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# Fall prevention and safety communication training for foremen:Report of a pilot project designed to improve residential construction safety

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## Abstract

**Problem—**Falls from heights account for 64% of residential construction worker fatalities and 20% of missed work days. We hypothesized that worker safety would improve with foremen training in fall prevention and safety communication.

**Method—**Training priorities identified through foreman and apprentice focus groups and surveys were integrated into an 8-hour training. We piloted the training with ten foremen employed by a residential builder. Carpenter trainers contrasted proper methods to protect workers from falls with methods observed at the foremen's worksites. Trainers presented methods to deliver toolbox talks and safety messages. Results from worksite observational audits (n=29) and foremen/crewmember surveys (n=97) administered before and after training were compared.

**Results—**We found that inexperienced workers are exposed to many fall hazards that they are often not prepared to negotiate. Fall protection is used inconsistently and worksite mentorship is often inadequate. Foremen feel pressured to meet productivity demands and some are unsure of the fall protection requirements. After the training, the frequency of daily mentoring and toolbox talks increased, and these talks became more interactive and focused on hazardous daily work tasks. Foremen observed their worksites for fall hazards more often. We observed increased compliance with fall protection and decreased unsafe behaviors during worksite audits.

**Discussion—**Designing the training to meet both foremen's and crewmembers' needs ensured the training was learner-centered and contextually-relevant. This pilot suggests that training residential foremen can increase use of fall protection, improve safety behaviors, and enhance on-the-job training and safety communication at their worksites.

**Impact on Industry—**Construction workers' training should target safety communication and mentoring skills with workers who will lead work crews. Interventions at multiple levels are necessary to increase safety compliance in residential construction and decrease falls from heights.



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**Keywords**

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## 1.Problem

Despite efforts by workers, unions, employers, safety professionals, researchers, and governmental agencies, falls in construction continue to be a significant source of mortality and morbidity. In 2010, falls accounted for one-third of all construction worker fatalities (Bureau of Labor Statistics, 2011). Among construction workers, the incidence rate of nonfatal injuries resulting in days away from work is also one of the highest (BLS, 2007). In 2010, 20% of the days away from work in construction workers were due to falls (BLS, 2011). The actual injury burden from falls is likely much higher than statistics reflect (Shishlov et al., 2011, Welch, 2007, Azaroff et al., 2002, Glazner et al., 1998).

In 2010, 64% of the residential construction worker deaths and 100% of the residential framers fatalities were due to falls (BLS, 2011). Residential apprentice carpenters in the Midwest were twice as likely to experience a fall as were apprentices working commercial construction (Kaskutas, 2010). Unsafe work practices are common in residential construction (Kaskutas et al, 2009), and controlling hazards to reduce falls is especially challenging in this sector of the construction industry. The work environment changes frequently and work crews are often small and dispersed. Individuals working for smaller contractors may be at greater risk, as safety problems are more prevalent at smaller construction companies (Cheng et al, 2010, Ringen, 1995, Shalini, 2009, Kines, 2003). Worksite training is often inadequate (Hung et al, 2010), on-site safety professionals are rare, safety innovation has lagged behind commercial construction, and conventional methods of fall protection are rarely used (Kaskutas et al, 2010). The recent recession has affected the home building industry significantly. The number of single-family home construction starts decreased drastically from 1.7 million in 2005 to approximately 400,000 in 2011 (National Association of Realtors, 2011). For workers in this sector of the construction industry job insecurities abound (Lipscomb et al, 2008). Many residential contractors who survived the housing downturn increase their productivity demands in order to maintain profit margins, raising the potential for decreased attention to safety hazard identification and abatement.

Despite these challenges, the time may be right to make substantial headway in residential fall prevention. The Occupational Safety and Health Administration rescinded the Interim Fall Prevention Guidelines for Residential Construction in 2011 (OSHA Directives, 2011), meaning that home builders must now comply with the conventional methods of fall protection mandated in OSHA’s Construction Standards 1926 (OSHA, 2006). Although OSHA has provided a one-year transitional phase and compliance assistance is available (OSHA Memorandum, 2-15-12), this regulatory change is forcing residential construction contractors to institute major and rapid revisions in their current fall prevention practices.

