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Pilot test of a tailored intervention to improve apprentice safety in small construction companies

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ABSTRACT

Background: Apprentices within construction have an increased risk of occupational injuries. In Denmark apprentices alternate between periods at school and extensive periods at training companies where they are employed during their education. Owner-managers are pivotal in securing safe working conditions for apprentices in training companies.

Method: A tailored intervention aimed at creating safe training companies by targeting owner-managers was developed through an iterative process. The intervention included both active work environment factors (a checklist approach based on a gold standard aided by specific tools) and motivational factors (assistance with mandatory systematic health and safety obligations, access to promotional materials and an option to get a free visit from a health and safety advisor) designed to motivate companies to participate. The intervention was pilot tested in a non-randomized controlled design to examine recruitment, implementation and effect.

Results: 67% of the training companies that were invited to participate accepted and 58% completed the intervention. At least one tool was used by 71% of the companies and there was a significant increase in the safety level of the training companies from baseline to follow-up. The intervention group reported non-significantly fewer injuries during the intervention period than the control group. Minor improvements were measured in safety climate in the intervention group and significant differences between the intervention and control group were found for 2 out of 7 safety climate measures at follow-up.

Conclusion: It may be feasible to prevent apprentice injuries by targeting owner-managers and the existing norms and practices in training companies.

1. Introduction

More than 3.2 million occupational accidents occur annually in the European Union. The construction sector accounts for approximately 12% of these and has one of the highest incidence rates of all sectors (Eurostat 2018). At the same time, young workers have an increased risk of injury due to unsafe working conditions, a lack of introduction to tasks, and less opportunity to voice their opinion regarding health and safety issues compared with senior workers (Breslin and Smith, 2005). It is therefore not surprising that previous studies have identified an increased risk of occupational injuries among apprentices within construction and that preventive efforts have targeted this group (Lipscomb et al., 2003, Nielsen et al., 2018, Holte et al., 2015).

Apprentices occupy a special position in the vocational and educational training system in Denmark, as their education is based on the shared responsibility of the vocational schools and the training companies (Jorgensen, 2013). After finishing a basic course for the first 20–40 weeks of their education, apprentices training for jobs in the construction industry are required to secure an apprentice employment in a training company to complete the typically 4-year education to become a trained craftsman. During this education, they alternate between shorter periods at school and extensive periods at the training company. At school, apprentices have theoretical courses on health and safety and gain some practical experience from workshop classes in which they are taught basic skills. However, the apprentices identify the company-based training as central to their practical learning, which may lead to dilemmas regarding the transfer of safety knowledge from school to workplace practice (Grytnes et al., 2018) While working at the training companies, apprentices find it difficult to apply school-based knowledge of safety. This is because they learn the trade by participating in the social practices of the companies (Grytnes et al., 2018) and because this learning is facilitated by a sense of being one of the

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workers and adapting to the existing norms and practices in the companies (Nielsen, 2012), even when these norms and practices entail suboptimal safety solutions. If they encounter poor safety arrangements, apprentices may be reluctant to voice their concerns, as maintaining good relations with the company owner and their co-workers is seen as important to keeping the apprenticeship (Lipscomb et al., 2008a, Grytnes, 2018). Thus, it is difficult for apprentices to influence safety norms and practices at their training companies and it is for this reason that attempts to empower them through training programs at school can fall short (Lipscomb et al., 2008a). Studies also show that apprentices report a higher and less ambiguous focus on safety in school than at their training company (Grytnes et al., 2018, Lipscomb et al., 2008a) and that co-worker safety practices are associated with injury outcomes for apprentices (Kim et al., 2014). However, according to Danish law, the training companies are responsible for the health and safety of apprentices whilst they are employed at the companies. Thus, vocational educational teachers have no means of influencing or helping the apprentices with safety-related concerns during company-based training (Grytnes et al., 2018). Furthermore, there are no formal demands for content and didactic principles of company-based health and safety training in training companies that are approved as such by local training boards consisting of school and company representatives.

It is clear that the dominant norms and practices at the training companies are pivotal for the health and safety of the apprentices, who, however, are seldom in a position to influence these norms and practices themselves. This is also reflected by the socio-ecological approach put forward by an American and Canadian expert group on the advances of young worker safety in the US and Canada. This group strongly suggests integrating injury prevention strategies within the organizational context (Runyan et al., 2012). This is further explored in another study that examines the ineffectiveness of safety training approaches among young workers. In this study, the authors stress the importance of the learning processes at the training companies (Laberge et al., 2014). Thus, preventive measures aimed at improving safety for apprentices may possibly be more effective if they are targeted at the existing norms and practices in the training companies instead of the apprentices' skills and knowledge. A feasible way to achieve this is to design interventions that affect (owner-)managers in the companies, since these play a key role in the company's safety climate (Kaskutas et al., 2009; Zohar, 2002).

This said, intervening in the norms and practices of (small) construction companies is no easy task. The construction industry is highly cost-conscious with low profit margins, unclear responsibilities and limited safety management systems. In such companies, safety is sometimes viewed as a bureaucratic burden that detracts from the primary production process and, therefore, the outlook for identifying and implementing evidence-based safety solutions does not appear overly positive (Swuste et al., 2012). Although managers display a positive attitude towards creating a good working environment, safety is often seen as a non-core task that is given a low priority due to a lack of resources and knowledge and the cost and difficulty of implementing and understanding good safety practices (Legg et al., 2015).

Studies of construction companies' motivation for participating in occupational health and safety programs identify the importance of whether the owner-manager acknowledges the need for a new approach and views the approach as meaningful for the company (Kvorning et al., 2015; Kidd et al., 2004). It is therefore essential that the content of any safety program is tailored to the specific company context, easy to understand and use, and offers clear benefits or added business value for the company (Kvorning et al., 2015; Cunningham and Sinclair, 2015). Recognizing the clear benefits of safety interventions is often a challenge, as the benefit (no injuries) is uncertain and often invisible while the resources needed to participate are certain and visible. Thus, the motivation to participate in safety interventions is often low in (small) construction companies and the owners-managers' initial judgments about time demands and benefits are decisive factors (Kidd et al., 2004).

