View metadata, citation and similar papers at core.ac.uk

brought to you by CORE

provided by Aberdeen University Research Archive

Investigation of UK farmer go / no-go decisions in response to tractor-based risk scenarios.

A.Irwin[1] J.Poots[1]

[1] Industrial Psychology Research Centre, School of Psychology, University of Aberdeen, Scotland, AB24 2UB.

Address for correspondence:

Dr Amy Irwin, School of Psychology, University of Aberdeen, William Guild Building, Aberdeen, AB24 2UB, Scotland, UK.

Tel: (01224) 273003; Fax: (01224) 273211; Electronic mail: a.irwin@abdn.ac.uk

Funding: This research was funded by the University of Aberdeen.

Disclosure: No financial interest or benefit has arisen from this research.

Acknowledgements: The authors would like to thank all of the farm participants for giving up their time to take part in this study.

Abstract

Objectives: Tractors are a source of injury and fatality in agriculture. Despite this farmers continue to engage in risk-taking behaviours, including operating tractors without appropriate equipment. In order to change behaviours and attitudes towards safety, it is important to understand how farmers approach different types of risk relevant to tractor use. The current study used a qualitative approach to investigate farmer perception of four types of tractor-based risk related to self, equipment, lack of safety features and environment.

Method: A sample of 148 farmers from the United Kingdom and Ireland were recruited from farming forums to take part in an online scenario-based qualitative study. Participants were presented with twelve tractor-based scenarios, three from each category of risk, and asked to indicate if they would proceed to use the tractor (go) or not (no-go), then report their reasoning. Thematic analysis was used to identify data patterns.

Results: Farmers appeared to assess the consequences of risk in broader terms than the risk of injury to themselves, they also evaluated risk in terms of potential costs (e.g. repair bill) and losses (e.g. delay). Analysis indicated that financial risk was considered with more caution than personal risk in many cases. Farmers also considered usability, such as the functionality of tractor seatbelts, indicating the importance of ensuring all safety equipment is fit for purpose.

Conclusion: The management of agricultural risk should consider farmer priorities (such as financial costs) in order to develop effective messaging that focuses on those priorities, with the aim of reducing risk-taking behaviours.

1. Introduction

Agriculture is a high risk industry with an estimated 170,000 farm worker fatalities occurring annually worldwide.[1] Farm machinery is a major source of injury and fatality including tractor rollovers, becoming caught in machinery, or being crushed.[2,3] Between 1992 and 2005, 1,412 farm workers died as a result of a tractor rollover in the United States.[4] In the United Kingdom, the Health and Safety Executive (HSE) states that approximately one worker a week dies as a result of farming activities. Between 2003 and 2013, 35% of these were reported as caused by being struck by a moving or overturned vehicle, usually an ATV, jeep or tractor.[5]

Despite guidance on tractor operation, agricultural fatalities persist and farmers continue to engage in unsafe behaviours, including operating tractors without appropriate equipment.[6] Research suggests that there are barriers that prevent farm safety behaviours, such as financial hardship, lack of training and risk attitudes.[2] It is vital to understand these barriers in order to remove them; where safety equipment is utilised, fatalities can be reduced.[2] The focus of the current paper was on one of these potential barriers to safety; farmer attitudes towards risk.

1.1 Risk perception

Risk perception entails the subjective view of the likelihood of an adverse event occurring, and the potential consequences of that event.[7] An individual's estimate of risk determines their response, on the basis of whether they consider the risk as acceptable or not.[7] This is distinct from the actual risk, which can be calculated on the basis of accident rates and simulations.[7] Risk perception has several stages, first the individual evaluates the risk, they then decide upon a response and the outcome of that response influences their future

evaluations and behaviours.[8] Risk-taking is where an individual engages in a behaviour that could have multiple outcomes, at least one of which could be negative or dangerous.[9]

Research indicates farmers are aware of, and understand, the hazards inherent in farm work, but this does not prevent unsafe behaviours, including disabling safety equipment and ignoring safety recommendations.[6, 10] Farmer risk-taking may be due to the farming environment, where hazards and associated risks are a consistent feature, which farmers feel they must adapt to.[6] Farmers also face financial hardships which can lead to cost cutting such as reducing staff numbers and not fitting safety equipment.[6] Finally, the social environment of growing up on a farm, where children frequently see corner cutting and risk taking, can lead to risk taking behaviour being normalised in adulthood.[6]

1.2 Risk characteristics

In comparison to risk perception related to personal safety, farmers have been reported as risk averse in their perspective on production, pricing and disease.[11] Farmers have also been categorised as risk averse when making decisions about new technologies, fertilisation practices and crop development.[12] This suggests that the characteristics of the risk could impact farmer perception and response.