Safety performance in construction has been associated with many factors, including top management’s attitude toward safety (Levitt, 1975), organizational culture (Molenaar, 2002), superintendent practices (Hinze, 1979; Hinze, 1978a; Levitt, 1987) turnover (Hinze, 1978b), job pressures and crew competition (Hinze, 1978a), good working relationships (Hinze, 1981), and safety meetings and safety budget (Jaselskis, 1996). After finding that safety communication predicted safety behaviors, Cigularov and colleagues (2010) concluded that the construction industry could benefit from positive and constructive error management and enhanced safety communication. This is consistent with the observation that apprentice carpenters who reported safer crew behaviors and a more proactive safety climate experienced fewer falls from heights (Kaskutas et al, 2009).

In industry, safety interactions between supervisors and employees have been reported to decrease unsafe behaviors and improve the safety climate (Zohar et al, 2003). Despite findings that construction supervisors knew more about safety and had higher risk perception ratings than their workers, first line supervisors rarely corrected their workers' unsafe behaviors (Hung et al, 2011). Since mentoring is a key component of the culture of construction work (Rogers, 2007), this is particularly troubling. New union construction workers traditionally complete an apprenticeship to acquire construction skills and safety training. While apprenticeships include several weeks of in-class time per year, the majority of the learning is designed to occur by working side-to-side with senior workers in the field. Despite accreditation by the Bureau of Apprenticeship Training, the quality of the training received in the apprenticeship school and at the worksite varies tremendously, and methods taught in school can conflict with what is practiced in the field (Lipscomb et al, 2008). The top skills demonstrated by superior construction mentors include the ability to communicate, share knowledge, and correct mistakes (Hoffmeister et al, 2011). Much of the feedback provided by journeymen is critical in nature (Lipscomb et al, 2008), with positive feedback a rarity. Safety meetings and informal training are often lacking in small, residential builders (Hung, et al, 2011).

There is some evidence that fall risk among apprentice carpenters can be modified through vigilant school-based training (Evanoff et al, 2011). However, fall safety ultimately depends on what happens at the worksite, rather than in the classroom. We sought to improve the safety and communication skills of residential construction foremen, in order to promote fall prevention behaviors among their crews. There is evidence suggesting that such training can improve construction foremen's safety communication (Smith et al, 2008, Kines et al, 2010). We now describe the development and initial experiences with a fall prevention and safety communication intervention for residential foremen; the work builds on our previous work with apprentice carpenters (Kaskutas et al, 2010). Long term study goals are to explore the effect of the training on the foremen receiving the training, the crewmembers that they supervise, and the worksites they direct. This work is in line with the National Occupational Research Agenda's Strategic Goal to strengthen and extend the reach of quality training and education in the construction industry via mechanisms such as construction safety and health training needs assessments (NORA, 2008).

## 2. Materials and methods

### 2.1 Site of work and research partners

This work represents continued collaboration with the Carpenters District Council of Greater St Louis and Vicinity, the Homebuilders Association of St. Louis and Eastern Missouri and the Carpenters Joint Apprenticeship Program (CJAP) focused on residential fall prevention. Historically, this geographic area has had a large, unionized residential workforce with training supported jointly by the union and contractors who hire union labor. The Institutional Review Board at Washington University School of Medicine approved all procedures for this study.

### 2.2 Identifying Training Needs

To facilitate the development of a curriculum that could improve fall prevention safety communication among residential construction foremen, we gathered data from apprentice carpenters and foremen through surveys and focus groups. Apprentice carpenters were recruited through their training school. An apprenticeship instructor read a recruitment script asking students to complete the written survey during class. Apprentice carpenters with 1–3 years of experience in residential construction were asked to participate in a 60-minute focus group at lunchtime. One large residential contractor invited us to attend their annual safety training to survey all of their foremen. The contractor invited a subgroup of these foremen to participate in a 40-minute focus group; participation was voluntary. All participants provided informed consent.

Surveys and focus group guides used in previous fall protection research with apprentice carpenters (Kaskutas et al, 2009, Lipscomb et al, 2008) were modified specifically for this work. The written surveys asked fall protection knowledge questions and measured self-reported fall protection behavior frequency on a 4-point ordinal scale. We also assessed frequency, content, and usefulness of worksite training, mentorship by senior carpenters, and safety communication delivered by the crew foreman. The focus groups explored fall protection use at the worksite, availability of technology for fall protection, and barriers to use. The frequency, content, delivery, and perceived effectiveness of worksite training was discussed; as was daily safety communication at the worksite, both globally (setting overall expectations) and specifically (task-based feedback).