To overcome these motivational issues, we developed a tailored intervention aimed at creating safe training companies for apprentices in the construction sector, which included active work environment factors as well as motivational factors designed to motivate the companies to participate. The purpose of the current project was to pilot test the intervention in a non-randomized controlled design to examine recruitment, implementation and potential beneficial effects of the intervention on apprentice injury experience and company safety climate.

2. Methods and participants

2.1. Developing and tailoring the intervention

The basis of the intervention was a checklist approach that had previously proved effective in creating health and safety improvements in other hard-to-reach target groups such as Danish farms (Rasmussen et al., 2003) and Italian metalworking micro-enterprises (Farina et al., 2015). The checklist approach consists of a visit from an external health and safety expert who audits the training companies' safety norms and practices against predetermined criteria through a 1-1½-hour interview with the owner-manager. Based on the audit, the owner-manager receives action-oriented feedback specifying which areas he/she needs to improve in order to comply with safety standards and action plans are jointly formulated to target these areas. Four months later, the company is re-audited to identify whether progress has been made on the identified areas. Such an approach is simple, easy to understand, action-oriented and requires few resources, which are some of the typical characteristics of successful health and safety interventions in small companies (Legg et al., 2015).

Building on this general checklist approach, the specific structure and content of the intervention was tailored to the target group through a participatory iterative process involving a panel of experts and interviews with the local training boards, apprentices and owner-managers of training companies.

Firstly, a gold standard for a good and safe training company, which would be used to develop the audit checklist, was formulated based on existing scientific and practical knowledge. This took place during two workshops with a panel of health and safety researchers, representatives from vocational schools, unions, employers' associations and the Danish Sector Work Environment Council for construction. At the first workshop, the existing scientific knowledge about health and safety for apprentices and small construction companies was presented and discussed alongside the existing materials and approaches used by the practitioners in the panel. After the first workshop, interviews were conducted with the local training boards for carpenters and bricklayers at the participating vocational school, a total of 12 carpenter or bricklayer apprentices recruited at the school, and seven owner-managers from training companies (four carpenters and three bricklayers) recruited through local branch associations. The purpose of these interviews was to learn more about the characteristics of good and safe training companies and to obtain the interviewees' opinions on and suggestions for which motivational factors to use in the project to encourage companies to participate. Based on the inputs from the first workshop and the interviews, a gold standard for good and safe training companies consisting of 11 criteria was developed (see Fig. 1). The standard centered on the topics *introduction*, *work tasks* and *basic structures* and was presented and discussed along with a time-plan for the intervention by the panel of experts at the second workshop. The gold standard contains both safety-related and more general aspects of being a good training company. It specifies 11 general criteria to meet (e.g. having a start-up plan for the apprentice, ensuring enough time to learn for the apprentices and having a focus on apprentices in company health and safety efforts) without a detailed description of how to meet them, since this latter question should be determined in a dialogue between the apprentice and the owner-manager or journeyman. The

