

Occupational Injuries and Communications in Swedish Agriculture Safety Interventions

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Abstract

Systemic changes in Swedish agriculture have seen the average farm size increase, employees become more common, adoption of new technologies and an ageing farm population. This has led to many new physical and psychological health risks and the need for continued work in preventing occupational injuries. To date, education has been the main tool (in terms of total spending) used by stakeholders to influence work safety behaviour. However, this approach has been criticised by occupational safety experts for being inefficient, if not largely ineffective. It is often unclear whether the education tool itself or its implementation is the problem. Given the need to improve safety at work within agriculture and identify the mechanisms underlying intervention outcomes, this thesis explored work safety interventions in Sweden and sought to develop a deeper understanding of how motivation can be used to effect behavioural change and the underlying cognitive factors promoting or hindering these changes. Over a six-year period, four studies were carried out using mixed methods and covering topics such as occupational safety intervention implementation, outcomes, fear appeals and cognitive mediation processes. The results confirmed that there is marked under-reporting of occupational injuries in Sweden. More importantly, they showed that, despite substantial efforts to reduce occupational injuries, on taking into account the reduced labour demand in agriculture and the decline in the number of farms since 2004, the rate of occupational injuries has not significantly decreased. Fear appeals were found to be the most common motivational tool used by the largest organisations in Sweden to influence work safety behaviours. Use of an extended parallel processing model (EPPM) to describe and evaluate marketing communications revealed a mismatch between the types of threats used in communications and the behaviours promoted. Contradictory evidence was also found. On the one hand, some farmers interviewed seemed to be aware of the most common threats in their environment and nearly all had made at least some changes to their work safety environment (crediting an intervention that took place one year earlier), indicating that the intervention had worked in terms of generating awareness and stimulating adaptive behaviours. On the other hand, many of the same farmers who had made adaptive changes also showed clear signs of maladaptation. These insights can be applied to address the communication motivation and cognitive challenges in safety interventions in Swedish agriculture.

Keywords: Agriculture, Farmer, Injury prevention, Injury statistics, Occupational injuries, Safety intervention program, Safe Farmers Common Sense, Marketing communications, Fear appeals, Extended parallel processing model, Cognitive mediation process.

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Dedication

This thesis is dedicated to all stakeholders who have the power to influence farmers' safe behaviour.

“If not every farmer is the same, why should an intervention be?”
(Catharina Alwall Svennefelt, 2019)

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List of publications

This thesis is based on the following papers, referred to by Roman numerals in the text:

- I Alwall Svennefelt, C. & Lundqvist, P. (2019). “Safe Farmers’ Common Sense”, a national 5-year education-based program for prevention of occupational injuries in Swedish agriculture – background, process and evaluation. *Submitted*.
- II Pinzke, S., Alwall Svennefelt, C. & Lundqvist, P. (2018). Occupational injuries in Swedish agriculture: Development and preventive actions. *Journal of Agricultural Safety and Health* 24(4), 193-2011.
- III Alwall Svennefelt, C., Hunter, E. & Palsdottir, A.M. (2019). Work safety interventions and threat complexity: A formative investigation into why farmers don’t act safely. *Published online in Annals of Agricultural and Environmental Medicine*
- IV Alwall Svennefelt, C., Hunter, E. & Lundqvist, P. (2018). Evaluating the Swedish approach to motivating improved work safety conditions on farms: Insights from fear appeals and the extended parallel processing model. *Journal of Agromedicine* 23(4), 355-373.

Papers II-IV are reproduced with the permission of the publishers.

My contribution to the papers included in this thesis was as follows:

- I Planned the study together with the second author, including making all preparations and research. Performed the analysis jointly with the co-author. Had the overall responsibility for writing the paper.
- II Planned and decided the content of the paper together with the co-authors. Performed the analysis and wrote the paper jointly with the other co-authors and Statistics Sweden.
- III Planned the study together with the second author, including making all preparations and research. Performed the analysis jointly with the other co-authors. Had the overall responsibility for writing the paper.
- IV Planned the study together with the second author, including making all preparations and conducting interviews. Performed the analyses together with all co-authors. Had the overall responsibility for writing the paper.

Definitions applied in the thesis

Accident	That occurrence in a sequence of events which usually produces unintended injury, death or property damage. Often the term 'accident' is used in casual conversation to mean 'injury', such as when collecting 'farm accident data' (Murphy, 1992). In this thesis, the term 'injury' is used instead of accident.
Attitude	A learn predisposition to think, feel and behave toward a person (or object) in a particular way (Allport, 1954).
Efficacy	Beliefs about the effectiveness of the recommended response in deterring or avoiding the threat (Rogers, 1975).
Farmer	Self-employed individual working in agriculture.
Farming	The practice of agriculture (Murphy, 1992).
Fatal injury	An injury that results in death to the victim.
Fear	A negatively-valenced emotions, accompanied by high level of arousal and is elicited by a threat that is perceived to be significant and personally relevant (Leventhal, 1970).
Health and Safety	The principles that are intended to keep people safe from injury or disease at work. The term used in this thesis is 'safety'.
Injury	Physical harm or damage to the body resulting from an exchange, usually acute, harm or damage to the body caused by exposure to physical energy (such as mechanical, chemical <i>etc.</i>) in amounts or rates that exceed the threshold of human tolerance (Murphy, 1992). This thesis deals with occupational injuries to farmers. The terms used in this thesis are 'fatal injuries' and 'non-fatal injuries'.
Injury prevention	An effort to prevent or reduce the severity of bodily injuries caused by external mechanisms.

Maladaptive Behaviour	Refers to the type of behaviour that inhibits a person's ability to ad certain situations (Janis, 1967).
Occupational injury	Bodily damage resulting from work (ILO, 1998). In this thesis, 'occupational injury' is used for injuries that occurred during work on the farm
Response efficacy	Beliefs about the effectiveness of the recommended response in deterring the threat (Witte, 1992; Rogers, 1983).
Risk	The likelihood of injury occurring to an individual as a result of exposure to, or contact with, a hazard (Ridley & Channing, 2008).
Safety intervention	An attempt to change how things are done in order to improve safety. Within the workplace, it could be any new programme, practice or initiative intended to improve safety (<i>e.g.</i> engineering intervention, training programme).
Safety	A state in which hazards and conditions leading to physical or psychological harm are controlled in order to preserve the health and well-being of individuals (WHO, 1998).
Self- efficacy	Beliefs about one's ability to perform the recommended, <i>e.g.</i> in response to avert a threat (Bandura, 1977).
Severity	Beliefs about the significance or magnitude of the threat (Leventahl, 1970).
Threat	A danger or harm that exists in the environment whether one knows it or not. Perceived threat is cognition or thoughts about danger or harm. Perceived threat is comprised of two underlying dimensions, severity and susceptibility (Witte, 1992).

Introduction

One of Sweden's most hazardous industries is struggling to provide safe working environments in the face of demographic changes in the agricultural workforce, new technologies, new kinds of enterprises, pushback against regulation and other forces. Such changes introduce new forms of occupational risk and create a greater need for appropriate safety communications.

This thesis explores work safety interventions and communications in Swedish agriculture and seeks to develop an understanding of how they influence farmers' work safety.

Background and context

Work on farms involves animal production, crop production, forest management, maintenance of buildings and machinery, planning and personnel management, as well as administrative tasks. Activities such as external contract work, processing of products and on-farm food markets, agritourism *etc.* are also common (Statistics Sweden, 2018).

Structural developments in Swedish agriculture over the past few decades have led to fewer, but larger, farms. In 2013, there were a total of 67,146 farms in Sweden and by 2016 there were 62,937, which corresponds to a decrease of 35% since 1990 (Statistics Sweden, 2017). Family farms are the dominant mode of operation, with few people employed and where working alone is common. 92% of Swedish farms are run by self-employed farmers (with no employees). There is a great diversity of operations, ranging from small family farms with a small number of animals and crop production to huge commercial farms employing many staff (Statistics Sweden, 2018). Nearly 6700 farms have between one and four employees. In total, there are 52,600 employees in the agricultural sector in Sweden. However, there has been a trend since 2007 for an increase in the number of temporary and seasonal employees on individual farms. Since 2007, the number of temporary employees in Swedish farming has increased by 63% (SWEA, 2017).

One in three Swedish farmers is 65 years or older. Women represent around one-third of Swedish farmers (Statistics Sweden, 2018). It is common for both small children and teenagers who grow up on farms to be present in the working environment for adults, where they play, watch, help or perform actual adult tasks. Other family members and close relatives also often participate in the work on the farm, for example on weekends, in the evenings or during intensive periods such as harvesting and spring tillage. It is very common for farmers, close family members and other relatives to continue agricultural activities past the age of 65 (Nilsson 2016a, 2010; Nilsson & Pinzke, 2011).

Occupational injuries and fatalities in Swedish agriculture

Farming is estimated to be one of the most hazardous industries in terms of number of fatal and non-fatal injuries (HSE, 2017; Eurostat, 2017; BLS, 2017; NIOSH, 2017). There is documented evidence that people working in agriculture have more than double the risk of work-related fatal and non-fatal injuries involving the farmers themselves, their families and employees compared with other sectors (Volkmer & Lucas Molitor, 2018; BLS, 2017; HSE, 2017; NIOSH, 2017; Svendsen *et al.*, 2014).

Agriculture construction and transport are the sectors with the highest rates of occupational injuries in Sweden (SWEA, 2017). A study some years ago comparing the Nordic countries found that in the period 2003-2008, Sweden had the highest rate of work-related fatalities (Tómasson *et al.*, 2011). However, there was a declining trend in the total number of occupational injuries in Sweden during the period 1996-2016 when taking into account the number of people actively involved in the relevant sectors (Figure 1). The decline was more pronounced for the agriculture sector than for the sum of all occupations in Sweden.

Despite this, fatality rates are still high in agriculture, 6.1 injuries per 100,000 employees compared with 0.8 per 100,000 employees for all industries in Sweden. In the official statistics for 1996, 1017 work-related injuries (including 20 fatalities) in Swedish agriculture were reported. The corresponding number for 2016 was 281 injuries, including six fatalities (Statistics Sweden, 1996-2016). During the period 2012-2016, 21 fatal injuries occurred, all of which involved men (SWEA, 2017).

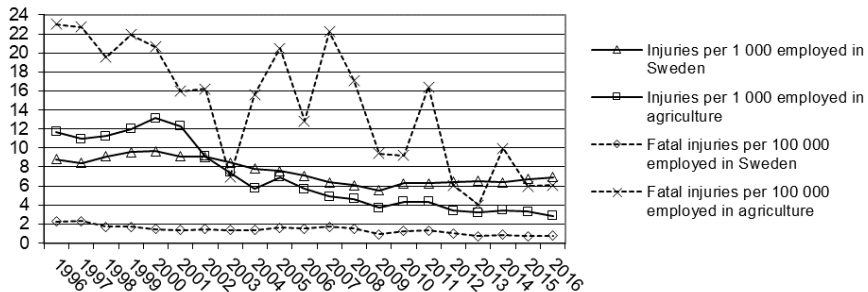


Figure 1. Reported occupational injuries in Sweden as a whole and in the agriculture sector (including, hunting, forestry and fishing), 1996-2016. Number of cases per 1000 employees and fatal injuries per 100,000 employees (Statistics Sweden, 1996-2016).

The official statistics on occupational injuries are based on injury reports to the Swedish Social Insurance Agency, but around nine out of 10 work-related injuries in agriculture are not reported to the agency (Pinzke & Lundqvist, 2007). It is well known that there is a high level of under-reporting of

occupational injuries, especially in agriculture, where farmers are generally self-employed. International studies also show under-reporting of injuries in agriculture (*e.g.* Chapman, 2017; NIOSH, 2017; Donham & Thelin, 2016, 2006; Karttunen, 2014; Solomon *et al.*, 2007). According to Statistics Sweden (2005), approximately 400 work-related injuries were reported in agriculture in 2004, but Pinzke & Lundqvist (2007) found that there were about 5000 occupational injuries in the sector in that year. This means that only 8% of injuries emerge in the official statistics, which could have consequences on both the individual and the societal level since if few injuries are reported, then the impression given is that this is a minor problem. It is very important to investigate occupational injuries to improve risk awareness, safety and preventive work environment measures in this sector (SWEA, 2015, 2013; Swedish Board of Agriculture, 2007). By comparing the frequency and extent of injuries caused by various health and safety issues, it is possible to obtain an indication of the problems that are most and least serious (Statistics Sweden, 2003).

Working conditions and external factors

Many work-related injuries in Sweden occur partly because the agriculture sector consists of many small workplaces performing a range of different tasks. Many of these tasks are risky and the nature and intensity of the work differs depending on the season and type of farming (*e.g.* Pinzke & Lundqvist, 2007).

The farmer often works alone, which can be risky for example when working with machinery and large animals (Figure 2). Machines are an integral part of agricultural work and therefore constitute an important factor contributing to elevated risks of injuries. The risks increase if machines are poorly designed, poorly maintained or improperly used (Lundqvist, 1996). Working with animals can be risky work, involving the danger of being trampled and kicked, while often also involving heavy work in poor work postures (Lindahl *et al.*, 2016; Pinzke, 2016; Löfqvist *et al.*, 2015; Lindahl, 2014; Lunner Kolstrup & Pinzke, 2013). In addition the work involves exposure to environmental factors such as poor lighting, noise, high levels of dust, gases, hazardous chemicals and climate factors (Lundqvist, 1996).

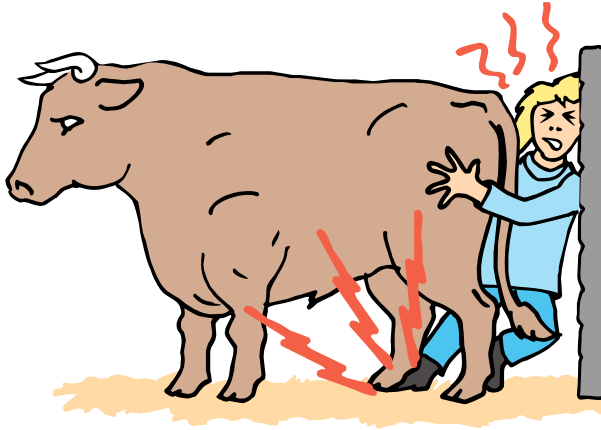


Figure 2. Working with cattle carries a risk of being trampled, butted or kicked and involves heavy work in poor work postures and exposure to environmental hazards such as dust, gases and noise (Illustration from Safe Farmers Common Sense).

Dairy production is the largest and most valuable enterprise in the agriculture sector and accounts for just over 20% of the total value of Swedish agricultural production (Statistics Sweden, 2018). Working in livestock production has been identified as a particularly risky occupation, with higher injury rates compared with other industrial sectors (*e.g.* Lindahl, 2014; Kolstrup, 2008). Previous studies have also found that dairy producers in particular experience more stress than other types of farmer (*e.g.* Lindahl & Lind, 2017; Douphrate *et al.*, 2013; Lunner Kolstrup & Lundqvist, 2013; Wallis & Dollard, 2008; Pinzke & Lundqvist, 2007). The injury risks are most severe when handling larger animals, such as cattle, horses and pigs (*e.g.* Lindahl *et al.*, 2015; Lindahl, 2014; Lundqvist, 2011).

Working with animals often includes working with large, heavy hay and straw bales (Figure 3). During 2018, four people were killed when handling big bales on Swedish farms (SWEA, 2017). A compilation of fatal injuries that occurred in connection with big-bale handling between 2005 and 2018 is presented in a recent report by the Swedish organisation *Health and Safety Consulting for Farmers* (Ivarsson *et al.*, 2018).



Figure 3. Working with large hay and straw bales involves particular risks (Illustration from Safe Farmers Common Sense).

Many work-related injuries on farms are directly connected to the use of machinery. For example, there is a risk of being crushed, of clothing getting caught in rotating parts or of the machine starting when maintenance is being carried out. Entanglement with the rotating power take-off (PTO) at the back of tractors (Figure 4) is a rather common type of injury that can lead to permanent disability or death (Tinc & Sorensen, 2019). However, machine-related work injuries can often be prevented early in the machine design and production stages and through installation of appropriate guards (SWEA, 2017).

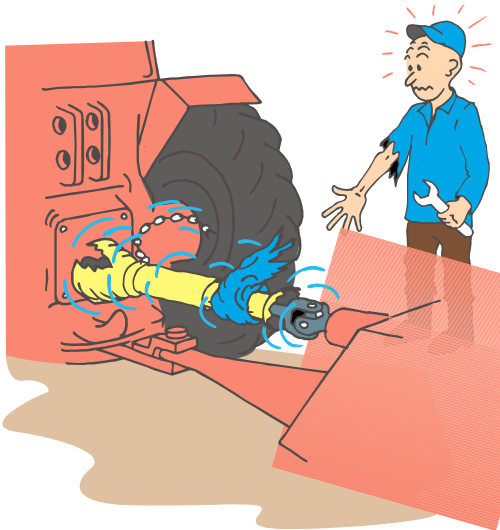


Figure 4. The rotating power take-off (PTO) at the back of tractors poses a risk of entanglement (Illustration from Safe Farmers Common Sense).

According to Pinzke and Lundqvist (2007), in 2004 the most common tractor-related occupational injuries in Sweden occurred during connection and disconnection of machinery, wagons and other implements.

As regards farm buildings and equipment, most injuries occur during repair and maintenance work. In addition to vehicle injuries and other injuries that occur on farms, farm vehicle drivers can also be involved in collisions and overturns involving tractors and all-terrain vehicles (ATVs) (Figure 5) (e.g. Stave *et al.*, 2017; The Swedish Transport Administration, 2013; Geng & Adolsson, 2013; Lundqvist, 2010) and other slow-moving vehicles (SMVs) on public roads. These collisions often lead to injuries to farmers, family members, farm workers and other road users (Pinzke *et al.*, 2014).