### 2.3. Development of the Training Curriculum

Results of the needs assessment were summarized and presented to two experienced CJAP instructors. With members of the research team, the instructors identified problem areas and opportunities for training. In order to ensure that principles taught met OSHA standards, Subpart M of 1926 was closely followed (OSHA Directive, 1999). Previously described training methods used in apprentice fall protection efforts were integrated into the training (Kaskutas et al, 2010). Safety communication interventions that have demonstrated efficacy were used (Gillen et al, 2002, Luria et al, 2008, Zohar et al, 2002, Smith et. al, 2010). Detailed lesson plans were written and compiled into a training manual. A carpenter apprentice instructor with recent foreman and superintendent residential experience was recruited to lead the training, along with an instructor with extensive fall protection teaching experience who helped develop the curriculum.

### 2.4 Piloting the Training

The large residential contractor who participated in the foremen's needs assessment recruited ten framing foremen to participate in the pilot training; each foreman provided written consent. The training occurred on two consecutive afternoons in a meeting room at the contractor's office. After training was complete, the foremen rated the usefulness of training and likelihood that they will use the training on a 10-point scale for the training areas: fall protection, worksite audits, toolbox talks, and safety communication. Six to eight weeks after the training, the lead trainer telephoned each foreman to reinforce concepts and trouble-shoot problems that the foreman identified.

### 2.5 Evaluating the pilot training

Worksites of participating foremen were visited by a carpenter research assistant 2–3 weeks before the intervention and twice afterwards (3 and 6-months post-intervention) to administer a written survey to each foreman and his crewmembers, and to perform an observation-based worksite audit to identify potential fall hazards. At least 30 crewmembers completed the survey at each time point. The St. Louis Audit of Fall Risks—SAFR (Kaskutas et al, 2008) measured worksite behaviors for nine domains of home construction: 1) general safety climate and housekeeping, 2) walking/working surfaces over 6' from lower level, 3) floor joist layout/installation, 4) wall layout/building/erection, 5) truss layout/setting, 6) roof sheathing, 7) ladders, 8) scaffolds, 9) conventional and alternative fall protection. Items were scored "yes" if every observation of the condition met described safety criteria; otherwise it was scored "no". Items/domains that were not seen were scored "not applicable," and were not included in the denominators for calculation of observed safe behaviors.

The written surveys were similar to those used for the needs assessment. Fall protection knowledge, frequency of self-reported fall protection behaviors, and safety climate were rated on a 4-point ordinal scale. We also assessed frequency, content, and usefulness of worksite training, mentorship by senior carpenters, and safety communication delivered by the crew foreman.

### 2.6 Data Analysis

We transcribed the focus group audio-tapes verbatim. Transcripts were imported into a text analysis package (QSR, 2000) in order to categorize and summarize major findings based on the major themes in the focus group guide. Straightforward descriptive analyses were conducted on the various surveys (Statistical Package for Social Sciences Statistics Version 18.0.0). Mean percent compliance was computed for items on the worksite audit by dividing the number of observations that met the safety criteria by the total number of observations for each item.

## 3. Results

### 3.1 Training Needs Identified

#### 3.1.1 Needs Assessment Survey Results

**3.1.1.2 Input from Apprentices:** Needs assessment surveys were received from 273 of the 283 apprentices asked to participate (96% participation rate). Apprentices reported many unsafe behaviors when working at heights; including standing on exterior top plates (69%, n=129), walking on floor joists (72%, n=136), climbing unsecured extension ladders (49%, n=134), and climbing step ladders that were folded and leaned onto a wall (47%; n=127). The most common reported reason for not using conventional methods of protection was that they could not be used in certain building situations frequently encountered at work (44% of apprentices). Another reason may be the push for productivity, as 30% (n=81) of the apprentices reported that there was not adequate time to work safely and meet production deadlines, and 28% (n=72) agreed that when pressure builds, their foreman wants them to work faster, rather than by the safety rules. The apprentices reported knowing how to use fall conventional methods of fall protection (91%, n=230), but 17% (n=46) of them noted that fall protection equipment was not available at their worksites.