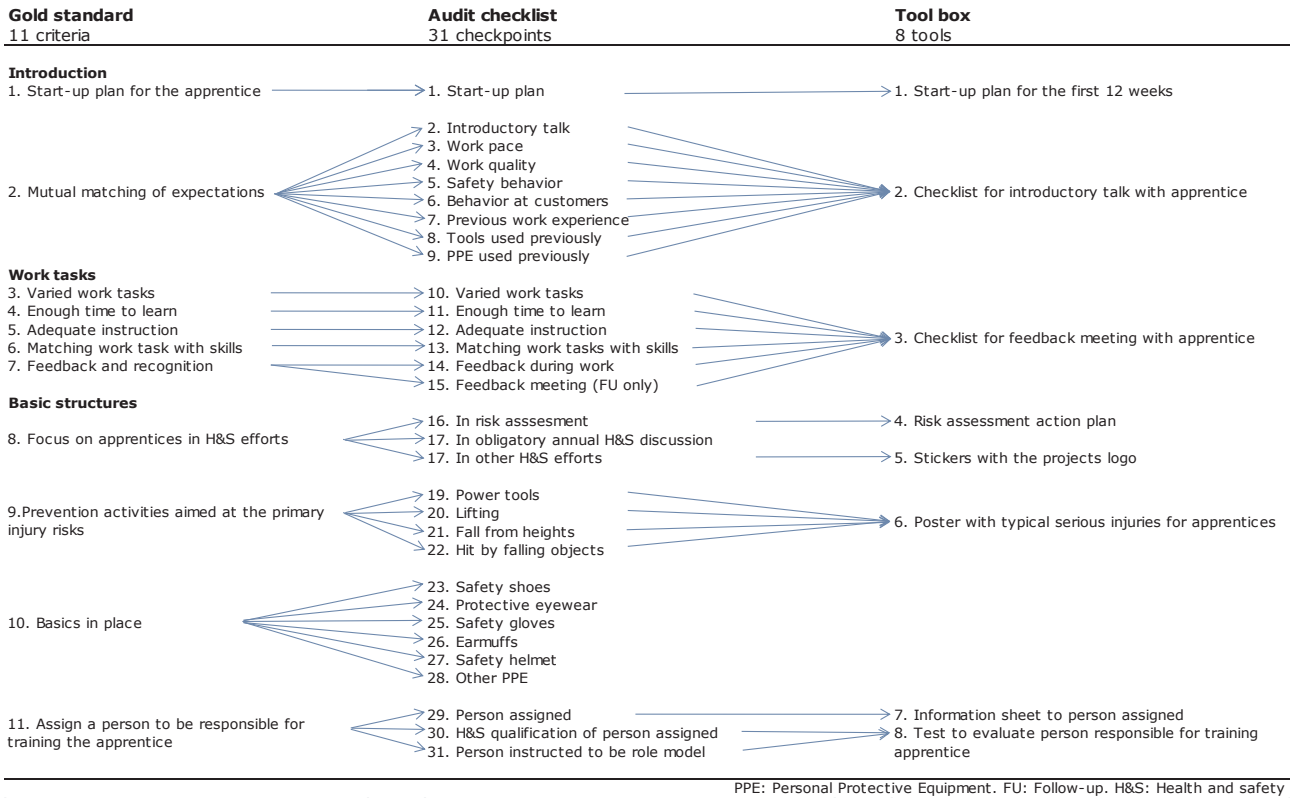

Fig. 1. Criteria of the gold standard, checkpoints of the checklist and tools in the toolbox.

criteria regarding *introduction* were included because apprentices and owner-managers reported that the introduction the apprentices received in the companies often lacked sufficient quality, was unsystematic and somewhat random. The criteria regarding *works tasks* were included because the apprentices reported that it took time, adequate instructions and feedback for them to learn how to perform tasks safely. The criteria regarding *basic structures* were included to ensure that the companies provided safe working conditions for the apprentices and were committed to safety. After the gold standard was established, a checklist that reflected the items in the gold standard and that could be used to audit the companies was developed by the researchers (see Fig. 1).

Secondly, specific tools were developed for the companies based on the requirements of the gold standard, so that, for all but one criterion, one or more easy-to-use tools were developed to help companies fulfill the criterion (see Fig. 1). The tools were developed by the researchers on the basis of existing materials from authorities, unions and work environment councils, and by involving the different members of the expert panel. For instance, the toolbox contained a checklist of important subjects (including the matching of expectations) for an introductory talk between the owner-managers and the apprentices, a test the owner-manager could use to evaluate the competences of the person assigned to train the apprentices, and a tailored poster with information about the most typical serious injuries for apprentices in the specific branch (carpentry, bricklaying or plumbing). Prototypes of the tools were presented to and discussed with five owner-managers from construction companies (recruited through a Google search for local carpenters and bricklayers) along with the content and time-plan for the intervention. The owner-managers provided input on the usefulness of each of the different prototypes of the tools and the content of and time-plan for the intervention. This led to a number of minor adjustments in the tools and the intervention.

Thirdly, the intervention was tailored to the target group in the choice of health and safety expert that should perform the audit. As part of the initial interviews regarding characteristics of good and safe training companies, the owner-managers were asked which type of expert they felt would be best suited to deliver the intervention. This method was used since a previous study of factors motivating small construction companies to participate in a health and safety program identified the importance of a trusting relationship between the owner-manager and the person delivering the intervention (Kvorning et al., 2015). In our study, several options were presented to the owner-managers, including an inspector from the Work Environment Authorities or a health and safety consultant. However, the owner-managers identified a certified health and safety teacher (H&S teacher) from the participating vocational school as the best option. They argued that a H&S teacher could contribute expertise regarding apprentices and could also strengthen communication and cooperation with the local school, which they felt had unfortunately declined in recent years as an increasing amount of communication was handled electronically.

Finally, the intervention was tailored by identifying motivational factors that would encourage companies to participate. Several suggestions were discussed with the owner-managers, and two of them were positively received by almost all of them. The first motivational factor was to design the intervention so it would assist the companies in the mandatory systematic work health and safety obligations which they often found difficult to perform without external assistance. To this end, the checklist was expanded to include several items covering other aspects of the work environment, including the mandatory workplace risk assessment, which the companies often either did not perform or paid an external health and safety consultant to perform. To support this, a workplace risk assessment tool was developed for the toolbox with clear instructions on the few extra steps the company had to perform after the audit to complete the mandatory workplace risk assessment. The second motivational factor, based on input from the owner-managers, was to provide access to promotional materials to highlight the company as making an extra effort for the health and safety of its apprentices. Stickers for the company cars with the project

logo and the slogan 'We take care of our apprentices' were developed and included in the toolbox and a digital version of the logo was available for the companies to use on their websites or mail signatures. The third motivational factor (which not all owner-managers considered relevant) was the option to receive a free visit from a health and safety specialist either in the company or at a construction site if an issue was identified during the audit for which external counseling was required.

2.2. Participants

Training companies were recruited through the construction program of a middle-sized Danish vocational school. A few weeks before the basic courses in carpentry, bricklaying or plumbing were completed and the apprentices started their first period in the training companies, the first author contacted the person responsible for apprentices in the training companies (typically the owner-manager). Contact was established by telephone, and the researcher presented himself as working with the vocational school to create better and safer education and training for apprentices. The owner-manager was informed about the aim of the project and asked if the company wished to participate. If they did, the researcher either booked a date for the first company visit from the health and safety expert and sent the 'toolbox' to the owner-manager (the intervention group) or booked a date for the baseline questionnaire (the control group).

The study was designed as a non-randomized controlled trial where the intervention companies were recruited in December 2016 and January 2017 among training companies whose apprentices completed the basic course in the fall of 2016 and started in the training companies in January 2017. The control companies were recruited in May/June 2017 among training companies whose apprentices completed the basic course in the spring of 2017 and started in the training companies in June/July 2017.

2.3. Measures

Two measures were used in the study: the checklist (intervention only) and the questionnaire (intervention and control).