Work with tractors often carries an increased risk of injuries due to a number of risk factors with moving parts such as the power-take off (PTO) and the components of the many different machines attached. Driving without a roll-over protection system (ROPS) has led to many fatalities world-wide in countries without appropriate legislation (e.g. Caffaro *et al.*, 2018; Lundqvist, 2012; Sorensen, 2009).



Figure 5. Overturns involving all-terrain vehicles are a common risk of farms (Illustration from Farm Safe New Zealand).

Another common source of injury is falls, often from ladders and platforms (Figure 6), and injuries due to flying or falling objects, often during repair work (SWEA, 2018; Lindahl *et al.*, 2008). Injuries during forestry work mainly occur when working with chainsaws (Figure 6). Injuries also often occur in connection with handling of firewood, e.g., chop damage to fingers (Pinzke & Lundqvist, 2007).

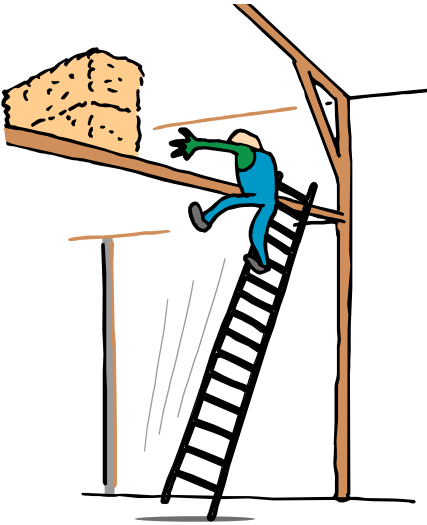


Figure 6. Other common risks on farms are falls from ladders and injuries involving work with chainsaws and firewood (Illustrations from Safe Farmers Common Sense).

Individual human factors

Stress and fatigue increase the risks of occupational injuries in agriculture. According to Pinzke (2018), farmers often suffer from fatigue, sleep disorders and insomnia, which can be related to the high workload and stress to which they are exposed. There is a strong connection between work with heavy loads

and conditions in the work environment (SWEA, 2017). Handling of heavy loads is often associated with heavy lifting, repetitive work and uncomfortable, strenuous and stressful postures and work movements (e.g. Pinzke & Lavesson, 2018). High work rates and stress can contribute to the development of stress disorders (Lindahl *et al.*, 2015). Lack of good visibility can also contribute to poor work postures (Pinzke, 2018). Overall, stress and fatigue in farmers can affect their ability to make decisions in dangerous situations such as working with machines, tools or animals.

Farmer age and farm ownership are often significantly associated with an increased risk of farm work-related injuries (Nilsson, 2013; Pinzke & Lundqvist, 2007). Because farming is largely a way of life, farmers often continue to work past retirement age. Vision, hearing and reaction ability deteriorate with age, but despite this most farmers continue to work as they have always done (Nilsson, 2016a). Two-thirds of the injuries in Swedish agriculture affect men of working age, with men in the older population (65+) being clearly affected (Nilsson, 2016a, 2013). The increasing trend seen for women working in agriculture is associated with higher risks of occupational injury within the context of the gendered role where men and women often work with different tasks on the farm. Livestock have been identified as a major agent of injury for women (Geng & Lindahl, 2015; Andersson & Lundqvist, 2014).

International studies found that individuals younger than 19 years and older than 65 years have an increased risk of work-related injuries in agriculture (e.g. Caffaro *et al.*, 2018; Kim *et al.*, 2016; Donham & Thelin, 2016; Karttunen, 2014; Murphy, 1992). The agricultural environment contains many risks. The children are particularly vulnerable because the farm is often home, playground and workplace. The risk of injury among the elderly may increase as they lose certain physical, cognitive and emotional skills.

Farm safety interventions in Sweden

Farm safety studies in the 1980s were often of a mapping and descriptive nature (Jansson, 1989; Lundqvist, 1988; Thelin, 1980). The occupational healthcare agency for the agricultural sector, Farm Health (*Lantbrukshälsan*) was the most active body during the 1980s (Höglund, 1990), but there was no scientific evaluation of its effect on the injury rate (Lundqvist, 2012). During the 1990s, the Working Life Fund (*Arbetslivsfonden*) was established and provided great opportunities for subsidised work environment improvements on farms. The farmers who were able to take part of this initiative invested primarily in the physical environment and to a much lesser extent (in relation to other sectors) in rehabilitation efforts, organisational development or skills development. In a follow-up evaluation, the farmers themselves reported that the injury risks had decreased significantly, due to new equipment, new machines *etc.* (Lundqvist, 1996).

Substantial combined efforts to promote safety on Swedish farms in the past were generally based on one or more of Haddon's "E-principles" (Haddon, 1980), the first three of which were later supplemented with financial incentives. These were: 1) *Enforcement: Legislation and rules* such as provisions for work with livestock (e.g. Lindahl, 2014; Kolstrup, 2008) or legislation regarding chainsaws (Synwolt, 2001) or roll-over protection systems (ROPS) (Thorson & Springfeldt, 1999). 2) *Engineering/Environment: Technology, environment and product design/modifications* such as ROPS on tractors and assessment of the impact of mandatory ROPS regulations on injury rate (e.g. Springfeldt *et al.*, 1998; Springfeldt, 1993). 3) *Education: Education, advice and information* in order to improve skills among farmers, e.g. public information campaigns on safe farming, workshops, safety fairs for farmers, safety days and insurance programmes (e.g. Danielson, 2013; Lundqvist, 2012; Stave, 2005).

Because farmers have a work environment that is associated with many safety risks and the farm is not just a workplace, but also a home environment for the entire farming family, not least children, there have been particular efforts to prevent injuries affecting children in agriculture (Nilsson, 2016b, 2013). Injury prevention efforts for children in agriculture are particularly important because of the many dangerous farm places and situations in which they can be injured (Lundqvist *et al.*, 2013).

Due to the high proportion of farmers and family members who remain active in farming to a high age, there is also a need for different measures to reduce the risk of injuries among the elderly (e.g. Nilsson, 2016a, 2013). Certain measures to improve safety on farms may also include financial incentives, such as insurance offers (Lundqvist, 2012).

Advisory service

A study by the Swedish Board of Agriculture (2007) found that agricultural injuries in Sweden cost Swedish society SEK 2-3 billion per year. As a result, it proposed a number of measures, such as farm-based advice on work environment issues and the need to pay special attention to vulnerable groups such as children and the elderly in agriculture. The report also stated that the farmer often has problems recognising the injury risks on the farm and therefore needs help to handle this "home blindness". The report concluded that in order for farmers to change their behaviour, they must first understand and realise the risks of their way of working. The report suggested that the most effective way to influence farmers is through farm advice by person-to-person communication (Swedish Board of Agriculture, 2007). The recommended tool to work with health & safety according to the Swedish Work Environment Authority (SWEA) is to follow the directives for systematic work environment improvement (SAM) (SWEA, 2015). The term 'systematic' refers to persistence in combination with consistent work. For the working environment advisor, this means giving farmers guidelines and tools for organising practical health and safety work on the farm (Figure 7). In

Sweden, farm advice (advisory services) has played an important role in efforts to change the attitudes and behaviour of farmers. Advisory services have been provided for a long time, within *e.g.* advice on external environmental factors, production and finances to support the development of agriculture (Swedish Board of Agriculture, 2007). This is also the case in an international perspective (Lewis *et al.*, 2013).



Figure 7. The working environment advisor gives farmers guidelines and tools for organising practical health & safety work on the farm (Alwall Svennefelt & Lundqvist, 2010).

Stakeholders in collaboration

The Swedish strategy for education-based interventions to reduce occupational injuries in agriculture during the past 10-15 years has included important components such as collaboration between industry, researchers and government with the focus on knowledge, attitude and behaviour (*e.g.* Danielson, 2013; Antonsson *et al.*, 2009; Stave *et al.*, 2007). This coordinated approach has also been applied in other countries, such as the United States and New Zealand (Tinc & Sorensen, 2019; Lundqvist, 2012; Scharf *et al.*, 1998). It seems to be an efficient way of using limited resources to achieve a higher impact in dealing with specific problems such as occupational injuries in agriculture (Lundqvist & Alwall Svennefelt, 2012).

A study by Pinzke & Lundqvist (2007) on occupational injuries in Swedish agriculture resulted in a number of initiatives to reduce work injuries in Swedish agriculture. One of the most significant of these initiatives was the education-based advice and information program Safe Farmers' Common Sense (*Säkert Bondförnuft*), which was influenced by Farm Safe New Zealand (Morgaine *et al.*, 2006) and *e.g.* the US National Childhood Agricultural Injury Prevention Program (Lee, 1997). The Swedish programme consisted of EU-subsidised, farm-focused advice and training courses that ran between 2009

and 2013, with the goal of reducing the number of injuries by 50%. The main focus of the programme was on changing farmers' attitudes and motivating them to act in a safe manner. The programme was implemented through a system of educated supervisors meeting with farmers: a) on farm walks or at farmers' meetings, in order to present the problem and injury prevention possibilities, b) by inviting farmers to take part in a three-step course to learn about risks and how to draw up safety plans for their own farms in collaboration with other farmers, or c) by having a supervisor visit the individual farm to discuss safety and to get the safety action plan started (Figure 8). The supervisors (n=180) were in most cases part-time farmers trained by The Swedish University of Agricultural Sciences (SLU) (Danielson, 2013).



Figure 8. Supervisor from the Safe Farmers' Common Sense programme, discussing safety during a farm visit (Illustration from Safe Farmers Common Sense).

Other active organisations and authorities during the period 2007-2013 were *e.g.* the Swedish Committee on Working Environment in Agriculture (LAMK), which played a coordinating role in bringing different stakeholders together to discuss the progress in their different initiatives, and a national farm-inspection project (2009-2012) run by the Swedish Work Environment Authority with the focus on technical devices and machinery in agriculture, animal production, dangerous substances and systematic work environment management towards risk evaluations (Markör, 2013). In addition, the Swedish Federation of Green Employers (formerly the Federation of Swedish Forestry and Agriculture Employers, SLA) ran a small-scale service programme on health & safety supervision for its members (mainly large farms with employees). They provided a two-hour farm visit to offer safety advice, which was free of charge and delivered by farm safety engineers, with the option to pay for an extended service (Alwall Svennefelt & Lundqvist, 2010). Another active stakeholder

was the Swedish Union of Municipal Workers (*Kommunal*), which had a system of regional safety representatives. It supplied advice and services to its members on farms and to their employers in order to support the use of systematic work environment management (SAM), which aims to improve working conditions and reduce the number of injuries (SWEA, 2017).

International trends in safety interventions

Much has been done to promote safety and safety interventions in agriculture from an international perspective (*e.g.* Holte & Follo, 2018; Donham & Thelin, 2016; Cryer *et al.*, 2014; Rautiainen *et al.*, 2008; Rasmussen *et al.*, 2003; Reynolds & Groves, 2000; Lee & Marlenga, 1999; Glasscock *et al.*, 1997; Murphy, 1992). Intervention studies are often combined with different methods, such as inspections of the safety on the farm and safety courses, best practice for management programmes and multi-faceted programmes, including health assessment, evaluation of workplace risks and education.

As in Sweden, most substantial combined efforts to promote farm safety in other countries are based on one or more of Haddon's E-principles (Lee *et al.*, 2017; Donham & Thelin, 2016; Legault & Murphy, 2000; Glasscock *et al.*, 1997). Similarly, the majority of the measures seek to prevent injury by developing and evaluating techniques such as control technologies, exposure guidelines and regulations, worker participation programmes and training. These techniques have been applied in agriculture with varying degrees of success to prevent injury (Donham & Thelin, 2016; Lundqvist, 2012; Rautiainen *et al.*, 2008).

Efforts to prevent injuries affecting children in agriculture have been carried out in many countries. Injury prevention efforts for underage children in agriculture are motivated by the fact that the children are present in the farmer's working environment, playing, staying or working in an adult workplace, which is unusual in other industries (*e.g.* Marlenga *et al.*, 2018; Lee & Marlenga, 1999). Hartling *et al.* (2004) found that school-based programmes and safety days were effective in increasing knowledge acquisition in the short term.

World-wide, interventions in general have been relatively short-term and have resulted in only temporary changes in knowledge, attitudes and behaviour (*e.g.* Holte & Follo, 2018; Marlenga *et al.*, 2018; McNamara *et al.*, 2017).

Perspectives on safety interventions in agriculture

Few studies have reported success for training and other efforts to prevent injuries on farms (Donham & Thelin, 2016; Lundqvist, 2012). Most previous studies emphasise the need for more accurate evaluation of effects deriving from measures such as education efforts (Lundqvist, 2012). Hartling *et al.* (2004) found that even if training efforts are completed correctly, the learning on safety knowledge does not always lead to concrete changes in safety

routines or behaviours. In this regard, most studies tend to describe education efforts as being less effective than technical and regulatory initiatives (e.g. Rautiainen *et al.*, 2008). A study by Lehtola *et al.* (2008) found no evidence that training efforts reduced the injury frequency among agricultural workers. Similarly, Rautiainen *et al.* (2008) found no evidence to show that education interventions improve safety conditions and concluded that financial incentives and regulations may be more effective. Holte & Follo (2018) evaluated a safety training course for farmers and concluded that the course design was not optimal for farmers since it addressed them as managers, requiring an understanding of theory, while farmers mainly view their occupation as practical. Holte & Follo (2018) concluded that the course design should be reconsidered to integrate farmers' daily practices.

Lilley *et al.* (2009) identified different problems with regard to injury prevention measures in agriculture, such as poor targeting of prevention programmes to reach the important agriculture-related types of disease or high-risk populations. This confirms the need to reach beyond education and consider other options with the focus on technology/design, organisation and legal solutions. It also indicates a need to understand the barriers to implementing interventions, in order improve the likelihood of success. Established change theories should be used to support the establishment of new action programmes (Lilley *et al.*, 2009).

Ambe & Murphy (1995) found that farm tractor safety and health education programmes for adults often assumed a relatively homogeneous population. In reality, however, there are often significant differences between young adults, older adults and their formal education, years of experience, beliefs, attitudes and behaviours with regard to tractor safety and physical training for using tractors. Ambe & Murphy (1995) concluded that it is important to assess these differences and to encourage active participation by e.g. tractor operators in programme development, implementation and evaluation, to improve the success and effectiveness of safety programmes.

Cryer *et al.* (2014) evaluated a New Zealand national education programme (FarmSafe) aimed at reducing farming-related injuries among sheep, beef and dairy farmers and farm workers. Based on its effects on injury rates, Cryer *et al.* came to the conclusion that FarmSafe had poor success in decreasing the rate of work-related injuries.

McNamara *et al.* (2017) found that farmers used risk assessment documents to a limited extent and that their focus in risk assessment was on identifying physical rather than organisational controls. Further that farm occupational health and safety (OHS) standards were associated with the farmer's attitude to OHS, the farm enterprise, farmer age category and labour requirement. Having knowledge of required occupational health and safety controls (OHS) didn't ensure implementation. Development of social learning in groups was considered as a significant means of increasing OHS farm adoption.

Training efforts play a crucial role in increasing safety-related knowledge and behaviour in children, but the effect of interventions on the injury rate is

unclear. For example, Hartling *et al.* (2004) found little evidence of an effect of the North American Guidelines for Children's Agricultural Tasks (NAGCAT) (www.nagcat.org) in reducing child injuries in agriculture. The priorities for NAGCAT were set by Doty & Marlenga (2006), who listed five main concerns: i) To address the perceptions and barriers associated with the use and non-use of the NAGCAT resource. ii) To revise and re-format a core set of the guidelines. iii) To develop a NAGCAT resource dissemination/marketing plan. iv) To provide training and support for agricultural safety professionals and parents using NAGCAT. v) To conduct further research to facilitate accomplishing these priorities.

Previous studies report a lack of evaluations to demonstrate the effectiveness of education-based injury prevention interventions (*e.g.* Jadhav *et al.*, 2015; Lundqvist, 2012; Rautiainen *et al.*, 2008; Witte *et al.*, 1992). Although training initiatives are the most commonly applied form of measure, a large part of the literature claims that education efforts are less effective than many other intervention methods. Studies have also pointed out the need to use more multi-faceted methods such as a combination of measures like economical incitements, use of checklists, technical solutions and legislation (*e.g.* Lundqvist, 2012; DeRoo & Rautiainen, 2000; Lilley *et al.*, 2009; Haddon, 1980) that combine different efforts with a single strategic approach. In this regard, studies have shown that work-related injuries suffered by farmers are multi-dimensional and that this requires multi-dimensional efforts to achieve success (*e.g.* Donham & Thelin, 2016).

Studies on occupational injuries are important for devising prevention measures in agriculture, as priority areas for further research on contributing factors and injury control measures. Occupational injuries are a major challenge to efforts to promote the agriculture sector as an attractive labour market with pleasant and safe workplaces where farmers and employees thrive and strengthen the company's profitability.

Aims of the thesis

General aim

Previous studies do not show whether or which education-based work safety actions have an effect on injury rates, whether some actions were effective and whether the problem lay in the intervention tool (*e.g.* education and information) or its implementation. Thus the general aim of this thesis was to explore work safety interventions in Sweden and develop a deeper understanding of how motivation can be used to achieve behavioural change and influence the underlying cognitive factors that promote or hinder these changes.

This overarching aim was addressed in four studies examining work safety on farms from different perspectives: (i) Longitudinal outcomes, (ii) statistics

on injuries on a national level, (iii) interviews with farmers to identify cognitive barriers and (iv) communicating information at a national level.

