

Investigation of UK farmer risk perception and Non-Technical Skills

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ABSTRACT

Livestock operations pose a high risk of injury and fatality in agriculture, especially for lone workers. In other high-risk industries, non-technical skills (NTS) are recognised as important for safe and effective task performance. However, dedicated research ought to be conducted to investigate how these findings apply to farmers, who are suggested to be highly risk tolerant. The current study used the vignette method to investigate farmer risk perception and risk management strategies, including NTS, in four types of cattle-handling risks related to self, equipment, environment, and animal characteristics. A preliminary sample of 50 farmers from the UK and Ireland was recruited through farming forums and organisational contacts to take part in an online qualitative study. Participants were presented with eight scenarios, two per category of risk, and asked to report their reasoning for proceeding or not and to detail any risk management strategies used. Thematic analysis was used to identify patterns. Farmers appeared to evaluate risk in the light of animal welfare and duty. Scenarios concerning faulty equipment and animal characteristics were perceived as too dangerous. Farmers reported using NTS such as task management, situation awareness, and decision-making to reduce risk. Farmers also considered facilities important for safe completion of livestock operations. These findings suggest that future interventions should aim to frame risk based on farmer priorities and to formally raise awareness about the importance of NTS.

KEYWORDS

Risk perception, non-technical skills, decision-making, scenarios, livestock

Introduction

A farm partner recently died from crush injuries after having entered a calf pen during calving and being attacked by the cow (HSE, 2018b). Unfortunately, this is not an isolated event, as farming accounts for approximately one in five fatal industrial accidents recorded in 2017/2018 in the United Kingdom (HSE, 2018a). The extent of the phenomenon might be even larger for non-fatal injuries when considering under-reporting in the farming sector (Solomon, 2002).

In other high-risk industries, non-technical skills (NTS), the social (leadership, teamwork, and communication) and cognitive skills (decision-making, situation awareness, and task management) required for safe and effective task performance (Flin & O'Connor, 2017), are recognised as complementary for formal knowledge and practical skills. Failures in NTS have been shown to lead to adverse events. For instance, lack of situation awareness has been linked to diagnostic error (Singh et al., 2012), whereas issues with task management have been shown to lead to ICU adverse incidents (Reader et al., 2006). However, these analyses cannot be extrapolated to farming, which differs in terms of work environment and roles (Olson & Schellenberg, 1986). Farmers work both alone and in teams, they depend on weather and seasonal changes, and they engage in activities

with different associated risks. An interview study by Irwin and Poots (2015) with British and Irish farmers was the first to address the gap in the literature and found that NTS are used by farmers in lone working and team settings. Additional research is necessary to replicate these findings.

Risk perception in farming

Understanding risk perception in farmers is crucial, especially as farmers are suggested to have a high level of risk tolerance (McLaughlin & Mayhorn, 2011). A novel method of investigation consists of vignettes describing possible scenarios involving a farm hazard. Irwin and Poots (2018) presented their participants with scenarios depicting risk factors related to tractor use and asked farmers to make a “go/no-go” decision and to detail their reasoning. It was suggested that whilst farmers perceive certain scenarios as too dangerous, they balance the consequences of personal risk with those of financial risk in scenarios perceived as less risky. Consequently, the authors argued that a better approach in safety interventions would be to frame risk positively, by outlining the potential financial advantages of not taking the risk. Future research should explore risk perception in scenarios involving other important farm hazards, such as livestock.

Lone worker NTS in agriculture

Working alone in farming is particularly hazardous should an emergency occur (Huang et al., 2013), especially in cattle handling (Karttunen & Rautiainen, 2013). The only paper to date to directly investigate lone worker NTS in agriculture is an interview study by Irwin and Poots (2015), which found that situation awareness, decision-making, and task management were cognitive skills relevant for lone workers. Some respondents reported that alertness was more important when working alone, as the vigilance of a second colleague was not available. A part of the interviewees also mentioned that they were more careful when making decisions, as there was no help available. Finally, planning was identified as an important skill for organising daily activities.