The majority of the apprentices believed that worker safety was a priority of their foremen and that their foremen were alert to safety problems and concerns. Apprentices generally felt they could report safety violations (81%, n=221); however, only 50% (n=156) perceived that their foreman would consider their suggestions to improve safety. Of concern is the finding that only 55% (n=142) of the apprentices noted that their foreman approaches them to discuss safety. When asked who provides the most guidance about safety, other journeymen on their crew (not the foreman) was the most frequent response (n=120). The majority of apprentices (87%, n=235) noted that journeymen on their crew teach them to work safely. Just over half (51%; n=136) of the apprentices reported receiving instruction, advice, or tips about work methods from experienced workers (journeyman or foreman) on a daily basis; however, 11% (n=29) of the apprentices reported that they never received this type of guidance. Some apprentices (20%, n=54) wanted more daily instruction and only several (4%, n=12) wanted less instruction as they felt "nagged". Most apprentices agreed that they did not already know the information they were being taught on the job (89%; n=243). Daily mentorship messages were described as both task and safety oriented; including learning how to perform a specific work tasks (55%, n=151). Only 36% (n=99) of apprentices surveyed believed that the guidance provided by seasoned workers improved their ability to work safely. Half of the apprentices reported that their foreman provides positive feedback when a job is done safely. Half also agreed that their foreman monitors a worker's behavior more after he has violated a safety rule, and that the foreman gets annoyed when a worker ignores safety rules.

Apprentices reported that toolbox talks occur daily (34%, n=93) or weekly (29%, n=79) at work, yet 17% (n=45) of the apprentices reported they never had tool box talks at work. The typical toolbox talks lasts 10-minutes or less (61%, n=165). The toolbox talks are usually read from a printed handout provided by their contractor (47%, n=122). Some apprentices reported that the crew identifies hazards (36%, n=97) and discusses the best ways to accomplish risky tasks during the toolbox talk (31%, n=85); however they rarely practice performing tasks (8%, n=23).

**3.1.1.2 Input from Foremen:** Surveys were received from all 65 foremen asked to participate; all of these foremen were employed by the same general contractor. Foremen reported the most difficult part of their job was maintaining productivity expectations (35%; n=17), followed by keeping workers safe (27%, n=13), dealing with workers who mess up tasks (12%, n=6), and following the company's safety rules (10%, n=5). Additional comments identified by the foremen included juggling productivity and safety, estimating materials, and dealing with shortages of supplies and materials. Foremen were asked about their understanding of OSHA fall protection standards; 36% (n=22) noted that they understood all of them well, 49% (n=30) understood most of them, 10% (n=6) were unclear about some of them, and 5% (n=3) did not understand most of them. Foremen reported providing instruction, advice, and/or reminders to crewmembers about how to perform a work task, with 49% (n=30) providing direction several times per day and 38% (n=23) providing it daily. Half of the foremen reported that worksite instruction was shared equally between them and other journeymen on their crew. Most foremen (89%, n=58) agreed that they alert their crew to hazards at the worksite; however, 23% of the foremen (n=15) reported they do not share their expectations regarding safety, instruct crewmembers in safe work methods, nor provide reminders about how to perform tasks safely. Forty percent (n=26) of the foremen did not believe that on-the-job instruction of apprentices taught the apprentices to perform work tasks nor to work safely (31%, n=20).

Most of the foremen (81%, n=52) reported giving daily tool box talks that lasted 10-minutes or less (94%, n=58). Given that only two of the foremen reported never having toolbox talks; this may well have been a requirement of the contractor for whom all of these foremen worked. Foremen reported that the toolbox talks focused on identifying current hazards of the worksites (83%, n=54), discussing ways to perform risky tasks (54%, n=35), and discussing the topic on the handout provided (47%, n=29). Three foremen (5%) said the talks were only to sign paperwork documenting a talk had been attended.

**3.1.2 Focus Group Results—**We held three apprentice focus groups with 26 apprentices, and three focus groups with 22 foremen.

**3.1.2.1 Preparation to Work at Heights:** Most apprentices agreed that they were exposed to work at heights immediately, often before training in the work task or safety hazards;

> "They just basically tell us to get up there and get the job done".

Others reported "see one, do one" training:

> "They'll put a guy on the ground at first, and you watch it. So before you go up for the first time, you've at least watched it being done."

Apprentices stated that they felt that they must accept these risks or make decisions about how much risk is acceptable,

> "It's part of the job – working at heights, and you know that. You know when you walk on the job site that there's a good chance of getting hurt, and you just have to take that and not let it happen."

Foremen agreed that all workers at residential worksites are exposed to fall risks, as they work at heights fairly immediately. Foremen described how they assess readiness to perform a task safely.

> "Agility is part of it, you got a guy that shuffles his feet around and can't pick his feet up then he is not going to be very good up there." "You can tell by the way they are acting too. You tell them to get up there and they start shaking in their boots, you can see how they have been working."

The work group forms "a team" that works together and knows each other's capabilities; however it was unclear how new apprentices fit into this and are accommodated for their own safety and that of coworkers.