Specific objectives of Papers I-IV were:

- To describe the background and the process of the largest education-based intervention programme for occupational injury prevention in Swedish agriculture and to evaluate its effect on farmers' actions to prevent hazards and occupational injuries on their farms (Paper I)
- To obtain statistics on actual injuries in Swedish agriculture and compare the results with those from earlier studies conducted in 2004, in order to gain a deeper understanding of the trends in injuries and their causes. The results were intended to provide a basis for evaluating the effect of Swedish initiatives to reduce occupational injuries in agriculture (Paper II)
- To explore the threats to safety that are recognised by, and arouse fear in, farmers, *i.e.* to identify fear-reducing work safety strategies that farmers perceive to be effective, manageable and cost-effective in reducing threats to safety, and to determine the actions farmers take to reduce perceived work safety dangers or their fear of them through adaptive behaviours (Paper III)
- To obtain data on how work safety interventions are communicated on a national level, in order to generate insights into why safety behaviours are adopted, ignored or avoided (Paper IV)

Limitations

Efforts to promote safety, in Sweden and in other countries, are generally based on one or more E-principles (Haddon, 1980), *e.g.* *enforcement*, *engineering/environment* and *education*. Since education-based interventions are the most common (but also criticised) approach, this thesis focused particularly on the education principle (education, advisory and information).

Thesis structure

Paper I provides background to and a process description of a national initiative for the prevention of personal injury in agriculture (Safe Farmers' Common Sense), and then describes experiences of the programme.

Paper II presents statistics on actual injuries in Swedish agriculture and compares them with results from 2004, in order to identify trends in occupational injuries and gain an understanding of the injuries and their causes. Since the frequency of injuries points to a great need for preventive efforts, the results provide a basis for evaluating the effect of Swedish initiatives to reduce occupational injuries in agriculture. **Paper III** describes fear-reducing work safety strategies that farmers perceive to be effective, manageable and cost-effective in reducing threats to safety. It also describes the actions farmers take to reduce perceived work safety hazards, or their fear of them, through adapting their behaviours. **Paper IV** systematically investigates eight of the largest farm work safety interventions in Sweden, in order to determine how work safety interventions are communicated and gain an understanding of how they use fear and other emotional appeals in their communications in an attempt to motivate improved work safety.

The structure of the work reported in the thesis is illustrated in Figure 9.

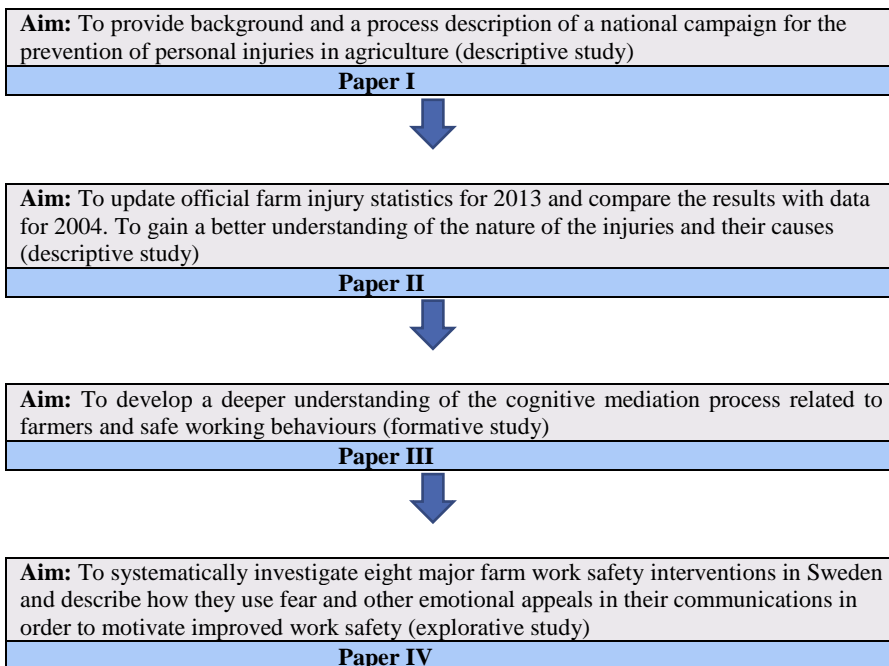


Figure 9. Structure of the thesis and objectives of Papers I-IV.

Theoretical Framework

Intervention and behaviour change

Most of the efforts aimed at preventing injuries within agriculture focus on information and education strategies and are based solely on changing human behaviour (*e.g.* Donham & Thelin, 2016; Murphy, 1992). To strengthen and potentially measure their impact, interventions can be based on the principles of strategy and hygiene, past experience and sometimes a theoretical model that explains how two or more variables work together to produce a certain outcome (Kaufman *et al.*, 2014; Witte *et al.*, 2001). According to Lee *et al.* (2017), agricultural safety and health interventions have lagged behind other occupational safety and public health approaches, but are increasingly adopting evidence-based strategies guided by theories and models that have been proven to be successful in changing unsafe traditions into safe behaviours.

Interventions to increase knowledge and impart new skills are necessary, but rarely sufficient, to induce behaviour change (*e.g.* Paulhus & Martin, 1987; Bandura, 1977). Individuals must also have the capacity, willingness and motivation to act on the knowledge and to use the skills (Wallace, 1966). The design and implementation of an information-based intervention and of other “complex interventions” (Craig *et al.*, 2008) usually need to be researched through careful investigations, using different kinds of methods. However, organising assessments of behaviour change interventions is highly challenging (Gordon & Finely, 2011), and there are few examples illustrating the design of replicable interventions that achieve lasting behavioural change in the context of an assessment. For example, changing work routines at population level requires decades of concerted, multi-faceted campaigns. However, attempts to increase farmers’ work environment efforts, including stress and risk-taking through systematic group discussions, have shown a significant increase (Stave, 2005). There is a lack of research describing education interventions to improve uptake and assessing their effectiveness. The quality of design in published studies is generally poor. There is some evidence to show that skills can be transferred to the workplace, but few have been able to demonstrate that interventions improve personal safety (Gordon & Finely, 2011).

Considering individual differences

The cause of occupational injuries is often explained by the human factor (*e.g.* Stave, 2005; Grieshop *et al.*, 1996). Hwang *et al.* (2001) found that farmers were the main risk factor leading to injuries because of age, joint problems, hearing loss, long working hours, their combined role as owner and business manager *etc.* Other studies have found that gender or past injury history

increases the risk of injury in agriculture (Stave, 2010; Gerberich *et al.*, 1998; Layde *et al.*, 1995).

Attempts to reduce the number of fatal and non-fatal injuries in agriculture have led to a clearer understanding that the battle is not simply about using protective equipment or avoiding stress at work. Rather, risks in daily work on the farm involve complex behaviours influenced at multiple levels, from an individual's knowledge, attitudes, emotions and risk perception to power dynamics between partners, accessibility of services, economic inequalities, vulnerable groups and policies (Donham & Thelin, 2016). In addition, poor organisational practices, regulatory policies, enforcement of policies and laws, market-influencing factors, quality of service providers, confidentiality, culture and economic barriers, previous experience of injuries, social influence such as friends and other farmers and new technology have been found to affect individual safely work (*e.g.* Lee *et al.*, 2017; Donham & Thelin, 2016; Kaufman *et al.*, 2014; Stave, 2005; Sorensen, 2009; Bronfenbrenner, 1979).

The diverse influences relating to farmers' behaviour change and work safety intervention are summarised in the model in Figure 10. The core principles of the model are that there are multiple influences on an individual's behaviours, including factors at the individual level, with increasing influence at different levels. This model of the influences relating to farmers' behaviour change and work safety intervention provides guidance on how a multi-faceted, multi-level intervention can maximise the potential for affecting behaviours and decisions made by farmers responsible for their own safety on farms. It is based in part on different theories explaining human behaviour (*e.g.* Lee *et al.*, 2017; Kaufman *et al.*, 2014; Bandura, 1977).

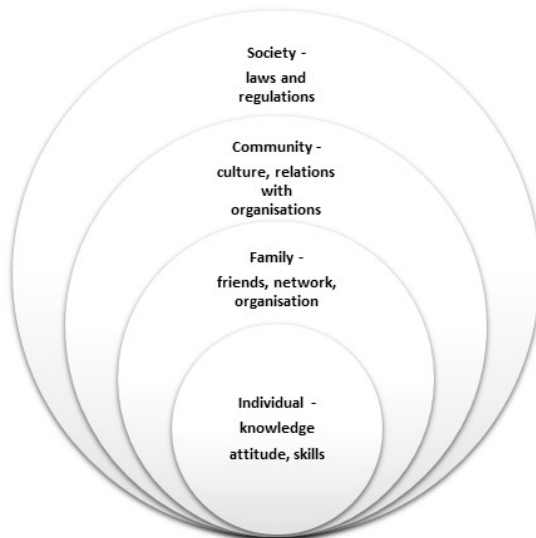


Figure 10. General model of the diverse influences relating to farmers' behaviour change and work safety interventions. Modified from Bronfenbrenner (1979).

Marketing and safety communications in agriculture

Interventions to improve self-management tend to use safety communications, usually through marketing communications, including advertising, direct marketing, branding, printed materials, public relations activities, sales presentations, sponsorships, trade show appearances *etc.* These aim to stimulate behaviour change by removing barriers and increasing motivators that exist in relation to the target behaviour (*e.g.* Krizan *et al.*, 2008). The range of emotions targeted may play an important role in the overall effectiveness of work safety interventions and in identifying opportunities for improving them. To evaluate the effectiveness of a safety intervention programme, organisations and marketers must be able to determine how the use of the various marketing communication tools influences individuals (Belch & Belch, 2004).

Sorensen (2009) found that marketing communications are a promising component in the development of injury or fatality prevention programmes in farm communities. However, Sorensen (2009) also found that social norms strongly influence farmers' decisions to work safely, as demonstrated by the strong correlations between behavioural intention measures and measures of social norms.

In recent reviews of work safety campaigns, communication experts have discussed the importance of reflective thinking about the capacity of campaigns to effect change (*e.g.* Dutta-Bergman, 2005). The literature on prevention campaigns has contributed to an understanding of individual-level behaviour change. In a review of research on consumer marketing communications, Peattie *et al.* (2009) identified four main communication challenges: (1) the targeting challenge; (2) the reality and relevance challenge; (3) the attitude-behaviour gap challenge; and (4) the message challenge. The targeting challenge departs from the fact that consumers differ in their concern about the change issue, their understanding of its relevance to their own way of living and their motivation to change their behaviour. The reality and relevance challenge emphasises the importance of consumers believing that the issue is real and linked to their own behaviours and that changing their behaviour actually can make a difference. Peattie *et al.* (2009) concluded that it is important to make an issue personally relevant in order to motivate consumers to change their behaviour. Various barriers prevent consumers from changing their behaviour, even when they are positive to the change *per se* and they know what they should do. Changes that do not interfere too much with people's existing lifestyles and/or are linked to financial savings are easier to put into practice than others.

Because consumers have to make many decisions, often based on their emotions instead of logic (Witte *et al.*, 2001), it is useful to look at research on how emotional, persuasive messages work. In most marketing and safety communications, the message is a 'fear appeal' or persuasive message that arouses fear to gain compliance. Theories of fear appeals suggest that fear-

inducing messages can be effective, but do not always lead to the desired change in behaviour (Rhodes, 2017).

Fear appeals as a communication strategy to motivate farm safety behaviour

Fear appeals are frequently used as an active strategy in persuasive media campaigns. Their usage has been justified by their ability to reliably produce persuasive effects under a variety of conditions (Dillard, 1994). Fear is one of many human emotions driving behaviour. Pleasure, hope, interest, pride and acceptance are other powerful emotions known to influence behaviour (Simons-Morton *et al.*, 2012; Fogg, 2009; Petty & Cacioppo, 1986).

Fear appeal as a marketing strategy is used when the sender's task is to get the recipient to change their attitude, intentionally by showing consequences (Neuman & Levi, 2003). Previous studies point out that fear appeals (sometimes called threat appeals) are the most common motivational approach used in interventions to influence farm safety behaviour (*e.g.* Tannenbaum *et al.*, 2015; Smith *et al.*, 2008; Murphy, *et al.*, 1996; Witte *et al.*, 1992). Other emotions targeted as part of farm work safety interventions have not been fully explored in the literature. The range of emotions targeted may play an important role in understanding the effectiveness of work safety interventions and in identifying opportunities for improving them.

Since fear appeals are the dominant communications approach used to raise awareness about safety issues and motivate behavioural changes, the goal of their message is to scare farmers by describing the terrible things that will happen to them if they do not do what the message recommends (Tannenbaum *et al.*, 2015; Danielson, 2013; Smith *et al.*, 2008; Murphy, *et al.*, 1996; Witte *et al.*, 1992). It is known that fear appeals evoke a danger control process (*i.e.* motivation to avert the danger or threat) which (sometimes) results in attitude, intention or behaviour change (Rogers, 1983). However, the outcome of this process depends on several cognitive factors, including the perceived seriousness of the threat and susceptibility, the costs involved and the self-efficacy and response efficacy of the proposed actions (*e.g.* Hunter & Rööös, 2016; Rogers, 1983). In a farm safety context, self-efficacy is the farmer's belief in their ability to exhibit control over on-farm events to achieve desired safety outcomes, while response efficacy is their belief in the worth of the safety message (Bandura, 1989).

Theories of fear appeals

Research on fear appeals is based on social psychology's theories of human driving forces. A number of theoretical perspectives, such as knowledge, behavioural capabilities and self-efficacy (Bandura, 1997, 1977), may be useful in understanding the impact of communication of safety issues and motivation of behavioural changes based on interventions (Gordon & Findley,

2011). Social cognitive theory can be applied, because of its strong empirical support and because seminal work in promotion of self-care skills has demonstrated its utility in understanding and predicting how behaviour change takes place (Bandura, 2004). The theory describes the interaction between behavioural, personal and environmental factors, all of which can be influenced to improve a person's safety. Combining information materials with skills interventions and structured motivational messages that build skills (behaviour factor) and self-efficacy (personal factor) can be useful in achieving optimal safety-promoting behaviour. By assessing individuals' knowledge and understanding, interventions can continue until the knowledge and behaviour goals are achieved (DeWalt *et al.*, 2009).

A number of historically and theoretically important models have been advanced to explain the persuasive effects of fear appeals (Mongeau, 2013). These include the drive model (Hovland *et al.*, 1953), the parallel response model (Leventhal, 1970), the protection motivation model (Rogers, 1975) and the extended parallel processing model (EPPM) (Witte, 1992). These models are usually reviewed chronologically, as the theoretical specifications within each are largely dependent upon previous theoretical explanations, such that each model incorporates and adapts various characteristics of its theoretical predecessors (Meczowski & Dillard, 2017). Despite certain similarities, the models advance differing perspectives on fear appeal processing. Each model yield different conclusions with regard to how practitioners might evaluate and construct effective fear appeal messages.

The extended parallel process model (EPPM)

The extended parallel process model (Witte, 1992) describes the cognitive dual processing of fear and deals with the design of messages and their impact on behaviour. EPPM is used to explain when and where fear appeals work and why they fail and to distinguish between two parallel processes – control of danger and control of fear. EPPM conceptualises people's reaction to safety messages, particularly messages in fear appeals that describe a loss (injury, death, economic loss) that could result from not adopting a safety behaviour (Witte & Allen, 2000). The model hypothesises that when people hear or see such a message that is relevant to their circumstances, they will respond by either accepting the message and acting to control the danger, or by rejecting the message to control (subdue) their fear of the event described in the message.

In the decision to accept a fear appeal message, Witte (1992) point out the importance of two factors. The first is the person's perceived threat of the event described (*e.g.* a tractor overturn). The perceived threat has two parts, the degree to which the person feels they are susceptible to the threat and the perceived severity of the threat. A farmer might perceive that they are not susceptible to an overturn. The same farmer might recognise that an overturn on a tractor without a ROPS could result in severe injury or death. Although

the farmer knows the harmful consequences of an overturn, they may decide not to invest in a ROPS and seatbelt because they believe that they personally are unlikely to experience an overturn. The other factor concerns the farmer's self-efficacy and their belief in response efficacy.

In a general context, Bandura (1989) defines self-efficacy as belief in one's ability to exhibit control over events to achieve desired outcomes, while response efficacy is belief in the worth of whatever is being recommended. Cole (2002) exemplifies EPPM in a farmer's perspective thus: A farmer sees a newspaper article or hears a radio report about a local farmer being permanently disabled when he overturned a tractor that was not equipped with a ROPS. The accompanying message might explain how a ROPS and seatbelt could have prevented this disabling injury. For the farmer to accept this message and control the risk of costly overturn injuries by installing a ROPS on his tractor/s, they must first believe in the efficacy of ROPS and seatbelts, *i.e.* that they are in fact very effective in preventing injuries during overturns. The farmer must also believe that it is within their capability to source, buy and have a ROPS installed on their tractor/s. A farmer may recognise the danger of an overturn and understand the severity of injury resulting from such an event, but may also feel that they cannot procure a ROPS for their tractor/s or cannot afford to purchase ROPS and have it installed. In this case, EPPM predicts that the safety message will be rejected, as a defensive reaction to control the farmer's fear.

It is apparent that the EPPM proposed by Witte (1992) is also an information-processing approach. All such models involve individuals taking in information, assimilating it with existing knowledge and experience, and attempting to make meaning from the information. The knowledge acquired may or may not influence the person's behaviour, depending upon many factors. Some factors are internal and related to established habits and attitudes of the individual. Other factors are related to the influence of individuals in the social referent groups to which the person belongs. Yet other factors are related to the person's resources and capabilities that are necessary to respond or take action (Cole, 2002; Sorensen, 2009; Witte, 1992).

Fear appeal has two components, the threat and the recommended response. The threat position of the message usually outlines the negative consequences that will occur if the individual does not do as advised. The recommended response is what the individual should do to avoid experiencing the threat. Figures 11, 12 and 13 show examples of fear appeals used in safety information in order to promote farm safety in different countries.