A study examining farmer perception of ATV accident risks proposed a model of quad bike risk perception and management. If the risk was perceived as too high, and could not be reduced via risk management, then the farmer would not use the quad.[13] Where a level of risk was accepted, the farmers used their skills and experience to manage the risk. The data suggested that farmers assessed ATV risk on the basis of several elements including their own experience, the terrain, environmental factors and personal attributes such as confidence.[13] This is indicative of variation in farmer risk perception across different

scenarios. Further research is required to explore specific risk categories and different types of farm machinery.

1.3 Aim

There is a lack of research examining farmer perception of different categories of risk relevant to tractor use. By understanding how farmers perceive and manage different types of risk, potential problem areas could be identified, and specific interventions developed.[14] Based on agricultural research and safety reports, there are several categories of risk that might influence tractor safety, including; factors related to the self, such as stress, ill health and tiredness.[15] Factors related to the mechanics of the tractor, such as maintenance and equipment functionality.[16] Environmental factors, such as land gradient and surface conditions.[16] The presence of safety equipment such as PTO shields and seatbelts.[16]

The qualitative method used was a 'go / no-go' decision-making scenario approach previously utilised in aviation and healthcare.[17, 18] Participants were presented with scenarios, each describing a single risk factor in the context of tractor use. Participants indicate if they would proceed with the task (go) or not (no-go) and then present their reasoning. A short scenario of this type places the element of study, the risk factor, in the context of an everyday task.[19] It was expected that farmer risk perception would vary across different risk categories, and that this variation would provide insight into farmer risk taking and management.

2. Method

2.1 Participants

A total of 148 participants (123 male, 25 female; age range 18 – 77 years) were recruited from UK and Ireland within a two month period (approximate 25% response rate based on views of online posts and emails sent). The participants were recruited from several types of

farm: Dairy farm (*n* = 21); Beef cattle (*n* = 16); Sheep (*n* = 12) and mixed animal farms (*n* = 20). There were also crop producers (*n* = 26) and mixed animal and crop farms (*n* = 36).

2.2 Questionnaire

Section 1: Demographic information was collected, including age, gender, training, years of experience farming, type of farm and size of farm.

Section 2: Twelve go / no-go scenarios, three from each of the following categories of hazard: Compromised performance (illness, tiredness, stress), Safety equipment missing or compromised (PTO shield missing, seatbelt missing, warning light malfunction), Faulty equipment (handbrake faulty, lack of maintenance, unidentified fluid leak), Environmental hazard (thunder storm, eroded ditch, 20% gradient). Each scenario detailed the hazard and asked the participant to indicate if they would go ahead and use the tractor, or not, on a five-point likert scale. Participants then reported their reasoning.

Scenarios were constructed based on guidelines to safe tractor use, avoidance of hazards by the HSE[16] and research indicating potential factors that could influence driver performance.[14] The style of each scenario adhered to the recommended structure for a go/no-go scenario within aviation and healthcare[17, 18] whereby each scenario was short (maximum two sentences) and described a task based on real-life to provide context. For example, the scenario detailing tiredness was as follows: 'You have had a busy weekend on the farm and didn't get to bed last night until 5am. You are due to begin cutting hay with a tractor at 7.30am'.

2.3 Data collection

The questionnaire was web-based, constructed using SNAP software. Participants completed an electronic consent sheet, and then the questionnaire online, with data collection occurring via SNAP.

Initial participants were contacted through organisations such as the National Farmer Union and the Welsh Farmers Association, with the organisers sharing the e-mail invite letter with their members. Following that the invite letter was shared through UK and Ireland based online farming forums.

2.4 Analysis

The data gathered from the likert scale response to each scenario was analysed to determine mean response. The scenario scores were then entered into a mixed measures ANOVA to determine if gender, training and farm type had an impact on the response to each scenario.

The data derived from the open-ended questions regarding responses to each of the twelve tractor based scenarios was analysed using inductive thematic analysis by the first author (AI). As such, themes derived from the data were data-driven.[20] The data was coded in three main phases: Initial codes categorising the data at a semantic level were developed. The codes were assessed in order to determine themes within the data, allowing categorisation of the initial codes. The initial themes were reviewed and refined in order to ensure each theme was valid and represented a coherent pattern of data.[20] The second author (JP) then cross coded four of the scenarios in order to allow a test of inter-rater reliability.