> "We pretty much know when we get to that point; who the guys are that can get on the roof". "This is why it is so important to keep the crew together."

**3.1.2.2 Productivity Competes with Safety:** Many apprentices identified an intense push towards productivity, which made workers feel pushed to take shortcuts in safety.

> "They're not concerned about you; they're concerned about money". "If you're residential and you don't have something, you don't have the luxury of making a phone call. They could be two hours away, and you can't wait."

The foremen echoed concerns that time competes with safety:

> "So you never have enough time to do things right, you really don't. All you can do is cut down on those mistakes and do it as safely as possible."

The foremen stated that safety is *"time consuming"*, and that the production deadlines are *"nearly impossible"*.

**3.1.2.3 Mentorship on the Job:** Some apprentices work for foremen who are good mentors. One apprentice stated,

> *"I notice him looking at someone doing a job. He'll get their attention, tell them to come down and say 'look man, the way you were doing that wasn't very safe. Try doing it this way'". "My foreman gives a heads up, like this can be dangerous. Try it this way before you just go up and hurt yourself."* An apprentice complimenting his foreman stated, *"if I've only done something a few times, he just always tells me to make sure I do it right. He doesn't get me in a rush."*

The foremen also recognized that it was their responsibility to protect the crew. One foreman participant stated,

> "Something comes up every day where you can tell them that this is how we should do this, or a different way of doing this".

However, other foremen thought apprentices should *"know everything"* from apprentice school. Some apprentices noted that other journeymen on their crew, besides the foreman, are willing to share their ideas about the quickest and safest way to do a task:

> *"They are teaching you to do little things, like if you are setting a ladder on a hill, they will come over and say ' This is how you can do this"*. Some of the apprentices believed that they needed to *"get in good with them"* if they want the journeymen to teach them. Another added, *"Some journeymen are afraid to teach you cause they don't want to lose their job".*

**3.1.2.4 Compliance of Journeymen with Fall Protection:** Apprentices noted that:

> *"A lot of older carpenters still don't like fall protection. They are stuck in their ways".* Several apprentices suggested that the foremen should be trained in fall protection. *"You work with one guy and the next guy says, 'that's stupid, who taught you that?'" "They need to understand that safety rules are not job dependent. You need to do it every time."*

Many foremen realized they were safety role models for their crew,

> *"Yea our crew, they are not dumb, they are watching every single thing we do", they are going to do what you do", "if you overlook some safety issue, the chances are they are going to over look something".* Some foremen admittedly break the safety rules, *"I am going to be honest, there are times I bend the rules, and it is not necessarily a good thing but, you know."*

Other foremen noted that they would like to have a clearer idea of the standards of practice to *"keep everybody on the same page"*. They noted that the rules changed frequently and they did not know which rules were OSHA's and which were their contractors. Several foremen stated that the rules *"lack common sense", "can't be done at a house"*, or are *"more hazardous to you"*.

**3.1.2.5 Negative Feedback Exceeds Positive Feedback:** Many apprentices indicated that negative feedback is the norm:

> "The positive feedback is that you are not getting negative feedback."
>
> "It would be nice if they would notice [the good things] sometimes".

One foreman noted he gave *"pretty good feedback, compliments"*. However another one stated he did *"not giving enough compliments maybe"*. Feedback is often nonverbal; *"Your mood and your reactions speak a lot for how you think your guys are doing"*.

**3.1.2.6 Toolbox Talks can be Improved:** Most apprentices reported that they participate in toolbox talks; however they expressed irritation that *"all you do is sign a piece of paper"*. Sometimes there is actually no written or spoken talk, other times there is, *"everyone passes the paper around, reads it, signs it, and passes it on."*

Some apprentices viewed toolbox talks as punitive,

> "Like the day I shot myself with a nail gun. The next day, I had to give it [toolbox talk] and it was about nail gun safety… they made me show the picture with the nail in my hand.".

Many suggestions were made to improve tool box talks and on-site training, including using real world examples from job sites, making it fun and informative, and to *"make [them] job-related and specific"*. Apprentices suggested having a quick briefing of what is to happen that day, including a review of the hazards. Practicing using new tools was also identified, because *"if you have never used a tool before, some of it is pretty dangerous"*.

Most foremen noted that they deliver the toolbox talk provided by their contractor; however,

> "The topics that they send are not very good. It has nothing to do with what we do most of the time". " I look at what needs to be done that day and go over the safety hazards of the day that are going to be present, what is really going on that day".