At both baseline and follow-up, a questionnaire was administered to the apprentice, the journeyman working most closely with the apprentice, and the owner-manager in all participating companies. The questionnaire for the owner-manager and the journeyman contained three subscales on safety climate: Management Safety Priority, Company Risk Acceptance, and Convenience Violations. Management Safety Priority and Company Risk Acceptance were measured using four and three items from subscales of The Nordic Safety Climate Questionnaire respectively (Kines et al., 2011) Sample items: "The owner-manager looks the other way when someone is careless with safety" and "In this company we consider minor accidents to be a normal part of our daily work". Convenience violations were measured using three items from the Danish Safety Culture Questionnaire (Nielsen and Mikkelsen, 2007) originally taken from the general unsafe behavior factor from the Offshore Safety Questionnaire (Mearns et al., 2003). Sample item: "I ignore safety regulations to get the job done".

The baseline questionnaire for the apprentices only included questions on how satisfied they were with their apprenticeship so far and the scale on Convenience Violation, as it was deemed unlikely that they could report validly on company safety climate after only a few days/weeks at the training company. At follow-up, the questionnaire for the apprentices was expanded with all safety climate scales and questions on whether the apprentices had suffered any of 8 specific injury types during their work at the training company.

Chronbach's alpha was calculated for each scale across all participants to check internal consistency. It was somewhat low for the Company Risk Acceptance scale (0.66) while it was acceptable to good for Management Safety Priority (0.76) and Convenience Violations (0.82). Removing the first item from the Company Risk Acceptance scale would increase alpha to 0.76. However, as analysis showed that this did not change any results, the original 3-item version was retained in the analysis.

The response rate was high due to the direct contact with both intervention and control companies. The owner-managers achieved a 99% response rate (100% in the intervention group and 97% in the control group), the journeyman 92% (intervention: 86%, control: 98%) and the apprentices 96% (intervention: 95%, control: 98%). However, a few of the apprentices did not realize that the follow-up questionnaire was two-sided, so some information was missing from these questionnaires, most notably injury experience.

The checklist was used to measure how safe the training companies were for apprentices. At baseline it consisted of 30 checkpoints that tapped into the 11 criteria from the gold standard for good and safe training companies (see Fig. 1). Each criterion had between 1 and 8 checkpoints. For instance, the checkpoints for the criterion "Mutual matching of expectations" included whether there had been an introductory talk between the owner-manager and the apprentice, whether it had been discussed which tools the apprentice had used before, what work tasks the apprentice had previous experience with and what expectations the owner-manager had for safety behavior. The checklist was completed at baseline and follow-up through a discussion with the owner-manager. Each checkpoint was coded as 'OK', 'Not-OK' or 'Non applicable' based on pre-specified requirements and the H&S teacher was instructed to ask for specific examples or other forms of documentations for answers. For instance, the checkpoint regarding the owner-managers expectations for safety behavior could only be coded as 'OK' if the topic had been explicitly addressed by the owner-manager during a conversation with the apprentice. Only 16 of the 30 checkpoints were used at follow-up as 14 of the original checkpoints were related to the apprentices' introduction to the company and were thus not relevant again at follow-up. Of these, only 8 were identical from baseline to follow-up. This was primarily due to different time frames being used; for example, where the checkpoint at baseline was whether the company had *previously* focused on apprentices in their health and safety effort, while the checkpoint at follow-up was whether the company had focused their health and safety effort on apprentices *since baseline*. One extra checkpoint regarding having feedback meetings was added at follow-up. The first author accompanied the H&S teacher on the first five company visits to test the inter-rater reliability of the checklist. During the discussion with the owner-manager, the first author and the H&S teacher both completed a checklist. After each visit, the scores were compared and any disagreements were discussed and the scoring criteria were refined. The checklist showed an acceptable inter-rater reliability of 80% at the start that increased over the five visits.

To evaluate the usefulness of the toolbox, the checklist also included questions on whether the companies had used the different tools. Furthermore, at follow-up, it was checked whether the action plans agreed upon at baseline were completed and the owner-managers were briefly interviewed by the H&S teacher about whether they found the toolbox and the visit from the H&S teacher useful and whether they had changed anything in the way they handled apprentices during the intervention compared with previous apprentices.

2.4. Analysis

Data was analyzed to evaluate recruitment, implementation and effect of the intervention. During the recruitment phase, the effect of the motivational factors was studied by identifying the percentage of companies who agreed to participate and the percentage of dropout during the intervention period. Companies who declined to participate were asked why so that possible adjustments in the intervention could be identified.

The level of implementation of the intervention was identified in

Table 1
Characteristics of the participating training companies.

		Intervention (n = 20 companies)	Control (n = 22 companies)
Trade	Plumbing	50%	30%
	Bricklaying	30%	35%
	Carpentry	20%	35%
Company size	< 10	41%	33%
	10–19	23%	28%
	20+	36%	39%
No. of owner-managers	1	60%	61%
	2	35%	17%
	3	5%	17%
	4	0%	6%
No. of journeymen	< 10	65%	50%
	10–19	10%	25%
	20+	25%	25%
No. of apprentices	1	15%	50%
	2–5	80%	25%
	6–9	0%	25%
	10+	5%	0%
Apprentice worked in the company prior to the apprenticeship	Yes	63%	67%
	No	37%	33%
Company has experience with apprentices	Yes	95%	85%
	No	5%	15%

three ways: Firstly, by counting the number of tools from the toolbox that the training companies used during the intervention period. Secondly, by comparing the percentage of identical checkpoints scored as 'OK' in the checklist at baseline and follow-up by using related *t*-test. This indicated whether the training companies had become safer during the intervention period. Lastly, by using the degree to which the companies had completed the agreed upon action plans at follow-up to measure their commitment to and engagement in the intervention.

The primary effect measure was the number the apprentices who suffered at least one injury during the intervention period. This was calculated by combining the responses to the eight specific injury questions in the follow-up questionnaire for each apprentice. If they reported at least one injury, they were coded as injured and, if they did not, they were coded as non-injured. The percentage of injured apprentices was then compared between the intervention and control group using Fisher's exact test. The secondary effect measure was improvements in safety climate from baseline to follow-up. This was analyzed by comparing means on the three safety climate scales from baseline to follow-up (related *t*-test) and between the control and intervention group (independent *t*-test). All scales were coded such that a high score reflected a positive safety climate. Cohen's d was calculated to evaluate the effect size of the difference between intervention and control on the safety climate scales. Statistical analyses were performed with IBM SPSS v.20.

