* (sample item: *did you take part in role-playing exercises that simulated practical situations*).

2.3 Statistical methods

Baseline differences between the intervention and control groups were examined using t-tests for continuous variables and chi-square tests for categorical variables, with SPSS version 23 (Sub-study I). The psychometrical properties of the study measures were explored using confirmatory factor analyses (Sub-studies II and III) and by calculating Cronbach's coefficients (Sub-studies I and III) and omega coefficients (Sub-study II).

In Sub-study I, the intervention outcome analyses were conducted using SPSS version 23 and generalized linear mixed modeling with student group-level random intercepts. All the outcome analyses in the main effect models were adjusted for gender, school grade and baseline measurement of outcome. To investigate whether intervention effects were moderated by personality factors, a two-way interaction term was added to the additional models (e.g., conscientiousness x intervention condition). Separate models for both the conscientiousness and sensation-seeking variables were calculated.

Sub-study II explored the mediating role of safety self-efficacy and internal safety locus of control in terms of motivational outcomes, using structural equation modelling (SEM) and TYPE = COMPLEX function of Mplus 7.4 software (Muthén and Muthén, Los Angeles, CA). Both the hypothesized mediators were entered simultaneously into the model to determine the unique effects of each one (Preacher & Hayes, 2008). To investigate whether internal safety locus of control and safety self-efficacy mediated the intervention's effect on safety motivation, we tested the mediation paths (indirect intervention effect). The mediation results were reported in standardized values. The analyses were controlled for baseline levels of mediators and safety motivation. The parameters of the models were estimated using the MLR estimation method and the student group was specified as the unit of clustering to adjust for standard errors.

Sub-study III explored the associations between the intervention's active ingredients and its outcomes, using separate GLMM models. Each model included a different active ingredient and intervention outcome and all models were adjusted for baseline outcome values. The intervention's active ingredient measures were treated as aggregated student group-level variables. Thus, intra-cluster correlations (ICC1 and ICC2) and within-group agreement statistics (RWg) for the group-level variables were calculated according to guidelines by Bliese (2000) and LeBreton and Santer (2008) to justify the use of aggregated variables in the models. Table 3 presents a summary of the study measures.

TABLE 3 Summary of study variables

Purpose of measures	Measures / Variables
Background characteristics	Age
	Gender
	School grade
	Length of time in current studies
	Work experience
	Accident history
Safety training outcomes	Safety preparedness (safety inoculation, safety self-efficacy)
	Safety locus of control (internal and external safety locus of control)
	Risk attitudes
	Safety motivation
Moderators of safety training outcomes	Conscientiousness
	Sensation-seeking
Intervention fidelity	Adherence related to acquisition of safety skills training
	Adherence related to acquisition of safety inoculation training
	Quality of delivery in terms of fostering positive learning atmosphere
	Quality of delivery in terms of utilizing active learning methods

2.4 Effectiveness of randomization and attrition

There has been discussion on whether baseline differences in randomized controlled trials should be tested. It is argued that baseline differences can always be due to chance (de Boer et al., 2015; Moher et al., 2010). Sub-study I explored and tested the baseline differences between the intervention and control groups. The results showed that the control condition had somewhat more female students (69%) than the intervention group (57%). Furthermore, the school grades of the intervention condition students (satisfactory 9.3%, good 66.2% excellent 24.4%) and the control condition students (satisfactory 5.7%, good 62.9%, excellent 31.4%) differed significantly. In addition, risk attitudes were slightly higher in the intervention condition at baseline (2.53 vs. 2.35). This was related to gender, as risk-taking attitudes were higher among the male students (2.80 vs. 2.23). As described in the previous section, statistical models were adjusted for gender and school grades. Follow-up data was on 80.8% of the study participants, who gave baseline measurements and were eligible to participate in the study. The differences between the students who provided only baseline data

and the students who completed both measurements were explored. The results showed that the students who did not provide follow-up data had lower scores at baseline in conscientiousness (3.59 vs. 3.73) and internal safety locus of control (3.98 vs. 4.14). Also, the mean age (20.5 vs. 19.8) and the proportion of students who had suffered an accident at work (28.7% vs. 19.3%) were higher among the students who did not provide follow-up data. Furthermore, drop-out did not differ between intervention conditions. There were no significant baseline differences between the intervention and control condition as regards those who completed only baseline measures. The following sections present the results of the outcome analyses, as they pertain to the research questions presented in the previous chapter.

3 SUMMARY OF RESULTS

3.1 Sub-study I: Cognitive and attitudinal effects of intervention program

The first aim of the study was to examine the short-term outcomes of a student-centered safety training program to enhance safety preparedness and internal safety locus of control and to decrease risk attitudes and external safety locus of control. Four separate GLMM models were used to investigate changes at follow-up among the intervention conditions (student-centered safety training program vs. control condition). The results showed that the student-centered safety training program had a beneficial effect on safety preparedness (b=0.15, p<0.01, CI=0.05, 0.24), internal safety locus of control (b=0.13, p<0.05, CI=0.02, 0.23) and risk attitudes (b= -0.25, p<0.01, CI= -0.39, -0.11). However, the intervention's effect on external safety locus of control was not statistically significant (b= -0.07, p=0.28, CI=-0.21, 0.06). Thus, the results supported study Hypotheses 1.1–1.3 but did not provide evidence for study Hypothesis 1.4. Finally, there were no significant moderator effects in terms of study participants' vocational track. Table 4 presents the results regarding the safety training effects.

3.2 Sub-study I: Individual-level moderators of intervention outcomes

The second aim of the study was to explore whether the conscientiousness and sensation-seeking level of the students (measured at baseline) moderated the effects of the student-centered safety training program. The moderation was examined in separate GLMM models with additional interaction terms between

the intervention condition and the sensation-seeking/conscientiousness level. To answer the research questions and to facilitate interpretation, the conscientiousness and sensation-seeking variables were transformed into categorical variables by splitting the values into three categories based on equal-sized cut-off points (low, medium, and high scores). The results revealed that conscientiousness moderated the intervention effect on safety preparedness (b=0.25, p<0.01, CI=0.10, 0.39) and risk-taking attitudes (b=-0.30, p<.0.01, CI=-0.54, -0.06). This indicated that the safety training effect on these two outcomes was stronger among the high conscientiousness students. However, a statistically significant interaction between the sensation-seeking level and the intervention condition was not detected, indicating that low- and high-level sensation-seekers benefitted equally from the safety training. Therefore, Hypothesis 1.5 was confirmed but the results did not support Hypothesis 1.6. Table 4 present the results of the moderation analyses.

TABLE 4 GLMM model results for Sub-study I

	Safety preparedness		**Internal safety locus of control**		**External safety locus of control**		**Risk-taking attitudes**	
	Estimate	**(95% CI)**	**Estimate**	**(95% CI)**	**Estimate**	**(95% CI)**	**Estimate**	**(95% CI)**
Intervention condition (a)	0.15**	[0.05, 0.24]	0.13*	[0.02, 0.23]	-0.07	[-0.20, 0.06]	-0.25**	[-0.39, -0.11]
Intervention condition x high CCT (b)	0.25**	[0.10, 0.39]	0.06	[-0.11, 0.24]	-0.04	[-0.24, 0.16]	-0.30*	[-0.54, -0.06]
Intervention condition x high SSE (c)	-0.008	[-0.15, 0.12]	-0.005	[-0.17, 0.16]	-0.008	[-0.20, 0.18]	0.13	[-0.09, 0.35]

Reference categories: a = control condition, b = low conscientiousness c = low sensation-seeking . * p<.05. ** p<.01.

3.3 Sub-study II: Mediators of intervention's effect on safety motivation

The third aim of the study was to investigate the motivational outcomes of the student-centered safety training and the fourth aim was to examine the underlying cognitive processes that triggered the motivational effects of the training program. First we defined a conceptual model focusing on the associations between the intervention process, cognitive factors and safety motivation. Following the proposed associations presented earlier in Figure 2, the study model included the hypothesis that the safety training effects on safety self-efficacy and internal safety locus of control contributed to the motivational outcomes. To examine whether safety self-efficacy and internal safety locus of control mediated the effect of the safety training program on safety motivation, we applied a multiple mediation model. First, the unmediated effect of the Attitude to work program on safety motivation was tested. The analysis showed that the intervention effect on safety motivation was statistically significant (β=0.11, $p<0.05$, CI=0.02, 0.20), with no mediators in the model. This indicated a beneficial intervention effect on safety motivation and supported Hypothesis 2.1. Next, we continued to estimate the structural equation model using hypothesized mediators. The model provided a good fit with the data: RMSEA=0.050; CFI=0.928; TLI=0.916; and SRMR=0.067. Furthermore, all the standardized factor loadings of the latent variable indicators were significant ($p<.001$) and were between 0.59 and 0.89. There was no significant direct path from the intervention condition to safety motivation when the mediators were included in the model, which indicated full mediation. The indirect effect of the intervention on safety motivation via internal safety locus of control was statistically significant (standardized path estimate for indirect effect =0.05, $p<0.05$). However, the indirect effect of the intervention on safety motivation via safety self-efficacy was only significant in one-sided testing (standardized path estimate for indirect effect =0.02, p=0.07). This suggests that the training effect on internal safety locus of control played a stronger role in increasing safety motivation. Accordingly, the results provided partial support for Hypothesis 2.2.

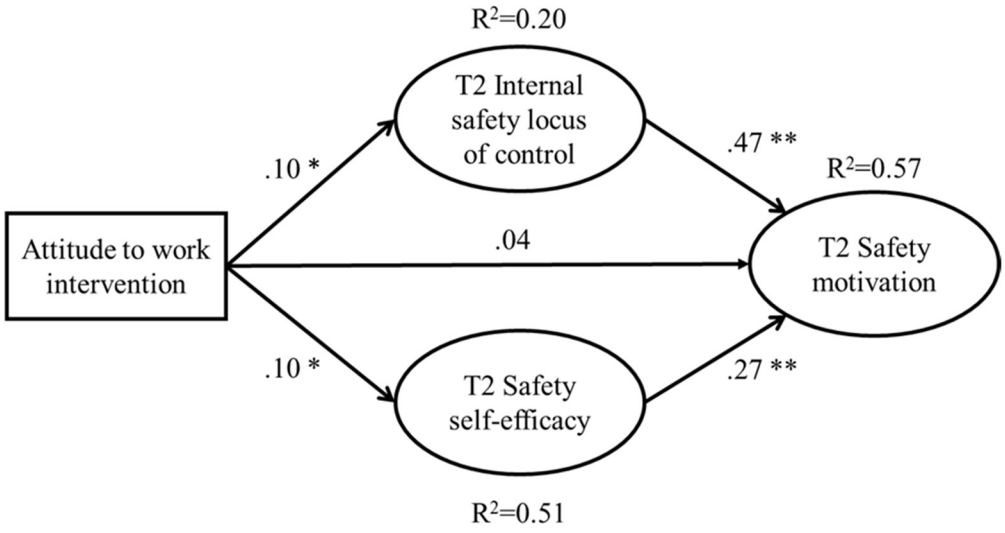

FIGURE 4 SEM model examining the effects of the safety intervention on safety motivation through internal safety locus of control and safety self-efficacy

3.4 Sub-study III: Associations between intervention's active ingredients and intervention outcomes

The fifth aim of the study was to investigate the associations between the intervention's active ingredients and outcomes. Using a revised version of a measurement technique developed by Vuori et al. (2005), this study developed a new approach to exploring the fidelity and active ingredients of a school-based safety training intervention. The study participants in the control condition did not participate in the Attitude to work program. Thus, the intervention fidelity analyses included only the study participants in the intervention condition. Overall, 229 students in the intervention condition participated in the follow-up questionnaires, which included measures of intervention fidelity and active ingredient implementation. The study participants in the intervention condition rated their learning experiences according to four sub-dimensions of the active ingredients at follow-up: (1) Adherence related to the acquisition of safety skills training (M=4.43, SD=0.52), (2) Adherence related to the acquisition of safety inoculation training (M=4.18, SD=0.65, (3) Quality of delivery in terms of supportive learning atmosphere (mean=4.26, SD=0.71), and (4) Quality of delivery in terms of active learning methods (M=4.14, SD=0.64). Considering that the response scale was from 1 to 5, these results indicated a relatively high intervention fidelity. Furthermore, across the 22 student groups, an acceptable within-group agreement level was indicated by mean Rwg>0.70 in all active ingredient measurements. Respectively, ICC1 ranged from 0.05 to 0.33 in the active ingredient measurements and ICC2 ranged from 0.44 to 0.86. These results provided support for aggregation procedures (LeBreton and Senter, 2008; Murphy & Myors, 1998; Fleiss, 1986).

In regard to Hypothesis 3.1, the implementation of the intervention's active ingredients was positively associated with the student outcomes. The results presented in Table 5 show differing associations between the intervention's active ingredients and the intervention outcomes. Adherence related to the acquisition of safety skills training had the strongest associations with the safety training outcomes. It contributed to the effects in terms of safety preparedness ($b=0.52$, $p<.01$), internal safety locus of control ($b=0.65$, $p<.01$) and safety motivation ($b=0.37$, $p<.05$). Adherence related to the acquisition of safety inoculation training had similarly statistically significant associations with safety preparedness ($b=0.28$, $p<.05$) and internal safety locus of control ($b=0.30$, $p<.05$). However, the association between safety inoculation training and safety motivation was not statistically significant. Quality of delivery in terms of fostering a positive learning atmosphere and utilizing active learning methods was strongly associated with motivational outcomes. Specifically, positive learning atmosphere had a statistically significant relationship with safety preparedness ($b=0.17$, $p<.05$) and safety motivation ($b=0.20$, $p<.05$). The implementation of active learning techniques had a positive association with only safety motivation ($b=0.18$, $p<.05$). Finally, no statistically significant association was found between any of the intervention's active ingredients and risk attitudes, suggesting that the previously reported effect on risk attitudes was related to other, unmeasured factors. According to these results, Hypothesis 3.1 was mostly supported.

TABLE 5 Summary of models exploring associations between intervention's active ingredients and intervention outcomes

	Safety preparedness		**Internal safety locus of control**		**Risk-taking attitudes**		**Safety motivation**	
	Estimate	**95% CI**	**Estimate**	**95% CI**	**Estimate**	**95% CI**	**Estimate**	**95% CI**
Group-level safety skills training	0.52**	0.27, 0.77	0.65**	0.34, 0.97	-0.26	-0.82, 0.29	0.37*	0.06, 0.69
Group-level safety inoculation training	0.28*	0.06, 0.50	0.30*	0.03, 0.57	0.02	-0.39, 0.44	0.18	-0.07, 0.44
Group-level positive learning atmosphere	0.17*	0.02, 0.31	0.14	-0.04, 0.33	-0.11	-0.39, 0.15	0.20*	0.03, 0.36
Group-level active learning techniques	0.13	-0.01, 0.28	0.11	-0.07, 0.30	-0.17	-0.44, 0.08	0.18*	0.03, 0.34

Active ingredient measurements were treated as aggregated student-group level measurements. Student group was included in all study models as a random effect to account for clustering. All models were adjusted for baseline outcome value.

4 DISCUSSION

It is often impossible to entirely remove hazards from the work environment. This emphasizes the role of young worker's personal competencies to deal with hazards and to execute self-protective behaviors. Individuals' actions and the ability to take the initiative play an important role in many ways, for example, in whether the person chooses a safe working method or decides to neglect safety procedures, whether a person communicates with their coworkers or supervisor about occupational safety issues, and whether a person puts effort into overcoming barriers to safe work. This fact makes it necessary to empower young people to actively promote occupational safety. The aim of this study was to extend our understanding of effective methods for enhancing the safety competencies of young people entering working life. To meet this goal, a student-centered safety training approach was developed. Training techniques utilized a peer learning process which has not been previously studied in the context of school-based safety training. A participatory peer-learning technique was chosen because it promotes student agency by stressing students' active role in safety promotion and provides learning experiences of one's personal contribution to safety-related matters. This study evaluated the short-term effects of the new safety training approach. It also investigated the mechanism that transmitted the training's impact. This chapter discusses the study findings, examines the strengths and limitations of the study, and provides practical suggestions for school-based safety training and directions for future research.

4.1 Intervention efficacy

Overall, the study results suggest that a student-centered approach accompanied by a peer learning process is important in empowering students to be active in terms of safety. As the students actively participate themselves in identifying ways to promote occupational safety and learn from each other, they gain experiences of personal influence. This stimulates their personal confidence to

plan and execute actions to promote safety, fosters attitudinal change, and modifies perceptions of personal control over safety. According to the study results, the student-centered peer learning process enhanced safety preparedness and internal safety locus of control, increased safety motivation, and decreased risk attitudes. When interpreting these results, it is important to consider the prior research evidence reviewed in the earlier chapters. Psychological factors such as self-efficacy, internal locus of control and motivation have been defined as the key determinants of human behavior (Bandura 1997; Rotter 1966; Vroom 1964). Earlier empirical studies have also highlighted their positive relationships with safety behaviors at workplaces (e.g. Christian et al. 2009). Therefore, by enhancing these key safety competencies, it is possible to equip young people with readiness to promote safety at the beginning of their working careers, as well as with resilience to overcome barriers to safe work.

Contrary to our expectations, the safety training program did not decrease external safety locus of control. This result may be influenced by the fact that the learning process addressed the importance of collaboration at the workplace and the role of the occupational safety and health representative and supervisor in promoting occupational safety. Group discussions covered how an employee can influence occupational safety by communicating safety issues across different levels in the organization. Perceptions of shared responsibility for promoting safety and preventing accidents may have located a sense of control also to external influences.