They may bring up activities that happened the previous day to make a point, such as close calls, which was also identified by apprentices.

### 3.2 Resultant Training Curriculum

The priorities established for the training curriculum included fall protection methods, fall prevention plans, auditing the worksite to identify hazards, abatement of fall hazards, effective tool box talks, safety communication and feedback, juggling safety with productivity, and empowering journeymen to mentor inexperienced workers. Specific fall protection priority areas identified were installation of floor joists, floor sheathing, exterior walls, and roof trusses. To ensure that training addressed gaps and priorities of the participants, results of the worksite audits and crewmember/foremen were shared initially. Next, the instructor demonstratesd safe methods to perform risky work tasks using a series of pictures of safe and unsafe work methods. When conventional fall protection cannot be used, the instructor identified alternative methods; the need to document these in a site-specific fall prevention plan is emphasized. Training moves out into a shop or field environment in order to apply what was learned in a "real-world" environment. Foremen handled fall protection anchors, reviewed installation directions, and demonstrated installation of these anchors onto a partially built home. The foremen were introduced to a worksite audit that identifies potential fall hazards. Next, the instructor had small foremen groups problem-solve specific methods to perform priority work tasks where there were no clear solutions; the groups presented their solutions to the class.

The second half of the training was devoted to best practices for crewmember training, safety communication and mentorship. Foremen learned how to design short, daily toolbox talks that alerted workers to the fall hazards at the worksite that day and actively engaged the crew in a discussion of safe work methods. Foremen learned about using safety communication and feedback to direct and mentor their crewmembers in safe work behaviors; including techniques for giving appropriate feedback, positive recognition, and daily verbal exchanges emphasizing safety. Lastly, we discussed how to use the journeymen at the worksite to train and mentor inexperienced workers.

### 3.3 Results of Pilot Training

The ten foremen participants had an average of 12.6 years of experience as foremen (SD=8.8 years), and had been employed by this contractor for a mean of 18 years (SD=7.4 years). One of the ten foremen who participated in the pilot training left employment with the contractor between the first and second post-training visit; therefore pre-training and post-training 1 results are for 10 foremen and their crewmembers, and post-training 2 results are from 9 foremen and their crewmembers. We gathered 97 total crewmember surveys during the worksite visits. The mean number of years of experience in the carpentry trade for the participating crewmembers ranged from 7–10 years; most had worked for their foreman at least one year.

**3.3.1 Process Evaluation Results—**The foremen participants were very engaged, interactive, and candid during the training. Training occurred in a small classroom only; a shop environment was not available practice using fall protection. Most of the foremen agreed that the training was useful and that it was likely that they would use material learned (Table 1). The safety communication portion of the training was rated as the most useful and most likely to use, possibly because it was not a topic commonly taught or discussed with foremen.

**3.3.2 Survey Results—**Baseline comparison between the survey results for the ten participating foremen and the crewmembers they supervise demonstrated differences in perspectives regarding toolbox talks. For example, 89% of the foremen reported toolbox talks occurred daily, but only 65% of their crew agreed. The crew rated the toolbox talks as less participatory than the foremen. Most of the foremen (90%) reported that they discussed the best way to do tasks in the toolbox talks; however, only 48% of their crew reported this occurred. The differences between the foremen's and crewmembers' perceptions regarding worksite mentoring were less dramatic. Foremen felt that the feedback they gave to their crewmembers helped them work safely (60%), whereas 45% of the crew believed it improved their safety. Interestingly, 20% of the foremen felt like they were nagging the crew with these safety interactions, while only 3% of the crew felt nagged.

When surveys prior to the training were compared to those after the training to examine the impact of the training, improvements in knowledge, safety behaviors, frequency of toolbox talks, and mentoring of crewmembers were noted. Prior to the training, only 10% of the foremen and crewmembers knew that standing on the top plate of walls was not allowed unless using a personal fall arrest system; after the training, this increased to 40% for both foremen and crewmembers. The frequency of crew-reported unsafe work behaviors decreased from 68% to 44% for standing on exterior top plates of walls, and from 45% to 27% for climbing on a folded step ladder leaned on a wall. Although these rates of unsafe behaviors remain unacceptable, improvements did occur. Crewmembers noted that the frequency of daily toolbox talks increased from 65% at pre-training to 79% at both post-training time-points. The toolbox talks became more participatory, with increased frequency of identification of hazards and discussion of methods to perform risky work tasks. Signatures were no longer considered evidence of providing the toolbox training. The frequency of daily mentoring increased from 71% to 82% per crewmembers and 60% to 89% per foremen. Daily safety communications by other journeymen on the crew also increased (60% to 90%). Most crewmembers rated the increased mentorship as "just right for me"; however, few crewmembers felt it was "too much", and a few responded, "not enough, I want more". Of the ten foremen participating in this research, the number reporting that they performed daily safety inspections increased from two prior to the training to five after the training.