3. Results

3.1 Participant characteristics

The majority of the sample were male and worked on farms with livestock. The level of agricultural training varied from no training to training at postgraduate level, with the majority reporting training to certificate or diploma level (Table 1). The size of farm reported ranged from 4 acres to 15000 acres (M: 776.6 acres).

Table 1 here

3.2 Scenario response

Preliminary analysis calculated the frequency and mean response to each go / no-go scenario, based on the five-point likert response scale (Table 2). The results indicated variation in mean response across scenarios.

Table 2 here

Mixed factor ANOVA (12 x scenario) x (gender / training level / farm type) indicated that there was a significant difference in response across scenarios: $F(9.34, 1308.22) = 71.651$, $p. < .001$, $Np = .34$. Pairwise comparisons using the Bonferroni correction were conducted and indicated multiple differences between the scenarios, as illustrated by Table 3. The pattern of differences indicate that the scenarios involving illness, ditch erosion, fluid leak and a missing PTO shield were all associated with a significantly lower mean (indicating a negative, or no-go response) than the remaining 8 scenarios. In comparison, the scenarios describing stress, gradient of 20%, a thunder storm and a faulty handbrake were all associated with a significantly higher mean score (indicating a positive, or 'go' response) than the remaining scenarios. There were no significant between groups effects, or interactions, for gender ($p. >.05$), training level ($p. >.05$) or farm type ($p. >.05$).

Table 3 here

3.3 Inter-rater reliability

In order to ensure that the codes used to categorise the response to each scenario were reliable, four of the scenarios were cross-coded by the second author (JP) with inter-rater reliability analysis conducted using the kappa statistic.[21] The results were as follows: Fatigue scenario $k = 0.69$, Handbrake scenario $k = 0.70$, Gradient scenario $k = 0.73$, Warning lights scenario $k = 0.78$. This indicated substantial agreement between the two raters.

3.4 Compromised performance

3.4.1 Lack of sleep

The majority of farmers reported a 'no-go' decision (see Table 4) in response to tiredness, often with a stated concern about the adverse impact of fatigue on their ability to complete the task:

'I would be too tired, which would mean I could fall asleep or not be aware of things'

For some farmers fatigue represented an acknowledged risk, with procedures in place to manage the effects:

'Strict policy on the Farm with respect to working while tired'

Farmers stating that they would go ahead were primarily concerned with managing work pressure and completing a task on time.

3.4.2 Illness

The majority of participants reported they would not go ahead whilst ill. Reasons included concern their performance would be compromised. There were also reported concerns about health:

'Would be more interested in achieving a speedy recovery myself - task secondary'

Some farmers who would go ahead indicated that illness was not a reason for stopping work:

'Not a serious issue, work can't stop every time you have a headache'.

3.4.3 Stress

The majority of respondents reported they would proceed with the task when stressed. The reasoning for this included perception of work as stress relief:

'I find simple manual tasks relaxing and it would help to de-stress me'

The cab of a tractor was described as a quiet space, where mobile phones could be switched off. There was also the perception that stress was a commonly experienced facet of farming life, and so work must continue:

'Farming is a stressful environment at times, if you didn't work when under a little stress then nothing would get done at all'

3.5 Safety equipment compromised or missing

3.5.1 Lack of seatbelt

The no-go responses focused on the potential danger to the driver through rollover and being ejected from the cab (Table 4):

'Too high a risk of getting thrown out in event of an overturn'

In contrast farmers reporting a go decision cited a variety of reasons for continuing without a seatbelt. This included the view that a seatbelt is not necessary. Where seatbelts were present some farmers reported that they would not use them due to issues with usability:

'I must admit I never wear them if they are fitted. I have tried them, but they are usually low quality lap belts fitted to meet legislation. They are frustrating when getting in and out regularly'

3.5.2 Warning light malfunction

The majority of farmers reported a no-go decision in response to warning lights malfunctioning. This was linked to avoiding damaging the tractor and receiving a repair bill:

'Modern tractors are controlled by a vast array of electronics, warning lights would tend to indicate a problem…Can't afford huge repair bills…'

Where farmers would proceed they often reported they would check the seriousness of the problem first, and only continue if the issue would not damage the tractor.

3.5.3 Lack of PTO shield

The majority of farmers would not proceed if a PTO shield was missing. There appeared to be a very high level of risk awareness of potential injuries:

'Unguarded PTO's are life threatening stuff!'

This awareness included past experience of a colleague or family member being injured by a PTO shaft, and viewing health and safety videos depicting potential injuries.

The participants who indicated they would proceed only did so with limitations in place, such as avoiding proximity to the shaft or taking additional care while working.