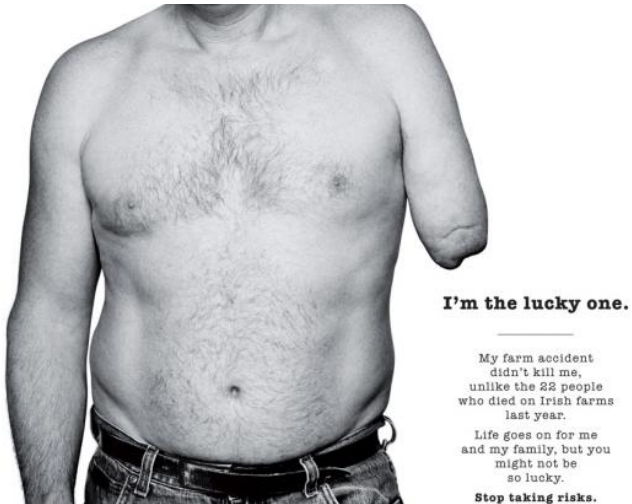


Figure 11. The Health and Safety Authority in Ireland used fear to urge farmers to stop taking risks, with the message 'My farm accident didn't kill me, unlike the 22 people who died on Irish farms last year' (McCann, 2012).

▲▲▲ Säkert Bondförnuft

"Det händer inte mig"

Lantbruket är Sveriges farligaste bransch. Varje år omkommer 10-15 personer, flera av dem barn. Dessutom skadas tusentals personer.

Välkommen att träffa våra handledare på Borgeby. Vi hjälper dig att se över din och familjens säkerhet på gården. I monter träffar du också Göran Andersson som själv miste benet i en tröskolycka.

Du hittar oss i monter nummer 8!



Säkert Bondförnuft är en riksmottagande kampanj med målet att halvera antalet olyckor till år 2013.



Figure 12. In Sweden, Safe Farmers' Common Sense, the largest safety intervention programme ever in Sweden, was fronted by a farmer who had lost his leg, as a telling example of what can happen on the farm (Danielson, 2013).



Figure 13. Advertisement published by an insurance company in New Zealand (acc.com.nz).

In these examples of fear appeals used in agriculture as a persuasive communication to improve safety behaviour, the messages contain a threat component and a recommended response component.

In the context of farm safety interventions, a farmer may experience fear of tractor injury, recognise and have the ability to reduce this fear by wearing a seatbelt, but fail to do so because a timely trigger is lacking. Belief, attitude, intention and behaviour change in accordance with the message recommendation play an important role in the adoption of safe behaviour changes (Witte *et al.*, 1992; Rogers, 1983). Defensive motivations occur when individuals are faced with a significant and relevant threat but believe themselves to be unable to perform the recommended response or believe their response to be ineffective (Witte, 1998). Coping responses that diminish fear, such as defence avoidance and reactance, lead to a fear control response. In summary, the influence of fear on subsequent behaviours depends on interactions with cognitive factors such as perceived vulnerability, severity, self-efficacy, response efficacy and response cost (Rogers, 1983, 1975), and will evoke a danger control response or a fear control response (Witte *et al.*, 2001).

Summary of Papers I-IV

Different methods were used in Papers I-IV to collect data. They included a mail survey, telephone interviews, online research and face-to-face interviews exploring different aspects of occupational injuries and communications in safety interventions in Swedish agriculture (Table 1). A short summary of the methods used in each paper is presented below. For a full description, see Papers I-IV.

In Paper I, a qualitative approach was used to investigate the largest safety intervention in Sweden. Paper II was based on quantitative data obtained in a mail survey and telephone interviews with Swedish farmers at national level. Paper III was based on interview data from farmers that participated in the Safe Farmers' Common Sense intervention programme. In Paper IV, telephone interviews were held with farmers who had participated in Safe Farmers' Common Sense and with farmers in a control group who had not taken part in the programme.

Table 1. *Summary of the research design used in Papers I-IV*

	Paper I	Paper II	Paper III	Paper IV
Title	Safe Farmers' Common Sense, a national programme for prevention of occupational injuries in Swedish agriculture – background, process and evaluation	Occupational injuries in Swedish agriculture - Development and preventive actions	Work safety interventions and threat complexity: A formative investigation into why farmers do not act safely	Evaluating the Swedish approach to motivating improved work safety conditions on farms: Insights from fear appeals and the extended parallel processing model
Participants	1080 farmers	6000 farmers	23 farmers	8 work safety intervention
Method	Telephone interviews	Mail survey and telephone interviews	Formative research with semi-structured interviews	Exploratory study with online research
Analysis method	Descriptive statistics	Descriptive statistics and significant analysis	*EPPM used to explore data and develop threat complexity typology	*EPPM used to organise observations of safety interventions and evaluate them.

*Extended parallel process model, which attempts to predict how individuals will react when confronted with fear (Witte, 1992).

Paper I. Safe Farmers Common Sense, a national programme for prevention of occupational injuries in Swedish agriculture – background, process and evaluation

Study objective

Paper I sought to describe the background and the process of the largest education-based intervention programme for occupational injury prevention in Swedish agriculture and to evaluate its effect regarding farmers' actions to prevent hazards and occupational injuries on their farms.

Method

A qualitative method including telephone interviews was used (Bryman, 2016). The telephone interviews were based on a semi-structured questionnaire comprising questions relating to the interviewee's activities to prevent hazards and other injury prevention measures on their farm during the previous 12-month period. All the questions from the interviews concerned activities undertaken by the farmers in the programme and by farmers in a control group.

The interviews included questions such as type of preventive actions taken by farmers who participated in supervision (short course or farm visit) in 2010 or 2012 within the Safe Farmers' Common Sense programme. The control group was asked about actions taken during the same period. The interviews included questions such as "Do you think that work environment work issues are more important to you since you participated in the Safe Farmers' Common Sense programme?"

An important aspect of intervention programmes is to test whether there has been any effect, in this case regarding real measures to prevent occupational injuries on participating farms. The key question in the telephone survey was to ask the participating farmers one year after the activity if they had actually made any real actions to eliminate or handle risks that could lead to an occupational injury.

Participation and data collection

In order to evaluate the outcome of the first effective full year (2010) of the Safe Farmers' Common Sense programme, telephone interviews were held in 2011 with farmers who had participated in either of the two major activities in 2010: a) Individual farm visits (220 participants) or b) the short course (364 participants). The interviewees were randomly selected from the list of participants in the national programme. A control group (209 participants) of farmers who did not take part in the programme was also randomly selected from the official farm register (Swedish Board of Agriculture, 2011). The second part of the study involved interviews in 2013 with new participants in either of the programme activities in 2012, *i.e.* a) individual farm visits (155 participants) or b) the short course (146 participants), plus a new control group (155 participants).

Data analyses

The results are presented as descriptive statistics (see Bryman, 2016). All the questions from the interviews were cross-tabulated against the activities that the farmers participated in, the short-course "Three Steps to Safe Farmers' Common Sense", farm visits and control groups. The results are reported in actual numbers and percentages. The questions on measures were cross-tabulated against the type of participant activity for 2010 and 2012. Tables were also developed with regard to perceived benefit of participation in the programme's various activities in 2010 and 2012. In addition, follow-ups one and three years later of participants who participated in 2010 were made regarding their work on injury prevention measures.

Results

The first part of the survey in 2011, regarding farmer participation in the programme in 2010, showed that more than 90% of the participants were satisfied with the organised activities, *i.e.* the short courses and individual farm visits organised by the supervisors.

The survey results showed that eliminating a risk factor was the most common type of action taken by participating farmers. This involved: fall prevention, improving animal handling systems, fixing guards on machinery, erecting fences around manure pits, repairing electrical hazards, preventing slipping etc. The highest level of actions regarding elimination of risk factors (68%) was reported by farmers who received an individual farm visit in 2010, while only 26.5% of those who received a farm visit in 2012 performed such actions. Farmers who participated in the short course in 2010 also reported being quite active (46%) in elimination hazards, but farmers participating in the short course in 2012 were less active (25%).

Another popular type of action was for farmers to prepare action plans for work with safety and risk prevention on the farm. The highest level of action in this regard was reported by farmers who received a farm visit in 2010 (47%). Other types of actions reported in telephone interviews were changes working routines and increased use of personal protection equipment (PPE).

The control groups in 2010 and 2012 were also asked if they had taken any actions to prevent occupational injuries on their farm during the preceding year. The responses revealed that among the control group the most popular action was again elimination of risk factors, but to a lower level (19 %) than by those participating in the intervention program.

Another question posed to participating farmers was whether they regarded health and safety as more important than before taking part in the programme. Almost 70% of participants said that taking part in the programme made them consider health and safety to be more important. When making comments about what had changed, many participating farmers reported that they are now more careful:

“I am much more careful when handling animals when the children are with me; I try to think ahead about the possible risks during different work tasks; I am more careful since I understand that there could easily be an injury”.

Other responses indicated that the farmers concerned now never work alone when moving large animals, some use the systematic work environment procedures and many talk with each other more about health and safety. A number of farmers brought up the problems of “home blindness”, which they report has made them involve others to discuss the need for improvements.

One question that was only asked in the 2010/11 survey was whether the farmers believed that, after taking part in the programme activities, they now had enough knowledge to continue to work on their own to eliminate hazards and risks and to improve the working conditions on their farm. Around 70% said that they feel confident that they will continue to work with these issues on their own. Some of those who did not feel confident in this regard wanted more supervision at the farm level, more education about health and safety, improved information material and practical training in the use of *e.g.* chainsaws and ATVs, animal handling and stress handling.

The telephone interviews showed that farmers who participated in 2010 were still quite active 2-3 years later. Elimination of risk factors was still the most common action, followed by preparing action plans and changing work routines. The control groups were not the same for the two studies, but it was clear from their responses that activities were less frequent among farmers in control groups than among participants in the programme, a difference that persisted over time.

Paper II. Occupational injuries in Swedish agriculture - development and preventive actions

Study objective

Paper II sought to obtain statistics on actual injuries in agriculture and compare the levels with those reported in earlier studies in 2004 by Pinzke & Lundqvist (2007) and thereby gain a deeper understanding of trends in injuries and their causes. The results were intended to provide a basis for evaluating the effect of Swedish initiatives to reduce occupational injuries in agriculture.

Method

The study, performed together with Statistics Sweden, was based on quantitative data from a mail survey and telephone interviews (Bryman & Cramer, 2012) with Swedish farmers on national level. The survey consisted of 21 questions on any injuries that had occurred on the farm, concerning *e.g.* type of injury, the person injured and how, whether the injury was reported as an occupational injury, where the injury occurred, within which activity and the cause. Respondents were also asked whether the farm had received any

work environment advice during 2011, 2012 or 2013 and whether the farm had implemented any action to prevent injury during the period.

The most important issue was whether there had been any occupational injuries in the agricultural enterprise during 2013. Occupational injuries were defined as any work-related injury to the body that prevented the individual from working. The study of occupational injuries included all injuries during work and all injuries at the workplace. It did not include injuries at home and during leisure time. The injuries were reported per sector activity within agriculture, *i.e.* farming, mixed farming-forestry, horticulture and other business activities (income-generating activities directly linked to agriculture). The telephone interviews comprised 11 additional questions about each injury on the farm, for example what happened at the time of the injury and what was the cause of the injury, whether a healthcare professional attended the injury, the body part/parts that were injured and whether any safety measures taken had been implemented because of the injury. In addition to the variables covered by the survey forms, a number of registry variables were retrieved from the Swedish Farm Register. These included the farm classification and operating orientation (according to agricultural typology). The information provided by the Swedish Farm Register referred to data collected in 2012. The questions in the mail survey and the telephone interviews were broadly in line with the questions in the previous investigations (in 2004), with some additional questions, such as access to occupational health and safety services and advisory services and whether injury prevention measures had been taken. To assess the value of the Safe Farmers' Common Sense project and other initiatives aimed at preventing injuries in the sector, questions were also asked about injuries following work environment advice and training measures during 2013.

Participant and data collection

The target population included in the survey comprised farms with more than 2 hectares (ha) of land in 2013, large-scale enterprises (regardless of acreage), and horticulture enterprises (at least 0.3 ha of open space or at least 200 m² of green space). The selection framework was set by the 2013 Swedish Farm Register, which is managed by the Swedish Board of Agriculture. It contains data about enterprises in agriculture and information about crops and the population is just over 63,000 enterprises. Within the selection framework, a stratified sample of 6000 enterprises was created as the basis for the mail survey in collaboration with Statistics Sweden. Telephone interviews were held with agriculture enterprises (defined as farming, mixed farming-forestry, horticulture and other related types of business activities) that reported injuries in the mail survey. A total of 3379 enterprises answered the mail survey (56% response rate). The corresponding response rate for the 2004 survey by Pinzke & Lundqvist (2007) was 81%. Data collection was performed from mid-April to mid-May 2014.

Data analysis

The data were analysed using descriptive statistics and significance analysis (Bryman & Cramer, 2012). Weights were developed to recalculate the results from sample level to population level. The results, expressed as estimated mean number of injuries by type of farm, were cross-tabulated to all questions in the mail survey. The standard error (SE) was used to calculate significant differences (*p*-values) in number of injuries between the years 2004 and 2013.

Results

The responses revealed that there were approximately 4400 injuries in Swedish agriculture during 2013 (66% in farming, 18% in mixed farming-forestry, and 14% in other related business activities). According to official statistics, there were only about 344 registered occupational injuries in that year, which means that only 7% of the injuries reported in the questionnaire responses were listed in official statistics. In all, at least one injury occurred on about 7% of all enterprises with farming or combined farming-forestry.

About 70% of the affected farms had animals and 17% of all dairy farms had one or more injuries during 2013. Comparison of the data showed that the overall number of injuries on farms had fallen by about 12% in 2013 compared with the level in 2004. However, taking into account the reduced labour demand in agriculture and the decline in the number of farms since 2004, the rate of injury was not reduced.

The farmer was still the person most like to suffer injuries, followed by family members (>18 years) and employees on the farm. Fewer family members were injured compared with the earlier study (in 2004), but the level of injuries among employees increased.

More women suffered farm-related occupational injuries in 2013 than in 2004. Almost half of all injuries in the animal welfare category involved women. Sick leave due to injuries had increased since 2004, with more days absent from work. Older farmers also seemed to be more affected, with a significant increase in days absent from work.

The median age of responding farmers was 55 to 59 years, compared with 50 to 54 years in the 2004 survey. Almost 33% of farmers running an enterprise in 2013 were aged 65 years or older, which is an increase compared with 2004 (17% aged 65 or older). Only 4% (2013) and 6% (2004) of all farmers were younger than 35 years. The data showed that the number of employees in agriculture in Sweden had greatly increased over the study period, with these employees mainly coming from Eastern Europe.

Animal-related injuries were the most common type of injury in both study years. In the 2004 study, the highest proportion of injuries occurred on farms with milk production. A reduction in occupational injuries was observed in 2013, but taking into account the reduction in the number of dairy farms, injury rates increased for these enterprises. This is illustrated by the fact that more than 17% of all remaining dairy farms were affected by one or more injuries during 2013, compared with 15% in 2004.

Paper II showed that farmers who took part in advisory and training activities introduced more measures to prevent injuries than those who did not access any advisory service. It also showed that farmers who experienced injuries in 2013 had taken more actions in preceding years to prevent injuries on the farm compared with farmers who did not experience injuries.

Paper III. Work safety interventions and threat complexity: A formative investigation into why farmers do not act safely

Study objective

The objective in Paper III was to develop a deeper understanding of the cognitive mediation process related to farmers and safe working behaviours.

Methods

An inductive approach (Glaser, 2014) with interviews was used to explore the threats to safety that are perceived by and arouse fear in farmers. The initial phase consisted of pilot interviews to help refine the language used in interviews and to familiarise the interviewee with the technical language and colloquialisms used by farmers when discussing work-related safety issues. Insights from the pilot interviews also helped to create a semi-structured interview guide used for the main data collection. Talking to six farmers provided enough awareness of how they reasoned and understood the theoretical terms used.

In order to address issues related to the risks involved in farm work and experiences of the Safe Farmers' Common Sense programme, farmers were asked to describe their farm in terms of production, occupancy, organisation and daily operations. The interview questions were structured around six different themes: 1) Farmers' concerns about work safety in the context of production, 2) occupancy, 3) organisation, 4) daily operations; 5) the barriers they perceived in improving work safety conditions on their farm and 6) steps they have taken to improve work safety. These themes corresponded to the threat appraisal, coping appraisal and adaptive or maladaptive behaviour steps in EPPM (Figure 14). Several additional themes were covered in the interviews, including the role of advisors in influencing participant behaviour and other inspiration to address work safety.

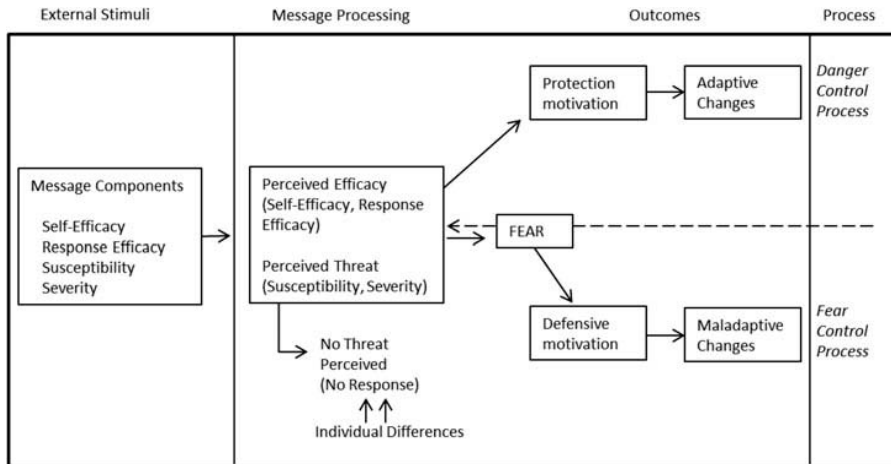


Figure 14. Components of the extended parallel process model (EPPM) (Witte, 1992).