Livestock handling

Global accident data from dairy farms compiled by Douphrate et al. (2013) indicated that livestock handling, especially cattle operations, represents one of the main hazards in farming. Bulls were found to be more hazardous than cows in an analysis of case studies from 14 countries (Sheldon et al., 2009). However, little is known about the subjective view of farmers on risk perception and risk management strategies associated with cattle handling. In a national survey conducted in England and Wales for the HSE (Knowles, 2002), 10% of farmers who identified livestock as one of the three most important farm hazards admitted frequently entering an occupied bullpen alone. The author argued that the bull might be misperceived as safe if it is familiar. In terms of risk management strategies, farmers interviewed by Lindahl, Lundqvist and Norberg (2012) acknowledged the importance of awareness of animal behaviour and of planning of escape routes for safe cattle handling. Nevertheless, additional qualitative research on risk perception and NTS in specific livestock handling scenarios ought to be conducted.

Theoretical model

An interview study with New Zealand farmers proposed a model of risk perception and risk management in farming when using quad-bikes (Clay et al., 2015). Farmers initially assess risk based on factors such as experience and duty of completion. Should the farmers decide to proceed in tasks with anticipated risks, they would use their skills and attention to prevent adverse events.

The outcome of the risky situation would then feed into future risk evaluations. Further research should assess the model in livestock handling scenarios and identify specific NTS required.

Using vignettes to explore risk perception and NTS

The vignette method represents a low-fidelity simulation of a high-risk scenario which may result in an adverse event. For example, Flin et al. (2010) reported that Anaesthetists' Non-Technical Skills were taught through discussions of high-risk scenarios, in which trainees would consider the influence of NTS in emergencies. Vignettes followed by a "go/no go" decision have also been used in healthcare to explore differences in procedural judgements between anaesthetists in critical situations (Greig et al., 2017). Thus, the vignette method offers the possibility of situating the hazard in the context of a regular task. Furthermore, vignettes can be administered online, allowing for the recruitment of participants from dispersed areas (Braun & Clarke, 2013).

Study aims

The aims of the present paper are to capture farmers' risk perception and to understand which risk management strategies, including NTS, they might use for safe and effective task performance. The analysis could help identify key problem areas and guide further interventions. The study focus is on livestock handling and lone working as important hazardous circumstances. The research purpose will be achieved through thematic analysis of responses in relation to different vignettes.

Method

Participants

The preliminary sample consisted of 50 participants (15 female; 33 male; 2 not stated; age range 19-73 years) recruited from the United Kingdom and Ireland over the course of a six-week period. Participants worked on several types of farm: dairy farm (n = 13), beef cattle (n = 8), sheep (n = 4), pigs (n = 1), mixed animal farm (n = 14), arable crops (n = 1), mixed animal and arable crops farm (n = 9). The recruitment criteria were farming as primary occupation and previous experience with cattle handling, due to the nature of the scenarios presented.

Questionnaire

Demographic information was collected first, including age, gender, training level, work environment when handling cattle (working alone or as part of a team), years of farming experience, work schedule (full-time or part-time), job status, and size and type of current farm.

The following section featured a "go/no-go" decision-making scenario approach. Participants were presented with eight scenarios, each detailing a single risk factor related to cattle handling, and were instructed to consider that they are working alone. The risk factors were from the following categories of hazard: compromised performance (fatigue and stress), equipment missing (crush not secured and no chain or bar to minimize movement), environmental hazards (slippery floor and no escape route), and factors related to the animals (borrowed bull and bull displaying signs of anger). Scenarios were derived from HSE recommendations on safe cattle housing and handling (HSE, 2012) and from research on risk factors in agricultural injury (Jadhav et al., 2015). As per previous studies from healthcare (Greig et al., 2017), the scenarios consisted of two sentences each. Participants were asked to indicate whether they would go ahead or not in each scenario. They were

then asked to provide the reasoning for their decision and to describe any risk management strategies which they would use if they were to proceed in the given scenarios.

Data collection

The questionnaire was administered online through SNAP Survey software. Participants completed an electronic consent form. Data collection was anonymous. The study was approved by the Psychology Ethics Committee of the University of Aberdeen. Participants were contacted through UK- and Ireland-based online farming forums and via social media groups. Emails were also sent to relevant organisations and contacts to aid recruitment.

Data analysis

Descriptive statistics were computed from the demographic data to situate the sample. The data obtained through the open-ended questions was analysed using inductive thematic analysis (Braun & Clarke, 2006), as the method is suitable for vignette studies and for the size of the sample. The process consisted of a coding stage in which data was categorized semantically by the first author. The codes were then checked by the second author and subsequently evaluated by both authors to determine overarching themes within the data and to ensure validity and coherent patterns.