**3.3.3 Outcome Evaluation Results – Worksite Audits—**Table 2 describes the frequency of observations for each scale and observation rates, along with the frequency and percent compliance with safety criteria. Only phases of construction that were occurring during the audit could be measured; therefore, the number of observations was low for some scales. Baseline audits demonstrated 100% compliance for wall openings and roof sheathing, suggesting a commitment to fall protection prior to the training (Table 2). Although compliance with personal fall arrest safety criteria decreased over time, it was observed in use at a higher rate during the second post-training visit. We observed increased safety behaviors in the walking surfaces and truss setting domains, two of the priority areas of the training. Overall compliance with items on the audit showed a gradual increase from 83% overall prior to training, to 85% at the first visit after training, and 88% at the second post-training visit (Table 2).

## 4. Discussion

This research used mixed methods to measure the state of fall protection and safety communication at residential worksites. Input from apprentice carpenters and residential foremen allowed us to identify training priorities and tailor the training intervention to address the broad range of gaps identified. We found that inexperienced workers are exposed to fall hazards that they are often not prepared to negotiate; this was consistent with previous research in this geographic area (Lipscomb et al, 2008). Our findings that school-based teaching is not reinforced at the worksite, and in fact fall protection practices are often incongruent with methods taught in school, agree with earlier work (Kaskutas et al, 2010). We hoped to see more consistent use of fall protection as trends in that direction were observed following revision of the apprentice carpenters' school-based fall protection training (Evanoff et al, 2011), but that was not the case.

The inexperienced workers participating in this study attended apprenticeship school a total of one month per year; the other 11 months were spent at the construction site performing on-the-job training. Most of the residential foremen in this study had never been taught how to deliver safety messages or to train workers, and some were unclear of the correct message to deliver regarding fall protection. Toolbox talks and safety communication at the worksite were not meeting the needs of the apprentices. As a result, many inexperienced workers did not receive the type and amount of worksite training needed to ensure their safety when working at heights. Since construction site safety improves when foremen increase safety messages (Kines et al, 2010), construction foremen should be shown how to teach their crewmembers and provide feedback to shape their safety behaviors. Behavioral integrity, the alignment between a supervisor's words and deeds, is also important (Simon, 2002). Fall prevention may well begin when a foreman 'walks the talk' and provides "on-the-job *learning*" versus "on the job *training*" or "work experience" (National Apprentice ship Act Final Rule, 2008).

This pilot suggests that a foremen's fall prevention and safety communication training curriculum can impact not only participating foremen, but also crewmembers working for the foremen and worksites that the foremen directs. The ten foremen who participated in our pilot training intervention actively engaged in problem-solving discussions for work situations that they commonly encounter. Use of trainers with recent residential construction experience increased relevance and effectiveness of the training. Following this pilot work, we have modified the training program and are testing its effectiveness among 60 residential foremen. This will allow us to more fully evaluate the effects of the training and examine differences between foremen. Given that feedback from foremen and recognition are amongst the most powerful incentives influencing job performance (Stajkovic and Luthans, 2003), this ongoing work has great potential importance.

A strength of this research is that we were able to address fall protection with a large group of residential construction workers, a hard-to-reach sector of workers with excessive morbidity and mortality due to falls. Partnerships developed through prior research collaborations with the apprenticeship training program, local residential contractors, and the carpenters' union, were instrumental. Another strength of this work is that we manualized the curriculum; therefore it can easily be delivered in other residential construction groups. There were numerous challenges which we needed to overcome in order to conduct this study. The same reasons that make control of risk in residential construction challenging, create obstacles to definitive research efforts. Even in a unionized workforce with joint labor-management ties, it is not easy to recruit large groups for research efforts. We wanted input from foremen participants as well as the crews who work under them. When worksites have typically five or fewer carpenters, the collection from large numbers of workers is very difficult.