Participants and data collection

A purposive sample of farmers in the Swedish province of Scania was chosen based on their recent participation in Safe Farmers' Common Sense. There was a heavy concentration of farms in a relatively small geographical area because the province is the main agricultural production region in Sweden. Prior to the actual data collection, pilot interviews were conducted with six randomly selected Scanian farmers who participated in Safe Farmers' Common Sense. The informants were selected from a list of participants provided by the Federation of Swedish Farmers' (LRF).

Following the pilot interviews, a further 23 farmers (also from Scania) were chosen for interviews. All of them had participated one year earlier in the Safe Farmers' Common Sense programme, during which they were exposed to a wide range of information on safety threats and on different strategies for reducing or mitigating threats. In the follow-up interviews one year later, the farmers were able to discuss the threats they saw in their environment and reflect on the work safety changes which did, or did not, take place. While Safe Farmers' Common Sense was implemented across all of Sweden, only farmers from Scania were invited to interviews because of their geographical concentration and because all of the main agricultural production activities are represented in Scania. This offered a good opportunity to access a group of participants active in a variety of farming activities with a wide diversity of demographic and production characteristics.

The farmers were contacted by telephone and informed about the project and how they were selected, and were invited to participate. They were also informed that all information would be treated confidentially and that they could cancel participation at any time. Of the 31 farmers contacted, 23 agreed to participate in the interviews. The 23 farmers (5 women, 18 men) ranged in age from 34-74 years. The majority were engaged in plant breeding, mostly in

combination with pig or beef production, fewer with horses and hens. Most of the farmers worked full-time on the farm, some of them had children, a few had employees and some had help from older relatives (e.g. their father).

Data analysis

A theory-driven thematic analysis (Braun & Clark, 2006) and selective sorting of themes based on EPPM (Witte, 1992) (see Figure 14) were employed to analyse the responses to interview questions. All interviews were recorded and transcribed. Each transcript was read numerous times to identify and obtain an overall understanding of relevant statements fitting the theoretical model. The transcripts were coded based on cognitive mediation components of EPPM (perceived severity, perceived susceptibility, self-efficacy, response efficacy and fear) as follows: Statements were coded as *fear* when topics revolving around something bad happening at work were discussed (e.g. children, elderly, foreign labour force, increased risk of falling due to getting older or knowledge shortages in animal management); as *perceived severity* when farmers shared their perceptions of how bad (i.e. the degree) it would be if their employees were to get hurt, on how the elderly don't listen or the risk to children playing around tractors or straw bales; as *perceived susceptibility* when farmers reflected on the likelihood of a threat or that something bad is going to happen, employees or children getting hurt; as *self-efficacy* when farmers' perceptions of profits, time and/or health reasons prevent them from performing the work satisfactorily; and as *response efficacy* when e.g. farmers shared their beliefs on whether improving work safety will make working on the farm safer.

Results

Most of the farmers interviewed reasoned similarly that farming is a dangerous business or, as one farmer explained:

“It is always in the back of your mind, there is no question, farm work is dangerous”.

When asked specifically to describe the threats they thought were dangerous, most of the responses could be categorised based on whether they were personal or impersonal and whether the threats were direct or indirect. Participants also discussed things they feared, but they were not always aware or able to articulate the specific threat that caused their fear. Participants said that farming is physically demanding and, because of long working hours, reported that they experience a lack of sleep which was associating with increased stress. Stress was also associated temporally with production intensity that varies throughout the year.

“When the harvest comes everyone on the farm works 16-17 hours a day, that's when you're really afraid that something's going to happen”.

Even though stress was attributed to the working conditions on the farm, neither the conditions perceived to cause stress nor stress itself were seen as a direct threat. Rather, the physical nature of the job was seen as posing a threat of back pain and lack of sleep a threat of increased injuries when operating machinery. In turn, back pain and tiredness were perceived as relevant and serious threats. In addition to back pain and tiredness, farmers viewed hitch hooks, power transmissions and difficulty breathing (*i.e.* reduced lung capacity) as factors to take into account. As such, farmers expressed vulnerability to threats that were immediate (*i.e.* direct) and threats that may affect them over time (*i.e.* indirect).

The types of threats that the farmers perceived were not limited to affecting themselves (*i.e.* personal as opposed to impersonal). For example, several farmers mentioned that they preferred to handle dangerous tasks themselves rather than let an employee carry them out. One farmer stated:

“When you have employees, you also have enormous responsibility...because of that, I don’t allow employees to do some of the dangerous jobs”.

Employees’ risk of being hurt seemed to be an issue for some farmers in the survey. Language barriers and foreign labourers lacking experience were threats perceived by the farmers. One farmer stated that:

“They do not have the animal traditions that we have”.

Some farmers expressed concern about their children, since the farm is an exciting but dangerous place they use as a playground. In particular, they felt their children were highly vulnerable to serious injury when playing with tractors and machines, and when playing on straw bales and climbing ladders. One farmer expressed this concern by saying:

“What I’m afraid of is for that little guy who runs around the farm... he climbs when the ladders are set, one day he may be in another place, this is what I’m most afraid of actually”.

Some of the farmers, in particular those whose parents were older and worked on the farm were concerned because “they continued to behave and work as they have always done and were difficult to influence”.

During the interviews, farmers were asked whether taking preventative steps to improve safety was effective and also about perceived barriers towards making work safety improvements. The majority of farmers reported feeling unable to prevent safety risks on their farm, most often when they were related to other people. In particular, those risks related to age, employees, children, the elderly, farmers’ economic situation and regulatory authorities.

The farmers who have employees reported that they implored them to follow safe work routines when handling animals and operating heavy machinery. However their requests were often ignored or misunderstood. One farmer, highlighting an instance of unreliability, told us:

“There is a bull in here, so I tell the employee to lock up when they leave. Sometimes it gets done and sometimes it does not. I can’t sit there the whole time and micromanage whether he locks the gate... the guy is nice but I usually have to follow up and close the gate myself. I can’t force him”.

Farmers with young children described the importance of creating a safe working environment for them to play, but expressed frustration and a lack of concrete ideas for achieving a safe working environment. They appeared resigned to the belief that the farm will always be a dangerous, yet captivating, place for children to play. The children “run around when operating heavy machinery” and are attracted to play in the most dangerous areas of the farm. The farmers try to mitigate the injury risks by closely supervising their children, but readily admit that over time “you get blunted and in the end you don’t see if they are around (danger)”.

Older farmers recognised that with age, their vision, hearing, reaction time and mobility worsened, leading to increased safety risks, although the younger farmers who had elderly relatives working on the farm saw things differently. They claimed that elderly relatives simply refused to acknowledge the age-related increase in injury risks or to listen to advice from their family. One farmer summed up the situation as follows:

“Dad is stubborn, we’ve told him he’s got to have a phone with him, but he refuses to even discuss the issue and just says no... he is an old man over 80 years and it is not possible to teach him anything”.

Farmers who experienced a bleak economic situation tended to operate older, poorly maintained machinery. One farmer said:

“First of all I have to have time, time to do something preventative and not just prevent acute emergencies... then of course money too ... to change stuff, that’s the economic reality, you need to be able to afford all of this... so my machinery is not quite tiptop”.

Most farmers maintained that they had made safety prevention changes to their working environment following their participation in the Safe Farmers’ Common Sense programme. These included installing fall protection on haylofts and purchasing fire blankets, goggles, eye rinse, dust masks and ear protection for tractor noise. Dressing areas were reinforced, worn hitch hooks were replaced, power transmission shafts were fitted with added protection and ergonomic seats were installed in machines. One farmer emphasised that he

became more careful after participating in Safe Farmers' Common Sense when it came to handling lorries, while another farmer reported more care in operating the combine harvester. One farmer reported that he has become more careful about heavy lifting (through better lifting technique) after suffering a back injury, while another farmer said that he had become more careful in silo work and is now using a protection harness.

Those farmers who expressed concerns for their children had made some improvements. For example, one farmer anchored his straw bales and another secured a tractor wheel to the wall because:

"I would always watch the tractor wheel to make sure my kid was not there, but my wife was terrified that he (my child) would sit there while we took a break".

One farmer continued to use a broken piston shaft even though he knew it was unsafe. He said "I only use it myself" and "remind myself that I must be careful". Another farmer acknowledged that the protective trousers he uses when operating a chainsaw offered inadequate protection:

"I have these protective trousers I wear and I've thought that sometimes I should have more protection".

That farmer convinced himself by saying:

"I'll just go down to the woods for a few hours, I'll be careful".

Another farmer who was strapped for cash avoided thinking about the threat by blaming others:

"If only the bank supported us, everything would be different on the farm".

That farmer expressed her frustration that both her husband and her father-in-law were sloppy and careless, despite the fact that there were children on the farm who had suffered an injury a year earlier. She was also fearful of the farm's bull.

The advisor's role in Safe Farmers' Common Sense was to guide farmers to create a good and safe work environment by helping them start to identify the farm's security shortcomings. According to some farmers, the supervisor should be knowledgeable on the subject and good at raising interest, and they should not be nonchalant while at the same time being pedantic.

"The advisor seemed to be lost when it came to logistics..., and the impression was the advice was not worth five pennies".

Another farmer quipped:

“So, a lot of it deals with classic questions about risks and reward trade-offs. Some things get discussed at the inspection and if it is not a risk, I am prepared to take that discussion...But as with all this, it must feel that it gives something back and that you (the advisor) have a clarity and professionalism when you come out”.

One farmer said that there are too many rules and that these do not concern the farmers who most need them:

“There are some rules that can be misinterpreted between what is required under Swedish law and what is general safety advice”.

The same farmer continued to refer to regulations and unnecessary costs for the single farmer:

“Then you do a risk analysis. How likely is it that I am fined for not following the rules of things I do not find important...we create our own rules for what we experience”.

Finally, several of the farmers simply chose to ignore information and advice given to them by advisors. For example, one farmer said:

“It is important that this is going on and I think it's hugely important for the whole industry...but it does not change anything in my life”.

Another said:

“There is always a case for improvement...we do not have written routines...I think questions (of safety) exist and they emerge naturally in dangerous circumstances”.

Paper IV. Evaluating the Swedish approach to motivating improved work safety conditions on farms: Insights from fear appeals and the extended parallel processing model

Study objective

Paper IV examined how work safety interventions are communicated on a national level, in order to generate insights into why safety behaviours are adopted, ignored or avoided.

Methods

A qualitative approach and an exploratory study involving online research (Bryman, 2016) were employed to investigate the largest safety education-based interventions in Sweden.

Data collection

The eight education-based intervention programmes studied were found to employ a wide range of conventional marketing channels, such as information folders, press releases and personal selling through farm visits and consulting, to communicate the need for better work safety on farms. They targeted a range of behaviours and attitudes geared towards a safe working environment, personal safety and the safety of close relatives (Table 2).

Table 2. *Summary of the eight interventions analysed*

Safe Farmers' Common Sense required farmers to register for a course or schedule a meeting with an advisor, to learn about systematic safety routines.
SLA, Small-scale health and Safety Supervision required individuals to join the organization before providing safety information or services.
The Swedish Work Environment Agency required individuals to comply with existing regulations and to do this, individuals were expected to self-educate.
Health and Safety Consulting for Farmers wanted individuals to permit farm visits or telephone calls, so that advice on a safe working environment could be provided.
Safe Farm wanted individuals to take safety courses to inform about risks and to use checklists. They also offered safety products on their webshop to help reduce the risks of injuries.
Safe Forest wanted farmers to take safety courses and take a test so they can become licensed.
Sigill wanted farmers to get certified regarding working conditions following a protracted certification process.
Prevent offered a variety of support, and wanted farmers to access training, checklists, inspirational articles, fact books, and websites.

The selection criteria for the programmes included in the analysis were as follows: national in scope, run by publicly funded organisation, current, and focusing on the major risk factors for a safe working environment in agriculture and forestry. The study also included one programme that is no longer running (Safe Farmers' Common Sense), because it was the most ambitious work safety programme ever run in Sweden in terms of total expenditure and collaboration across actors.

Data analysis

Using an inductive approach and EPPM as a framework (see Figure 14), the following aspects of each campaign studied were coded and identified: Objective(s) and targeted behaviour(s); the threats used and the behaviours targeted (if any), including how threat severity and threat susceptibility were framed; how self-efficacy was framed or targeted; and how response efficacy was framed or targeted.

Results

Vulnerable groups such as children and the elderly were highlighted in the information, but the farmer was the target of behavioural change. For example, the Swedish Work Environment Agency focused on existing laws and used inspections to ensure farmers were informed and in compliance. The Safe Forest programme focused specifically on safe operation of forestry equipment and used legal arguments to encourage farmers to become licensed.

Each organisation involved required the individual to perform an action (behaviour) indirectly related to improving safety. All but one of the organisations used threats to explain the need for safer working environments. Two distinct types of threats were used, pertaining to physical injuries and to financial penalties. Regarding physical injuries, threats were communicated as *e.g.* “Farming is one of the most dangerous workplaces for children and adolescents” and “Every year thousands of injuries occur in Swedish agriculture”. Regarding financial penalties, the messages used were *e.g.* “To reduce the number of injuries, there are rules that make the work safer....you may be obliged to pay a fine if you do not follow them”.

Of the threats communicated by each organisation, some, but not all, included an appeal. For example, the Small-scale Health and Safety Supervision programme (run by SLA) stated that employers might be subject to fines by the Work Environment Authority during inspections if a systematic work environment assessment is not performed in the workplace. It also stated that: “As a member, you will receive advice and support in your systematic work environment”.

Ethical considerations

This section deals with the research ethics and the consideration of ethical questions regarding the surveys in Papers I-IV. There are a number of regulations that had to be followed in the research (Vetenskapsrådet, 2017).

In the work reported in Paper I, the research procedures followed Swedish rules and regulations on the use of human subjects in research. Since the telephone interviews did not involve questions on sensitive areas such as politics or mental health, did not involve children or other vulnerable groups, did not involve experiments and did not solicit any business or individual-level information that could be triangulated to identify where the data came from, no formal ethical approval was needed for the study.

The mail survey in Paper II was accompanied by a letter providing information about the study and about how the results would be used (for research, development and education) to reduce the number of injuries. On answering the questionnaire, the farmer was assured that the answers would be sent unidentified to researchers at SLU. In cases where the farmer reported injuries, an agreement was reached with Statistics Sweden and the name, address and telephone number of the farmer concerned was sent to SLU to enable contact to ask for further information about the injury. An identification key was saved at Statistics Sweden until 31 December 2014, as agreed in a consultation between SLU and Näringslivets Regionnämnd (NNR). The information letter also stated clearly that all information provided was protected by confidentiality. Since the study in Paper II involved questions and interviews regarding personal experience of injuries, it required the approval of the Regional Ethical Review Board in Lund, which was granted (Dnr: 2014/172, 253). The research procedures followed Swedish rules and regulations on the use of human subjects in research.

In the initial phase of Paper III, a random pilot study was conducted to check the relevance of the questions. Subjects in both the pilot study and the main study were identified from the personnel register at LRF (The Federation of Swedish Farmers) listing farmers who had participated in Safe Farmers' Common Sense. Farmers was contacted by telephone to ask about the possibility of holding an interview on their farm. The information described the purpose, how the survey would be carried out and possible benefits of the research and explained that new knowledge would be used for future interventions in agriculture. Farmers were informed about their independent right to decide for how long and on what conditions they would participate. It was also important to inform them about confidentiality. Ethical guidelines in accordance with the Swedish Research Council (Vetenskapsrådet, 2017) were followed, with the aim of protecting and respecting informant confidentiality. The material was decoded, treated confidentially and made available only to the research team. Since the interviews did not involve questions on sensitive areas, such as politics or mental health, did not involve children or other

vulnerable groups, did not involve experiments and did not solicit any business or individual-level information that could be triangulated to identify where the data came from, no formal ethical approval was required for the study.

The method used in Paper IV did not require ethical approval. However, the research procedures followed Swedish rules and regulations on the use of human subjects in research.

Methodological considerations

Paper I

In Paper I, telephone interviews were used to examine whether the Safe Farmers' Common Sense campaign made farmers more active regarding different types of measurable actions to prevent hazards and occupational injuries on their own farm.

Telephone interviews are generally neglected in the qualitative research literature and, when they are discussed, they are often depicted as a less attractive alternative to face-to-face interviews (Bryman, 2016). However, telephone interviews are a common method in studies (*e.g.* Bryman, 2016; Burnard, 1994). The purpose of the chosen method in Paper I was primarily to reach as many farmers who participated in the programme as possible and a control group. In addition, it was a cheaper option to conduct qualitative interviews by phone than to hold direct face-to-face interviews. It cannot be said whether it was more difficult to answer sensitive questions on the telephone than if interviewers and respondents had been in the same physical space. The absence of visual signals by telephone is believed to result in the loss of contextual and non-verbal data and to compromise the reporting, probing and interpretation of responses. However, the telephone interviews in Paper I were designed to make the respondents feel relaxed and able to reveal information and there is no evidence that they produced lower quality data.

Paper II

Quantitative analysis was used in Paper II to study research problems requiring a description of injury trends and an explanation of the relationship between different variables. Since the study had to deal with a great deal of data and questions from a previous study (Pinzke & Lundqvist, 2007), the study design was cross-sectional (Bryman, 2016).

Farmers who answered the questionnaire were then surveyed in the following telephone interview. In cases where another person on the farm had been affected by an injury, only the farmer's description of the event and consequences was obtained. This reduces the reliability of the information provided about the event and its consequences. In addition, the time aspect must be taken into account, as it may have affected the farmer's recall of the injury event. The data collection work in the postal survey ran from mid-April to mid-May 2014, while most of the telephone interviews were conducted in 2015.

Paper II could have suffered from self-selection bias, which could have affected the results in two ways: 1) those with injuries may have had barriers to responding or 2) those with injuries may have been more knowledgeable and more interested in responding.