3. Results

3.1. Recruitment and drop-out

The base population for the intervention and control group consisted of 37 and 44 carpenter, bricklayer or plumbing apprentices who completed the basic course at the participating school in the fall of 2016 and the spring of 2017 respectively. The training companies of 12 of the apprentices (4 from the intervention group and 8 from the control group) were not invited to participate as the target number of approximately 20 companies in both the intervention and control group had been reached before these apprentices were included. Thus, the training companies of 33 apprentices were invited to participate in the intervention. This resulted in 20 companies covering 22 (67%) of the apprentices agreeing to participate in the intervention; the training companies of 7 (21%) apprentices declined and 4 (12%) companies were undecided and thus precluded from the intervention when the target number of 20 companies was reached. In the control group, the training companies of 36 apprentices were invited to participate. Twenty-two of the companies covering 25 (69%) of the apprentices accepted before inclusion was closed. At that time, 6 (17%) companies had declined to participate while 5 (14%) were still undecided. The primary reasons given by the companies for declining the intervention was that they had extensive experience with apprentices and in general no problems with either apprentices or health and safety. One company claimed they were currently too busy to participate but would be interested in the near future. In the control group, the primary reason for declining to participate was a lack of time.

During the intervention, three companies (9%) each with one apprentice dropped out. One filed for bankruptcy while another dismissed the apprentice due to non-attendance. The third company dropped out of the intervention group because, despite repeated efforts, the H&S teacher performing the intervention was unable to contact them at follow-up. Four companies (11%) each with one apprentice dropped out of the control group. They were all excluded because, despite being reminded twice, nobody in the company completed the baseline questionnaire. One of the companies actively withdrew while the other three simply failed to respond.

In total, 67% of the companies invited to participate in the intervention accepted and 58% eventually completed the intervention, while 69% and 58% of the companies invited to participate in the control group accepted and completed the control condition respectively.

As can be seen in Table 1, the training companies were primarily small enterprises with one owner-manager and fewer than 20 employees. There were small differences between the intervention and control group. The most significant difference was the number of concurrent apprentices in the intervention and control companies, where 50% of the control group but only 15% of the intervention group had only one apprentice at the time of the study. There is no apparent reason for this difference, although company size and the number of owner-managers were somewhat higher in the control group. Similarly, there were more plumbing companies in the intervention group and more carpentry companies in the control group. Almost all the companies had prior experience with apprentices. It was surprising that around two-thirds of the apprentices had worked in their training company prior to the apprenticeship; for example, as junior workers or on a trial period before entering the basic course. However, this most likely reflects a recruitment bias, as the study only included apprentices who had an apprenticeship employment at the end of the basic course. Approximately 40% of the apprentices who attended the basic courses, from which the intervention and control groups were recruited, did not have an apprenticeship employment at the end of the basic course. It is unlikely that these apprentices would have worked in their training companies prior to the basic course, as they had to find an apprenticeship after completing their course.

Three motivational factors were included in the intervention to enhance participation: assisting the companies with the mandatory systematic work health and safety obligations, providing the companies with access to promotional materials, and offering the companies a free visit from a health and safety specialist. The possibility to receive assistance with mandatory systematic health and safety obligations was the motivational factor that most of the interviewed owner-managers requested during the tailoring of the intervention. However, in practice, none of the companies took advantage of this option. The extra checkpoints developed on the checklist were not used in any of the companies; however, in a few instances, companies decided on action plans in order to complete a workplace risk assessment. Likewise, as can be seen in Table 2, only three intervention companies ended up using

Table 2
The training companies use of the tools in the toolbox.

	Yes	No	N/A	%-Yes
Baseline visit (n = 20 companies)				
Checklist for introductory talk with apprentice	1	5	14	17%
Test to evaluate person responsible for training apprentice	0	11	9	0%
Information sheet for person responsible for training apprentice	0	9	11	0%
Start-up plan for the first 12 weeks	0	11	9	0%
Poster with typical serious injuries for apprentices	0	15	5	0%
Total used tools at the baseline visit	1	51	48	2%
Follow-up visit (n = 17 companies)				
Test to evaluate person responsible for training apprentice	1	14	2	7%
Information sheet to person responsible for training apprentice	8	6	3	57%
Start-up plan for the first 12 weeks	2	9	6	18%
Checklist for feedback meeting with apprentice	3	5	9	38%
Risk assessment action plan	1	4	12	20%
Poster with typical serious injuries for apprentices	5	12	0	29%
Stickers with the project's logo	3	14	0	18%
Total used tools at follow-up visit	23	64	32	26%
Used at least 1 tool (n = 17) (0–5)	12	5	0	71%

N/A: no opportunity to use tool

Table 3
Average score on the audit at baseline (BL) and follow-up (FU).

	All (# of items)		Identical (# of items)	
Gold standard checklist	BL (30)	FU (17)	BL (8)	FU (8)
Start-up plan for the apprentice (1 point)	0.35	0.29	0.35	0.29
Mutual matching of expectations (8 points)	3.41			
Varied work tasks (1 point)	0.88	0.88	0.88	0.88
Enough time to learn (1 point)	0.76	1.00	0.76	1.00
Adequate instruction (1 point)	0.71	1.00	0.71	1.00
Matching work task with skills (1 point)	0.76	1.00	0.76	1.00
Feedback and recognition (BL: 1 point/ FU: 2 points)	0.41	1.18		
Focus on apprentices in health and safety efforts (3 points)	0.76	0.76		
Prevention activities aimed at the primary injury risks (4 points)	2.59	1.59		
Basics in place (6 points)	4.65			
Assign a person to be responsible for training the apprentice (3 points)	1.12	2.29	1.12	2.29
Total	16.41	10.00	4.59	6.47
% of met checkpoints	55%	59%	57%	81%

the promotional stickers designed to highlight the extra effort the company was making for the health and safety of its apprentices. The motivational factor that was most used was the free visit from a health and safety specialist (either in the company or at a construction site) if an issue was identified during the audit for which external advice was required. This occurred in five cases.