The study results indicated marginally positive to small intervention effects, which should be borne in mind when interpreting the results. More broadly in terms of intervention research, this result does not differ greatly from previous studies, as educational interventions have often small effects (see Coe, 2002). Furthermore, smaller effect sizes are more often found in randomized field trials than in quasi-experimental studies (Cheung & Slavin, 2016). To prevent selection bias, the outcome analyses included a small number of students who did not participate full time in the intervention program. This may have led to somewhat conservative estimates of the intervention's effects. Moreover, Bakker et al. (2019) stressed the importance of "scalability" and "costs" when assessing the practical significance of intervention effects. They pointed out that small intervention effects can be practically significant if the intervention program is cost efficient and scalable. In vocational education, preventive safety training programs reach a large number of young people. Furthermore, cognitive and motivational outcomes may affect a wide range of preventive behavioral actions.

4.2 Emergence of a motivational impact

The safety training's effect on internal safety locus of control was associated with motivational outcomes. This result provides further insight into the cognitive mechanisms through which safety training influences safety motivation and helps make school-based safety training more effective in terms of motivational

impact. In comparison to safety self-efficacy, a more generalized perception, measured using internal safety locus of control, played a stronger mediating role in terms of motivational outcomes. In order to interpret this result, it is important to consider the key difference between self-efficacy and internal locus of control constructs. Safety self-efficacy refers to one's confidence in being able to effectively carry out safety-related activities such as identifying job-related hazards and acquiring safety-related instructions at the workplace. Internal safety locus of control refers to the extent to which individuals believe they have personal control over accidents in a more general sense. Because many young people have a limited amount of work experience, the practical significance of their ability to carry out safety-related activities at work may be somewhat hard to comprehend. Under these conditions, a more general perception of one's control over accidents may play a stronger role in terms of safety motivation. The impact of safety self-efficacy on safety motivation may increase later in working life as work experience increases and the individual encounters safety-related work situations in which they assess their own ability to function effectively.

4.3 Individual-level moderators of the impact of safety training

An important question concerns how individual-level factors such as conscientiousness and sensation-seeking affect the impact of school-based safety training. Exploring intervention effects across subgroups provides knowledge for future refinement of intervention programs (Supplee, Kelly, MacKinnon, & Barofsky, 2013). The study results revealed that students with higher levels of conscientiousness benefitted more from the safety training program. Previous studies have indicated that conscientiousness is associated with motivation to acquire new knowledge and skills (Collquitt, Pine, & Noe, 2000) and positive attitudes towards occupational safety (Henning et al., 2009). Thus, it is possible that conscientiousness contributed to engagement in safety learning activities during the training program. This interpretation provides a basis for practical implications regarding the future development of school-based safety training programs.

Based on the activation model of information exposure (Donohew et al., 1998), it was expected that the effects of the safety training program on high-level sensation seekers would be weaker. The assumption was that high-level sensation seekers need an intensive intervention process, which is more suspenseful and emotionally arousing than the training methods explored in this study. However, the results showed that sensation-seeking did not modify the intervention outcomes. One possible interpretation of this finding is that in a student-centered learning approach, students are provided with the opportunity to influence the learning process in terms of their own experiences, ideas and viewpoints. They are also given the opportunity to bring examples and issues that appeal to them to the discussion. This may attract and hold attention despite the personal sensation-seeking level. It is important to note that in many passive

safety training approaches (e.g. videos) the safety message design is often framed in advance and the training content is pre-selected, which does not offer learners the opportunity to contribute content to the educational process from their own perspective. The earlier chapters linked sensation-seeking to various risk behaviors. Thus, the study finding that low and high-level sensation-seekers benefitted equally from a student-centered peer learning process provides important knowledge for developing safety training methods targeted at potential risk groups in terms of work-related risk behavior.

4.4 Active ingredients of the training

In this study, the pre-specified active ingredients of the new safety training method were divided into four components, which included adherence related to the acquisition of safety skills training, adherence related to the acquisition of safety inoculation training, quality of delivery in terms of fostering positive learning atmosphere and quality of delivery in terms of utilizing active learning methods. Together, these active ingredients provided a multidimensional framework for assessing intervention fidelity. Furthermore, intervention fidelity was evaluated using student perceptions. The results showed a high level of fidelity, suggesting that the intervention program was carried out as intended. The results also showed that each active ingredient of the intervention contributed to positive outcomes and complemented each other.

Adherence related to the acquisition of safety skills training was the strongest active ingredient in terms of positive effects and was significantly associated with all intervention outcomes, except risk attitudes. Adherence related to safety inoculation training had similar associations, but the results showed no significant relationship with safety motivation. Safety inoculation training was targeted at abilities to overcome potential barriers to safe work. If a student has not yet faced or heard about the possible barriers discussed during training, preparing for them in advance will not necessarily have an immediate effect on motivation. A lack of previous personal experiences may affect an individual's perception of the importance of preparation for safety-related barriers. In these situations, the personal preparation process may be limited to identifying potential obstacles and challenges. However, the learned anticipatory behavioral strategies may have important motivational consequences for young people later in working life if they encounter issues that hinder safety at work. Overall, the results highlight the bottom-line role of adherence to the intervention program. The extent to which intervention activities are delivered plays an important role in transmitting the positive effects.

Exploring the quality of the delivery of the intervention program was an important part of the process evaluation. It involved an assessment of whether the teacher succeeded in creating a positive learning atmosphere and whether they successfully implemented active learning methods in the student group. The study results showed that the quality of delivery in terms of fostering a positive

learning atmosphere was associated with the motivational outcomes. This result indicates that a positive learning environment inspired and motivated students during training activities. Previous studies have emphasized that a supportive learning environment plays an important role in student engagement and learning outcomes (see Shernoff, Ruzek, & Sinha, 2017). However, this has not yet been studied in the context of safety training in upper secondary-level vocational education. The study results present new evidence that fostering a supportive learning environment plays an important motivating role in school-based safety training. Moreover, the results show that utilizing active learning methods is related to safety motivation. This finding is in line with a previous study by Hedlund et al. (2016), according to which safety training methods based on a participatory and an active learning approach had beneficial outcomes in terms of safety motivation.

The fact that no statistically significant relationship was found between any the active ingredients and risk attitudes was unexpected. It is important to discuss this result in more detail. One interpretation stems from the fact that social influence has an impact on attitudes (see Smith & Louis, 2009). Particularly in the case of adolescents, the impact of peer-group influence is often strong (Brown, Bakken, Ameringer, & Mahon, 2008). For a more detailed explanation, it is useful to look at the concept of injunctive safety norms. Injunctive safety norms refer to the extent to which individuals perceive others' approval and expectations of safety-related behavior (Fugas, Melia, & Silva, 2011). Reid and Aiken (2013) explored the impact of normative feedback on health protection attitudes and behavior. They found that changes in injunctive norms created a positive attitude toward sun protective behaviors. In addition, Pek et al. (2017) found that injunctive safety norms among friends were associated with work-related risk-taking among young workers. Moreover, a study by Westaby and Lowe (2005) showed that young workers' risk-taking attitudes at the workplace is influenced by peer worker behaviors. It possible that the group learning situation, the social exchange of positive views between students, and the positive role-modeling during the training program resulted in attitudinal changes through injunctive safety norms. For example, the sharing of personal safety goals during the intervention program may have influenced the perception of the injunctive safety norms in the student group. However, implementation process measures did not address these normative aspects and this interpretation should be confirmed in future studies.

Overall, the results regarding the implementation analyses were in line with prior research (Durlak & Dupre, 2008), showing a positive relationship between intervention fidelity and the targeted outcomes. The study results emphasize the importance of supporting and monitoring intervention fidelity in school-based interventions. According to the implementation analyses in this study, a high level of intervention fidelity was achieved. The key elements of implementation support included teacher training workshops, easy-to-use intervention guidelines and structured lesson plans. Ensuring that teachers have the necessary

skills to implement new school-based prevention programs is likely to contribute to the impact of the programs (see Durlak & Dupre, 2008).

There has been a call for approaches to evaluate intervention fidelity and active ingredients from the perspective of the target group. There has also been a need to develop approaches that enable testing the associations between specific and separate active ingredients and outcomes of the intervention. Building on previous research (Vuori & Vinokur, 2005; Abry et al., 2017), this study provides new insights into the intervention fidelity assessment of school-based interventions. The fidelity measure developed in this study can be utilized in future school-based prevention studies to monitor intervention fidelity from a student perspective and to explore the associations between separate active ingredients and outcomes of the intervention. Furthermore, the identification of active ingredients in this study facilitates the dissemination of essential safety training elements to everyday practice in vocational schools and supports replicating the active content of the training program.

4.5 Study strengths and limitations

4.5.1 Study strengths

This study is the first to investigate the effects of a student-centered peer learning process on school-based safety training. It is also one of the few studies that have applied a theory-driven design to safety intervention development. The theory-driven study design enabled systematic construction of the study hypotheses, provided a basis for determining the mechanisms through which the hypothesized effects were expected to manifest, and facilitated the investigation of the psychological concepts involved.

The main strength of this study relates to its use of a relatively large sample size and its randomized controlled design. Randomized controlled trials are recognized as providing evidence of causal relationships between intervention efforts and hypothesized outcomes (Deaton & Cartwright, 2018). This study complemented the efficacy evaluation with fidelity analysis, which increases internal validity (Abry et al., 2015). Furthermore, the fidelity evaluation was based on the students' reports and the identification of the separate active ingredients of the intervention. This measurement approach may provide a more accurate implementation assessment, because intervention providers may over-report fidelity (Berkel et al., 2011; Lillehoj et al., 2004). Moreover, disassembling intervention fidelity measurements into multiple sub-dimensions permitted the determination of a more complete picture of the implementation process and provided an opportunity to explore the contributing role of each active ingredient in terms of the intervention outcomes.

One study strength was related to the fact that the safety training program was implemented as part of the school's curriculum and safety training process. As a result, it can be assumed that the students' awareness of the ongoing

research did not significantly influence the results. Moreover, the students were informed that they were not graded on the basis of their responses to the questionnaires. This may have reduced the risk of socially desirable responses. Finally, as the Attitude to work training method was developed in collaboration with workplaces and educational institutions, the practical needs of both educational institutions and workplaces were considered in the content of the intervention.

4.5.2 Study limitations

Several study limitations must be acknowledged. The most important shortcoming of the current study is its focus on short-term effects, leaving questions about its long-term effects. The risk of bias arises when intervention effect is evaluated using only short-term follow-up data. Nevertheless, immediate impact assessment is considered an important part of safety training evaluation (see Kirkpatrick, 1994; La Duke, 2016). Behavioral-level outcomes and safety-related outcomes (e.g. accidents) should be investigated in the future. In this regard, it important to acknowledge that psychological constructs such as self-efficacy, internal locus of control and motivation have been defined as the key determinants of human behavior (Bandura, 1997; Rotter, 1966; Vroom, 1964). Earlier empirical studies have also shown their associations with safety behaviors at workplaces (e.g. Christian et al., 2009). Therefore, study results are meaningful in terms of designing effective preventive strategies in vocational education.

It should be noted that the focus of this study was targeted at only one level of potential safety intervention approaches. Although the focus of this thesis was on the role of individual-level factors, this should not be seen as downplaying the role of contextual and work-related factors in terms of occupational safety. Individual safety behaviors must always be considered in a physical, organizational workplace setting. Occupational safety involves a complex interaction of organizational factors, a physical and psychological work environment, and group- and individual-level factors (Teperi, 2012). Moreover, earlier studies (e.g. Neal, Griffin, & Hart, 2000; Neal & Griffin, 2006) have shown that contextual factors such as safety climate, safety norms, work pressure and leadership have an impact on individual safety motivation. Hence, it is important to acknowledge that positive safety climate and an encouraging atmosphere are also important factors for keeping young people motivated in terms of safety promotion and safety performance. A Danish review study (Dyreborg, 2013, as cited in Hanvold et al., 2019) indicates that the most effective safety interventions target many levels (e.g. individual and organizational) simultaneously. Nevertheless, it is important to identify effective intervention techniques at each level. This study provides important knowledge regarding school-based safety interventions. Several human-related issues, such as risk perception, fatigue, cognitive overload and stress can also lead to unsafe work behavior (see Reese, 2012). This study examined the characteristics of the individuals rather narrowly, from the perspective of social-cognitive theories and motivational theories.

The results regarding the effectiveness of randomization showed a small baseline difference between the intervention and control groups in terms of gender distribution and school grade. The subsequent analyses were adjusted for these variables, so the baseline difference is not considered to have a major impact on the results. Furthermore, previous studies have pointed out (de Boer et al., 2015; Moher et al., 2010) that despite an appropriate randomization process, differences in baseline levels can arise from chance. Nevertheless, the baseline imbalance should be recognized as one potential study limitation.

Only one baseline measurement was used in this study. Previous school-based intervention studies based on social-cognitive theories and similar outcome variables have also taken a similar approach (e.g. Koivisto, Vuori, & Nykyri, 2007). However, the current study would have been better supported by the implementation of two baseline measurements, to explore whether the levels of outcomes were stable pre-intervention.

One study limitation concerns the study measures. In Study I, the conscientiousness scale had low internal consistency. Previous studies using adolescent samples have shown similar results regarding the internal consistency of conscientiousness scales (Vazsonyi, Ksinan, Mikuška, & Jiskrova, 2015). The mean age of study participants in the study sample was under 20. Thus, the age of the study participants may have affected the reliability of the conscientiousness measure (see Soto, John, Gosling, & Potter, 2008).

Using only one data source to explore the antecedents of safety motivation presents the risk of common method bias, but the questionnaires in this study included different instructions and sections for predictor and criterion variables, which may have reduced the risk of bias. Nevertheless, the association between safety self-efficacy, internal safety locus of control and safety motivation should be further explored using new datasets. Ideally, this would involve several measurements of the antecedents of safety motivation and safety motivation at different time points (see Podsakoff, MacKenzie, Podsakoff, & Lee, 2003).

The risk of the ”spill-over” effect is an important aspect to consider in school-based intervention studies. In this cluster-randomized study, this risk was reduced by the fact that the classes in the control group and the classes in the experimental group had different teachers. Furthermore, this study focused on the immediate intervention effects on individual abilities such as motivation and attitudes. The spill-over of intervention effects is likely to require longer-term social interaction between students and peer influence via social-network ties across different student groups. Moreover, as such a spill-over is expected to hinder the beneficial effect observed in the intervention group, it does not threaten the conclusions drawn.

In this study, the methodology and research material were limited to a quantitative perspective. A qualitative perspective would have complemented the analysis of the implementation process in Study III. Qualitative analysis of the implementation process using first-hand accounts of students would have helped gain in-depth insights into the learning process during the intervention program. Qualitative analysis would made it possible to identify specific

educational activities that trigger motivational and attitudinal change among students. Moreover, predetermined measures can miss factors important to participants that go beyond those foreseen by the researchers. Process analysis could also have been strengthened by taking the teachers' perspective into account in the analysis. For example, including a teacher perspective in the implementation process evaluation helps identify the potential barriers, practicability and applicability related to delivering a school-based safety training program (see Nilsen, 2015). In light of all these factors, a more comprehensive mixed-methods approach would have offered a fuller picture of both the intervention process and its impact.

Finally, the generalizability of the results needs to be considered. The study sample was from upper secondary-level vocational schools and involved mostly second-year students who already had some work experience in their occupational field. This should be kept in mind when interpreting the results. More research and additional study samples are needed to generalize the results to first-year students.

4.6 Practical implications

One of the key concerns in school-based safety training is the lack of ready-to-use and evidence-based training methods. Previous studies (Lecours & Therriault, 2017; Pisaniello et al., 2013) have pointed out that a lack of pedagogical tools and resources may hinder the delivery of OSH training in schools. Hence, this research has important implications for the delivery of safety training in schools. The Attitude to work safety training method provides structured guidelines for delivering safety training. More generally, the study results support the use of student-centered peer-learning methods in school-based safety training. Based on the current study, several practical implications to school-based safety training can be suggested. First, to increase safety motivation through safety training, it is important that a young individual acknowledges the controllable causes of accidents and the association between their own safety behaviors and accidents. This involves reinforcing the perception that each individual is in control of their own safety behaviors and stressing personal control over safety. When a student in vocational education perceives that they are an active participant in the promotion of occupational safety, their safety motivation becomes stronger.

Second, it is important that behavioral strategies are not only discussed but also practiced. An active peer learning process, in which learners can create their own ideas and solutions, is an important factor in safety training. The perspectives, thoughts, experiences and ideas of students should be given a central place in the learning activity. An example of this is the "hazard map exercise" in which students create a drawing of their workplace, review the hazards of the work environment and plan how to handle them. Another important safety training technique is to utilize behavioral modeling with role-

playing exercises. The Attitude to Work training program used role-playing activities to practice communicating about safety issues and safety-related information-seeking.

Third, safety training for young people should also offer an insight into how to act if they encounter a barrier to safe work. Using appealing case examples of potential barriers and unexpected safety-related situations at work provides a basis for identifying effective behavioral strategies to respond to unsafe situations at the workplace. Accordingly, this activity supports the development of safety-related problem-solving skills.

It is important to emphasize that peer learning is not about "leaving students alone" in a learning situation. When it comes to safety learning, it is essential that the teacher monitors the learning process and guides the learning in the right direction. Predefined learning goals and the teacher's active facilitation play an important role. This involves asking questions that stimulate student learning; showing interest in students' experiences, thoughts and ideas about occupational safety; using appealing case examples that stimulate student participation; presenting inspirational problem-solving tasks; and, if necessary, correcting erroneous thinking patterns or providing supplementary safety knowledge. However, it is also important to give students the opportunity for self-directed learning in occupational safety. This supports an active orientation towards occupational safety in general. Moreover, in a student-centered learning process, it is important that learners feel comfortable discussing and sharing their own ideas and experiences. In the Attitude to work training method, group exercises are planned so that students receive positive reinforcement from both the trainer and their peers. Sharing positive feedback is also integrated into the content of the exercises. For example, in role-playing exercises, students give each other positive feedback on how they made suggestions for improvement.