Paper III

The findings in Paper III are based on semi-structured interviews with a sample that may not reflect the views of farmers in the north of Sweden, let alone those in other parts of the world. It follows therefore that the types of risks identified and strategies for reducing risks may be very different in other regions of Sweden and, particularly, in other parts of the world. For example, southern Swedish agriculture is known for its efficient production of commodity products in processes driven by innovation. As such, the machinery the farmers operate and the pressure they experience to ensure low cost and high output places them under considerable stress that other, possibly more conventional, farmers do not face. Moreover, the interviews were only with farmers who previously participated in a work safety intervention. The EPPM approach is generally used to isolate a specific threat, followed by an analysis of the cognitive mediation surrounding the threat and subsequent behaviour (Ralston, 2016; Lewis *et al.*, 2013; Maloney *et al.*, 2011; Rimal, 2001; McMahan *et al.*, 1998; Ambe & Murphy, 1995; Witte, 1993). Because semi-structured interviews were used in Paper III to explore work safety behaviour and EPPM was used as a theoretical lens, several insights were gained into the range and complexity of perceived threats, cognitive mediation and subsequent behaviour. This would not have been possible using more conventional methods.

The majority of the interviewees were male and it was not known whether the results would be different if more female farmers had been included. Being asked about what kind of threats the farmers experience may not have given the whole picture, because the interviews were conducted in the farmer's kitchen and not directly in their work among the animals or machine handling. A limitation with interviews might be that the farmers gave what they believed to be the 'right' answer, or did not understand the question, despite the use of a pilot phrase. The fact that the interview was conducted one year later also raises some doubt about whether the farmer remembered events correctly. Moreover, selection bias might have arisen when recruiting participants. However, an interview is a complex situation with inherent problems and events which at best can only say something about the actual interview situation. Kvale & Brinkman (2009) list a number of different issues that the interviewer should think about, while Alvesson (2010) lists sources of error that may arise in the actual interview situation, such as gender, social status and age, with the interviewee constantly trying to guess what the researcher wants to find out.

Without a control group, it is not possible to know to what extent interviewees' risk perceptions and related cognitions were related to the specific intervention, or whether they are representative of other farmers who did not participate in the intervention. The approach in Paper III offered several advantages in this regard. For example, the EPPM approach is generally used to isolate a specific threat, followed by an analysis of the cognitive mediation surrounding the threat and subsequent behaviour. Using semi-structured

interviews to explore work safety behaviour and EPPM as a theoretical lens yielded insights that could not have been obtained using more conventional quantitative methods.

The initial coding in Paper III was performed by the researcher who conducted the interviews (myself). The coding was then evaluated by the other researchers to avoid single author bias and to ensure agreement in data interpretation (Guest *et al.*, 2012).

Little has been written about ethical problems regarding the use of fear appeal (especially for agriculture, which almost exclusively works with frightening messages). A question raised during the research in this thesis was whether it is ethically sound to expose a large number of farmers to potentially negative messages without their consent. Risk message that emphasise threat or fear and point out farmers' risk of being killed or seriously injured in their work can well lead to severe anxiety in single workers and the most vulnerable. There is also a risk of increased social inequality between those who respond to the risk message and participate in programmes, and those who do not, *i.e.* farmers who are perceived to be less educated and less well financially equipped to deal with the messages. Another consideration is whether it is ethically acceptable to expose a whole population of farmers to a message that may be intended for a particular sub-group of farmers.

Paper IV

In order to obtain a deeper understanding of how work safety interventions are communicated on a Swedish level, exploratory research was conducted. Exploratory research takes place when problems are in a preliminary stage (Stebbins, 2001) and when the issue is new and data are difficult to collect. The exploratory research approach was chosen for Paper IV because it is flexible and can address research questions of all types (what, why, how). EPPM is considered to be a useful tool for evaluating interventions that use fear to motivate changes in behaviour (Witte, 1992). Real-world interventions use multiple fear appeals and target multiple behaviours within and across campaigns. This made it challenging to identify and analyse patterns in Paper IV. When using EPPM, it proved useful in Paper IV to begin by identifying the specific behaviours each individual campaign targeted, followed by abstracting all the information to represent higher-level concepts in EPPM. This was also the greatest limitation of the study because, due to the complexity of actions, it was necessary to raise the level of analysis above minor variations in the data. Thus, outlier activities, smaller initiatives not included in the dataset and other micro-level factors may have exerted more influence on the aggregate level than was accounted for. However, these issues were discussed by the research group and care was taken to avoid using only examples that fitted the narrative.

Statistical generalisability (*e.g.* Bryman, 2016) is not always the intention of research. Instead, theoretical generalisability (Mook, 1983) can play an important role, as found in Paper IV. If the Swedish approach is indicative of how other nations implement work safety interventions, the challenge in Paper

IV was not in finding more effective tools to influence work safety, but rather in ensuring that the tools available are implemented wisely. Selection bias relates to both the process of recruiting participants and study inclusion criteria. Successful research begins with recruiting participants who meet the purpose of the study. For example, recruitment bias could occur if participants were invited to participate in a survey posted on the internet, which automatically excludes individuals without internet access.

Synthesis of results

The work in Papers I-IV was initially rather descriptive. The interest was in understanding whether all interventions over a 10-year period contributed to reducing the number of occupational injuries in agriculture. Based on the statistics, it emerged quite early that the level of occupational injuries had not decreased, but the data did not explain why. Previous research had shown that threat communication is a common factor in communicating interventions, including in the Safe Farmers' Common Sense programme. The questions addressed in this thesis were whether intervention is effective, how effective it is, whether it is used correctly and whether it leads to changed behaviour (or if not, why not).

Safe Farmers' Common Sense

This first study was conducted in 2013 and described the background and the process of the largest education-based intervention programme for occupational injury prevention in Swedish agriculture. The programme had a farmer-centred perspective and included short courses, on-farm visits by supervisors and a number of education events and awareness-promoting activities. The aim in Paper I was to evaluate the effect of the programme regarding farmers' actions to prevent hazards and occupational injuries on their farms. The results showed that the concept was successful, since it involved farmers to a greater extent and prompted a higher proportion of those who participated to introduce injury prevention measures on their farms, compared with a control group of farmers.

Eliminating a risk factor was the most common type of action found in the study, through fall prevention, improving animal handling systems, fitting guards on machinery, erecting fences around manure pits, repairing electrical hazards, preventing slipping *etc.* The highest level of actions regarding elimination of risk factors (68%) was reported by farmers who had individual farm visits in 2010, while only 26.5% of corresponding farmers in 2012 did so. Farmers who participated in the short course in 2010 were also more active (46%) in elimination actions than farmers participating in 2012 (25%). Another popular type of action was to prepare action plans for work with safety and risk prevention on the farm. Previous research (*e.g.* Stave, 2005; Ljung, 2001) has focused on the problem faced by farmers as they decide whether to adopt a potentially profitable new behaviour, *e.g.* how farmers learn about a new safe technology, adopt it or change their working routine. There are many possible sources of information about risk factors. A farmer may learn from their own experience in their daily work. Moreover, advice and information may be available from the media or advisory service. If there are many farmers in somewhat similar circumstances, then the process of learning about change risk behaviour may be social. Farmers may learn about risks from neighbours'

experiences. The differences in learning to improve working conditions between farming courses and individual farm visits presented in this thesis may be because some farmers learn best in a group with others, while other need individual help on the farm or their learning is socio-economically conditioned.

The highest success rate in terms of adoption of safety actions in this thesis (47%) was reported by farmers who received a farm visit in 2010. Other types of actions reported in telephone interviews were changing work routines and increased use of protective equipment. The analysis also showed that these activities persisted 2-3 years after participation in the programme. The reason for this is difficult to determine, but it may be that interest was higher among the farmers when the programme was new and there was a lot of information about courses *etc.* The results might have been different if the farmers who participated in the programme were surveyed in 2014.

The Safe Farmers' Common Sense programme was not found to have any effect on the level of occupational injuries, although the level of fatal injuries was lower during the intervention period. Thus the investment can be questioned as regards the high costs and the limited impact on the number of work-related injuries in Swedish agriculture. It was also not the only investment during the period, as a variety of interventions were implemented, with inspections, training and advice as primary tools.

Occupational injuries in Swedish agriculture

There was an interest in this thesis in understanding whether all interventions over a 10-year period contributed to reducing the number of occupational injuries in agriculture. Therefore the aim in Paper II was to obtain statistics on actual injuries in agriculture in 2013 and compare the data from results from an earlier study conducted in 2004, and thereby gain a deeper understanding of trends in injuries and their causes. The results were intended to provide a basis for evaluating the effect of Swedish initiatives to reduce occupational injuries in Swedish agriculture.

Official Swedish statistics from the beginning of the 2000s show that more than 1000 work-related injuries were reported in agriculture, forestry, hunting, and fishing in Sweden per year. The corresponding number for 2016 was below 300 (Statistics Sweden, 1996-2016). Overall, the official statistics show a decrease in both occupational injuries and occupational diseases in the agriculture sector during the period 1996-2016 (SWEA, 2015). A similar trend has been reported in other countries (Donham & Thelin, 2016).

The results in Paper II also show a decrease in the number of injuries in agriculture. Extrapolated to population level, an estimated 4400 injuries occurred in agricultural enterprises in 2013. This is a decrease of about 12% compared with 2004, when there were approximately 5000 injuries. In the farming sector itself, the reduction was estimated to be 22%. These differences are not statistically significant, but are still so large that there is relatively good reason to believe that there has been an actual reduction. However, the number

of active agricultural enterprises decreased during the period 2004-2013, resulting in fewer farms and farmers, while the remaining enterprises grew in size (Statistics Sweden, 1996-2016). Taking into account the reduced labour requirement in agriculture and the decrease in the number of farms since 2004, the rate of injuries has not decreased.

A minor reduction in fatal injuries in agriculture can be seen in the official statistics, although the level is still high (SWEA, 2016b). One explanation for this reduction may be increased knowledge among farmers and a number of initiatives such as Safe Farmers' Common Sense or inspections by the Swedish Work Environment Agency (SWEA) leading to positive results regarding the most serious risks such as animal handling and falls.

Paper II shows that the number of unreported injuries in agriculture is still very high, as only 7% of the injury cases in 2013 appeared in the official statistics, compared with 8% in 2004. This under-reporting of occupational injuries in agriculture continues to be a problem in several ways (Lundqvist, 2012; Pinzke & Lundqvist, 2007). Injuries not reported to Swedish Social Insurance might lead to loss of financial compensation. They also mean that the real scope of the problem is not visible to relevant authorities, politicians and other stakeholders, *i.e.* if injuries are not reported, there is no official problem.

While some of the values reported in Paper II can be considered uncertain, a question arises of whether farmers have increased awareness and a greater willingness to report injuries after participating in projects such as Safe Farmers' Common Sense. Interestingly, the results obtained indicated that farmers who participated in some form of safety training activity reported more injuries than those who did not. Farmers seemed to see no benefit from reporting injuries to the Social Insurance Fund. An explanation for their reluctance could be that healthcare in Sweden is largely tax-funded, a system that ensures everyone has equal access to healthcare services. Many self-employed farmers see no benefit in reporting occupational injuries that affect only themselves. However, under-reporting is not only a problem in Sweden but also in many other countries (*e.g.*, Donham & Thelin, 2016; Murphy, 1992). Neighbouring Finland uses an approach whereby farmers are required by law to report personal injuries to the Farmers' Social Insurance Institution in order to receive compensation (Mela, 2017). Sweden may need to take a similar approach.

The results in Paper II indicate that the farmer is the person most likely to suffer injuries, followed by family members (>18 years), and employees on the farm. Fewer family members were injured compared with the earlier study (2004), but the level of injuries among employees increased. Furthermore, working alone was still common for farmers in 2013, and employees and seasonal workers had to a great extent replaced family members working on farms compared with the situation in 2004. This change in farm labour may have altered the work situation and the exposure to various risk factors that can lead to injuries and illness, despite improved technologies and safer methods

(e.g. animal handling). Foreign labour in agriculture solves labour needs, but can also entail new risks due to communication problems (Svensson *et al.*, 2012).

Because farming is also often a lifestyle, farmers often continue to work into old age. Vision, hearing and reaction ability deteriorate, but despite this, they continue to work as they have always done. Paper II found a significant increase in older farmers affected at work. Older farmers are generally considered a risk group (e.g. Nilsson, 2016a; Karttunen, 2014), possibly due to the difficulty in influencing them to change than with younger farmers – many do as they have always done, which with higher age can mean safety risks.

Around 70% of the farms with injuries in Paper II had animals. More than 30% of injuries occurred on farms with milk production in 2004. In 2013, this share had decreased to 18%. At the same time, the number of dairy farms decreased, which resulted in 17% of all remaining farms being affected by one or more injuries in 2013. The corresponding value for 2004 was 15%. Previous studies have shown that milk producers in particular experience stress and financial worries to a greater extent than other producers in the agriculture sector (e.g. Karttunen, 2014; Lunner Kolstrup & Lundqvist, 2013). This can explain why the injury rate among Swedish milk producers has not decreased since the 2004 study.

Pinzke (2016) discusses health effects in milking farmers. If farmers with symptoms stop farming and healthy farmers remain and continue to be exposed to risks, there could be a healthy worker effect. A similar trend was seen in Paper II regarding injuries among farmers, in which farmers with injuries were likely to leave farming and those without injuries were likely to continue working in agriculture.

The data obtained in Paper II did not show whether farm injuries in Sweden became more or less serious during the period 2004-2013, but the average level of sick leave (number of days absent from work) increased (SWEA, 2016a).

Paper II could have suffered from self-selection bias, which could have affected the results in that those with injuries may have had barriers to responding or may have been more knowledgeable and more interested in responding. The high response rate (56%) is a strength of the study.

Work safety intervention and threat complexity

Agricultural marketing and communication strategies mainly use fear appeal to influence farmers to change their behaviour (Smith *et al.*, 2008; Murphy *al.*, 1996; Witte *et al.*, 1992). The purpose is to communicate unpleasant phenomena in order to frighten the recipient into action. This approach was also used in the Safe Farmers' Common Sense programme (Danielson, 2013). To understand how effective it had been, whether it was used correctly and whether it led to changed behaviour (or why not), Paper III explored the threats to safety perceived by, and arousing fear in, farmers. The analysis included fear-reducing work safety strategies perceived by farmers to be effective,

manageable, and cost-effective in reducing threats to safety and the actions farmers take to reduce perceived work safety dangers or their fear of them through adaptive behaviours.

A typology and continuum of perceived threats emerged from the data (Figure 15). Several patterns emerged where different kinds of threats (or threat typologies) appeared to play an important role in threat appraisals and EPPM factors clarified by Witte (1992). Ultimately, the type of threat seemed to have a profound influence on subsequent behaviour. Paper III showed that many, if not most, of the perceived farm safety threats discussed in the study are known to the research community (*e.g.* Donham & Thelin, 2016; Lundqvist, 2012; Murphy, 1992).

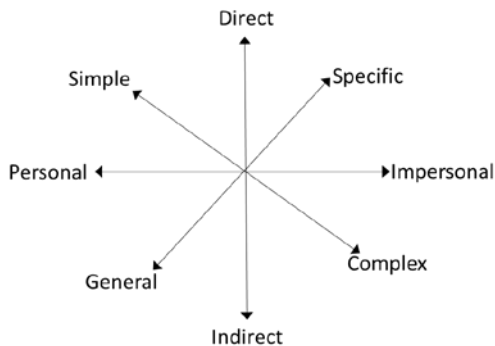


Figure 15. Typology and continuum of threats perceived by farmers.

Direct and indirect threats relate to the immediacy of the perceived danger. At one end of the continuum, perceived direct threats are those that pose an immediate danger, such as being gored by a bull, whereas the danger posed by indirect threats is deferred, *e.g.* loss of hearing due to operating loud machinery or breathing problems caused by dusty and dirty working environments. Overall, direct threats were not viewed as being more severe or the individual being more vulnerable, but on the whole respondents took more actions to prevent direct threats than indirect threats, as discussed *e.g.* in Swedish Board of Agriculture (2007).

Threats can also be distinguished by whose safety is at stake. The farmers talked about personal threats to their health and wellbeing that included back injuries from heavy lifting and hearing loss due to operating loud machinery. Personal threats also included being fined by occupational safety inspectors when farm hands violate rules, as described by SWEA (2015). At the other end of the continuum, impersonal threats are those involving *others* whose health and wellbeing matter to the farmer. Of these *others*, children and other family members were found to be important, as were farm hands. Interestingly, farmers tended to view others or impersonal threats as being more likely to occur and more serious. Similar findings, for example regarding children, have been reported by Lundqvist *et al.* (2013) and Lee *et al.* (2017).

In Paper III, it proved useful to distinguish threats based on their general or specific nature. General threats are those commonly perceived on farms, such as fires and machinery injuries, whereas specific threats pertain to farmers in a specific context (Caffaro *et al.*, 2018; Lindahl & Lind, 2017; McNamara *et al.*, 2017; Lindahl, 2014; Lundqvist, 1996). The “specific context” referred to includes protective equipment when working in silos or getting caught in a power transmission shaft, but is not limited to physical threats such as heavy machinery that could fail and injure due to the lack of time or money needed to conduct routine maintenance. While no patterns in how general and specific threats influence factors in EPPM were detected, the results showed that context had a strong influence on the kinds of threats perceived by farmers (*e.g.* financially distressed farmers mentioned threats to wellbeing more than farmers who were well off).

Paper III revealed differences in threat complexity. Many of the threats discussed, such as the threat of fire or hearing loss, had relatively simple causes that farmers understood well. However, there were a number of ‘complex’ threats discussed, such as age-related injury and stress. Due to their complexity, farmers were not always able to pinpoint or fully account for what caused the threat. In the case of stress, farmers viewed it as an action barrier, as discussed by Pinzke (2018), but not as a threat in itself. Overall, when threats were complex (*i.e.* cause and effect were more difficult to understand), action was less noticeable.