3.2. Implementation (fidelity) of the intervention

A few days after they were included the intervention, companies received the 'toolbox' with the optional tools that could help them implement the intervention. As can be seen in Table 2, the tools had hardly been used at the baseline visit that took place a few days to a few weeks after the apprentice started at the company. During the visit, the H&S teacher presented the tools that could be particularly relevant for the specific company based on the audit with the owner-manager. At follow-up, the tools had been used a little more, especially the information sheet for the journeyman responsible for training the apprentices. The companies used 0–5 of the tools and 12 of the 17 training companies had used at least one of the tools. Not all tools were relevant for all companies; for example, some companies only consisted of the owner-manager and the apprentice, and thus there was no journeyman to evaluate or provide with the information sheet.

During the baseline visit, the H&S teacher audited the company against the gold standard through a semi-structured interviewed with the owner-manager about the conditions in the company. During the interview, the H&S teacher asked about the different checkpoints in the checklist. At baseline, companies averaged 16.4 points out of 30 (55%) on the checklist (range 8–28). At follow-up, the companies averaged 10.0 out of 17 points (59%) on the checklist (range 5–14). On the 8 identical items, the average score increased significantly ($t = -3.52$, $df = 16$, $p = 0.03$) from 4.59 (57%) at baseline to 6.47 (81%) at follow-up (see Table 3). This indicates that the safety level in the training companies improved during the intervention period.

During the audit, the owner-manager was encouraged to formulate action plans for the items where the company did not meet the criteria in the gold standard and wished to improve. In total, 29 action plans (range: 1–3, average 1.7) were formulated in the 17 companies that completed the intervention. Examples include the owner-manager having a feedback meeting with the apprentice, the owner-manager talking to the journeyman responsible for training the apprentice about how to be a good role model, and the company conducting a risk assessment that focuses particularly on the apprentices' work environment. At follow-up, 14 (48%) of the action plans had been implemented. Some of the owner-managers claimed they still planned to implement more of the action plans, such as feedback meetings and risk assessments, and that, until now, they had simply not had time to do so.

3.3. Effect

The primary effect measure in the study was the number of occupational injuries suffered by the apprentices during the study period. Thirty-five apprentices completed the items on injury experience in the follow-up questionnaire, and 83% (29 out of 35) of these apprentices reported suffering at least one injury during the approximately 4 months intervention period. As can be seen in Table 4, the apprentices in the intervention group suffered slightly fewer injuries than the apprentices in the control group. However, the difference is not statistically significant ($p = 0.25$).

The secondary effect measure was improvements in safety climate from baseline to follow-up. In the control group, the results show either no change or minor decreases in the three safety climate scales. In the intervention group, the results show minor non-significant increases in all three scales for both owner-managers and journeymen. By combining these results, we find that there were no differences between the intervention and control companies at baseline, while there were

Table 4
Percentage of apprentices that suffered different types of injuries during the intervention period.

	Intervention (n = 16 apprentices)	Control (n = 19 apprentices)
Cutting injury	69%	47%
Eye injury	56%	74%
Fallen or twisted foot/ ankle	44%	32%
Other injuries	13%	0%
Trapped or caught	6%	11%
Fallen from height	6%	21%
Lifting injury	6%	32%
Hit by falling object	0%	0%
% with at least one injury	75%	89%

Table 5
Changes is safety climate scales from baseline (BL) to follow-up (FU). All scales are coded 1–6. 6 best.

		Owner-manager				Journeymen				Apprentices			
		n	BL	n	FU	n	BL	n	FU	n	BL	n	FU
Management safety priority	Control	19	4.84	17	4.75	20	4.43	20	4.41		–	20	4.23
	Intervention	20	4.93	18	5.11	16	4.58	17	4.72		–	17	4.47
Company risk acceptance	Control	19	4.34	17	4.33	20	4.32	20	4.13**		–	19	4.26
	Intervention	20	4.55	18	4.64	16	4.71	17	4.76**		–	16	4.29
Convenience violations	Control	19	4.47	17	4.43*	20	3.90	20	3.72**	21	3.86	19	3.72
	Intervention	20	4.67	18	4.87*	16	4.23	17	4.31**	19	3.54	17	3.75

* = $p < 0.10$ between intervention and control.
** = $p < 0.05$ between intervention and control.

statistically significant differences at follow-up for the journeymen concerning convenience violations ($t(35) = -2.15$, $p = 0.04$, $d = 0.73$) and company risk acceptance ($t(35) = 2.30$, $p = 0.03$, $d = 0.78$) (see Table 5).

4. Discussion

The purpose of the current study was to pilot test a tailored intervention aimed at creating safe training companies for apprentices in the construction sector in a non-randomized controlled design to examine recruitment, implementation and potential effect of the intervention.

The recruitment showed that 67% of the training companies that were invited to participate accepted and that 58% completed the intervention. This is a satisfactory result as studies have shown that it can be problematic to recruit small construction companies to participate in health and safety programs (Kvorning et al., 2015; Kidd et al., 2004). This group of companies may not be representative of small construction companies in general, but we believe these results can apply to the group of small construction companies that employ apprentices. It does not appear that the content of the intervention deterred companies from participating, which is underlined by the fact that acceptance reached the same level in the intervention group as in the control group, where companies were required to make far less effort (complete questionnaires at baseline and follow-up). The intervention included three motivational factors to enhance participation. These were used as selling points in the recruitment phase and may have been effective in initially convincing companies to participate. However, during the intervention phase, these motivational factors were not widely used. So while the motivational factors may have originally convinced the owner-manager that participation was worthwhile (Kidd et al., 2004), they were not pivotal in the intervention phase, where they were not utilized more than the active work environment factors.