Considering the student-centered approach of the Attitude to work program, it is probably best suited to second- or third-year students who have a basic understanding of occupational safety issues, safety procedures and some work experience, which they can use in active learning during small group tasks, discussions and exercises. This allows the teacher to shift from the role of a specific safety information provider to that of a facilitator. It is also important to acknowledge that the teaching methods used in this study do not substitute other safety training methods in vocational education, such as practical hands-on training in how to use personal protective equipment. Furthermore, it is also important to practice safe working methods (e.g. how to use work machinery safely) under the supervision of teachers and more experienced workers.

As stated earlier, the training methods investigated in this study complement other safety learning approaches, particularly in terms of safety-related beliefs, motivation and attitudes. This study also highlighted a new aspect of safety training related to the barriers to safe work. It is important to strengthen young people's resilience and ability to respond to situations or circumstances that may lead to unsafe work. The Attitude to work training program trained students in how to react to colleagues' risk-taking, unexpected

safety-related events and unclear work assignments. During this learning process, students may acquire a better understanding of the barriers to safe work at the workplace and become empowered to overcome these barriers. The principle of safety inoculation training should be extended to other safety-related issues at the workplace. For example, appropriate techniques for coping with work overload, pressure and stress at work should be discussed with young people.

In addition to discussing the practical application of the principles of the Attitude to work program, it is important to consider future directions for reinforcing its efficacy. First, the duration of training in this study was relatively short (12 hours). In the future, the duration of similar student-centered safety training programs should receive attention. A longer program may provide more opportunities for dialogue and reflection. Furthermore, it is important to consider how the safety training program could be developed to address the role of conscientiousness in terms of effects. One potential way to address this is offered by the bottom-up model for personality change (Magidson et al., 2014). The key principle in the model is to make the individual aware of their tendencies and then increase their motivation to change these. Magidson et al. (2014) integrated a bottom-up approach with the expectancy value theory (Eccles & Wigfield, 2002; Eccles, 2009) and outlined how an individual's decision to spend time and energy on an activity depends on the values and expectations that they attach to the activity, and that these decisions may provide experiences which drive further personal development. Magidson et al. (2014) proposed that interventions should focus on altering the processes that underlie the manifestation of the trait, which are more accessible to change. Changes in motivations and behaviors may later become automatized (see Hampson, 2019; Magidson et al., 2014). A bottom-up model by Magidson et al. (2014) provides ideas for the future development of safety training programs. Safety training programs in vocational education may include additional modules that guide students to identify their personal tendencies related to safety behavior and the health-related implications of these tendencies. In this manner, the aim would be to guide the students to acknowledge problems that may emerge from their personal tendencies in terms of safety behavior. Increasing self-awareness, acknowledging the pros and cons of their present personal tendencies and weighing alternative safety behaviors may help them identify the personal importance of safety training and support motivation to learn new safety skills.

4.7 Future studies

During the study process, many ideas about further research topics emerged. First, this study focused on safety-related beliefs, perceptions and motivation and did not investigate the training impact on factual knowledge about occupational hazards and safety procedures. Even though workplace safety training studies (Burke et al., 2006; Burke et al., 2011) have found that participatory training methods are effective in the acquisition of safety-related knowledge, this should

be further investigated in the context of school-based safety training. Future studies should measure changes in student safety knowledge using tests with open-ended and multiple-choice questions.

Further research is also necessary to better understand the antecedents of students' safety motivation. According to previous studies (see Salmela-Aro, 2009; 2010; Salmela-Aro, Mutanen, Koivisto, & Vuori, 2010), the personal goals of young people guide and regulate behavior during the school-to-work transition process and have motivational consequences. Personal goals for promoting safety can therefore direct one's safety motivation. Previous school-based intervention programs using similar background theories (Koivisto, Vuori, & Nykyri, 2007) have been successful in increasing work-related goals among adolescents. However, this has not been investigated in terms of safety training programs. In the Attitude to Work training program, students set personal goals related to occupational safety. It would be important to investigate whether a school-based safety training program can increase the personal safety-related goals of young people and to what extent these personal goals are linked to safety motivation. Also, according to Vroom's Expectancy Theory (1964), the affective orientations and subjective value that one places on the activity in question influences one's motivation. Thus, future studies should investigate how subjective safety values affect the safety motivation of young people.

As mentioned earlier, an important future study topic to explore is whether enhancing safety preparedness, internal safety locus of control and safety motivation during vocational education leads to behavioral outcomes at workplaces and reductions in occupational accidents. For example, safety inoculation is an anticipatory personal resource which may have important behavioral consequences at the beginning of a working career. Tucker and Turner (2011) developed a scale to assess how the young respond to hazardous work. This measure could be used to assess the association between safety inoculation and behavioral strategies (e.g. safety communication). Overall, more empirical studies are needed to explore whether the individual-level cognitions have behavioral outcomes among young workers.

Future research is also needed to explore additional dimensions of the implementation process, such as student responsiveness (Berkel et al., 2011) which involves judgments by students about the relevance of the intervention content. Moreover, potential teacher-level predictors of implementation fidelity should be investigated. This includes factors such as the perceived need for new safety training methods, the skills necessary for implementation, and teachers' confidence in their ability to use participatory and student-centered safety training methods (see Durlak & Dupre, 2008). Possible interactions between the intervention's active ingredients should also be considered when studying the implementation process. In particular, there may be a link between the learning atmosphere and the delivery of active learning techniques. A positive learning atmosphere and trust between students may create better conditions for the beneficial effects of participatory small group assignments and role-play exercises.

The sustainability of the intervention program should also be evaluated. Future research topics related to this include exploring whether schools have incorporated the new safety training method into their curriculum and existing routines.

Previous studies have also highlighted that contextual factors have an impact on school-based intervention outcomes (Durlak & Dupre, 2008; Lendrum & Humpfrey, 2012; Payne & Eckert, 2010; Pas & Bradshaw, 2012). Moreover, it is important to acknowledge that learning is an interaction between the person and the environment (Bandura, 1997) and that motivation to learn is influenced by situational factors (Colquitt, Lepine, & Noe (2000). It is therefore important to consider the social context in which the safety training program is implemented. Student groups' safety norms in particular are a potential contextual moderator of safety training effects. For example, it is possible that injunctive safety norms influence the relationship between conscientiousness and the safety training outcomes. A student group with strong pre-existing injunctive safety norms may not allow individual-level traits to influence the level of engagement in the learning process during a safety training program. In contrast, a student group with negative pre-existing safety norms may hinder intervention efficacy by acting as a contextual barrier to safety learning. Exploring the moderating role of student group safety norms in the effects of a school-based safety training program could provide insights into targeting school-based interventions. For example, should interventions also focus on modifying the safety norms of student groups? This research topic can also be viewed from another perspective. If peer learning approach increases the safety-related positive interaction between students, this may also result in improved injunctive safety norms in the student group. In this regard, it would important to measure injunctive safety norms before and after the safety training program. Finally, this study had a school-based design. Thus, future research should examine the generalizability of the current findings using a sample of young workers in employment at workplaces. The workplace context must also be taken into account to sustain the impact of school-based safety training. Therefore, future studies should examine how organizational factors such as safety climate and safety leadership contribute to the longer-term impact of school-based safety training.

4.8 Conclusion

School-based safety training provides an essential opportunity to enhance young people's personal abilities to protect themselves from occupational hazards. It is fundamental that safety training in vocational education provides young people with facts regarding occupational hazards and safety procedures. Safety training should also actively engage young people in terms of safety and help them put their safety knowledge into action. A key message of this study is that student-centered peer-learning techniques offer an opportunity to empower young people in safety, stimulate attitudinal change and help them discover their own

capacities for influencing occupational safety. Young people need to be engaged in safety learning processes and should not be seen as merely passive recipients of information.

It is important to acknowledge that only one dataset was used in this study. In future, the impact of the intervention program should be evaluated using additional data sources and longer-term follow-up measures. The detailed description of the Attitude to work group method provided in this thesis will help complementary studies. Although the results of the present study represent only short-term findings, this study still contributes to scientific knowledge in three ways. First, the results suggest that a student-centered safety training method based on a peer learning process has a beneficial impact on the antecedents of safety behavior. On the basis of earlier studies of workplace safety behaviors and occupational accidents, it can be expected that positive outcomes in safety preparedness, internal safety locus of control, risk attitudes and safety motivation contribute to the occupational safety of young individuals at the beginning of their working careers. Today, the career trajectories of young people usually include different jobs and employers (Akkermans, Brenninkmeijer, Huibers, & Blonk, 2013). Consequently, these changes will often lead to encountering new work environments and different hazards. This emphasizes the importance of the personal and transferable resources, such as safety preparedness.

Second, the results indicate that modifying the perception of personal control over safety plays a significant role in terms of the motivational outcomes of safety training. Here, it is important that the young individual recognizes that occupational accidents are predictable and can be prevented. It is important to guide young individuals toward identifying the controllable causes of accidents and towards acknowledging personal control over safety.

Third, this study presents a new multidimensional approach to exploring the implementation fidelity of school-based prevention programs. Identifying the intervention's active ingredients facilitates understanding the aspects through which positive outcomes are transmitted. To conclude, it is important to empower adolescents and young adults to be active in occupational safety. This requires that young people find their own potential through self-directed learning and receive peer reinforcement for motivational change.

YHTEENVETO (FINNISH SUMMARY)

Nuorten turvallisuusvalmiuksien vahvistaminen

Työ muodostaa merkittävän osan ihmisen elämästä. On tärkeää, että kaikilla on mahdollisuus ja kyky työskennellä turvallisesti. Työhön ja työympäristöön liittyviin vaaroihin kuuluvat mm. koneiden ja työvälineiden käyttöön liittyvät vaarat, raskaiden taakkojen siirtämiseen tai nostamiseen liittyvät vaarat sekä biologiset ja kemialliset vaarat työssä. Työtapaturmat aiheuttavat vuosittain suurta terveydellistä haittaa, poissaoloa työstä ja voivat pahimmillaan johtaa kuolemiin. Aiemmat tutkimukset ovat osoittaneet, että nuorilla työntekijöillä on suurempi riski joutua työtapaturmiin. Vähäinen turvallisuuskoulutus, kokemattomuus ja heikommat valmiudet turvalliseen työskentelyyn heikentävät nuorten työturvallisuutta. Lisäksi nuoret tekevät usein tapaturmille alttiimpia fyysisiä työtehtäviä. Vuonna 2018 nuorten tapaturmia sattui Suomessa eniten rakennusalalla ja kuntasektorilla.

Tehokkain keino työturvallisuuden edistämiseen on poistaa työhön liittyvät vaarat kokonaan. Käytännön syistä johtuen työhön liittyviä vaaroja ei kuitenkaan yleensä voida poistaa täysin. Esimerkiksi rakennusalan työhön liittyy usein työlaitteiden käyttämistä, joihin liittyy tapaturmavaaraa. Terveysalalla puolestaan on usein vaikea poistaa kaikkia biologisia ja kemiallisia työhön liittyviä vaaroja. Monilla ammattialoilla suoritetaan työtehtäviä joihin liittyy riski tapaturmalle tai muun terveyshaitan syntymiselle. Työturvallisuutta on mahdollista edistää lainsäädännön ja työpaikkatason toimenpiteiden (esim. työmenetelmien turvallisuuden kehittäminen) avulla. Tutkimusten mukaan ihmisen henkilökohtainen turvallisuuskäyttäytyminen on kuitenkin keskeinen tekijä työturvallisuudessa ja tapaturmissa. Tämän vuoksi on tärkeää vahvistaa myös nuorten henkilökohtaisia valmiuksia turvalliseen työskentelyyn. Aiemmat tutkimukset ovat osoittaneet, että psykologiset tekijät kuten pystyvyyden tunne, sisäinen hallinnan tunne ja motivaatio turvalliseen työskentelyyn ovat yhteydessä työturvallisuuskäyttäytymiseen. Näihin tekijöihin vaikuttamiseksi tarvitaan käyttäytymistieteelliseen tietoon perustuvia menetelmiä.

Ammatillisten opintojen aikana toteutettava turvallisuuskoulutus on keskeinen väylä vahvistaa nuorten henkilökohtaisia valmiuksia turvalliseen työskentelyyn. Aiemmat tutkimukset viittaavat myös siihen, että ammatillisen koulutuksen aikana saadulla turvallisuuskoulutuksella on ennaltaehkäisevä vaikutus työuran alussa sattuvien tapaturmien kannalta. Aiheeseen liittyviä interventiotutkimuksia on kuitenkin tehty toistaiseksi melko. Erityisesti tarvitaan satunnaistettuja ja kontrolloituja tutkimusasetelmia tehokkaiden koulutusmenetelmien määrittämiseksi. On tärkeää tunnistaa keinoja, joiden avulla on mahdollista vaikuttaa nuorten turvallisuuskäyttäytymistä ennustaviin tekijöihin.

Tämän tutkimuksen päätarkoituksena on lisätä tietoa keinoista nuorten turvallisuusvalmiuksien vahvistamiseen ammatillisen koulutuksen aikana. Tutkimuksessa arvioitavan koulutusmenetelmän vaikutusmekanismi perustuu sosi-

aalis-kognitiiviseen teoriaan, opiskelijalähtöisen oppimisen periaatteisiin ja Työterveyslaitoksella aiemmin kehitettyyn vertaisoppimisen malliin. Opiskelijat jakavat koulutuksen aikana toisilleen turvallisuustietoa ja määrittävät yhdessä keinoja työhön liittyvien vaarojen torjumiseen sekä turvallisuutta heikentävien ongelmien ratkaisemiseen. Opettajan rooli on fasilitoida ja seurata opiskelijoiden ryhmätyöskentelyä. Valmennusohjelma täydentää ammatilliseen koulutukseen sisältyvää turvallisuuskoulutusta erityisesti asenteisiin ja motivaatioon vaikuttamisen keinoin. Keskeisiin koulutussisältöihin kuuluvat mm. käyttäytymismallit tapaturmien ennaltaehkäisyssä, ihmisen kyky vaikuttaa työturvallisuuteen, turvallista työskentelyä heikentäviin vastoinkäymisiin varautuminen, turvallisuutta koskevien kehittämisideoiden esittäminen ja epäkohtien esille nostaminen sekä työturvallisuutta tukeva tiedon- ja tuenhankinta. Lisäksi valmennusohjelman aikana asetetaan ohjatusti vastaväitteitä riskiasenteille, jotka voivat heikentää työturvallisuutta.

Koulutusmenetelmän vaikutuksia tutkittiin satunnaistetussa kenttäkokeessa (n=464) kahdeksassa ammatillisessa oppilaitoksessa lukuvuonna 2016-2017. Tutkimukseen osallistuneet opiskelijat satunnaistettiin kahteen joukkoon alkukyselyn jälkeen. Puolet henkilöistä osallistuivat 12 – tunnin laajuiseen opettajien toteuttamaan valmennusohjelmaan n. 2 viikkoa alkukyselyn jälkeen. Puolet tutkimukseen osallistuneista toimivat vertailuryhmänä sekä perehtyivät vastaavan sisältöiseen kirjalliseen turvallisuusmateriaaliin. Valmennusohjelmaan osallistuneet henkilöt vastasivat seurantakyselyyn välittömästi koulutuksen jälkeen. Vertailuryhmään kuuluvat henkilöt vastasivat seurantakyselyyn samalla viikolla. Tutkimuksessa arvioitiin osallistavan turvallisuuskoulutuksen välittömiä vaikutuksia opiskelijoiden turvallisuusajatteluun.

Väitöskirja sisältää kolme osatutkimusta samasta tutkimusaineistosta ja koulutusprosessista. Ensimmäisen osatutkimuksen tulokset osoittivat, että opiskelijakeskeinen ja vertaisoppimiseen perustuva turvallisuuskoulutus vahvisti työturvallisuuteen kohdistuvaa valmistautuneisuutta ja sisäistä hallinnan tunnetta sekä vähensi riskiasenteita. Toinen osatutkimus osoitti, että koulutuksella oli positiivinen vaikutus motivaatioon edistää työturvallisuutta. Lisäksi havaittiin, että koulutuksen vaikutukset sisäiseen hallinnan tunteeseen olivat yhteydessä motivaation vahvistumiseen. Tämä havainto lisää tietoa turvallisuusmotivaatiota ennustavista psykologisista tekijöistä sekä mekanismeista, joiden kautta turvallisuuskoulutus vaikuttaa motivaatioon. Tulos viittaa siihen, että henkilökohtaisten vaikutusmahdollisuuksien tunnistamisella on motivoiva vaikutus turvallisuuskoulutuksessa.

Koulutusmenetelmän vaikutusten arviointia täydennettiin implementaatioprosessin laadun tutkimisella. Koulutusprosessin toteutumista arvioitiin opiskelijoiden kokemusten perusteella, joka on harvemmin käytetty näkökulma koulupohjaisten interventioiden tutkimisessa. Tavoitteena oli tutkia koulutusohjelman noudattamisen ja toteuttamisen laadun yhteyksiä positiivisiin vaikutuksiin. Tulokset osoittivat, että koulutusohjelman noudattamisella oli voimakas yhteys positiivisiin vaikutuksiin. Lisäksi havaittiin, että aktiivisen oppimisen menetel-

mien hyödyntäminen ja positiivinen oppimisilmapiiri vaikuttivat turvallisuusmotivaatioon. Yleisesti ottaen, kolmannen osatutkimuksen tulokset olivat samansuuntaiset aiemman tutkimustiedon kanssa osoittaen interventioprosessin laadun ja positiivisten vaikutusten välisen yhteyden. Tulos korostaa implementaation laadun tukemisen merkitystä kouluympäristöissä toteutettavissa interventioissa. Tässä tutkimuksessa käytettyä lähestymistapaa prosessiarviointiin voidaan käyttää jatkossa muissa interventiotutkimuksissa.

Yhteenvetona voidaan todeta, että vertaisoppiminen ja opiskelijakeskeinen lähestymistapa turvallisuuskoulutukseen on yhteydessä myönteisiin vaikutuksiin turvallisuuskäyttäytymistä ennustavissa tekijöissä. Vahvistamalla työturvallisuuteen kohdistuvaa valmistautuneisuutta, sisäistä hallinnan tunnetta ja motivaatiota, on mahdollista aktivoida nuoria työturvallisuuden edistämiseen. Tulokset tarjoavat käytännön ehdotuksia kouluissa toteutettavaan turvallisuuskoulutukseen.