When perceived threats and actions were summed up using the typology developed in Paper III, a pattern emerged. As a group, farmers primarily acted on simple threats to safety where cause and effect were easy to discern (*e.g.* risk of fire → buy fire extinguisher; broken seatbelt → replace seatbelt), and where the threat primarily affected them personally (Figure 16).

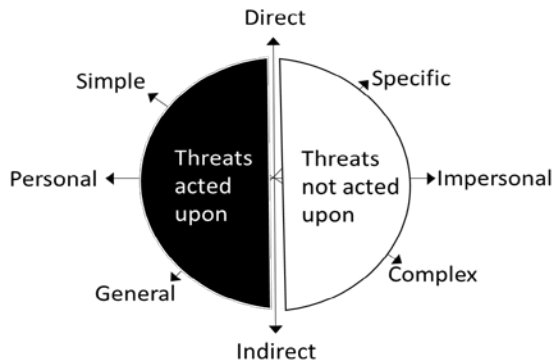


Figure 16. Typology of threats and disconnect between perceived threats and actions taken by farmers.

Overall, farmers were more likely to take adaptive actions when threats were general, personal, and simple. As regards general threats, EPPM states that when a perceived threat is strong enough to arouse fear, the individual is motivated to protect themselves *if* the linear combination of their self-efficacy and response efficacy are greater than the response cost (Witte, 1992). In the present context, general threats “refer to threats that are common to most farms (e.g. Donham & Thelin, 2016; Lundqvist, 2012; Murphy, 1992). Because of this, these threats are more likely to have proven solutions that work (*i.e.* response efficacy is high). At the same time and for similar reasons, the ability to manage general safety threats such as faulty wiring or a broken seatbelt is greater, due to their routine occurrence. In contrast, context-specific threats could be expected to have solutions that are less well-defined, which decreases perceptions of response efficacy, while because of their specificity there are fewer people to turn to for help in managing the threat (thereby lowering self-efficacy).

Threats that are simple by nature have causes that are easy for farmers to identify and effects that are known, as discussed by Pinzke & Lundqvist (2007), Kolstrup (2008) and Lundqvist (2012). This makes it more likely that simple threats will be identified and that farmers understand what will happen if adaptive action is not taken. The opposite is arguably true for complex threats, *i.e.* they are more difficult to identify and in many cases have multiple causes. For example, most of the farming parents surveyed feared for their children being injured on the farm. However, the underlying reasons for the feared injuries were so complex that most parents did not know how to respond. If they secured a tractor wheel, the children would play with the hay bales. If they tied the hay bales down, the children would move on to the next most dangerous thing. Parents vowed to “try harder” to keep an eye on their child, but it never removed the complex threat of injury. In lieu of effective responses to this complex threat, many of them maladapted by turning a blind eye or blaming inadequacies in their safe work education.

There was a disconnect between the work safety threats farmers feared most and the actions they took to remove the threats. This was most obvious when threats were distinguished by a personal-impersonal nature. Farmers especially feared threats to others/impersonal threats, yet spent most of their time taking action to remove threats of a personal nature. EPPM offers a simple explanation for this peculiar finding. First, farmers indicated repeatedly that they lacked the ability to influence ‘others’, claiming that elderly parents simply refused to follow safety requests, that children were impossible to monitor at all times and that farm hands were either too unreliable or too unaware to understand safety instructions. Reported inability to control ‘others’ is an indication of low self-efficacy and a prime explanation for a lack of adoption of safety measures.

The EPPM approach was used to gain insights into how farmers cognitively processed threats and their subsequent behaviour. The results revealed that farmers seemed to be more fearful of work safety threats related to family

members and employees, yet the actions they took to reduce threats were mostly personal in nature. Overall, simple, common and direct threats to safety tended to lead to adaptive, threat-reducing behaviours, while complex, general or indirect threats promoted more maladaptive behaviours that reduced fear, but not threats.

Swedish approaches to improve work safety on farms

Farm work safety intervention programmes based on educating and informing have been criticised for not demonstrably improving work safety (*e.g.* Jadhav *et al.*, 2015; Cryer *et al.*, 2014; Lundqvist, 2012; Lehtola *et al.*, 2008; Rautiainen *et al.*, 2008; Hartling *et al.*, 2004; Witte *et al.*, 1992). The study in Paper IV on how interventions in Sweden are designed to create awareness and motivate safe behaviour was inspired by *e.g.* Belch & Belch (2004) and Sorensen (2009). Evaluation at national level was an important, although not widely used, tool to confirm or reject criticisms of intervention effectiveness. Thus in Paper IV, eight of the largest farm work safety interventions in Sweden (Table 2) were systematically investigated. The results showed how safety interventions use fear and other emotional appeals to motivate improved work safety in their communications to farmers. Peattie *et al.* (2009) emphasise that it is important to make an issue personally relevant in order to motivate people to change their behaviour. Various barriers prevent people from changing their behaviour even if they are positive to the change *per se* and they know what they should do.

The predictions made by EPPM depend on the behaviours targeted (*e.g.* Witte & Allen, 2000; Witte, 1992). Assuming there is sufficient fear, adaptive, pro-safety behaviours depend on beliefs that the promoted behaviours reduce the source of danger (response efficacy) and that the individual has the ability (self-efficacy) to carry out the behaviour. Consequently, identifying the behaviours promoted by each actor was a crucial first step in understanding farm safety behaviour in Paper IV.

All organisations analysed in Paper IV shared the common goal of improving safety conditions in the agricultural sector and *targeted farm owners exclusively* with their messages. There seemed to be some differences pertaining to which aspects of safety were targeted, who was expected to benefit and the means used by the organisations to achieve their goal. For example, the Safe Farmers' Common Sense programme adopted a holistic approach to safety and wanted farmers to work systematically with safety to prevent injury (Danielson, 2013). While vulnerable groups such as children and the elderly were highlighted in the programme's information, the farmer was the target of behavioural change. The intervention by the Swedish Work Environment Agency focused on existing laws and used inspections to ensure farmers were informed and in compliance (SWEA, 2017). Again, the farmer was targeted for behavioural change, even if this change was intended to

benefit employees too. The Safe Forest programme focused specifically on safe operation of forestry equipment and used legal arguments to encourage farmers to become licensed. The targets of change were those working in forestry who fitted the legal requirements (*e.g.* those licensed to operate heavy machinery) and not others, such as children.

Regarding the immediate behavioural change targeted, Paper IV found more similarities than differences. Each organisation emphasised a slightly different aspect of safety that it aimed at improving, yet they all appeared to require the individual to perform an action (behaviour) indirectly related to improving safety, as is common in work safety studies within agriculture (*e.g.* Holte & Follo, 2018; McNamara et al., 2017). In summary, the immediate behavioural changes targeted by the largest work safety organisations seemed limited to acquiring knowledge about risks. Even if the target behaviours lead to actions like wearing seatbelts or using ear protectors when necessary, they are mediated by the need to first acquire more information. Furthermore, because only farmers are targeted with behavioural change, there is a missed opportunity to directly influence vulnerable individuals such as children, the elderly or hired farm workers.

Fear appeals and targeted behaviours

Fear arousal is generated in individuals by threats that are perceived to be severe and likely to occur. According to EPPM, individuals will reduce the threat when efficacious options are available (response efficacy and self-efficacy) and reduce the feeling of discomfort when they are not. It follows therefore that to arouse fear and motivate action, the threats must be severe and/or likely to occur (Witte, 1998, Cole, 2002). All but one of the organisations (Sigill) used threats to explain the need for safer working environments. Two distinct types of threats were used, pertaining to physical injuries and financial penalties. As regards communication of threats that relate to physical injury, the results showed a clear pattern of avoiding specific and salient threats. It proved very difficult to find examples that went beyond “farming is dangerous” or “thousands of injuries occur every year” and directly mentioned *e.g.* why farming is dangerous and what causes the preponderance of injuries. Whether or not the general threats and vague messages used elicited a sense of severity is an empirical question that could not be answered in Paper IV, but it was surmised that severity perceptions were not heightened by the messages. Similarly, it is doubtful whether these messages serve to increase perceptions of susceptibility, as farmers are generally aware of safety threats in their work. More accurately, the combined interaction of severity and vulnerability is what leads to fear. Therefore, fear may be aroused if severity is very high and vulnerability is very low (and *vice versa*).

Penalties seemed to be backed up with mandatory or random inspections. This may lead to perceived susceptibility to financial penalties being high, whereas the severity was relatively low, as predicted by EPPM. Arguably,

financial penalties are perceived as less severe than physical penalties. The literature refers to threats combined with solutions as fear appeals, *e.g.* Bandura (1989) and Cole (2002). For a threat to be effective, it not only needs to be relevant and likely to occur, but must also be accompanied by appeals to perform a behaviour that *reduces the threat*. Some of the threats communicated by each organisation analysed in Paper IV, but not all, included an appeal. For example, the Small-scale Health and Safety Supervision program (provided by SLA) stated that employers may be subject to sanctions from the Work Environment Authority during inspections unless a systematic work environment assessment is performed in the workplace. It also stated that: “As a member, you will receive advice and support in your systematic work environment”. The appeal to certain behaviours was inconsistent with the threats used. For example, even if an individual perceives farming to be dangerous and knows that they are highly susceptible to being one of the thousands of casualties, an appeal to follow rules may not be a credible solution to their fear.

Efficacy and targeted behaviours

The final aspects described in Paper IV concerned response and self-efficacy. Response efficacy relates to the belief that a certain action will reduce the source of fear (*i.e.* the threat). Self-efficacy is about increasing the belief in an individual that they have the ability to perform a certain action. The general impression gained from the results was that there is a wealth of information on the effectiveness of safe work practices (*e.g.* facts on injuries, persuasive arguments relating to different responses) and numerous opportunities to boost self-efficacy in the form of courses and consultancy. On the surface, therefore, it appears as though response efficacy and self-efficacy should be high in Sweden. However, EPPM states that individuals will only engage in the necessary cognitive processing related to self-efficacy and response efficacy if fear is aroused. Here there appears to be an inconsistency between the immediate behaviours targeted and the common approach in Sweden to increasing efficacy. If the organisations in question targeted specific behaviours such as wearing ear protectors or using a seatbelt, the wealth of information available and possibly the opportunity to receive training would make sense in increasing efficacy. Yet the behaviours targeted mostly involve getting individuals to process information and accept training. To be consistent, the type of information available should be geared more towards explaining why receiving educational support or more information is a viable way to reduce fear. In short, the means for boosting self-efficacy and response efficacy seem inconsistent with the immediate behavioural changes desired by Swedish organisations.

One weakness observed with EPPM is that it is often used to understand specific behaviours connected with specific threats (that arouse fear) and efficacy, often in connection with a specific message that triggers fear. For

example, one group in an experiment might receive information that breast cancer kills and that it can be prevented by simple screening by mammography, while another group might receive no threatening message. The behavioural intentions of the two groups are then measured to see if fear is elicited by the message and if there are differences in intentions. In other words, a trigger (*i.e.* the message used) is used to stimulate *e.g.* fear and then behaviour. In work safety campaigns, this trigger is not always as evident or timely. The model developed by Fogg (2009) theorises that, in addition to motivation and ability (which are similar to fear and efficacy in EPPM), a trigger of sorts is also needed for the behaviour to occur. In Paper IV, the concept of 'trigger' was borrowed from the Fogg model and built into the EPPM conceptual framework. The Fogg model considers a wider range of motivators (*e.g.* pleasure, happiness) than EPPM, which only focuses on fear. While fear may be the dominant approach to motivating individuals in a farm safety context, other forms of motivators such as pleasure, hope and acceptance have been used to influence behaviour (*e.g.* Bandura, 1997; Witte *et al.*, 1992).

Discussion

The insights gained from Papers I-IV and the knowledge synthesis above are used in this discussion section to form new insights. The main finding was that EPPM is a valid framework for understanding why fear-based persuasion may succeed or fail. In this thesis, the focus was on education-based intervention and how it is used to influence occupational safety behaviour. There were two main reasons for this focus: (1) To date, education has been the main tool (in terms of total spending) used by stakeholders in Sweden to influence work safety behaviour (Danielson, 2013; Markör, 2013; Lundqvist, 2012), but (2) education has been criticised by occupational safety experts for being inefficient, if not largely ineffective (*e.g.* Holte & Follo, 2018; McNamara, 2017; Nilsson, 2016a; Cryer *et al.*, 2014; Lundqvist, 2012; Rautiainen *et al.*, 2008).

Consequently, the majority of studies to date have shown weak or no correlation between *e.g.* educational work safety interventions and improvements in work safety. One response to this might be to re-direct intervention efforts to Haddon's other E-principles such as increased legislation and engineering solutions such as ROPS (which have proven effective) (*e.g.* Rautiainen *et al.*, 2008). In this thesis, I argue instead that such conclusions are premature and may not be feasible. For example, much of the data that informs moving away from educational interventions is corollary in nature and says little about why the intervention failed to achieve its goal of improved work safety. Consequently, it is often unclear if the intervention tool (*i.e.* education) or its implementation is the problem (see Paper IV). Moreover, education is the most common intervention (Lundqvist, 2012) because, unlike increased regulation, it has support across the political spectrum and the agricultural sector. Together, this suggests that more evidence and a deeper understanding of education-based interventions and the mechanisms behind their implementation are needed.

One area that has not received enough attention in the literature concerns how educational (farm work safety) interventions motivate individuals to adopt safer behaviours (*e.g.* discussed by Lee *et al.*, 2017; Donham & Thelin, 2016; Kaufman *et al.*, 2014; Witte, 1992). During the course of this thesis work, it emerged that (in Sweden and elsewhere) fear appeals are the dominant approach used to motivate behavioural change in agricultural work safety. Whether or not a fear appeal is effective or leads to unintended consequences such as maladaptive behaviour is suggested in previous studies to be dependent on the individual's cognitive mediation process (Witte & Allen, 2000; Witte, 1992). Given the need for more evidence on education-based interventions in the agricultural work safety intervention arena and the importance of understanding mechanisms underlying their outcomes, this thesis is important in providing a deeper understanding of how motivation is used to influence

behavioural change and the underlying cognitive factors which promote or hinder these changes.

Figure 10 provides a general picture of the diverse influences relating to farmers' behaviour change and work safety intervention. The core principles of the model are that there are multiple influences on an individual's behaviours, including factors at the individual level with increasing influence at levels (Lee *et al.*, 2017; Kaufman *et al.*, 2014). Previous studies on marketing communication emphasise that it is important to make an issue personally relevant (Peattie *et al.*, 2009), while *e.g.* Kaufman *et al.* (2014) highlight the importance of considering individual differences in skill, knowledge *etc.* The level of this model that is most influential is not clarified in this thesis. However, in order to evaluate the effectiveness of a safety intervention programme, organisations and marketers must determine how various marketing communication tools influence individuals (Belch & Belch, 2004). A model such as that in Figure 10 showing influences relating to farmers' behaviour change and work safety intervention provides guidance on applying a multi-faceted, multi-level intervention to maximise the potential for impact on behaviours (Lee *et al.*, 2017; Kaufman *et al.*, 2014).

Using EPPM to describe and evaluate marketing communications revealed a mismatch between the types of threats used in communications and the behaviours promoted. In addition, it revealed that the response cost, or time/money/effort required for farmers to receive information. Thus the motivation to adopt behaviours based on the marketing communications is predictably low and the potential for maladaptation is high.

Previous research shows that work safety interventions have done a poor job in influencing safer work environments. However, contradictory evidence was found in this thesis (see Paper III). On the one hand, the farmers interviewed seemed to be aware of the most common threats in their environment and nearly all had made at least some changes to their work safety environment (crediting the intervention that took place one year earlier). Therefore that intervention appeared to work in terms of generating awareness and stimulating adaptive behaviours (Paper I). However, many of the same farmers who made adaptive changes also showed clear signs of maladaptation. They were aware of threats (*e.g.* their child being injured, stress, father working himself to death), but instead of working to remove them, they performed strategies to lower their fear. In relation to these threats, the intervention succeeded in elevating awareness and arousing fear, but failed to achieve the more important objective of a safer working environment. In fact, the measures taken by farmers to reduce threats were mostly personal in nature. This was surprising, since farmers were less concerned with threats of a personal nature than those related to others they cared about. Nevertheless, the threats that farmers were most anxious about, such as those related to family and employee injury, were often ignored and there was clear evidence of maladaptation. It seemed that farmers were more fearful of work safety threats related to family members and employees, yet the actions they took mostly

served to reduce threats that are personal in nature. To help explain this finding, a typology of threat complexity was developed. The typology revealed that simple, common and direct threats to safety tended to lead to adaptive, threat-reducing behaviours, whereas complex, general or indirect threats promoted more maladaptive behaviours that reduced fear, but not threats.

The Safe Farmers' Common Sense intervention had no theoretical approach or process evaluation, so it was difficult to perform a deeper analysis of the programme structure and implementation, farm advice, pedagogics in the education activities or whether the activities were right. It was also not possible to determine whether the concept of allowing everyone who had a work environment interest in agriculture to train as a supervisor was appropriate. A large part of the training for supervisors dealt with theoretical factors about risks in agriculture and much less about communication and related obstacles and opportunities. The whole programme was driven by farmer perspectives and from the outset farmers stated that they wanted an approach with person-to-person education/training. The organisers of the programme were convinced that farmers will respond to advisors (supervisors) who are willing to talk to them and find out what they are interested in. This interactive and partnership bottom-up community approach, where researchers, policy makers, business organisations and farmers are equal partners and where there is continuity of participants from development and delivery through implementation and maintenance, differs from conventional farm safety education and information approaches (Donham & Thelin, 2016; Lilley *et al.*, 2009; Ambe & Murphy, 1995).

According to Scharf *et al.* (1998), the main task in any intervention campaign/programme is making that which is socially relevant seem personally relevant. The task for farm safety interventions is translating agricultural injury problems into personally meaningful practice for farm families (*e.g.* Marlenga, 2018; Hartling *et al.*, 2004; Ambe & Murphy, 1995). Targeting the individual level is not sufficient, since according to Scharf *et al.* (1998) the community level should also be included. Community-level interventions may provide the bridge for translating broad societal goals into individual and family concerns and practice. However, there was no real incentive to discuss alternative intervention strategies such as those described by Rautiainen *et al.* (2008), *i.e.* engineering/technology, education/behaviour change, legislation/enforcement and multi-faceted interventions using more than one basic approach.