Preliminary results

The majority of participants were male and worked on farms with livestock. Most of the respondents were farm owners and considered farming their full-time occupation. The level of agricultural training varied from on-farm training to postgraduate degree, with the majority reporting training to an undergraduate level. Self-reported farming experience ranged from 8 to 54 years ($M=31.95$ years). More than half of the respondents reported working both alone and as part of a team when interacting with livestock (Table 1).

Table 1. Participant characteristics (mean or frequency)

Personal characteristic	Category	Mean (SD)	Frequency (%)
Gender	Male		33 (66)
	Female		15 (30)
	Not stated		2 (4)
Age		47.6 (12)	
Farming experience (years)		32 (12.5)	
Training level	On-farm training		13 (26)
	Certificate/Diploma		15 (30)
	Undergraduate degree		20 (40)
	Postgraduate degree		1 (2)
	Other		1 (2)
Work schedule	Full-time		36 (72)
	Part-time		14 (28)
Status	Farm owner		35 (70)
	Farm manager		4(8)
	Farm worker		5(10)
	Temp worker		2 (4)
	Other		4 (8)

Farm purpose	Animals	40 (80)
	Crops	1 (2)
	Mixed	9 (18)
Farm size (acres)	583.7 (1019)	
Working with cattle	Alone	14 (28)
	As part of a group	8 (16)
	Both alone and as part of a group	27 (54)
	Not stated	1 (2)

Compromised performance – Fatigue and stress

The majority of farmers indicated a “go” decision in response to scenarios involving both fatigue and stress, stating the necessity of completing the task due to animal welfare reasons or duty. The needs of the animals were seen by some participants as more important than human needs. Interestingly, in the stress scenario, a small number of respondents stated that another reason for proceeding was profit, thus directly associating animal thrive with the financial status of the farm. Where a subjective risk evaluation was clearly articulated, respondents stated that the risk level was perceived as low. Both tasks were regarded as routine by some of the farmers, who consequently did not consider any additional precautions necessary, except for adhering to normal routines. In the stress scenario, some participants engaged in risk assessments by considering different hazards and factors, which included complications of the move and animal familiarity with the procedure.

Although having decided to proceed when tired, some farmers expressed concern about the adverse impact of fatigue on their abilities and wellbeing. Reported fatigue management strategies included rest after task completion and stimulant use, such as consuming coffee, tea, or energy drinks. Attitudes regarding stress varied. Some farmers stated that chronic stress is no longer an issue, whilst others considered livestock handling and stress unrelated. Others implied that mood is important in livestock operations and suggested postponing the task or taking a break if affected by the negative consequences of stress. Interestingly, working with cattle was seen as a method of stress relief by some respondents who decided to proceed, which was selected over spending time in the enclosed space of the office. Some farmers indicated that a clear separation between personal versus professional life was desirable when working with cattle.

Whilst in the fatigue scenario, unavailability of relief staff was provided as a reason to proceed, a number of farmers perceived working alone as dangerous in the stress scenario. Strategies to compensate for the lack of help were suggested in response to both scenarios, such as bringing in relief cover or keeping in contact with others.

Farmers also acknowledged that certain elements of task management were important when working tired. Thus, planning was reported as crucial by some farmers in order to both avoid high-risk situations from happening and to organise the present activity better. A part of the respondents also reported using their prioritisation skills when fatigued. Essential tasks were prioritised, whereas miscellaneous tasks were postponed, in some cases after the farmer was able to rest. Perhaps in accordance with their concern about the adverse effects of fatigue, some farmers recommended that the task was completed slower than normal. A part of the respondents also stated they would maintain standards to manage risk efficiently and not deviate from established processes. Some

farmers also reported a clear decision-making process, such as identifying options and reflecting on possible outcomes in both scenarios concerning compromised performance.