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ORIGINAL PAPERS

I

ENHANCING SAFETY COMPETENCIES OF YOUNG ADULTS. A RANDOMIZED FIELD TRIAL (RCT)

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Enhancing safety competencies of young adults: A randomized field trial (RCT)

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ABSTRACT

Introduction: Young workers are exposed to various occupational hazards, often with limited experience and skills. In this study, we investigated the effects of the *Attitude to Work Program* on the safety competencies of young workers. Based on the social cognitive theory, the intervention was developed to help young people adopt an active role in preventing occupational hazards and overcoming barriers to safe work. *Method:* The program was implemented in eight upper secondary-level vocational schools in Finland during 2015. A total of 464 students participated in the cluster randomized field trial. Those in the intervention group ($n = 229$) participated in the *Attitude to Work Program*. During the program, students identified and practiced behavioral strategies to prevent occupational hazards. Students in the control condition ($n = 235$) received written material about the same safety-related topics. *Results:* The short-term follow-up showed that the intervention significantly increased safety preparedness and the internal safety locus of control among the students in the intervention condition in comparison to those in the control condition. Students in the intervention condition also showed reduced risk-taking attitudes relative to those in the control condition. Furthermore, those who benefited most from the program were high conscientiousness students. The sensation-seeking level or vocational track did not moderate any of the intervention effects. *Conclusion:* The results demonstrated that safety competencies can be modified by intervention techniques based on a social-cognitive framework. *Practical implications:* This study provides tools for school-based safety training and future intervention development. Further research is needed to study the relationships between cognitive factors, safety behavior, and accidents.

1. Introduction

Young people entering working life face various challenges, such as having to develop their skills and go through the occupational socialization process (Akkermans, Nykänen, & Vuori, 2015). Adolescents and young adults represent a vulnerable group when it comes to occupational safety. Previous studies have shown that younger age groups are at an elevated risk of accidents at work (Salminen, 2004; Breslin & Smith, 2006). Inexperience, short job tenure, and type of industrial establishment/workplace setting (e.g., restaurant and construction sector, manual labor) can all lead to a greater risk of occupational accidents among young people (Bena, Giraudo, Leombruni, & Costa, 2013; Breslin, Polzer, MacEachen, and Shannon, 2007). The importance of occupational safety and health (OSH) training in vocational education has been recognized (Schulte, Stephenson, Okun, Palassis, & Biddle, 2005; Okun, Guerin, & Schulte 2016). A large amount of future young workers can be reached in secondary vocational education, and thus high-quality safety training at this stage is very important. Secondary education also provides an opportunity to foster positive attitudes toward preventive safety practices and strengthen young peoples' confidence to adopt a proactive role at workplaces. However, previous studies indicate that in upper secondary-level education, students' knowledge and awareness of occupational safety is often limited, and that the implementation of OSH in education varies in its duration, content, and methods used (Salminen & Palukka, 2007; Andersson, Gunnarsson, and Rosen, 2015).

Providing young workers with OSH-related information is not sufficient, considering their newcomer status at the workplace. Due to a lack of experience or self-confidence, the abilities of young workers to put into practice what they have learned during education may be limited (Schulte, Stephenson, Okun, Palassis, & Biddle 2005). Chin et al. (2010) emphasized that safety training for young people should promote their skills to put safety knowledge into action and encourage them to think about how to advocate safety at the workplace. Readiness and confidence for actions to influence occupational safety are important competencies for young workers, who face an unfamiliar work environment and begin to adapt to a new job. Despite the development of

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numerous safety training programs directed at young workers, there is a lack of randomized controlled intervention studies that examine the effects of safety interventions (Breslin et al., 2007). More knowledge is needed on effective techniques for enhancing young peoples' safety competencies. This study focuses on psychosocial resources that help young workers adopt an active role in preventing occupational hazards and overcoming barriers to safe work. Our aim is to study whether safety competencies, as embodied by the social-cognitive theory, can be improved by a safety intervention targeted toward upper secondary-level students entering working life. We examine the short-term effects of the psychosocial safety intervention in Finnish upper secondary-level vocational schools in a cluster randomized experimental field trial. The *Attitude to Work Program* group method aims to develop skills and confidence to work safely and prepare young people for the possible to working safely.

2. Social-cognitive framework on safety competencies

The framework of this study is grounded in the social cognitive theory, which explains how people acquire behavioral strategies (Bandura, 1997; Rotter, 1982). Although the social-cognitive framework has been recognized in occupational safety research, empirical studies are lacking. Previous studies have nonetheless highlighted that a framework for measuring and changing behavioral determinants in the domain of occupational safety is useful (DeJoy 1996; Clissold, Buttigieg, and De Cieri, 2012; Cheung & Chan, 2000; Casey, Krauss, & Turner 2017). The social cognitive framework provides a practical basis for intervention strategies (Bandura, 1997).

2.1. Safety preparedness

Koivisto, Vuori, and Vinokur (2010) used a concept of preparedness that combines self-efficacies with the concept of inoculation against setbacks. Inoculation against setbacks refers to skills that help an individual maintain active behavior when facing barriers or setbacks (Meichenbaum, 1985). In this study, we introduce safety preparedness as a new construct to assess individual readiness and resilience related to occupational safety. In addition to self-efficacies, safety preparedness comprises plans and skills for successfully confronting barriers to safe work. Self-efficacy refers to the degree of confidence in one's ability to effectively organize and perform activities in a given context (Bandura, 1997). Occupational safety-related self-efficacy can be defined as an individual's belief in their abilities to perform specific actions that are essential to prevent occupational accidents and injuries. Self-efficacies have shown to have a positive impact on safety behavior (Cheung & Chan, 2000; Real, 2008). The stronger one's beliefs are that safety behavior will prevent negative outcomes, the more favorable one's attitude will be toward performing preventive actions.

In general, inoculation against setbacks is about identifying setbacks and the means with which to tackle them, and practicing these means to resolve the respective problematic situations. Inoculation can be viewed as a complementary element related to specific self-efficacies (Vuori & Vinokur, 2005). We propose that inoculation against setbacks is essential for sustaining the behavioral efforts involved in safety behavior. As newcomers to working life, young workers may face difficult situations, such as unclear instructions, risky work behavior of co-workers, unfamiliar work tasks, or pressure to perform at too fast a pace in relation to their own skill levels. Young people may lack skills and training in how to appropriately respond to working practices that are unsafe (Kincl, Anton, Hess, and Weeks, 2016). Mullen (2004), for example, found that young workers may choose not to use safety equipment or may tend to work unsafely to avoid being teased by their co-workers. Tucker and Turner (2013) in turn describe how young workers' reluctance to take action to solve safety problems can be related to an underlying fear of being fired, newcomer status, and feelings of powerlessness. For example, if an organization's management discredits injury reports, this may discourage young workers from reporting injuries in the future (Chin et al., 2010). Therefore, even if a young worker feels capable of implementing actions that will reduce the risk of accidents or harmful events, perceived barriers to safety behavior may reduce their motivation to work safely. This evidence shows that it is also important to prepare future young workers to overcome barriers to safe work.

Okun, Guerrin, and Schulte (2016, pp. 47) stated that "Young people need the opportunity to increase self-efficacy, through building skills and confidence, to overcome the barriers to taking preventative actions." Building on this idea, we apply the concept of safety preparedness to the domain of occupational safety. By occupational safety preparedness we refer to young peoples' readiness to implement actions that support occupational safety, and their resilience to deal with barriers or problems related to occupational safety and safe working.

2.2. Safety locus of control

Breslin, Polzer, MacEachen, and Shannon (2007) found that young workers may see injuries as 'part of the job.' According to their study, this perception was attributed to young workers' feelings of lacking control over working conditions. The locus of control concept refers to the degree to which an individual perceives that the outcomes of the situations they experience are under their personal control (Rotter, 1982). People with a higher internal locus of control perceive events as resulting more from their own actions, whereas individuals with a high external locus of control view events as being under the control of external factors such as luck, fate, or the actions of others. (Rotter, 1982; Marsh & Weary, 1995). The safety locus of control concept is an adaptation of the original locus of control concept. Jones and Wuebker (1985) developed the concept to study perceived control over occupational accidents and injuries. According to previous studies, employees with more external safety locus of control orientations have reported more occupational accidents (Jones & Wuebker, 1993). It has been suggested that those who have an internal safety locus of control are more likely to put a greater effort into preventing injuries, as they believe that they have control over their environment (Forcier, Walters, Brasher, & Jones, 2001).

We propose that the internal safety locus of control, together with safety preparedness, are important resources that help young workers adopt an active role in occupational safety, and handle occupational hazards. The intervention in this study is targeted at both safety preparedness and the internal safety locus of control. Although preparedness and the internal safety locus of control bear some degree of conceptual overlap, there are a few distinctions. The internal safety locus of control refers to the degree to which people perceive personal control over their occupational safety in general, and the extent to which individuals attribute the outcomes of events to their own control. Safety preparedness comprises one's beliefs in one's own ability to successfully practice specific safety behaviors, and the resilience to implement these actions in the face of difficulties or barriers.

2.3. Risk-taking attitudes

People may adopt unsafe work practices if the perceived positive aspects of risk-taking outweigh the potential negative aspects (risk of being injured; Mullen, 2004). For example, people may take safety-related risks at work when they feel the need to perform quickly, or ignore personal safety equipment in order to work more comfortably. Moreover, young workers may believe that if they work swiftly they will receive more recognition in their work community, even if this involves risk-taking (Lykke-Nielssen, 2012). Previous studies have shown that young workers' risk-taking orientation at work is also influenced by peer workers (Westaby & Lowe, 2005). The Expectancy-value theory states that expectancies interact with attitudes. Expectancy is the degree to which the individual believes that a certain outcome will result from a given activity (Westaby, 2002; Eccles et al., 1983). Therefore,

individuals who expect positive outcomes to occur from preventive safety behaviors may form a more positive attitude toward occupational safety. In order to prevent unsafe work behaviors, intervention efforts should counteract negative safety attitudes that may result in unsafe work practices and accidents.

3. Individual-level moderators of safety interventions

The aim of this study is to examine the short-term effects of an intervention targeted at young workers' abilities to practice safety-promoting behaviors at the workplace. Prior studies have demonstrated how different subgroups may respond differently to intervention efforts (Bloom & Michalopoulos, 2013; Winslow et al., 2017). Therefore, we consider it important to also study individual characteristics that may moderate the outcomes of an educational safety intervention.

Conscientiousness is a personal trait that is characterized by being responsible, careful, and achievement oriented (Clarke & Robertson, 2005). Previous studies have shown that conscientiousness is associated with positive attitudes toward occupational safety and the motivation to work safely (Henning et al., 2009; Christian, Bradley, Wallace, & Burke, 2009). Another personality trait that has previously been linked to safety attitudes and behavior is sensation-seeking. Sensation-seeking is "a trait defined by the seeking of varied, novel, complex, and intense sensations and experiences, and the willingness to take physical, social, legal, and financial risks for the sake of such experience" (Zuckerman, 1994, p. 27). Sensation-seeking has an impact on how individuals perceive and appraise risks associated with various health behaviors (Hoyle Stephenson, Palmgreen, Pugzles Lorch, and Donohev, 2002; Roberti, 2004). A few studies also indicate that sensation-seeking is associated with OSH-related behavior and attitudes (Beus, Dhanani, & McCord, 2015; Henning et al., 2009). Although many studies have explored the relationships between personality traits, accident involvement, safety attitudes, and behavior, there remains a lack of knowledge regarding the relationship between personality traits and safety intervention effects.

4. The attitude to work program

The *Attitude to Work* training program was developed in collaboration with upper secondary-level vocational schools and workplaces. The intervention program is based on the principles of social-cognitive theory (Bandura, 1997; Rotter, 1982), the expectancy-value theory (Eccles et al., 1983) and earlier experiences of behavioral interventions that have applied similar background theories (Koivisto, Vuori, & Nykyri, 2007; Vuori & Vinokur, 2005). Based on the process of social learning (Bandura, 1997), intervention program utilizes the following learning mechanisms: mastery experiences, vicarious learning, and peer reinforcement. The main goal of the *Attitude to Work Program* intervention is to increase the occupational safety preparedness of young people entering working life. In addition, the intervention aims to strengthen the internal safety locus of control, decrease the external safety locus of control, and reduce risk-taking attitudes among young workers. The intervention's primary target groups are second and third year students in vocational education, where the intervention program is implemented by teachers. The program guides students to identify effective behavioral strategies for safe work and ways in which to prevent accidents or harmful events. Students are encouraged to analyze the factors preceding accidents or other harmful events, initiate a sequence of problem-solving processes for overcoming barriers to safe work, and then generalize learned behavior strategies for everyday work behavior. Group activities also include enhancing risk identification and increasing awareness of the positive outcomes of preventive actions and the negative consequences of working unsafely, in order to induce attitudinal change. This learning method is implemented in the same pedagogical format across different vocational fields, but the information on the hazards, and the case examples in the group exercises, are occupation specific. The intervention's educational topics, goals, and instructional methods are presented in Table 1, and the practical examples of training activities in Appendix A.

The active ingredients of the *Attitude to Work Program* intervention can be divided into four components. The first is *Safety skills training*. These skills are related to identifying occupational hazards, reducing the risk of accidents or harmful events, seeking guidance at the workplace, confidently expressing work safety concerns to others, and speaking out against unsafe practices. The second active component of the intervention is *Safety inoculation training*. During group activities, the participants learn strategies and practice how to act when they encounter co-workers' risky behavior at the workplace, when they face unfamiliar work tasks, when work machines malfunction, or when they encounter other unsafe work situations. The third component of the intervention is *Active, participatory learning methods,* which are practiced in group discussions, role play, and small-group and problem-solving exercises. Instead of lecturing, the trainers use the knowledge and

Table 1
Description of intervention program.

	Day 1		
	Educational topic	Purpose	Method
1.	Introduction to behavioral actions that support occupational safety	To share beliefs and experiences about safety at workplace	Group discussion with opinion line-up exercise
2.	Identifying hazards at the workplace	To increase awareness of occupation specific hazards and preventive actions	Small-group exercise, hazard visualization with flip-charts
3.	Analyzing the factors preceding accidents, relationship between unsafe behavior and accidents, identifying behavioral strategies for preventing accidents	To strengthen positive attitudes toward preventive actions and safety performance	Group discussions about case-stories, sharing previous experiences of accidents, harmful events or near-miss events
	Day 2		
4.	Negative consequences of staying silent about safety issues and positive consequences of information-seeking and speaking about safety at work	To identify how workers can communicate with co-workers, supervisors and safety representatives, and ask questions and report problems or concerns when they feel unsafe. To practice social skills that support safety behavior at workplace, and to strengthen positive attitudes toward safety performance.	Group discussion, role-playing exercises
5.	Safety inoculation training	To identify behavioral strategies that help overcome barriers to safe work, and to strengthen individuals' degree of self-confidence in such situations	Problem-solving exercises based on case stories
6.	Personal safety goals	To foster personal commitment and motivation toward safe work and preventive actions	Group discussion with goal-setting cards

work experiences of the participants themselves as part of the learning process. During the practical exercises, students plan in small groups how to control various hazards, engage in problem-solving case exercises, and search for solutions to prevent accidents or other harmful events. The trainer facilitates the discussions by guiding participants toward the desired conclusions of the exercises. The fourth component is *Supportive and positive learning environment,* which involves positive feedback and open discussions on OSH, hazards, and strategies to prevent accidents, which are essential for positive results.

5. Study hypotheses

Previous studies have shown that employment preparedness during the school-to-work transition can be enhanced using group training methods that are based on the principles of social learning (Koivisto, Vuori, & Vinokur, 2010). On the basis of this previous study finding, we expected a similar effect on safety preparedness.

Hypothesis 1. *The Attitude to Work Program intervention increases safety preparedness.*

A traffic safety intervention based on the active participation of participants showed a beneficial impact on risk-taking attitudes (Iversen, Rundmo, & Klempe, 2005). Based on the Expectancy-value theory (Eccles et al., 1983), the *Attitude to Work Program* intervention also encourages participants to change their attitudes by becoming more aware of the negative consequences of working unsafely and identifying the positive outcomes of preventive actions.

Hypothesis 2. *The Attitude to Work Program intervention reduces risk-taking attitudes.*

Huang and Ford (2011) found that attributional retraining during a driving safety program increased the internal driving locus of control and lowered the external driving locus of control. During the *Attitude to Work Program,* students identify how workers' preventive actions reduce the risk of accidents or other harmful events at the workplace. In this way, students' knowledge regarding accident processes increases, and they are guided toward identifying controllable causes for accidents. This leads us to:

Hypothesis 3. *The Attitude to Work Program intervention increases the internal safety locus of control.*

and

Hypothesis 4. *The Attitude to Work Program intervention reduces the external safety locus of control.*

In our study, we also aim to explore the extent to which the program's effects are moderated by personality traits measured at baseline. Previous research has proposed that high-level sensation-seekers need different types of interventions than low-level sensation-seekers in order to feel any effects. Moreover, high-level sensation-seekers may need intervention efforts that are more suspenseful, fast-paced, and emotionally arousing (Donohew, Lorch, & Palmgreen, 1998; Donohew et al., 2000). Therefore, we hypothesize that the safety intervention effects are smaller among high-level sensation-seekers. Strong sensation value was not a guiding principle in developing this intervention program. Thus, we formulated:

Hypothesis 5. *High sensation-seeking level reduces the intervention effects on risk-taking attitudes, the internal safety locus of control, the external safety locus of control, and safety preparedness.*

Previous studies have also shown that conscientiousness is associated with safety motivation (Christian et al., 2009). This relationship may have an impact on behavioral safety intervention effects. High conscientiousness may increase engagement in learning safety skills during group activities. Therefore, we hypothesize that:

Hypothesis 6. *A high conscientiousness level is related to a stronger reduction in risk attitudes and a stronger increase in safety preparedness and the internal locus of control.*

6. Method

6.1. Participants

The *Attitude to Work Program* study was a school-based pair-matched cluster randomized-controlled trial (RCT), carried out in 2015 in Finnish secondary-level vocational schools. In Finland, after completing the mandatory nine-year basic education period, young people can choose to continue their educational track in either general upper secondary education or vocational education and training. General upper secondary education focuses on preparation for higher education. The emphasis of the vocational secondary education track is on learning practical and work-specific skills in specific occupational fields. The teaching of vocational skills is usually shared between vocational schools and workplaces. The length of studies for vocational qualifications is approximately three years. Students with a completed vocational upper secondary qualification have the basic vocational competence required for working life. Vocational education provides students with knowledge of occupational safety regulations, work environment factors, vocational field-specific hazards, and the identification of risks. Occupational safety issues relating to a certain work task are taught together with work skills. The Board of Education and the Ministry of Education have set OSH competence goals.