The Safe Farmers' Common Sense programme was a success in how it reached a large proportion of Swedish farmers through activities, meetings, the media and other means (Paper I). Evaluation of the farmers who participated in the programme showed that it had the ability to motivate farmers to increase their work on injury prevention activities, even years after the activity. However, it was not found that this programme, together with other activities initiated by different stakeholders, has had any impact on the number of occupational injuries in the agricultural sector, although fatal occupational

injuries stayed on a lower level during the five-year programme period (SWEA, 2017). The programme was quite expensive, but was perhaps too short to have a lasting effect.

It was not possible to determine whether if Safe Farmers' Common Sense or similar interventions employing fear appeals do more good than harm. However, the findings in this thesis raise several important questions and opportunities for future research. For example, should work safety interventions try to reduce all threats or perhaps those very complex threats that are difficult to manage? Should they instead only focus on a subset of the most common or most dangerous or simple threats? In aiming too broadly or at too complex issues, safety interventions risk generating fear without providing threat reduction strategies that are credible or manageable. This creates conditions where farmers are motivated to manage their fear rather than manage safety risks (*e.g.* Holte & Follo, 2018; Donham & Thelin, 2016; Kaufman *et al.*, 2014; Stave, 2005; Sorensen, 2009; Bronfenbrenner, 1979). This could conceivably lead to situations where maladaptive behaviours become contagious (*e.g.* "no matter how many changes I make, in the end farming is still dangerous, so what is the point") and the farmer simply disengages from work safety information and improvement processes and goals. Alternatively, limiting interventions to very specific threats, such as those that are simple, common or present extreme dangers, would make it easier to find strategies that are manageable and credible (and perhaps reduce the likelihood of maladaptive behaviour). On the surface, this seems like a safer approach to intervention. However, most farmers are already aware of the most common and dangerous threats and, if the threats are simple enough to understand, they (or at least the farmers surveyed here) tend to take action to avoid them, without needing an intervention.

While there is sometimes a tendency to focus on influencing farmers in work on preventing injuries, there are other important influences (see *e.g.* Kaufman *et al.*, 2014; Bronfenbrenner, 1979). Farmers, and stakeholders in education on work safety, should know that it takes a whole community to reduce injuries in agriculture.

Overall, this thesis provides some evidence that (at least in Sweden) part of the problem with education-based work safety interventions and their effectiveness resides in their implementation. The results also highlight that the dominant approach to motivation is through fear. Fear appeals can motivate attitude and behaviour changes when used together with high efficacy messages, which makes them an attractive tool for work safety interventions. However, fear appeals should be used with care, since they may promote adaptive or maladaptive behaviours. Even if interventions are successful in reducing some injuries, they may very well be missing a golden opportunity to reduce a wider range of work safety risks that are too complex, general or "indirect". This thesis does not confirm whether information and communication that utilise the fear of the farmer do more harm than good.

Swedish and international experiences of intervention initiatives and other strategies for reducing occupational injuries in agriculture raise the question of whether there is a sufficiently functional way of working, because advisory, intervention programmes/campaigns do not always reach the farmer. Examining how the various phenomena are interrelated (the components of complexity) and why interventions rarely turn out as planned suggests a need for a complementary approach to education-based intervention initiatives. It could consist of an even more solution-focused approach that is based on learning, participation and dialogue, with a future focus on clear goals and concrete planning on work environment safety. Implementation of such a method should be based on a systemic approach and, in order to achieve a change in farmers, their social context needs to be managed to a greater extent. Against this background, there is a need to better understand farmers' perceptions and implicit theories of communication and the (in) efficiency of advisory services and education-based interventions.

Conclusions

- Taking into account the reduced labour demand in Swedish agriculture and the decline in the number of farms since 2004, the rate of injury in Swedish agriculture has not been reduced. It is alarming that despite all efforts to reduce injuries in agriculture, the level is still high. The number of unreported occupational injuries in agriculture is still very high, with only 7-8% of injury cases being reported. Follow-up studies on occupational injuries and access to reliable statistics are important for devising preventive measures in agriculture and identifying priority areas for further research on contributing factors and injury control measures.
- Fear appeals are a widely applied marketing and communication strategy in farmer safety efforts, but their usefulness in educational-based interventions is debatable. Fear appeals seem to arouse reactions among farmers, but not always the desired reaction. The farmer may choose to reject the risk message rather than responding to its intention. Farmers are affected by fear appeals, but their influence is probably extremely individual and possibly also situation-based. This means that farmer will not necessarily react in the same way every time they are confronted with the message.
- The extended parallel process model (EPPM) is a valid framework for understanding why fear-based persuasion may succeed or fail. Stakeholders in Swedish agriculture believe that recommendations to change safety behaviour are less effective than messages accompanied by fear appeals. A combination of high threat and high efficacy messages seems to produce a strong and stable level of attitude, intention and behaviour change. Fear appeals with low efficacy messages seem to be less persuasive.
- Changing safety behaviours in farming is complicated and challenging. This thesis provides some insights into the communication, motivation and cognitive challenges. The findings will hopefully inspire further research in this area and prompt others to go beyond the framework provided to explore other complex issues, such as social, cultural and institutional forces that inhibit a safer working environment.

Future research

The findings in this thesis do not show whether interventions employing fear appeals do more good than harm. However, they raise some important questions and opportunities for future research and strategies on education-based interventions. For example, should work safety interventions try to reduce all threats or perhaps only those very complex threats that are difficult for the farmer to manage?

This thesis did not deal with issues regarding attitudes and behaviour, such as knowledge, ability and norms, which can provide an additional explanation as to why the number of occupational injuries has not been reduced to a greater extent. Creating a safe working environment by reducing risks and risk behaviours in agriculture requires efforts in several areas at the same time. Increased knowledge, meaningful actions, supportive social norms, technical aids, incentives and other supporting structures play a role and influence the possibility of change. This complexity requires a systematic way of working, *e.g.* where everyone in the farm is given the opportunity to express their views on problems (farmers, family, employees), and also a systemic understanding and approach (beginning) in the actual communication.

When introducing fear appeal programmes and campaigns in the future in order to decrease occupational injuries and change farmers' behaviour, it is critical to carefully define and make constructs operational. It is important to assess attitudes, intentions and behaviours (danger control responses in EPPM) but also fear control responses, such as defensive, avoidance and reactance responses.

The theoretical scope of EPPM seems to be limited to explaining and predicting reactions to fear appeals. It is important to note that fear appeals are one of a variety of different effective persuasive messaging techniques and are not always the most appropriate technique for motivating safety behaviours. The findings in this thesis suggest that stakeholders designing education-based interventions addressing serious risk issues can have confidence in using the framework's utility for explaining the persuasive process and outcomes of fear-based persuasion, but also of emotion-based persuasion more broadly, including appeals to positive emotions, such as pride, humour and happiness.

The key to motivating farmers is through increasing their self-efficacy in adopting safety behaviour alternatives and educating them on the importance of their actions in reducing the risks in their work. Including self-control as a complementary factor within EPPM could be effective in designing education-based prevention programmes to motivate farmers to adopt safer behaviours. More work is needed to determine whether designs for education-based safety interventions can be improved by integrating measures of self-control into EPPM.

The agriculture industry probably has expectations of a certain traditional intervention-based education and advisory approach, but it less well-informed

about which measures are best. Thus approaches tend to be based on traditions, experiences and beliefs, rather than on improvement measures that farmers can work with. Therefore, the media, educators, insurance agents, farm advisors and others are in a key position to help achieve safe work on farms through safety interventions and strategies, both in the early phase and over the long term. It is important to avoid basing programmes on simple truths and to try to understand the complex situation of the farmer, considering individual differences and the need to handle many levels of information simultaneously. This requires change on many levels, within individuals and throughout the education and advisory system. Future marketing and communication strategies in Swedish agriculture need to consider communication challenges, such as the targeting challenge, the reality and relevance challenge, the attitude-behaviour gap challenge and the message challenge. The core aim should be to understand the multiple influences on an individual's behaviours, including factors at the individual level and increasing influence at different levels. The model presented in this thesis (see Figure 10) on influences relating to farmers' behaviour change and work safety intervention indicates how a multi-faceted, multi-level intervention can maximise the potential to influence behaviours and decisions made by farmers regarding safety on their farms

It is my hope that this thesis inspires continued research in the area and that others will go on to explore other complex issues, such as social, cultural and institutional forces that hamper creation of a safer working environment.

Svensk sammanfattning

Svenskt lantbruk har under de senaste decennierna genomgått en omfattande strukturrationalisering som medfört att företagen blivit färre men större. Det är vanligare med anställd personal, ny teknik och en åldrande lantbrukarkår. Detta har lett till en rad nya fysiska och psykologiska hälsorisker och behov av fortsatt arbete för att förebygga arbetsskador.

I många former av skadepreventivt arbete som tillämpats har det funnits kopplingar till någon eller flera av Haddon's "E-principer: 1) *Enforcement* – lagstiftning och regler, 2) *Engineering/Environment* – teknik, miljö och produktdesign/modifiering samt 3) *Education* – utbildning, rådgivning och information. I denna avhandling ligger fokus på utbildning och hur den åtgärdsstrategin används för att påverka lantbrukares säkerhetsbeteende av två huvudsakliga skäl: Traditionellt har utbildning varit det viktigaste verktyget som lantbrukets intressenter använder (i form av totala kostnader) för att påverka arbetsmiljöarbetet med fokus på att förebygga arbetsskador. Samtidigt har utbildning som metod kritiserats av arbetsmiljöforskare för att vara ineffektiv. Till stöd för dessa argument har majoriteten av forskningen visat svag eller ingen korrelation mellan t.ex. utbildningsbaserade interventioner och förbättringar av den faktiska arbets säkerheten. En slutsats från detta kan vara att styra om interventionsinsatserna till Haddons andra principer, såsom ökad lagstiftning (som har visat sig vara effektiv). Jag argumenterar istället för att sådana slutsatser är för tidiga och kanske inte är möjliga.

Flertalet av de tidigare studier som pekat på behovet av att välja andra strategier än pedagogiska insatser har sällan haft någon form av analys om varför insatsen har misslyckats med att uppnå sitt mål om förbättrad arbets säkerhet. Följaktligen är det ofta oklart om interventionsverktyget (dvs utbildning) i motsats till dess genomförande är problemet. Utbildning är dessutom den vanligaste interventionsmetoden eftersom den, till skillnad från ökad reglering, har stöd över det politiska spektret såväl som av lantbrukssektorn. Tillsammans visar detta på behovet av ökade kunskaper och en djupare förståelse för utbildningsinsatser och mekanismerna bakom deras genomförande inom det förebyggande säkerhetsarbetet.

Ett område som inte har fått tillräcklig uppmärksamhet handlar om hur pedagogiska insatser motiverar individer att anta säkrare beteenden vad gäller risker för personskador i lantbruket. Under det här avhandlingsarbetet framgick det att känslomässig påverkan med skrämmande budskap (*fear appeal*) för att motivera mottagaren till en beteendemässig förändring har varit den dominerande metoden. *Fear appeal* börjar med att kommunicera ett hot (t ex risken att välta med traktorn) och (vanligen) med efterföljande information om hur lantbrukaren ska bete sig för att minimera detta hot (t ex att använda säkerhetsbälte). Om *fear appeal* är effektivt eller leder till oönskat beteende som förnekelse och försvar är beroende av lantbrukarens kognitiva

bearbetningsprocess baserat på bl a tidigare erfarenheter, kunskaper och attityder.

Med tanke på behovet av mer underlag och ökade kunskaper om utbildningsbaserade interventionsinsatser för säkrare lantbruksarbete var det övergripande syftet med denna avhandling att studera utbildningsbaserade interventioner i Sverige och utveckla en djupare förståelse av hur motivation används för att påverka beteendeförändringar och de underliggande kognitiva faktorer som främjar eller hindrar dessa förändringar.

För att uppnå målet har fyra studier genomförts med hjälp av *mixed methods*, som omfattar ämnen som; implementering och resultat av kunskapsbaserad intervention för säkrare lantbruksarbete, analys av interventioner baserat på *fear appeal* och dess kognitiva processer över en period av 6 år. Insikten från dessa studier och en kunskapsyntes användes för att bilda nya insikter i avhandlingens kapp.

En av studierna i avhandlingen bekräftade, som i tidigare forskning, att underrapportering av arbetsskador i lantbruket är mycket hög. Ännu viktigare, visar studien att lantbruket fortsatt är en av de mest skadedrabbade branscherna i Sverige. Trots att stora ansträngningar har genomförts för att minska arbetsskadorna så visar studien att arbetsskadorna inte har minskat om hänsyn tas till den minskade efterfrågan på arbetskraft inom jordbruket och minskningen av antalet gårdar sedan 2004.

En möjlig förklaring till dessa resultat kan vara hur olika aktörer kommunicerat behovet av förändring av sektorns arbetsförhållanden. Det konstaterades att *fear appeal* var det vanligaste motivationsverktyget som använts av de största aktörerna i Sverige för att påverka lantbrukarnas säkerhetsbeteende. Med hjälp av EPPM-modellen (*the extending parallel processing model*) för att beskriva och utvärdera deras marknadsföringskommunikation blev det tydligt att det fanns en obalans mellan de typer av "skrämmande" budskap som användes i kommunikationen och de beteenden som främjades. Förutom detta var kostnaden i form av tid / pengar / ansträngning som krävdes för att lantbrukarna skulle få ta del av råd om t.ex. hur man minskade risker för arbetsskador (onödigt) hög. Mot bakgrund av detta var motivationen på en förväntat låg nivå för att följa säkerhetsbeteenden baserade på marknadsföringskommunikationen och potentialen hög för att lantbrukaren skulle undvika att följa råden. En annan förklaring framkom efter intervjuer med lantbrukarna. Tidigare forskning har hävdade att utbildningsbaserade interventioner traditionellt sett har gett bristfälliga resultat vad gäller påverkan för att skapa säkrare arbetsförhållanden. Inom föreliggande studier framkom motsägelsefulla resultat. Ur ett perspektiv verkade intervjuade lantbrukare medvetna om de vanligaste riskerna i sin arbetsmiljö och nästan alla gjorde åtminstone vissa förändringar för att minska risker och förbättra säkerheten (baserat på den intervention som genomfördes ett år tidigare). På detta sätt verkade insatserna fungera när det gällde att skapa medvetenhet och stimulera adaptivt beteende. Ur ett annat perspektiv visade många av dessa lantbrukare som gjorde adaptiva

förändringar tydliga tecken på försvarsbeteenden. De var medvetna om risker (t ex deras barn kunde bli skadade, stress, gamla pappan jobbar riskfyllt) men istället för att ta bort dessa risker fann de andra strategier för att minska nivån på sin egen rädsla. I förhållande till dessa hot lyckades interventionen öka kunskap och väcka rädsla, men var mindre framgångsrik med att uppnå det viktigaste målet om en säkrare arbetsmiljö. Faktum är att de åtgärder som lantbrukarna tagit till för att minska riskerna var mestadels personliga. Detta var oväntat eftersom lantbrukarna var mindre oroad för risker av personlig karaktär än de som var relaterade till andra personer i sin närhet. Trots att de risker som lantbrukarna var mest angelägna om, till exempel de som relaterade till familj och anställda, ignorerades ofta dessa risker vilket var tydliga bevis på att de undvek de faktiska råd som gavs. För att förstå detta utvecklades en risk-typologi baserat på mönster i intervju data. Typologin avslöjade att enkla, vanliga och direkta hot mot säkerheten tenderade att leda till anpassade, riskreducerande beteenden medan komplexa, generella eller indirekta hot främjade mer alternativa beteenden som minskade rädslan men inte riskerna.

Sammanfattningsvis ger denna avhandling bevis för att (åtminstone i Sverige) en del av problemet med effektiviteten i utbildningsbaserade interventioner ligger i genomförandet. Resultaten belyser också den dominerande inställningen till motivation sker genom upplevd rädsla. *Fear appeal* som metod kan motivera till attityd- och beteendeförändringar tillsammans med tydliga signaler om konsekvenser. Detta gör den till ett attraktivt verktyg för interventioner för säkrare arbetsmiljö inom lantbruket. *Fear appeal* bör dock användas med försiktighet, eftersom denna metod kan främja såväl adaptiva som maladaptiva beteenden.

Även om interventioner lyckas med att minska vissa personskador kan de mycket väl sakna ett gyllene tillfälle att minska ett brett spektrum av risker som är för "komplexa", "generella" eller "indirekta". Vidare framkommer inte i denna avhandling om information och kommunikation som använder den känslomässiga rädslan hos lantbrukaren gör mer skada än nytta.

Avhandlingen pekar på flera angelägna frågeställningar och möjligheter till framtida forskning. Till exempel, bör interventioner försöka minska alla risker eller kanske fokusera på de mer komplexa riskerna som är svåra att hantera? Förmodligen bör även andra motivationsmetoder förutom rädsla, såsom altruism, lycka, humor (dvs positivt validerade tillvägagångssätt) prövas och utvärderas grundligt innan man dömer ut utbildningsbaserade interventioner som strategi för en säkrare lantbrukssektor.

Att ändra säkerhetsbeteenden i lantbruket är komplicerat och utmanande. Denna avhandling ger viss insikt i att förstå och ta itu med kommunikations-, motivations- och kognitiva utmaningar.

Jag hoppas att denna forskning också inspirerar till fortsatt forskning på detta område och "motiverar" andra att gå utöver det ramverk som tillhandahålls för att utforska andra komplexa frågor, såsom sociala, kulturella och institutionella krafter som hämmar en säkrare arbetsmiljö.

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