Implementation was evaluated by examining the uptake of tools from the toolbox, the development in company safety level, and implementation of agreed upon action plans. Although 71% of the companies used at least one of the tools from the toolbox, the total uptake of the intervention tools was rather low at 26%. There can be several reasons for this. First of all, use of the tools was optional and was presented as such to the companies. It was never the intention that every tool should be used by every company. Rather, the intention was that, if required, every company could find a tool to remedy the issues that were identified through the audit. Secondly, some of the tools were identified as relevant for some companies but the companies had not used them by the time the follow-up took place. For instance, the checklist developed for feedback meetings with the apprentices was seldom used because the feedback meetings were not due before the follow-up. So it can be assumed that the uptake of tools will increase after follow-up. However, this was not the case for every tool. For example, the test to evaluate the journeyman was simply not used in practice, even though owner-managers had stated that it was a good idea during the development phase. So, thirdly, some of the tools turned out not to be relevant for the companies in practice. There were different reasons for this, one being that many of the apprentices had worked in the training companies prior to the apprenticeship and had therefore already been introduced to the norms and practices at the training companies prior to the intervention. The tools and suggestions for activities designed to introduce the apprentice to the company (for instance, having an introductory talk with a mutual matching of expectations) therefore seemed redundant for some of the owner-managers, and this might have weakened the implementation of the intervention. Thus, the tools and intervention activities need to be further adapted so they can be used under different circumstances, for instance, by focusing more on the start of the apprenticeship and not the start of employment.

The implementation rate of agreed upon action plans was relatively low at 48% at 4-month follow-up. This was somewhat disappointing, although some managers stated that they still planned on implementing more of them. A polite reminder after one or two months could possibly have increased implementation. The last implementation measure was the evaluation of the safety level in the training companies, where a significant increase from baseline to follow-up was identified. This shows that the intervention companies had worked on some of the issues. Taken together, the implementation measures indicate a satisfactory implementation of the intervention, although the completion rate of action plans and uptake of tools could have been higher.

The effect of the intervention was evaluated using questionnaires. Although the apprentices in the intervention group reported fewer injuries during the intervention period than the apprentices in the control group, the difference was insignificant. Minor improvements were measured in all the safety climate scales in the intervention group which, coupled with no or negative development in the control group, meant that significant differences between the intervention and control group were found for 2 out of 7 safety climate measures at follow-up.

Taken together, the results of the pilot test show that the intervention was generally well received and implemented and showed encouraging results in the effect measures that indicate a positive development in the intervention companies. Thus, it seems that the developed intervention is a feasible approach to increasing apprentice safety in smaller construction companies. As it was a pilot test, the study was primarily designed to test recruitment and implementation and not to measure statistically significant effects in the questionnaire (the statistical power was low due to the limited number of training companies included). However, all seven measurements of safety climate in the intervention group show a positive development from baseline to follow-up. This pattern across all measurements may be a small indication that the intervention had a positive effect and that it is not simply random variation that caused two of the measures to show statistically significant improvements. Furthermore, although the statistically significant differences were relatively small, the effect sizes were moderate to large, indicating that they may not be trivial. Still, the differences we see in the intervention group from baseline to follow-up are minor and the positive effect is only realized due to a simultaneous

slight decrease in the control group from baseline to follow-up. Thus, the results should be interpreted with caution.

It is worth noting that the questionnaire data showed that 83% of the apprentices were injured during the approximately 4-month study period. This is in line with previous research that has identified a high risk for injuries during the initial months in a new job (Breslin and Smith, 2006). Although it is likely that most of the injuries reported in the current project are minor, the prevalence of injuries in the study population clearly shows that injuries are significant problems that affect almost all apprentices in the construction sector. Hence, apprentices are at risk of being socialized into a work practice where (minor) injuries are viewed as an inherent part of the job.

The gold standard for good and safe training companies, which was developed during the tailoring of the intervention, is crucial for the intervention as the audit and action plans are based on whether the companies meet the standard. Therefore, it is important that the standard reflects issues that are connected with safety and injury outcomes. The participatory and iterative approach adopted when developing standard assured inclusion of both scientific and practical knowledge. Some of the identified criteria are clearly linked to safety, such as adequate instruction, a focus on apprentices in health and safety efforts, and prevention activities aimed at the primary injury risks. However, other criteria focus more on relational and psychosocial factors and were formulated based on the information given in the interviews with apprentices and owner-managers. These criteria illuminated the fact that the owner-managers seldom knew the specificities of the vocational curriculum taught at school or the level of knowledge and skills of the apprentices when they started at the company. The apprentices also explained that they were unsure of what was expected of them and found it hard to admit to the owner-manager or journeymen that they did not know how to perform specific work tasks. One apprentice explained that he was commissioned for a work task in which he needed to use fall protection equipment but that he did not know how to use it and received no instruction. Based on this information, we found it necessary to include mutual matching of expectations in the gold standard and develop a tool that could ensure such matching. Likewise, in the interviews, the apprentices consistently called for feedback on the work they performed. They often felt uncertain as to whether they had performed a satisfactory job, especially at the start of the apprenticeship when it was important to meet the owner-manager's expectations. For this reason, feedback and recognition was introduced as an important criterion in the gold standard and several of the tools in the toolbox included giving feedback on performance. Identifying social relations as important for health and safety in the training companies is in line with previous research which has shown that social relations are pivotal for the apprehension of health and safety in small businesses (MacEachen et al., 2010).