All available schools were recruited for the study. Eight schools in Southern and Eastern Finland participated in the study during an occupational safety development project initiated by the Finnish Board of Education. A total of 893 students and 50 student groups were eligible and had the opportunity to participate in the effectiveness trial. Students were informed of the study and told that participation in the study was voluntary and that non-participation would have no consequences. Parents of students under the age of 18 were also informed of the study.

6.2. Randomization procedure

All study participants were assessed at baseline and at the end of the intervention program. Both questionnaires were completed in classrooms. In a matched-paired cluster randomized trial, similar clusters are matched, after which the intervention condition is randomized within pairs. The aim of pairwise randomization is to ensure balanced allocation into intervention and control conditions. In this study, student groups were first paired within schools by vocational track (practical nurses, carpenters, etc.). This criterion was chosen because the vocational track is associated with gender distribution and the focus areas of safety training. Randomization was carried out by a research assistant who did not participate in the baseline or follow-up assessments, and had no contact with the students.

Half of the student groups in each school were randomized into the experimental condition and the other half into the control condition. Student group sizes ranged from 6 to 22 in the intervention condition ($M = 13.6$ $SD = 5.2$) and from 6 to 26 in the control condition ($M = 12.7$ $SD = 5.0$). If a cluster did not provide data at baseline (T1) or at follow-up (T2) due to school schedules, the matched cluster was discarded in order to preserve the integrity of the study design (Donner & Klar, 2004). Using this procedure, two otherwise eligible student groups were excluded from the study at T1. A total of 580 eligible students from 46 student groups were included in the randomization process. For a more detailed description of enrollment, allocation and follow-up, see Fig. 1.

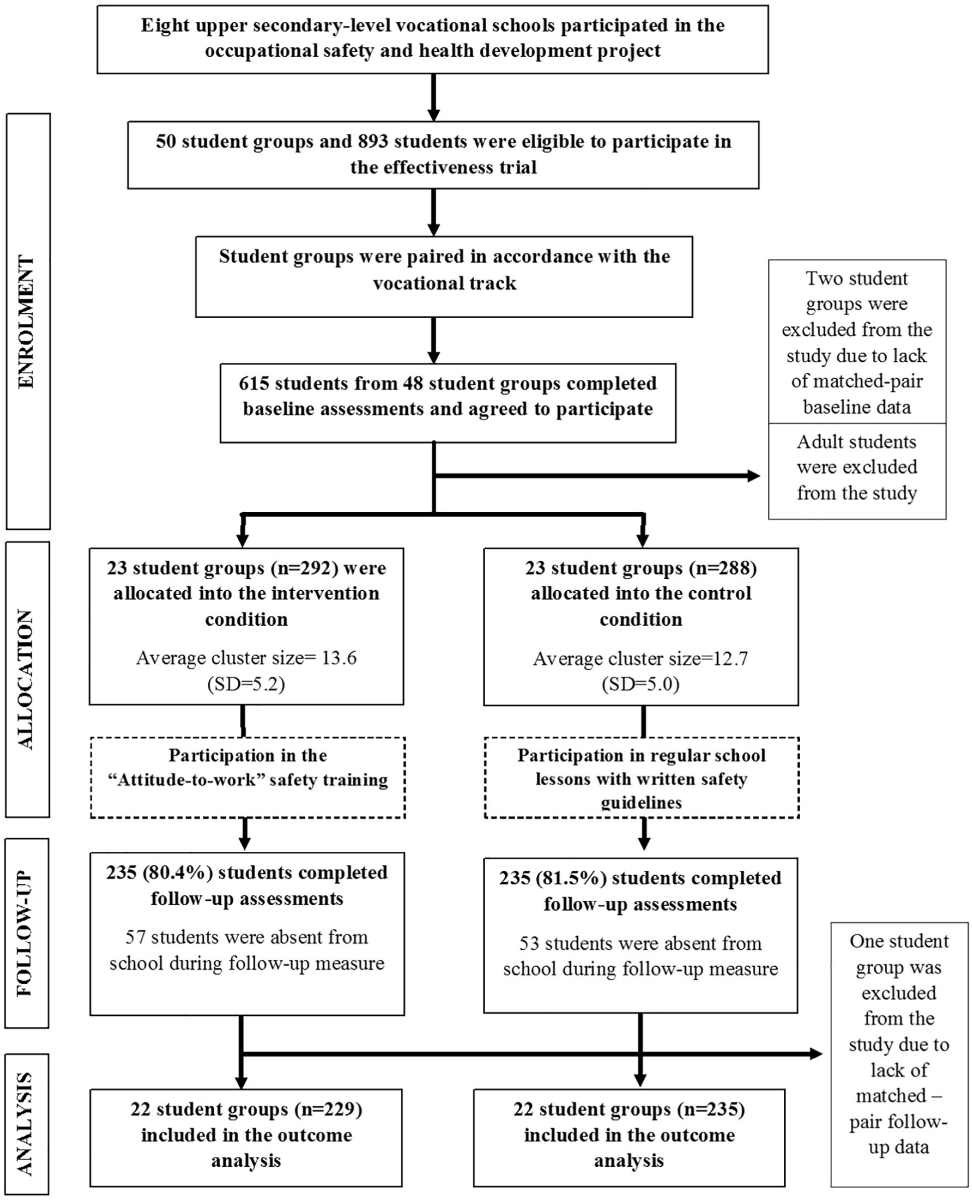

Fig. 1. Participation flowchart of effectiveness trial.

6.3. Response rates, and attrition

A total of 94.4% of the students in the eligible student groups gave informed consent to be included in the study. Twenty-five percent ($n = 228$) of the eligible students were absent from baseline measurements and were therefore excluded from the effectiveness trial. Since the intervention study was targeted at young students entering working life, we also excluded over 30-year-old adult students ($n = 22$) from the effectiveness trial after baseline measurements. A total of 470 (81%) of the student study participants who responded to the T1 measurements completed the follow-up questionnaires. The response rate at follow-up varied within student groups in the intervention condition from 42.8 to 100% (M = 80.4%, SD = 12.4), and in the control condition from 50 to 100% (M = 81.5%, SD = 14.8).

Attrition at follow-up occurred due to students being absent on the day of the follow-up survey. In addition, one student group was excluded at T2 due to lack of matched-pair data. A complete case analysis was performed and no imputation techniques were used. The sample size included in the final analyses was 464 students. Of these, 229 (in 22 student groups) were in the intervention condition, and 235 students (in 22 student groups) in the control condition. A total of 47% of the study participants were studying for a vocational qualification in social and health care, 40% for a vocational qualification in technology and transport, and 13% for a vocational qualification in business or tourism.

6.4. Intervention and control conditions

Each school received their own two-day teacher training, during which teachers were familiarized with the content, training principles, and practical implementation of the intervention. After the training workshop, the *Attitude to Work Program* intervention program was implemented at school by the teachers. The intervention program comprised two days and lasted 12 h in total. During implementation, teachers used trainer's manuals and participants' workbooks. The trainer's manual included detailed instructions for the implementation of group activities. Participants used the *Attitude to Work Program* workbook as learning material during the intervention program. The students wrote their answers in the workbook and made the notes during exercises. The program took place during school hours as part of regular studies, but students were not graded on any aspect of it. Student groups that were allocated into the experimental condition participated in the 12-h *Attitude to Work* intervention program within approximately two weeks of baseline measurements. Follow-up measurements of students in the intervention condition were conducted at the end of the intervention program. The student groups that were allocated into the control condition participated in regular school work. In addition, they received written guidelines containing information on the same topics discussed in the *Attitude to Work Program*. Therefore, the students who were allocated into the control condition completed an intervention that included only some of the content of the intervention provided to the experimental group. The main difference was that the active learning process was missing and the control condition did not involve group exercises or problem solving exercises. The follow-up measurements of the controls were conducted during the same week as those of the intervention group.

6.5. Measures

Safety preparedness. To measure the safety preparedness of students, we used a scale especially designed for this study. This safety preparedness measure included items on both self-efficacies and inoculation against setbacks. In the self-efficacy items, respondents were asked about their confidence in various safety-related activities. Six 5-point (1 = very poorly 5 = very well) self-efficacy items were related to (1) identifying job-related hazards, (2) recognizing factors that affect the occurrence of accidents, (3) reducing the risk of accidents, (4) thinking about ways in which to improve safety at work, (5) acquiring instructions or guidelines at work in order to work safely, and (6) considering ways in which to improve working conditions in terms of occupational safety. Three 5-point inoculation items (1 = very few, 5 = very many) measured the extent to which participants had ideas or plans for situations in which they may encounter various safety-related barriers or problematic situations at the workplace. Items included in the measure were: (1) There is an unaddressed problem at the workplace, (2) Coworkers' attitudes and behavior are harmful to occupational safety, and (3) Unexpected and unsafe situations arise at the workplace. The reliability (Cronbach's α coefficient) of the safety preparedness scale was 0.84 at T1 and 0.87 at T2.

The *Safety locus of control* scale used in this study included six 5-point items adapted from a measure by Mazaheri, Hidarnia, and Ghofranipour (2012). The scale used in this study assessed beliefs regarding accident causation and included two sub-dimensions: (1) The internal locus of control (2) environmental and equipment control. The reliability (α) of the safety locus of control scale was 0.67 at T1 and 0.63 at T2.

Risk-taking attitudes. We used a risk attitude scale that was adapted from the general safety attitude scale developed by Henning et al. (2009). The 5-point scale included three items that measured the extent to which participants viewed occupational safety-related risk-taking as appropriate at the workplace (e.g., sometimes it is necessary to take risks to get a job done). The reliability (α) of the risk attitude scale was 0.81 at both T1 and T2.

Previous safety training. To measure the perception of previous safety training, we used a scale specifically designed for this study. Three 5-point items assessed the perceived extent of received safety communication, knowledge and training during previous studies. Items included in the measure were: (1) We discussed job-related hazards during my training, (2) Information about occupational safety was available during my training, and (3) We practiced safety procedures during my training. The reliability (α) of the scale was 0.85. The extent of safety communication and training was evaluated at base-line.

Implementation quality. We evaluated the fidelity of the intervention using a modified version of the instrument developed by Vuori, Price, Mutanen, and Malmberg-Heimonen (2005). Our purpose was to measure student experiences of the group activities related to the active ingredients of the intervention mechanism described earlier. The fidelity of the intervention in the experimental group was evaluated using four measures at follow-up (T2). The safety skill training measure included five items (e.g., during the training we practiced preventing job-related hazards, $\alpha = 0.867$), the safety inoculation training measure included three items (e.g., during the training we practiced how to act when facing risk attitudes at work, $\alpha = 0.845$), the positive atmosphere measure included three items (e.g., during the training the atmosphere was positive and encouraging, $\alpha = 0.840$). The active learning techniques included five items (e.g., the trainer asked questions that inspired discussion within the student group, $\alpha = 0.765$). We also included a scale that measured the participants' own assessments of how the *Attitude to Work Program* intervention had enhanced their abilities related to OSH.

Sensation-seeking. To measure study participants' sensation-seeking scores at baseline, we used the scale developed by Hoyle et al. (2002), which includes eight 5-point items. We chose this scale because it was developed using young age groups as a target group. The reliability (α) of the sensation-seeking scale was 0.77.

Conscientiousness was measured using nine questions adapted from the Big Five scale developed by John, Naumann, and Soto (2008). The reliability (α) of the conscientiousness scale was 0.64.

6.6. Statistical analysis

The efficacy trial had two time points (baseline and short-term follow-up), and a two-level structure in which students were nested within student groups. All of the outcome variables were close to the normal distribution in visual inspections as well as in terms of skewness (from −0.48 to 0.41) and kurtosis (from −0.67 to 0.83). To determine whether the randomization process successfully achieved baseline balance, we compared the differences between the experimental and control groups at the individual level using *t*-tests for continuous variables and chi-square tests for categorical variables. We used generalized linear mixed models (GLMM) to compare changes in safety preparedness, risk attitudes, and the internal and external safety loci of control among the study groups (intervention vs. control). The main effect models included the condition variable (0 = intervention, 1 = control), baseline measurement, gender (0 = male, 1 = female), and school grade (1 = satisfactory, 2 = good, 3 = excellent) as fixed effects. The potential effect of clustering due to student groups was taken into account by using a random intercept model. We used Bayesian information criterion to determine the best fitting model and covariance structure.

We also used moderation analyses to explore whether intervention effects varied across levels of a specific secondary factor (Wang & Ware, 2013). To investigate whether intervention effects were modified by personality factors, we added a two-way interaction term to the model (e.g., conscientiousness x intervention condition). We calculated separate models for both the conscientiousness and sensation-seeking variables. In order to facilitate interpretation, the conscientiousness and sensation-seeking variables were first transformed into categorical

variables by splitting the values into three categories on the basis of equal-sized cut-off points (low, medium, and high scores). In addition, we tested whether the intervention effect varied across different vocational tracks. The vocational track variable in moderation analyses had three categories: Vocational qualification in social and health care, Vocational qualification in technology and transport, and Vocational qualification in business and tourism. We examined statistically significant moderators by drawing the intervention effect on the outcome variable at different levels of the baseline moderator. The statistical software used in the analyses was SPSS version 23.

7. Results

7.1. Effectiveness of randomization and descriptive statistics

Table 2 presents the baseline characteristics of the intervention and control condition. Despite randomization, the gender distribution and school grades of the experimental and the control conditions showed a significant difference. In addition, risk attitudes were slightly higher in the intervention condition at baseline (2.53 vs. 2.35, $p < 0.05$). This was related to gender, in that risk-taking attitudes were higher among male students (2.80 vs. 2.23, $p < 0.01$). We controlled for baseline imbalances by adjusting the statistical models for gender and school grades.

Furthermore, using *t*-tests, we studied whether the participants who completed the follow-up questionnaires differed from the participants who completed only the baseline measures. We found that those who did not participate in the follow-up measures had lower scores at baseline in conscientiousness (3.59 vs. 3.73, $p < 0.05$) and internal safety locus of control (3.98 vs. 4.14, $p < .05$). Moreover, the mean age (20.5 vs. 19.8, $p < 0.05$) and the proportion of students who had suffered an accident at work (28.7% vs. 19.3%, $p < 0.05$) were higher among the students who were absent at follow-up. There were no significant baseline differences between the intervention and control condition as regards those who completed only baseline measures.

We also examined the number of participants who attended group activities in the experimental condition. Eighty percent of participants in the experimental condition reported full participation, 15% reported that they had participated most of the time, and 5% that they had participated half of the time. We also examined the number of students in the control condition who had familiarized themselves with the written safety information material. Sixty-two percent of students in the control condition had read all the written material, 13% had read half of the material, and 25% had read less than half. Consistent with the intention to treat principle, the analysis included all available cases, regardless of whether students had participated full time in the intervention program or had familiarized themselves with the written material. The means, standard deviations and correlations of all study variables appear in Table 3. Table 4 shows the initial (T1) and follow-up (T2) values for the intervention and control groups.

7.2. Main effect analyses

We calculated the intra-cluster correlations (adjusted for baseline covariates) for each outcome using GLMM. The intra-cluster correlation for preparedness at T2 was 0.076, for risk attitudes 0.064, for the internal locus of control 0.030, and for the external locus of control 0.034. These values indicated a relatively small cluster effect. Table 5 presents the parameter estimates and confidence intervals of the GLMM analyses for the full study sample. The results supported Hypotheses 1–3 by indicating that, compared to the students in the control condition, the students in the intervention condition showed a greater increase in safety preparedness (estimate 0.15, $p = 0.002$) and in internal safety locus of control (estimate 0.13, $p = 0.012$) at follow-up. The results also indicated that the students in the intervention condition showed a stronger decrease in risk attitudes (estimate −0.25, $p < 0.001$) than the students in the control condition. However, contrary to Hypothesis 4, there was no significant intervention effect on the external safety locus of control (estimate −0.07, $p = 0.298$).

7.3. Moderation of intervention effects

The moderating role of conscientiousness and sensation-seeking in the intervention effect was examined using the interaction terms between the intervention condition and the sensation-seeking/conscientiousness level. The results are shown in Table 5. Contrary to Hypothesis 5, the interaction between the sensation-seeking score and

Table 2
Baseline characteristics of intervention and control condition.