Animal characteristics – Unfamiliar bull and bull displaying signs of anger

Unlike the responses to scenarios concerning compromised performance, the risk perception in scenarios involving hazards related to animal characteristics indicated an unacceptable level of risk for most participants. In the first scenario which involved a borrowed bull, participants were mostly concerned with the dairy breed of the animal, as well as with the fact that the animal was unfamiliar to them and could have unpredictable reactions. A few respondents also mentioned that owning dairy bulls, as well as borrowing animals from neighbouring farms, was a dangerous practice due to safety and biosecurity reasons. In the second scenario involving a bull displaying signs of anger, some participants considered the risk in the light of damage or injury in a confined space. Only a few respondents saw risk as minimal in the second scenario contingent on the task being routine for both handler and bull, thus mirroring the responses to compromised performance scenarios. Another factor considered by many participants in both scenarios were appropriate handling facilities, such as the availability of an escape route or of a safe remote handling system. Working alone was also considered dangerous by some of the respondents when dealing with an unfamiliar bull.

When a decision-making process was apparent in the first scenario, farmers generated two main courses of action. They either considered bringing in additional help to reduce the risks associated with working alone or isolating the bull in a remote pen whilst cleaning. In the second scenario, elements of decision-making included considering the option of removing the bull and reflecting on potential consequences. A particularly important element of situation awareness mentioned by respondents in response to the second situation was the ability to read, comprehend, and predict animal behaviour, which subsequently informed the decision to proceed or not.

Irrespective of deciding to allow the bull to pass through the parlour or not in the second scenario, many respondents stated that they were aiming to minimise animal stress. The belief that the bull will decide which course of action is suitable and that farmers must avoid the danger zone and must manage the environment was also expressed by some. A squaring or culling regime on the farm was also proposed in response to the angry display of the bull in the second scenario.

Environmental hazard – No escape route and slippery floor

The results of the risk assessment in the first scenario of this category were more balanced than in scenarios concerning compromised performance and animal characteristics. In contrast, most participants indicated a “go” response in the second scenario involving an environmental hazard, conditional on cleaning the floor or on spreading sand before starting the task. Participants acknowledged that animal welfare was to be considered both when deciding to proceed with milking and when acting to reduce the risk of slipping and injury.

An alternative strategy when dealing with a slippery floor was adjusting gait to the conditions or wearing appropriate footwear to avoid slipping. Not scaring the animals whilst at the same time avoiding the danger zone was another preferred strategy in both scenarios.

The lack of an escape route was the most frequent risk factor mentioned by participants in their risk assessments related to the first scenario. Since no information about the type of cattle or the nature of the task were provided, many participants also considered these factors in their risk assessments. Knowledge of own livestock was also factored in the risk assessment by some respondents, who

stated that they would be comfortable to proceed with familiar animals. Facilities were considered in both scenarios by some respondents who suggested changing the faulty systems in the future to avoid such situations, thus demonstrating planning and preparation.

Actively monitoring the situation by observing and predicting animal behaviour was an important element of situation awareness mentioned by some participants in response to the first scenario. Furthermore, some respondents reflected on the potential consequences of not cleaning the milking parlour in the second scenario. Perhaps due to the time element mentioned, a few of the participants also considered the time available for cleaning.

Equipment missing – Crush not secured and no rump bar or chain

The majority of farmers stated that the risk level was too high in both scenarios concerning a faulty crush and as a consequence decided not to proceed. The main hazard identified in the first scenario was the possibility of the crush moving. A few farmers reflected on potential consequences of proceeding and stated that both personal safety and cattle safety were in danger. Interestingly, not only was the task considered risky in the second scenario, but also impractical by some respondents who preferred not to proceed. Farmers who considered risk to be low in the first scenario stated that it is not necessary to secure crushes to the ground or to a vehicle, due to new design features such as heavy-duty crushes or integral floors. Similarly, a few respondents indicated a “go” decision in the second scenario, stating that the risk level was in fact acceptable, because of previous experience.

In both scenarios, some farmers acknowledged that appropriate facilities were necessary for performing the task safely and used their planning skills to adjust the system for future use. Important factors when assessing the level of risk in both scenarios were age and size of cattle.

A useful skill highlighted by some respondents in relation to the first scenario was the awareness of changes in the position of the equipment or of the animal. Checking the integrity of equipment was also mentioned by a few respondents as an important standard. Some participants also considered alternatives in their decision-making process in the second scenario, such as bringing in relief staff.

The most common course of action for risk minimisation in both scenarios was fixing the crush, which contributed to the effective restraining of the animal. Some farmers suggested improvising with different tools available on the property. A secondary strategy was minimising animal stress.