The constantly changing state of residential construction sites prevented us from observing all aspect of the construction process measured by the SAFR at each visit. While the apprentice group was a representative sample of inexperienced union carpenters in our geographical area, the foremen sample was drawn from one contractor noted for its active safety program. Thus, the foremen's responses may not be representative of residential foremen in general. Similarly, the training program was tested in a group of ten foremen from this same contactor. Finally, our study is occurring in the midst of a dramatic economic downturn in new home construction, which has resulted in changes in crew composition (more senior workers are more likely to remain in the construction workforce) and may in part account for safety shortcuts to maintain profitability, as a challenging economic climate may lead to the prioritization of production over safety in construction (Wadick, 2007).

This formative work and pilot study were conducted before OSHA rescinded the Interim Fall Prevention Guidelines for Residential Construction in 2011 (OSHA Directives, 2011). The training has since been modified to comply with the conventional methods of fall protection mandated in OSHA's Construction Standards 1926 (OSHA, 2006). As we proceed with an intervention study based on a revised training program, we may find that OSHA's national regulatory mandate changes the effectiveness of foreman training, or raises the baseline levels of fall prevention activities. Despite the challenges of field research in residential construction settings, we believe this work is important due to the high risk of the work, and the presence of modifiable risk factors.

## 5. Conclusion

A multi-faceted approach is needed to decrease falls from heights in residential construction workers. This research identified a wide range of fall protection and safety communication training opportunities for foremen working in residential construction. The 8-hour training curriculum was well-received among foremen and there are some indicators of improvements in safety behaviors, on-the-job fall protection training, and safety communication among foremen and crew. These findings came from an initial pilot study with a limited sample. More comprehensive evaluation of training effectiveness must await results of our ongoing study of 60 foremen from multiple contractors. In future studies, efforts should be directed across organizational levels and the effects should be monitored over a longer period of time.

### Impact on Industry

Construction workers' training should target safety communication and mentoring skills among workers who will lead work crews. This study demonstrates how a structured process can be used to identify and remedy gaps and improve safety training for crew members through efforts focused on their foremen. The challenges, and potential implications, are greater in the non-union sector, where most U.S. residential work is done. Interventions at multiple levels are necessary to increase safety compliance in residential construction and decrease falls from heights.

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**Table 1**

Pilot Participants Ratings of Foremen Training on 1–10 point scale* (n=10)

| | Fall Prevention | Worksite audit | Safety communication | Toolbox talks |
|---|---|---|---|---|
| **Training useful** | 6.2 | 7.2 | 7.6 | 7.1 |
| **Likely to use** | 7.4 | 7.8 | 8.0 | 7.9 |

*1=least positive response, 10= most positive response

## Table 2

Number and rate of observations and compliance with safety criteria at each time point

| | Baseline (n=10) | | Post-training 1 (n=10) | | Post-training 2 (n=9) | |
|---|---|---|---|---|---|---|
| **Scale** | **Items observed/All items (Rate)** | **Items safe/All items (Rate)** | **Items observed/All items (Rate)** | **Items safe/All items (Rate)** | **Items observed/All items (Rate)** | **Items safe/All items (Rate)** |
| General Safety | 30/30 (100%) | 29/30 (97%) | 30/30 (100%) | 28/30 (93%) | 27/27 (100%) | 25/27 (93%) |
| Walking Surface | 27/60 (45%) | 17/27 (63%) | 31/60 (52%) | 21/31 (68%) | 28/54 (52%) | 23/28 (82%) |
| Wall Openings | 12/20 (60%) | 12/12 (100%) | 10/20 (50%) | 10/10 (100%) | 14/18 (78%) | 12/14 (86%) |
| Truss Setting | 4/60 (7%) | 2/4 (50%) | 4/60 (7%) | 1/4 (25%) | 3/54 (6%) | 3/3 (100) |
| Roof Sheathing | 8/70 (11%) | 8/8 (100%) | 20/70 (29%) | 19/20 (95%) | 19/63 (30%) | 19/19 (100%) |
| Ladders | 36/100 (36%) | 31/36 (80%) | 27/100 (27%) | 24/27 (89%) | 31/90 (34%) | 27/31 (87%) |
| Personal Fall Arrest | 2/20 (10%) | 2/2 (100%) | 2/20 (10%) | 2/2 (100%) | 4/18 (22%) | 2/4 (50%) |
| **Overall** | **127/520 (24%)** | **106/127 (83%)** | **124/520 (24%)** | **105/124 (85%)** | **126/468 (26%)** | **111/126 (88%)** |

Not all items could be observed at each audit due to phase of construction, floor joist and scaffold scales not are included in overall ratings but not scale ratings due to low rates of observation.