Variable	Intervention Condition ($n = 229$)	Control condition ($n = 235$)
* $p<0.05$	Mean *(SD) [min-max]*	Mean *(SD) [min-max]*
Gender *		
- Male	43%	31%
- Female	57%	69%
Age	19.7 (2.2) [17–29]	19.9 (2.4) [17–29]
Part-time job		
- Yes	22.5%	22.6%
- No	77.5%	77.4%
Work experience in same occupational field as study field (months)	4.2 (7.3) [0–60]	5.4 (8.3) [0–60]
Work experience in general, including on-the-job training and summer jobs (months)	15.4 (22.0) [0–144]	14.3 (18.5) [0–101]
Has had work-related accident		
- Yes	20.3%	18.5%
- No	79.7%	81.5%
School grade * (vocational modules)		
- Satisfactory	9.3%	5.7%
- Good	66.2%	62.9%
- Excellent	24.4%	31.4%
Length of time in current studies (months)	15.8 (7.3) [1–37]	16.7 (7.8) [1–36]
Previous safety training	4.22 (0.7) [1.6–5.0]	4.1 (0.74) [1.0–5.0]
Sensation-seeking	3.42 (0.7) [1.0–5.0]	3.33 (0.7) [1.1–5.0]
Conscientiousness	3.70 (0.5) [1.6–5.0]	3.76 (0.5) [2.2–5.0]
Safety preparedness	3.55 (0.5) [1.8–5.0]	3.51 (0.6) [1.6–4.8]
Risk attitudes*	2.53 (0.9) [1.0–5.0]	2.35 (0.9) [1.0–5.0]
Internal safety locus of control	4.12 (0.5) [2.3–5.0]	4.15 (0.5) [2.0–5.0]
External safety locus of control	3.33 (0.6) [1.6–5.0]	3.23 (0.6) 1.0–5.0]

Table 3
Means, standard deviations and correlation coefficients (Pearson's r) of study variables.

Variables	M	SD	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1 Intervention condition (0 = intervention 1 = control)	0.50	0.50	1														
2 Age	19.82	2.36	0.03	1													
3 Gender (0 = male 1 = female)	0.63	0.48	0.12**	0.09*	1												
4 School grade	2.20	0.55	0.09*	0.20**	0.14**	1											
5 Safety preparedness T1	3.53	0.54	−0.03	0.05	0.00	0.14**	1										
6 Internal safety locus of control T1	4.14	0.54	0.02	0.02	0.01	0.00	0.26**	1									
7 External safety locus of control T1	3.28	0.63	−0.07	−0.04	−0.07	−0.07	0.19**	0.35**	1								
8 Risk attitudes T1	2.44	0.92	−0.10*	−0.09*	−0.29**	−0.17**	−0.07	−0.22**	0.08	1							
9 Conscientiousness T1	3.73	0.54	0.06	0.10*	0.13**	0.32**	0.31**	0.15**	0.03	−0.26**	1						
10 Sensation-seeking T1	3.37	0.75	−0.05	−0.23**	−0.03	−0.12**	0.05	−0.02	0.13**	0.23**	−0.17**	1					
11 Safety preparedness T2	3.60	0.54	−0.13*	0.03	0.09*	0.21**	0.62**	0.19**	0.13**	−0.13**	0.41**	0.03	1				
12 Internal safety locus of control T2	4.14	0.56	−0.08	0.02	0.10**	0.02	0.17**	0.40**	0.21**	−0.16**	0.19**	0.17	0.33**	1			
13 External safety locus of control T2	3.21	0.63	0.02	0.01	0.00	−0.02	0.12**	0.17**	0.36**	0.11*	0.01	0.09*	0.11**	0.25**	1		
14 Risk attitudes T2	2.28	0.92	0.06	−0.05	−0.32**	−0.14**	−0.08	−0.23**	0.06	0.65**	−0.26**	0.22**	−0.22**	−0.23**	0.14**	1	
15 Previous safety training	4.17	0.74	−0.06	0.08	−0.21**	−0.01	0.21**	0.15**	0.11*	0.02	0.00	0.02	0.08	0.09	0.05	0.04	1

* $p < 0.05$ ** $p<0.01$.

Table 4
Comparison of T1 and T2 outcome values of intervention and control conditions. Unadjusted means.

Variables	T1 M (SD)	T2 M (SD)	Mean difference T2-T1
Safety preparedness			
Intervention condition	3.55 (0.55)	3.68 (0.53)	0.12
Control condition	3.51 (0.54)	3.53 (0.55)	0.01
Internal safety locus of control			
Intervention condition	4.12 (0.54)	4.19 (0.53)	0.07
Control condition	4.15 (0.54)	4.09 (0.53)	- 0.05
External safety locus of control			
Intervention condition	3.33 (0.63)	3.19 (0.64)	−0.13
Control condition	3.23 (0.64)	3.23 (0.61)	0.00
Risk attitudes			
Intervention condition	2.53 (0.92)	2.22 (0.90)	−0.30
Control condition	2.35 (0.91)	2.34 (0.94)	−0.02

the intervention condition was not significant. This lack of interaction suggested that low and high sensation-seekers benefitted equally from the intervention.

The results of the moderation analyses provided partial support for Hypothesis 6. The intervention effects on the safety preparedness and risk attitudes of high, medium, and low conscientiousness students differed. The slopes for the association between conscientiousness level and outcome (Fig. 2) demonstrate how the interaction effect on both risk attitudes and safety preparedness increased among students with high conscientiousness scores at baseline. Specifically, the intervention effect on safety preparedness (estimate 0.25, $p = 0.001$) and risk attitudes (estimate −0.30, $p = 0.013$) was stronger among high conscientiousness students than among low conscientiousness students.

To interpret the moderating role of conscientiousness, separate subgroup models were specified for each conscientiousness level (low, medium, high). These analyses demonstrated that students with high baseline conscientiousness showed the strongest positive changes as a result of the intervention in safety preparedness (estimate 0.21, $p < 0.001$) and in risk attitudes (estimate −0.30, $p = 0.028$). Among the medium conscientiousness students, the intervention effects on both safety preparedness (estimate 0.18, $p = 0.020$) and risk attitudes (−0.27, $p = 0.014$) were lower but nonetheless significant. Among low conscientiousness students, the intervention effect on safety preparedness (estimate 0.11, $p = 0.062$) and risk attitudes (−0.22, $p = 0.053$) was only marginally significant. Therefore, the results provided no direct evidence of an intervention effect among the low conscientiousness students. Finally, there were no significant moderator effects for the vocational track.

7.4. Intervention integrity

The participants perceived that the intervention greatly increased their safety knowledge and skills. Students in the intervention condition evaluated the extent to which the *Attitude to Work Program* intervention increased their knowledge on four 5-point scales at follow-up: more specifically, they rated the extent to which the intervention had enhanced their abilities to: (1) identify work-related hazards (M = 4.27, SD = 0.75), (2) prevent hazards at the workplace (M = 4.31, SD = 0.71), (3) report hazardous events at the workplace (M = 4.36, SD = 0.70), and (4) seek information and support at the workplace (M = 4.27, SD = 0.72). The students in the intervention condition assessed the intervention program's delivery of active ingredients according to four 5-point scales at follow-up: (1) Safety skills training during the program (mean = 4.4 SD = 0.5), (2) safety inoculation training (mean = 4.1 SD = 0.6), (3) implementation of student centered active learning techniques (mean = 4.1 SD = 0.6), and (4) learning atmosphere

Table 5
GLMM model results for intervention condition and moderation effects.

	Safety preparedness		Internal safety locus of control		External safety locus of control		Risk-taking attitudes	
	Estimate	(95% CI)	Estimate	(95% CI)	Estimate	(95% CI)	Estimate	(95% CI)
Intercept	1.59**	[1.31, 1.86]	2.42**	[2.04, 2.80]	2.02**	[1.73, 2.32]	0.63**	[0.46, 0.80]
T1	0.58**	[0.51, 0.65]	0.41**	[0.33, 0.50]	0.36**	[0.27, 0.44]	0.64**	[0.57, 0.71]
Intervention condition (a)	0.15**	[0.05, 0.24]	0.13*	[0.02, 0.23]	−0.07	[−0.20, 0.06]	−0.25**	[−0.39, −0.11]
Gender = *male* (b)	−0.09*	[−0.18, −0.008]	−0.12*	[−0.22, −0.02]	−0.002	[−0.12, 0.12]	0.27**	[0.13, 0.42]
Low school grade (c)	−0.27**	[−0.43, −0.11]	0.01	[−0.18, 0.21]	−0.03	[−0.26, 0.19]	0.07	[−0.19, 0.33]
Intervention condition x high CCT (d)	0.25**	[0.10, 0.39]	0.06	[−0.11, 0.24]	−0.04	[−0.24, 0.16]	−0.30*	[−0.54, −0.06]
Intervention condition x high SSE (e)	−0.008	[−0.15, 0.12]	−0.005	[−0.17, 0.16]	−0.008	[−0.20, 0.18]	0.13	[−0.09, 0.35]

Reference categories: a = control condition, b = female, c = excellent, d = low CCT, e = low SSE. Student groups were set as random effects in all models
* $p < 0.05$. ** $p < 0.01$.

(mean = 4.2 SD = 0.7). These results indicated relatively good implementation quality.

8. Discussion

Evidence-based knowledge on how to foster positive attitudes toward risk prevention, or to enhance young workers' confidence in performing safety practices at the workplace and overcoming barriers to safe work is limited. We want to highlight that safety training in vocational education and at workplaces should acknowledge the psychological factors that influence safety behavior and motivation at the workplace. The focus should be on intervention techniques that achieve an impact on safety competencies.

In this study, we investigated the short-term effects of a school-based safety intervention. As we hypothesized, the intervention had beneficial effects on young peoples' safety preparedness, their internal safety locus of control and risk-taking attitudes. These findings increase the knowledge on effective intervention strategies to enhance the safety competencies of young people entering working life. Our results indicate that intervention techniques based on a social-cognitive framework (Bandura, 1997; Rotter, 1982) are beneficial in safety training.

We found no intervention effects on the external safety locus of control. This may be due to the fact that during the group activities, in addition to their own safety actions, participants also practiced how to promote occupational safety in collaboration with co-workers, supervisors, and safety representatives. Feelings of shared responsibility for a safe and healthy workplace may also have emphasized external influences in preventing accidents.

We also explored individual differences as possible moderators of intervention outcomes. The intervention effect of increasing safety

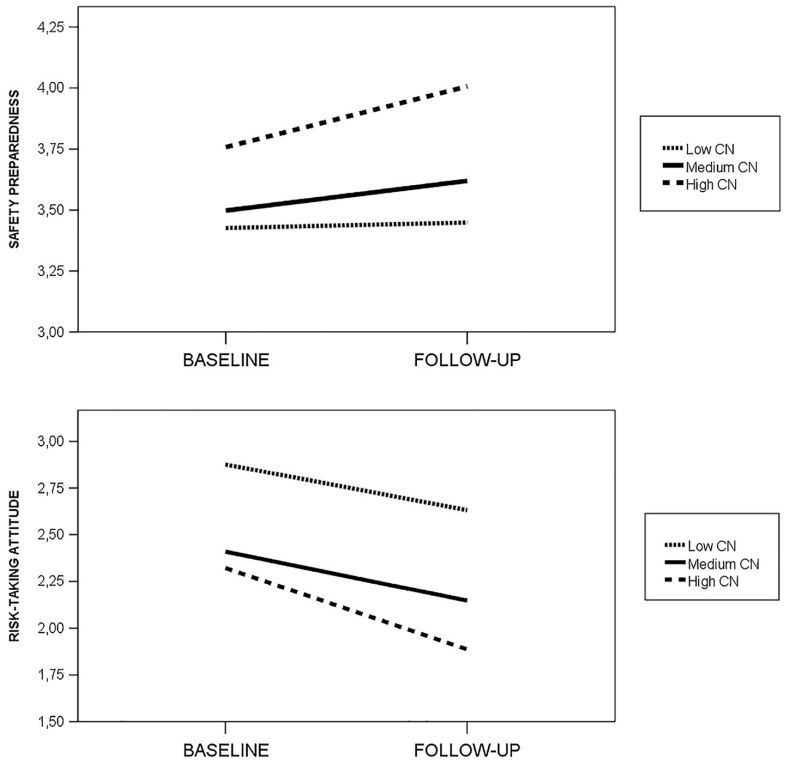

Fig. 2. Intervention effects by conscientiousness level.

preparedness and reducing risk-taking attitudes was particularly evident among students who scored higher than others in conscientiousness. This can be understood in the context of the core elements of conscientiousness: responsibility, carefulness, and achievement-orientation. High conscientiousness students may have been more engaged in the intervention program and may therefore have benefited more. The intervention effect on low conscientiousness students' safety preparedness and risk-taking attitudes was only marginally significant.

Sensation-seeking at baseline did not moderate any of the intervention effects at follow-up, which suggests that the effects were similar among both high and low sensation-seekers in this study. One explanation for this could be that risk perceptions may differ among individuals and according to the function of context (Weber, 1998). Previous studies have presented evidence that sensation-seeking influences health and safety risk-taking through risk perception and expected benefit (Zhang, Zhang, & Shang, 2016). If the perceptions of negative consequences outweigh the perceived positive outcomes of work-related risk-taking, the sensation-seeking level in itself probably has no association with safety intervention effects. However, this study did not measure the perceived consequences of risk-taking, and this interpretation should be studied in the future. Another explanation could be related to the fact that in participatory student-centered learning, students are able to influence the style of messages, examples, and information shared during training. This may be more advantageous than, for example, video-based preventive safety messages, the message style and content of which are pre-selected and do not necessarily appeal to all different sub-groups.

8.1. Limitations and strengths

The current study has some distinctive strengths. First, it was an RCT, which is rare in the field of occupational safety attitudes of young people. Intervention studies applying the RCT design are considered to be the "golden standard" of efficacy studies. Second, the *Attitude to Work Program* is a theory-based intervention that enables focused investigation of the theoretical concepts involved. In addition, the program was developed in collaboration with workplaces and schools. Close collaboration with the end-users of the program adds to the applicability of the intervention.

As for the limitations, the study results indicated marginally positive to moderately positive intervention effects. Even smaller effects may accumulate if the intervention is integrated into the school system and reaches a larger amount of the age group at secondary-level education. Finally, participants' awareness of being studied, and the impact of this on their behavior has been seen as a possible risk in intervention studies (McCambridge, Witton, & Elbourne, 2014). However, as in this study the intervention program was introduced to students as part of their curriculum and safety training, the students' possible awareness of having their attitudes assessed should not have greatly affected the study results.

8.2. Practical implications

Both the expectancy-value theory and the social-cognitive theory offer principles that can be incorporated into safety training targeting the safety competencies of students and young workers. By incorporating intervention programs such as the *Attitude to Work Program* into vocational studies and workplace safety training, it is possible to prepare young people to take an active role in safety at work. Vocational teachers, supervisors, and workplace trainers can be trained to enhance the safety competencies of young workers by supplying them with the required knowledge on fundamental concepts and educational strategies. We suggest that that train-the-trainer model is an effective method for disseminating new evidence-based practices.

Students and young workers should be equipped with preparedness to use specific behavioral strategies to promote safety, readiness to take action, and resilience to overcome barriers to safe work. These competencies could be applied to a range of situations in working life. In addition, students and young workers should be guided toward identifying the controllable causes of accidents and toward acknowledging their personal role in the prevention process. This may motivate them to put a greater effort into preventing injuries and influencing others to promote safety.

It is also important that young people apprehend the positive outcomes of preventive actions and negative outcomes of risk-taking. Sharing knowledge on the positive outcomes of preventive behavioral strategies modifies attitudes toward risk-taking. We propose that active and social learning, which include mastery experiences through problem-solving exercises, learning vicariously, and receiving peer reinforcement during group discussions and exercises, are all important educational strategies to enhance safety competencies. In this kind of peer group activity, the social context supports competencies – the participants from the same student group or workplace share their thoughts and ideas and find strategies to promote occupational safety together.

The moderating role of conscientiousness has practical implications for the future development of behavioral safety interventions. Previous research suggests that conscientiousness can be modified using behavioral interventions (Magidson, Roberts, Collado-Rodriguez, and Lejuez, 2014; Hudson & Fraley, 2015). The framework presented by Magidson et al. (2014) provides potential guidelines for future safety training efforts. It stresses that interventions can be targeted toward behavioral manifestations that characterize specific personality traits. We propose integrating additional modules into safety training; modules that can help students identify their personal tendencies related to safety behavior by improving their self-monitoring skills. Self-awareness and self-reflection may trigger engagement in learning processes during intervention activities. This potentially supports the impact of safety training on different subgroups.

8.3. Implications for future research

We propose several topics for future research. First, in order to increase understanding of the intervention mechanisms, the relationship between the safety locus of control, safety preparedness, risk attitudes, and safety motivation should be further explored. Second, our study focused on the intervention's proximal impact on psychosocial factors. Therefore, the intervention's more distal effectiveness in increasing safety behavior to prevent accidents at the workplace should be explored in the future. Previous studies also indicate that the implementation process and contextual factors have an impact on school-based intervention effects (Durlak & Dupre, 2008). Another possible area of future research would be the relationships between implementation quality, the inclusion of active ingredients, perceived peer-group safety norms, and intervention effects.

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II

SAFETY SELF-EFFICACY AND INTERNAL LOCUS OF CONTROL AS MEDIATORS OF SAFETY MOTIVATION – RANDOMIZED CONTROLLED TRIAL (RCT) STUDY

by

Mikko Nykänen, Katariina Salmela-Aro, Asko Tolvanen & Jukka Vuori, 2019

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Safety self-efficacy and internal locus of control as mediators of safety motivation – Randomized controlled trial (RCT) study

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ABSTRACT

Behavioral factors play a fundamental role in preventing occupational injuries and accidents. Previous studies have shown that engagement in safety behavior is influenced by workers' safety motivation. However, understanding of the cognitive factors that contribute to safety motivation is lacking. In this study, we examine internal safety locus of control and safety self-efficacy as mediators of the effects of a safety intervention on safety motivation. In 2016, 464 students from eight vocational schools participated in a school-based cluster randomized, controlled intervention study conducted in Finland. In the multiple mediation model investigated using structural equation modeling (SEM) analysis, participation in the safety intervention predicted significant increases in both safety-related self-efficacy and the internal safety locus of control. The intervention also predicted significant increases in safety motivation. The model had no significant direct path from the intervention condition to safety motivation when the mediators were included in the model, which indicated full mediation. The indirect effect of safety intervention on safety motivation via the internal safety locus of control was statistically significant. These results indicate that the internal safety locus of control mediated the effect of the intervention on safety motivation. Therefore, the effect of a safety intervention on safety motivation was dependent on the internal safety locus of control being an intermediate factor. We propose that modifying the safety locus of control is a potential avenue for increasing safety motivation.