Table 2. Thematic analysis of reported reasoning and risk management strategies across all scenarios

Global themes	Themes	Subthemes	Codes (frequency collapsed across participants and scenarios)
		Preparation	Planning is crucial (30)
			Workload management (7)
			Time management (11)
		Prioritisation	Postpone (18)
			Take your time (8)
			Establishing priorities (10)
			Concern about fatigue (9)
			Fatigue management (13)
			Stimulant use (9)

Non-technical skills (NTS)	Task management	Stress and fatigue management	Stress is always there (6)	
			Stress is not an issue (3)	
	Situation awareness	Maintaining standards	Work as stress relief (9)	
			Mood matters (9)	
			Wellbeing (2)	
			Time out when necessary (2)	
	Decision-making	Perception of surroundings	Maintaining standards (8)	
			Keep alert and be careful (26)	
	Decision-making	Comprehension of situation & prediction of events	Reading and predicting animal behaviour (27)	
			Identifying options	Considering alternatives (32)
Decision-making	Reflecting on outcome	Reflecting on consequences (30)		
Risk perception	Risk assessment	Result of risk assessment	Risk is too high (94)	
			Injury (10)	
			Damage (2)	
			Safety first (7)	
			Risk is low (35)	
	Risk assessment	Too difficult	Too difficult (7)	
			Biosecurity	Biosecurity (6)
			Considering hazards and factors	Considering hazards and factors (28)
			Animal welfare	Rules and regulations (3)
				Animal welfare (53)
	Animal>carer (6)			
	Duty	Duty (38)		
		Lack of human resources	Unavailability of staff = duty	Unavailability of staff (15)
			Working alone is dangerous	Working alone is dangerous (13)
	Risk perception (continued)	Facilities matter		Facilities matter (48)
New design feature (11)				
Escape route/refuge (22)				
Set up (10)				
No contact of animal with people (2)				
Animal characteristics		Animal type	Confined space (4)	
			Animal type (22)	
			Knowledge of cattle is important (10)	
			Fear of the unknown (12)	
			Concern about animal reaction (12)	
Personal characteristics	Dairy bulls are dangerous	Dairy bulls are dangerous (8)		
		Personal strength (2)		
		Experience and knowledge (3)		
Routine matters		Importance of routine (12)		
		Routine set (7)		
		Environment and weather (3)		

Risk management	Other factors		Decision depends on task (11)
			Profit (12)
	Avoiding animal stress		Avoiding animal stress (22)
			Bring in the help (43)
	A helping hand		Keep in contact (9)
			Working dogs (1)
			Clean it up! (28)
			Management of environment (31)
	Significantly reducing risk		Isolating/restraining the animal (64)
			Secure/fix the crush (12)
Risk management	Animal selection system		Culling for poor temperament (4)
			Selling the animal (2)
	Taking action		Adjust gait/use good boots (5)
	Use of protective equipment		Use of sticks (7)
	Adhering to routines		Adhere to routines (25)
			Proceed with common sense (21)
			Avoid danger zone (14)
Risk management	Miscellaneous strategies		Personal vs. professional life (9)
			Cattle can decide on their own (7)
			Food as bait (6)

Preliminary discussion

In accordance with the theoretical model proposed by Clay et al. (2015), the themes suggest an initial evaluation of risk based on various factors and hazards, followed by the selection of direct risk management strategies. In line with the findings of Irwin and Poots (2015), farmers appear to use cognitive NTS to reduce risk. Interestingly, bringing in additional help was a frequently selected course of action, suggesting that communication might also be relevant for lone workers.

Similar to the vignette study involving hazards related to tractor use (Irwin & Poots, 2018), some categories of risk were perceived as too dangerous in the present study. Conversely, risk was considered acceptable in scenarios involving compromised performance and environmental hazards. This suggests that the characteristics of the risk could influence perception and that in certain situations farmers could be risk averse. Nevertheless, the nature of the tasks might have also influenced responses, as animal needs were perceived as paramount across the entire data set.

Considering the unique aspects of farming and the limited research available on human factors in agriculture, the outlined findings raise awareness of the importance of NTS in the mitigation of risk and can contribute to the development of a framework of NTS in agriculture to be used in safety communication and training. The current results can be utilized to further develop interventions by considering farmer priorities, such as animal welfare, when framing risk. Future research could employ interviews to explore NTS in depth, particularly social NTS which were less prevalent here.

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