Although the current study focuses on the role that training companies play in preventing apprentices' injuries and argues that preventive efforts should target companies rather than schools, the point of the study is not to disregard school-based preventive efforts but instead to show that prevention is most effective when vocational school and company-based efforts complement each other (Lipscomb et al., 2008b). However, studies show that there is a greater focus on safety in the schools than at training companies (Grytnes et al., 2018; Lipscomb et al., 2008a) and that apprentices do not receive adequate safety training and role modeling at work sites (Kaskutas et al., 2009). These results are mirrored and expanded in the current study, as many of the interviewed apprentices expressed a high level of loyalty to their training company and a clear understanding that it was (too) expensive for the owner-manager to provide proper scaffolding or rent cranes or lifts for heavy duties. This loyalty toward the company underlines the importance of the owner-manager's attitude, as the apprentices would most likely not complain if they were presented with sub-optimal safety solutions. However, in small construction companies owner-managers often delegate safety responsibilities to the individual workers and do not see themselves as role models (Ozmec et al., 2015) which is in stark contrast to evidence showing that safety leadership is crucial for organizational safety outcomes (Zohar, 2002; Mullen et al., 2017; Zohar and Luria, 2003). Thus, new methods to promote an increased focus on safety introduction and social relations in the training companies are required. It has been argued that opportunities for in-person meetings are essential for creating engagement in occupational health and safety in smaller companies (Cunningham and Sinclair, 2015) and that there is greater safety compliance and training in large contractors (Kaskutas et al., 2009) as they have better and more formalized routines for receiving and training apprentices (Holte and Kjestveit, 2012). This claim is supported by the results of this project, since the owner-managers generally found the audit visits from the H&S teacher helpful because they encouraged them to act on the identified issues and created dialogue with the school.

4.1. Strengths and limitations

The primary strength of this study is the thorough iterative developmental process that involved different types of stakeholders in designing a tailored and flexible intervention. Through the audit interview, the H&S teacher adapted the intervention to focus on the specific problem areas that were relevant for the specific training company. Although this adaptability means that the precise content of the intervention differed from company to company, the ability of the intervention to be tailored to the specific company is important in encouraging companies to participate (Kvorning et al., 2015).

Another strength of the study is that the intervention is aimed at one organizational level (owner-managers) while the primary effect is measured at another level (apprentices). The apprentices were not directly involved in the intervention; however, one way to further strengthen the intervention could be to involve the apprentices in the intervention, e.g. to invite the apprentice and/or the journeyman working most closely with the apprentice to participate in the audit. By doing so, the intervention would very directly create interaction between the owner-manager and the apprentice/journeyman regarding company safety norms and practices and thereby possibly create a stronger mutual obligation towards apprentice safety. However, such increased involvement would also require more resources for the companies to participate, and previous studies have shown that this may be a barrier for some companies (Kidd et al., 2004; Masi and Cagno, 2015)

It is also a strength of the study that it is based on an existing shared responsibility between the school and the training companies for apprentices' education. However, if the intervention were implemented beyond this project, this may also give raise to problems, as the school has no formal right to interfere with the work environment of the training companies in the Danish educational system. The legislation and educational system is different in other countries, such as Sweden, where the apprentices are student workers and are not employed by the training companies. This makes the schools more able to influence and/or select training companies (Grytnes et al., 2018).

The lack of random allocation of the training companies to either the control group or intervention group is a limitation of the study. Companies were allocated to either group based on the year group of the apprentices. Neither researcher nor companies were blinded during or after the allocation. However, in the current project, it is unlikely that this significantly affected the results, as most of the invited companies agreed to participate and there was no difference in recruitment level between the intervention and control group. However, in a large-scale test of the intervention, a blinded randomization to control or intervention would help to evenly disperse unmeasured confounders.

It is also a limitation of the study that it measures safety climate at the individual level, through a questionnaire to single individuals (e.g. journeymen), and not at the group level (with all employees or members of the work group). However, we assume that the journeymen

represent the safety climate emanating from their participation in organizational practices. This method has been used in other studies (Ajslev et al., 2017) though it is more likely to hold with smaller companies than large companies. A further limitation is that the audits were completed through interviews with the owner-managers, whose perception of the company's safety norms and practices may be somewhat idealized and unrepresentative of the actual state of affairs. This could be because they wished to present themselves and their practice in a positive way but also because they might be somewhat distant from the day-to-day practice in the field. Again, this may be more relevant to larger companies, where the owner-manager has a more administrative role, than in smaller companies, where the owner-manager and the apprentice may be the only employees in the company. So, although part of the instruction for the audit interview was to ask for specific examples or other forms of documentation for answers, this is not an objective measure of how safe the companies were for apprentices. However, as owner-managers are pivotal for the norms and practices in companies, it was important that the intervention specifically targeted them, and the audit interviews were used both as a measurement and as an important part of the intervention where the owner-managers reflected on current norms and practices. Furthermore, the implementation was measured by examining the difference in audit scores from baseline to follow-up, so it makes no difference if the level is too high, since this will presumably influence both audit scores equally and thus not the difference between scores.

Finally, it is important to consider that this is only a pilot study that focused primarily on developing an intervention that would be accepted and implemented in training companies in the construction sector. As such, the study was not designed to demonstrate an effect of the intervention and therefore the results from the effect measures should be interpreted with caution. A larger scale study designed to demonstrate a potential effect of the intervention and better control for bias and confounding is required before any firm conclusions can be drawn regarding the effectiveness of the intervention.

5. Conclusion

The study shows a satisfactory recruitment to and implementation of a tailored intervention aimed at creating safe training companies for apprentices in the construction sector. The study also supported the feasibility of the developed intervention as a useful approach to improve apprentice safety in the participating companies. The results of the pilot test indicate that the tailored intervention and gold standard may be effective in preventing apprentice injuries and improving company safety climate in small training companies. Thus, the study supports an approach where injury prevention strategies aimed at improving apprentices' health and safety takes an organizational approach.

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