1. Introduction

Several studies have shown that behavioral factors play a fundamental role in preventing occupational injuries and accidents (Ford and Tetrick, 2008; Christian et al., 2009). According to Christian et al. (2009), workers' engagement in safety behavior is mainly influenced by their safety motivation. Despite this finding however, knowledge on the psychological factors that contribute to safety motivation is scarce. Furthermore, only a limited amount of studies has evaluated intervention techniques for increasing safety motivation.

Previous studies have shown that 18- to 24-year-olds are more likely to have an accident at work than older adults (Salminen, 2004; Breslin and Smith, 2005). Young workers are often less aware of risks and hazards and may not have the confidence to speak up about the health and safety issues that affect them. Schools and vocational education play an important role in preparing young people to adopt an active role in occupational safety (Okun et al., 2016). However, previous studies have shown that vocational education may lack a systematic approach to organizing OSH training at school (Andersson et al., 2015). Basic knowledge of safety and health risks at the workplace is essential if we are to reduce occupational injuries and accidents among young workers. It is also important that young people are empowered to enact safety behaviors and actively participate in the workplace's safety activities. Increasing safety-related motivational resources during the school-to-work transition prepares young people to become active participants in the creation of safe work environments. Strengthening safety motivation during the school-to-work transition is an important factor in preparing young people for a healthy and safe work life.

Mullan et al. (2015) proposed that "more theory-driven research is needed to structure intervention efforts and determine the mechanism of effective safety interventions." Our study aimed to explore the cognitive processes that underlie safety motivation. Specifically, we examined the mediators of the effects of a safety intervention on motivational outcomes during vocational education. This will advance

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understanding of how safety interventions work and help develop more effective intervention approaches in the future in vocational education and workplaces. By identifying the factors that have an impact on safety motivation, future intervention efforts can be targeted at the competencies that contribute to positive motivational outcomes.

1.1. Safety motivation

Previous studies have shown that the introduction of safety legislation or regulations is not sufficient to move attitudes and behavior in the desired direction (Lehtola et al., 2008). Workers may not be motivated to exhibit the safety-related behaviors they have learned (Ford and Tetrick, 2008). Human motivation has been defined as "the set of psychological processes that cause the initiation, direction, intensity, and persistence of behavior" (Klein, 1989). Theoretical perspectives of motivation focus on how individuals' beliefs, values and goals relate to their achievement behaviors (Eccles and Wigfield, 2002). Motivation has also been acknowledged as an important research topic in the domain of safety research (e.g. Hedlund et al., 2010; Neal and Griffin, 2006). In their review article, Beus et al. (2016) provided a synthesis that captures the theoretical mechanisms that influence safety-related behaviors. One of the proposed conceptual linkages highlighted the role of individual-level factors (attitudes, abilities, etc.) as antecedents of safety motivation and behavior. Beus et al. (2016) pointed out that more research is needed to substantiate relationships between different individual-level factors. The integrative framework provided by Vierendeels et al. (2018) also highlights the role of personal psychological factors in safety behavioral processes at workplaces.

Motivation theories provide explanations for why individuals choose to engage in different safety-related activities and how their beliefs relate to their safety behavior. Neal and Griffin (2006) defined safety motivation as "an individual's willingness to exert effort to enact safety behaviors and the valence associated with those behaviors" (p. 947). Previous studies have shown that safety motivation plays an important role in whether workers follow safety rules and engage in safety-related activities (Neal and Griffin, 2006). A meta-analysis by Christian et al. (2009) showed that safety motivation has a positive association with safety behaviors and a negative association with accidents. However, most previous studies have examined the relationship between contextual and organizational level factors (e.g. safety climate, management practices, production pressure) and the safety motivation of employees (Neal and Griffin, 2006; Christian et al., 2009; Jiang and Tahira, 2016; Guo et al., 2016). Recently, Sprung and Britton (2016) provided evidence that subjective norms influence safety motivation among farm couples. Sawhney and Cigularov (2018) found that employee safety attitudes and perceived safety norms mediated the relationship between active leader behaviors and employee safety motivation. Curcuruto et al. (2016) also found that perceived behavioral control and self-efficacy were motivational drivers of proactive safety behavior: However, they did not specifically explore the role of safety motivation in this process. Fugas et al. (2012) studied connections between organizational and psychological processes and their relations to safety. They found that perceived behavioral control over safety was a proximal antecedent of self-reported safety behaviors. Hedlund et al. (2016) evaluated whether six different interventions had any impact on safety motivation at workplaces and found that safety interventions that were based on a high degree of employee participation increased safety motivation. However, their study did not specifically investigate *how* the interventions influenced safety motivation. Recently, Casey et al. (2018) evaluated the impact on safety motivation of safety training based on the stage-learning theory (Anderson, 1982) and social learning theory (Bandura, 1997), using a quasi-experimental, single group pre-post-post study. Their results indicated a positive effect on safety knowledge but not on safety motivation. We argue that previous studies lack knowledge on the specific intervention mechanisms of safety motivation change, and that this information is needed in order to direct future efforts to intervene in the factors that trigger safety motivation. The current study complements previous studies by examining the cognitive mediators of safety interventions' effects on motivational outcomes, using a randomized-controlled study design.

1.2. Cognitive antecedents of safety motivation

According to motivation theories, motivation and cognition are usually interrelated (Eccles and Wigfield, 2002). Vroom's expectancy model (1964) is an influential model in work-related motivation research. It specifies that the motivational process is a result of the perceived relation between effort and performance, the perceived relation between performance and relevant outcomes, and the subjective value of these outcomes (Ford and Tetrick, 2008). Theories focusing on expectancies of success or sense of control over outcomes provide analytical tools for studying the cognitive processes in human motivation to promote occupational safety. To develop a model of the cognitive process through which individual level factors influence safety motivation, we build upon social-cognitive theories. The focus of our study is on the role of self-efficacy and the locus of control (Bandura, 1997; Rotter, 1982).

According to Bandura, self-efficacy has an impact on how people motivate themselves to carry out certain tasks (Bandura, 1997). By safety-related self-efficacy we refer to the degree of confidence in one's ability to perform essential safety-related activities successfully, such as voicing safety concerns or acquiring instructions or guidelines at work in order to work safely. Previous studies have highlighted self-efficacy as an important factor to consider when designing safety interventions at the workplace (DeJoy, 1996; Okun et al., 2016). A study by Chen and Chen (2014) showed a positive association between generalized self-efficacy and safety motivation, and Katz-Navon et al. (2007) found that safety self-efficacy was positively associated with patient safety in health care. Previous studies also indicate that self-efficacy influences motivation to drive safely (Newnam et al., 2014) and motivates public sector employees to adopt safe driving behavior (Sinelnikov and Wells, 2017).

Each individual has beliefs regarding what causes occupational accidents and the factors that are important for their prevention. These beliefs influence attitudes towards hazard prevention activities at the workplace. (Kouabenan, 2009). The locus of control reflects a general belief that the events in a person's life are under their personal control. More specifically, it refers to the degree to which outcomes are attributed to one's own ability to alter a situation, as opposed to external factors such as other people, luck or chance (Rotter, 1982). The internal locus of control tends to make individuals active participants in relation to their environment and circumstances (Ng et al., 2006). Jones and Wuebker (1985) developed the safety locus of control concept to study perceived control over occupational accidents and injuries. People with a high internal safety locus believe that their own work behavior plays an important role in preventing injuries or harmful events. In contrast, people with a high external safety locus of control see less associations between their own actions and safety (Jones and Wuebker, 1985).

Previous studies have shown that the locus of control has various associations with occupational safety and safety behavior. Jones and Wuebker (1993) found that employees with greater external safety locus of control orientations reported more occupational accidents. Christian et al. (2009) also found that the locus of control was related to safety performance at workplaces. A study by You et al. (2013) showed that the general locus of control influences safety operation behavior indirectly by affecting risk perception. In addition, a study by Cigularov et al. (2009) indicated that a high internal safety locus of control has a positive effect on the safety-related error communication of young farm workers. Furthermore, Huang and Ford (2011) found that the locus of control can be influenced by safety training and feedback.

Both self-efficacy and locus of control are measurable and modifiable psychological factors that may stimulate human motivation and

behavior. Previous studies (Peterson and Stunkard, 1992; Bandura, 1997; Stajkovic and Luthans, 1998) have stressed the importance of differentiating the locus of control and self-efficacy concepts. Both are related to a person's perception of their ability to manage work situations to avoid injuries and accidents. However, safety self-efficacy focuses on the perception of one's ability to perform safety-related activities effectively, and the safety locus of control focuses on the perception of control in avoiding accidents. For example, an employee may perceive that they have a high level of personal control over their occupational safety but may not feel efficacious with regard to performing specific preventive actions. Drawing from the social-cognitive theory, we hypothesize that both safety-related self-efficacy and the internal safety locus of control exert a positive influence on safety motivation.

1.3. Intervention

The *Attitude to Work* safety training program was developed in collaboration with upper secondary-level vocational schools and workplaces in 2016. It is targeted at students finishing upper secondary-level vocational education in Finland, and utilizes a social cognitive approach (Bandura, 1997; Rotter, 1982) to empower students to adopt an active role in occupational safety. The content of the program includes topics such as identifying behavioral strategies for preventing accidents and overcoming barriers to safe work, assertive behavior in safety communication, and setting personal occupational safety and health goals. The principles of social learning and the techniques of active learning (Bandura, 1997) guide the student-centered approach, which includes mastery of experiences through problem-solving exercises, learning vicariously through watching others, and receiving peer reinforcement during group discussions and exercises. This involves students working in pairs or small groups to discuss concepts or finding solutions to case examples. Students identify how workers' preventive actions reduce the risk of accidents or other harmful events at the workplace and are guided towards identifying controllable causes of accidents. Building on these activities, the program engages students by enabling them to feel they have personal control over and are personally involved in safety promotion and hazard prevention. Appendix A includes examples of the links between the content of the intervention and hypothesized intervention outcomes. Previous results have shown that participation in the intervention increases the safety preparedness of vocational students, conceptualized as their safety self-efficacy and their inoculation against safety-related barriers (Nykänen and Vuori, 2017). The intervention has also strengthened the internal safety locus of control and decreased the risk-taking attitudes of participants. The present study aims to add to previous findings by investigating the extent to which the intervention affects safety-related self-efficacies and how the internal safety locus of control directs the study participant's motivational resources towards working safely. According to our hypothesized model, a safety intervention based on the social cognitive approach will have a positive impact on cognitive processes and thus affect the enhancement of safety motivation. We used mediation analysis (MacKinnon et al., 2007) as an analytical tool to test the hypotheses regarding the relationships between intervention efforts, cognitive processes and safety motivation. Mediation analyses answer the questions of how and why an intervention effect takes place (Baron and Kenny, 1986). By integrating the internal safety locus of control, safety self-efficacy and safety motivation into one model, this study examines the intermediate factors in safety-related motivational processes.

2. Study hypothesizes

Previous studies have indicated that safety training based on employees' active participation increases safety motivation (Hedlund et al., 2016). The *Attitude to work* intervention includes the implementation of social and active learning methods, and the social learning theory stresses the importance of dialogue as a key element of the learning process (Burke et al., 2007). Therefore, the intervention is based on a student-centered approach, making the trainer a facilitator of learning, who supports self-directed problem-solving among the students. We hypothesized that the *Attitude to work* program would increase safety motivation.

Hypothesis 1. Participation in the Attitude to work intervention affects safety motivation

According to the social-cognitive theory (Bandura, 1997), self-efficacy beliefs provide the foundation for human motivation. Self-efficacy has a positive impact on the effort, persistence and resilience of an individual when performing a behavior (Burke et al., 2007). Previous studies have highlighted a positive relationship between self-efficacy and motivational outcomes in work-related settings (Stajkovic and Luthans, 1998). We expected safety self-efficacies to contribute similarly to the willingness to make an effort to contribute to occupational safety.

Hypothesis 2. Safety self-efficacies will mediate, at least partly, the effect of the Attitude to work intervention on increasing safety motivation

According to Rotter (1982), the internal locus of control is associated with higher motivation to achieve. Spector (1982) also argued that individuals with a stronger internal locus of control show more motivation in work situations, as they perceive themselves as having greater control over their environment. Ng et al. (2006) explored the association between the work locus of control and work motivation. Their study indicated that an internal locus of control is positively related to intrinsic task motivation operationalized as motivation to engage in work tasks or work effort. We propose that the internal safety-related locus of control and safety motivation may have a similar association. Therefore,

Hypothesis 3. The internal safety locus of control will mediate, at least partly, the effect of the Attitude to work intervention on enhancing safety motivation

3. Method

3.1. Study participants and procedure

This study was a school-based, cluster randomized controlled trial conducted in 2016 in Finnish upper secondary-level vocational schools. Eight schools in Southern and Eastern Finland participated in the study as part of an occupational safety development project initiated by the Finnish Board of Education. The study participants consisted of students aged 17–29 who were in their third year of upper secondary-level vocational education in Finland. The participating student groups were match-paired according to their vocational track at their schools (practical nurses, carpenters, etc.) and randomly allocated into either an intervention or control group. Randomization was carried out by a research assistant who did not participate in the baseline or follow-up assessments and had no contact with the students. This process was conducted separately for each participating school. The student groups were numbered, and the numbers were placed into envelopes which were then sealed. The research assistant shuffled the envelopes and dealt them into two piles. Research staff monitored the randomization process.

Overall, 48 out of 50 eligible student groups participated in the baseline survey. The participants provided written informed consent and were informed that participation in the study was voluntary and that non-participation would have no consequences. Of 893 eligible students, 615 completed the baseline questionnaires. If a student group

did not provide data at baseline (T1) or at short-term follow-up (T2) due to school schedules, the matched student group was discarded in order to preserve the integrity of the study design (Donner and Klar, 2004). Using this procedure, two otherwise eligible student groups were excluded from the study at T1. In total, 46 student groups and 580 students were included in the randomization process. After randomization, half of the student groups attended the 12-hour *Attitude to work* training program and the other half received written material on safety and participated in normal school activities and lessons. The student groups that were allocated into the intervention condition participated in the *Attitude to Work* intervention program within approximately two weeks after the baseline measurements. The program consisted of two full, consecutive training days and was implemented in all student groups using the same delivery format. The students in the intervention condition completed the follow-up questionnaires immediately after the *Attitude to work* program. The controls' follow-up measurements were conducted during the same week as those of the intervention group. Therefore, the time between baseline and follow-up was approximately two weeks. One student group was excluded due to a lack of matched-pair data at T2. Thus, the sample size included in the final analyses consisted of 44 student groups. In total, 229 eligible students in the intervention condition and 235 in the control condition provided both baseline and follow-up measures. Attrition at baseline and follow-up was due to changes in school schedules or to students being absent from school.

3.2. Measures

3.2.1. Demographic and background variables

We assessed the participants' age, gender, previous work experience and school grade using standard survey questions.

3.2.2. Intervention condition

The intervention condition was coded with a value of 1 for students who participated in the *Attitude to work* program and 0 for students in the control condition.

3.2.3. Safety motivation

We measured safety motivation using a scale developed by Neal et al. (2000). All items were measured on a five-point rating scale ranging from 1 (strongly disagree) to 5 (strongly agree). The scale had three items: (1) "I feel that it is worthwhile to make an effort to maintain or improve my personal safety" (2) "I feel that it is important to maintain safety at all times" (3) "I believe that it is important to reduce the risk of accidents and incidents at the workplace." At T1, the coefficient omega was 0.84, bootstrap corrected 95% CI [0.79, 0.88]; and at T2, 0.84, bootstrap corrected 95% CI [0.78, 0.88].

3.2.4. Internal safety locus of control

The internal safety locus of control was assessed using two items adapted from the scale developed by Mazaheri et al. (2012). Both items were measured on a five-point rating scale ranging from 1 (strongly disagree) to 5 (strongly agree). The scale had two items: (1) "If workers follow all the rules and regulations, they can avoid many accidents," (2) "People can avoid injury if they are careful and aware of potential dangers." At T1 the coefficient omega was 0.74, bootstrap corrected 95% CI [0.68, 0.79]; and at T2, 0.78, bootstrap corrected 95% CI [0.71, 0.82].

3.2.5. Safety self-efficacy

We developed the safety self-efficacy scale specifically for this study. It consisted of self-efficacy items that safety training experts at the Finnish Institute of Occupational Health considered important for adapting an active role in terms of occupational safety and health, especially for newcomers to work life. Rather than being job specific, our items were more general and could be applied across a wide variety of occupations in vocational education. We defined safety self-efficacy as a unidimensional construct. We asked the participants about their confidence in various safety-related activities. The six five-point (1 = very poorly 5 = very good) self-efficacy items related to (1) identifying job-related hazards (2) recognizing factors that affect the occurrence of accidents, (3) reducing the risk of accidents, (4) thinking about ways in which to improve safety at work, (5) acquiring instructions or guidelines at work in order to work safely and (6) considering ways in which to improve working conditions in terms of occupational safety. We adapted a response format (1 = very poorly 5 = very good) from previous intervention studies (Vuori et al., 2012). At T1, the coefficient omega was 0.82, bootstrap corrected 95% CI [0.79, 0.84]; and at T2, 0.84, bootstrap corrected 95% CI [0.82, 0.86]. Further details on the psychometric properties and results of a confirmatory factor analysis on the structure of the scale are presented in the Results section.

3.3. Statistical methods

First, we compared the study groups' baseline characteristics. In accordance with the CONSORT statement, "significance testing of baseline differences in randomized controlled trials (RCTs) should not be performed" (Moher et al., 2010; de Boer et al., 2015), we did not include these analyses in this article. Based on previous studies (Dunn et al., 2014), we calculated the omega coefficient measure of scale internal reliabilities. Previous studies have highlighted the benefits of latent variable approaches in analyzing intervention effects on pre-post design. For example, structural equation modeling can accommodate a lack of normality in the data, allows the researcher to confirm that the measurement structure of the study scales is equivalent across groups and over time, and offers an appropriate analytical procedure to test the mediation hypotheses. (Alessandri et al., 2017; Baron and Kenny, 1986). Therefore, we chose confirmatory factor analyses and structural equation modeling as the statistical methodology for this study. The second set of analyses tested the model fit. We conducted confirmatory factor analysis to examine the proposed measurement model. Model fit was assessed using the chi-square index ($\chi 2$), the Tucker-Lewis index (TLI), the standardized root mean square residual (SRMR), the comparative fit index (CFI), and the root mean square error of approximation (RMSEA). We also tested both longitudinal invariance and invariance across the intervention condition. Next, we estimated the structural model and examined the results in terms of the three hypotheses outlined previously. Before testing our mediating hypotheses, we tested an unmediated intervention effect on safety motivation. The third set of analyses examined the hypothesized mediation model. We tested the SEM model using all the data that were available in order to estimate the model without imputing the data. The intention-to-treat analyses used all the participants assigned to the intervention and control conditions, regardless of whether they participated in the intervention program. We used the TYPE = COMPLEX function of Mplus 7.4 (Muthén and Muthén, Los Angeles, CA). Because of the clustered-randomized design, the student group was specified as the unit of clustering to adjust for standard errors (Raudenbush and Bryk, 2002). We fit the mediation models, entering both hypothesized mediators simultaneously to determine the unique effects of each mediator on each outcome variable (Preacher and Hayes, 2008). In both mediators, we used the baseline scores of each variable as covariates. The mediation results are reported in standardized values. Fig. 1 shows the conceptual model of mediators. To investigate whether the internal safety locus of control and safety self-efficacies mediated the intervention effect on safety motivation, we tested whether the mediation paths (indirect intervention effect) were statistically significant. The parameters of the models were estimated using the maximum likelihood robust (MLR) estimation method, which is more robust to the non-normality of observed variables.

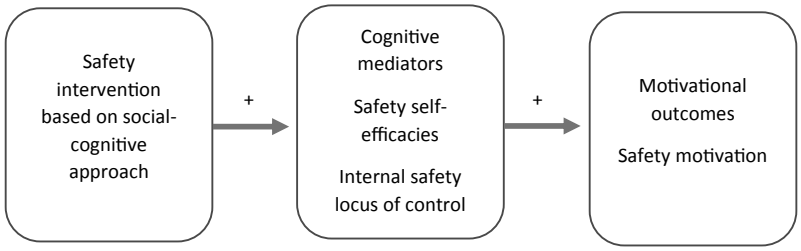

Fig. 1. Hypothesized study model.

4. Results

4.1. Descriptive results

The study participants' ages varied from 17 to 29, and the mean age was 19.7 (SD 2.2). The mean work experience in the same occupational field as that of the study was 4.8 months (SD 8.0). Of the final study sample, 170 (36.6%) were male and 294 (63.4%) were female, 47% of the study participants were studying for a vocational qualification in social and health care, 40% were studying for a vocational qualification in technology and transport, and 13% were studying for a vocational qualification in business or tourism.

Tables 1–3 show the baseline characteristics, study variable means, correlations and standard deviations. The skewness coefficients of the observed variables were from −1.32 to −0.04, and all kurtosis coefficients were from −0.52 to 2.38.

4.2. Model fit and invariance tests

The measurement model showed good model fit with $\chi 2$ (df = 191) = 427.656, $p < .001$; RMSEA = 0.048; CFI = 0.941; TLI = 0.929; and SRMR = 0.045. As the measurement model achieved the required level, we proceeded to test measurement invariance. First, we specified a model in which all factor loadings were freely estimated (configural model). Second, we ran a model in which all factor loadings were constrained equally across the time points (metric model). Third, we ran a model in which both the factor loadings and item intercepts were constrained to be equal across time points (scalar model). Using the chi-square difference test in measurement invariance tests may be problematic due to its sensitivity to sample size (Putnick and Bornstein, 2016). Therefore, we looked into differences in CFI and RMSEA. If the difference in the fit indices between a model and the (preceding) less constrained model were below the accepted cutoffs (equal or less −0.01 for CFI and equal or less −0.015 for RMSEA (see Cheung and Rensvold, 2002; Chen, 2007), we considered that the level of measurement invariance was achieved.

We found that the differences in the CFI and RMSEA were below the accepted cutoffs at each step of longitudinal invariance assessment process: Configural model (CFI = 0.940, RMSEA = 0.048), Metric model (ΔCFI = 0.000, ΔRMSEA = −0.001) and Scalar model

Table 1
Baseline characteristics.

Variable	Intervention condition (n = 229) mean *(SD)*	Control condition (n = 235) mean *(SD)*
Gender		
Male	43%	31%
Female	57%	69%
Age	19.7 (2.2)	19.9 (2.4)
Part-time job		
Yes	22.5%	22.6%
No	77.5%	77.4%
Work experience in same occupational field as study field (months)	4.3 (7.4)	5.4 (8.4)
Work experience in general, including on-the-job training (months)	15.4 (22.0)	14.3 (18.5)
School grade (vocational modules)		
Satisfactory	9.3%	5.7%
Good	66.2%	62.9%
Excellent	24.4%	31.4%

Table 2
Means and standard deviations of study variables.

Variable	Range	Total sample (n = 464)		Intervention condition (n = 229)		Control condition (n = 235)	
Baseline		M	SD	M	SD	M	SD
Safety motivation T1	1–5	4.31	0.60	4.31	0.61	4.31	0.58
Internal safety locus of control T1	1–5	4.44	0.51	4.41	0.54	4.47	0.48
Safety-related self-efficacies T1	1–5	3.77	0.41	3.78	0.39	3.77	0.43
Follow-up							
Safety motivation T2	1–5	4.46	0.52	4.51	0.48	4.40	0.57
Internal safety locus of control T2	1–5	4.46	0.56	4.50	0.50	4.42	0.60
Safety-related self-efficacies T2	1–5	3.84	0.41	3.90	0.39	3.79	0.43

Table 3
Standardized factor loadings of latent variable indicators and estimated correlations in measurement model.

Variables	Standardized factor loadings of indicators	Range skewness of observed variables	Range kurtosis of observed variables	1	2	3	4	5	6	7
1 Intervention condition	–	–	–	1						
2 Safety self-efficacies T1	0.59/0.64/0.66/0.66/0.65/0.71	−0.325, −0.147	−0.272, 0.434	0.00	1					
3. Safety self-efficacies T2	0.65/0.68/0.66/0.71/0.69/0.74	−0.228, −0.041	−0.522, 0.178	0.10*	0.71**	1				
4 Internal safety locus of control T1	0.84/0.68/	−1.106, −0.867	1.128,1.911	0.00	0.39**	0.27**	1			
5 Internal safety locus of control T2	0.89/0.72	−1.280, −0.849	0.007, 2.225	0.10*	0.17**	0.13**	0.44**	1		
6 Safety motivation T1	0.74/0.86/0.81	−1.329, −1.056	1.558, 2.296	0.00	0.34**	0.24**	0.55**	0.24**	1	
7 Safety motivation T2	0.69/0.85/0.84	−1.266, −1.028	0.571, 2.386	0.12*	0.38**	0.41**	0.46**	0.60**	0.50**	1

* p < .05.
** p < .01.

(ΔCFI = −0.004, ΔRMSEA = 0.000). Next, we tested for measurement invariance across intervention conditions. First, we specified a model with all factor loadings and intercept parameters freely estimated across two intervention conditions (CFI = 0.930, RMSEA = 0.053). Second, we ran a model in which all factor loadings were constrained equally across the intervention conditions (metric model, ΔCFI = −0.003, ΔRMSEA = 0.000). Third, we ran a model in which both the factor loadings and item intercepts were constrained to be equal across intervention conditions (scalar model, ΔCFI = −0.001, ΔRMSEA = −0.001). When we applied the different levels of constraint, the difference in fit indices were below the accepted cutoffs, indicating similarity among factor loadings and intercepts across intervention conditions.

As already mentioned, we developed the safety self-efficacy scale for this study. Therefore, we conducted separate confirmatory factor analyses to confirm the factor structure of the scale. Safety self-efficacy showed acceptable model fit at T1, with $\chi 2$ (df = 8) = 24.372, p = .002; RMSEA = 0.062; CFI = 0.982; TLI = 0.966; and SRMR = 0.025. Using the same procedures as those described above, we also confirmed longitudinal measurement invariance (Configural model CFI = 0.935 and RMSEA = 0.073, Metric model ΔCFI = −0.001 and ΔRMSEA = −0.003, Scalar model ΔCFI = −0.005 and ΔRMSEA = −0.001) and measurement invariance across intervention conditions (Configural model CFI = 0.934 and RMSEA = 0.074, Metric model ΔCFI = −0.003 and ΔRMSEA = −0.002, Scalar model ΔCFI = −0.002 and ΔRMSEA = −0.003).

Next, we continued to estimate our structural equation model, which provided a good fit with the data, with $\chi 2$ (df = 217) = 512.486, $p < .001$; RMSEA = 0.050; CFI = 0.928; TLI = 0.916; and SRMR = 0.067. All the factor loadings of the manifest indicators were significant ($p < .001$) and were between 0.59 and 0.89. Table 3 presents the standardized factor loadings of the latent variable indicators.

4.3. SEM analyses

The intervention effect on safety motivation was positive and statistically significant (β = 0.11, CI = 95% 0.02–0.20, $p < .05$) with no mediators in the model. Thus, Hypothesis 1 was supported. Fig. 2 presents the results of the final structural equation model. The one-headed arrows represent the regression paths, and the bold text represents statistical significance. There was no significant direct path from the intervention condition to safety motivation if the mediators were included in the model, which indicated full mediation. The multiple mediation model had a statistically significant path from the intervention condition to the safety-related self-efficacies (β = 0.10, CI = 95% 0.00–0.21, $p < .05$) and the internal safety locus of control (β = 0.10, C = 95% 0.00–0.20, $p < .05$) at follow-up, indicating that the increase in safety competencies was stronger among the intervention group participants than among the comparison group participants. The indirect effect of the intervention on safety motivation via the internal safety locus of control was significant (standardized path estimate for indirect effect = 0.05, CI = 95% 0.00–0.09 with standard error = 0.02, $p < .05$), thus supporting Hypothesis 3. However, the safety self-efficacy mediation between the intervention and safety motivation was only significant in one-sided testing (standardized path estimate for indirect effect = 0.02 CI = 95% 0.00–0.05 with standard error = 0.01, p = .07). Therefore, the results did not support Hypothesis 2.

5. Discussion

Although the identification of the mechanisms that contribute to safety motivation and to the effects of safety interventions on safety motivation is a focal topic of safety literature, it has received little empirical attention. The strength of our study is in its theory-based

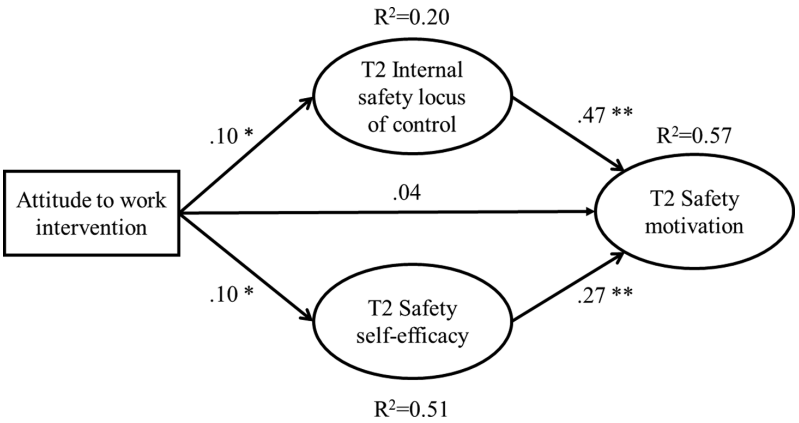

Fig. 2. Multiple mediation model examining standardized coefficients and effects of safety intervention on safety motivation through internal safety locus of control and safety self-efficacy, controlled for baseline levels of mediators and safety motivation. *p < .05 **p < .01.

randomized controlled design. This study thus provides insights into the causal relationships between cognitive processes and safety motivation.

We aimed to evaluate whether beneficial change in safety self-efficacy and in the internal safety locus of control mediated the intervention effect on safety motivation. The results provided partial support for our hypothesized mediation model. Our mediation analyses indicated that the effect of the safety intervention on safety motivation was dependent on the internal safety locus of control being an intermediate factor. The increase in the internal safety locus of control resulted in a small but beneficial impact on safety motivation. The results are consistent with Vroom's expectancy model (1964) and social cognitive theories (Rotter, 1982). The non-significant indirect effect of safety self-efficacy on safety motivation requires more thought: As students completing their vocational education have limited work experience, a more generalized expectancy that accidents or injuries are controlled by their own preventive actions may more strongly influence safety motivation. It is also possible that the pathway between safety self-efficacy and safety motivation was not strong enough to be detected because of our sample size. The findings of this study bring new knowledge regarding the relationship between cognitive factors and safety motivation. In sum, this study provides support for targeting the internal safety locus of control as an intervention outcome with the potential to increase safety motivation during vocational education and the school-to-work transition.

5.1. Study limitations

This study has some limitations. First, it was conducted within the context of vocational education in Finland. However, although the school setting is different to that of workplaces, vocational education in Finland does have some similarities to work life settings. Studies at Finnish vocational institutions take place in real work environments such as wood workshops, construction sites and restaurants. Of our study participants 22% also worked in part-time jobs. Nevertheless, many of the characteristics of the study setting still differed to those of workplaces. Therefore, further research of workplace safety training is needed. Second, we used a general safety motivation measure in this study. Previous studies (Hedlund et al., 2016) have made a distinction between intrinsic and extrinsic safety motivation. Future studies should examine how cognitive processes interact with intrinsic safety motivation, and long-term follow-up assessments are needed to investigate the effectiveness of interventions on the behavioral level. Finally, confidence intervals and relatively small effect sizes should be taken into account, as even small intervention effects can translate into important safety outcomes. Our results indicate that the intervention had a beneficial, indirect effect on safety motivation, but further analyses could use larger samples. As previous studies have shown that safety motivation is a proximal antecedent of safety behavior and plays an important role in preventing accidents (Christian et al., 2009), knowledge of effective motivational change techniques is important in planning safety training at workplaces and in vocational education. The current study focused on the intervention's short-term effect on the psychological and motivational predictors of safety behavior. Future research should use long-term follow-up data to evaluate interventions' consequent impacts on safety performance and preventing accidents.

5.2. Future research topics

Previous studies have shown that the locus of control is influenced by contextual factors and previous learning experiences (Strauser et al., 2002; Serin et al., 2010). In order to uncover any underlying moderation mechanisms, future studies should explore how peer-group safety norms, teacher attitudes and the personal accident history of students may potentially modify the motivational outcomes of educational safety interventions. Future research should aim to identify the group- and organization-level factors that have positive impacts on the internal safety locus of control. This knowledge may help build a work environment that enhances the safety motivation of young workers.

5.3. Practical implications

Our results provide information for developing effective intervention techniques to increase safety motivation during safety training. Students in vocational education should be guided to attribute accidents to factors that are under their personal control. It is important that students identify the aspects of safety that are under their own personal control as well as those that they can influence indirectly in collaboration with co-workers, supervisors and safety representatives. This may help them acknowledge that occupational accidents are contingent on what they do rather than on events outside their personal control, such as luck. The internal safety locus of control can be viewed as a transferable safety competency, meaning that it transcends any particular organizational setting and occupational field. This viewpoint is consistent with the previous discussion on foundational workplace safety and health competencies for the emerging workforce by Okun et al. (2016). Our results, in line with those of earlier studies (Hedlund

et al., 2016), suggest that engaging intervention techniques (i.e., requiring trainees' active participation) effectively increases both the internal locus of control and safety motivation. The *Attitude to work* group method is an example of a practical tool to facilitate this process and can be used in both vocational education and workplaces as part of safety training.

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Appendix A. Examples of safety training activities and learning processes

Example of safety training activities	Learning process	Hypothesized outcome
Students work in small groups and draw a visual representation that reflects their potential future workplace. They draw potential hazards and mark them using different colors. When the drawings are ready, small groups make a list of hazards associated with the map of the workplace. In addition, preventive action or behavioral strategies are written next to each hazard with the help of the trainer. Finally, the small group reports back to the class as a whole and trainer facilitates the discussion.	The learning approach emphasizes the problem-solver role of the students. Instead of lecturing, the trainers use the knowledge and ideas of the participants as part of the learning process. The trainer facilitates the discussions by guiding the students towards identifying hazards and strategies to prevent them. Both mastery experiences and learning vicariously supports the learning.	Safety self-efficacy
Group discussions on case-stories of occupational accidents and incidents at the workplace. The students plan in small groups how to control various hazards that may result in accidents. They are encouraged to analyze the factors preceding accidents, explore the relationship between unsafe behavior and accidents, and identify effective behavioral strategies for preventing accidents.	The focus is on how employees can promote occupational safety in collaboration with co-workers, supervisors and safety representatives. Students' knowledge of accident processes increases, and they are guided towards identifying controllable causes of accidents.	Internal safety locus of control
The trainer puts different cards on the table. Each card contains a specific way of influencing occupational safety and preventing accidents. Students are asked to choose three cards. Once they have chosen their cards, the trainer asks the students to take turns in sharing their thoughts about why these are important to them.	Students receive peer reinforcement to set personal goals in terms of occupational safety.	Safety motivation

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III

IDENTIFYING THE "ACTIVE INGREDIENTS" OF A SCHOOL-BASED, WORKPLACE SAFETY AND HEALTH TRAINING INTERVENTION

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