Table 4 here

3.6 Equipment malfunction

3.6.1 Faulty handbrake

The majority of farmers would continue to use a tractor with a faulty handbrake, with many respondents stating that a handbrake is redundant on a tractor (Table 5). Additionally, participants indicated hardware, such as a plough, could be used in place of a handbrake:

'Very few modern tractors need to use a handbrake in day to day use, most call it an emergency brake, plus there is a plough on the back as a brake'

A proportion of farmers reported that they would take additional precautions to minimise any risk of the tractor rolling away:

'The machine can be chocked, left with plough in the ground or wheels butted'

3.6.2 Fluid Leak

The majority of farmers reported they would not proceed. This was based on the need to investigate the cause of the leak and fix it where possible:

'I would find the source of the leak. It might be condensate from the aircon but it might be coolant or lubricant or even brake fluid'

The main concern prompting this investigation appeared to be related to maintaining tractor function, rather than safety concerns about the driver:

'Need to work out where leak from and sort it before damaging tractor'

In comparison, where famers stated they would go ahead, this encompassed acknowledgement of leaks being a common problem with no effect on functionality.

3.6.3 Lack of maintenance

The majority of farmers would go ahead if a tractor had not had any maintenance done. In many cases the farmer reported they would check the vehicle over before use, though this varied from a quick visual check to a more thorough assessment:

'Tractor needs checked first for fluid levels and safety such as brakes and steering correct function'

Some farmers reported that maintenance is not necessarily required, with tractors rarely subject to maintenance:

'As long as the machine is operational why would you stop because it hadn't had an oil change for a while?'

Table 5 here

3.7 Environmental hazards

3.7.1 Thunder storm

The majority of farmers would proceed (Table 5), with many responses focusing on the ability of a tractor to function in all weathers:

'Tractors are designed to work safely in heavy rain'

Farmers who would not proceed focused on ground conditions and the potential risks inherent in slippery, muddy fields, rather than tractor function:

'If steep ground is being worked there is a risk of the tractor sliding on wet grass'.

A proportion of farmers also referred to the potential damage to the land if a tractor was used in wet conditions:

'If it was wet I would damage the pasture ….the biggest issue would be damage to the sward'

3.7.2 Ditch erosion

The majority of farmers indicated they would not go ahead if they had to drive close to a ditch. This was linked to awareness of the risks involved in driving along a ditch edge, including tractor overturn and slipping into the ditch:

'Danger of bank collapse and tractor overturning'

A proportion of farmers indicated that they were familiar with the risks associated with ditches:

'Erosion might well have weakened the remaining or new edge. Never underestimate the dangers of a drop-off such as a ditch or cliff edge'

3.7.3 Gradient

The majority of farmers would proceed in driving their tractor up a hill with greater than 20% gradient. In most cases the reasoning was simply that the participants judged their tractor able to make the climb:

'The slope should be within the capacity of the tractor and driver'.

In a proportion of cases there was an element of risk management, with farmers indicating that adverse road conditions, or an elderly or under-powered tractor would require additional care.

4. Discussion

The current results suggest that despite research indicating that farmers are risk takers when it comes to personal safety,[6] this does not appear to apply to all categories of risk. There was some consensus regarding the scenarios where most farmers would not proceed; illness, ditch erosion, fluid leak and missing PTO shield. This indicates the majority of farmers viewed these scenarios as potentially risky. In comparison, there was a trend for farmers to indicate they would continue in the scenarios describing stress, a gradient of more than 20% and a

thunder storm. This suggests that characteristics of a described risk could influence perception.

4.1 Limitations

The scenarios used included a task to provide context and add realism, but it is possible that the described task also influenced the responses in addition to the described risk. This was mitigated by the qualitative nature of the study, where the answers indicated that farmers focused on the risk, rather than the task, in their reasoning. Each scenario presents a hypothetical situation, rather than a real life experience. However, the aim was not to examine real life responses, but was to gain insight into the way in which farmers think about risks associated with tractor use, in this case scenarios were appropriate.[19] Finally, sampling bias could influence the results, as the voluntary participants might represent proactive farmers interested in safety.

4.2 Compromised performance

Stress, tiredness and illness have been identified as accident predictors among farmers.[3,22] Within the current study farmers recognised fatigue and illness as risk factors, and raised concerns about reduced concentration and awareness. An awareness of the environment, comprehension of the information present, and anticipation of future issues is encapsulated by situation awareness.[23] Situation awareness has been reported as critical in maintaining safety and reducing the likelihood of accident and injury across multiple industries including oil and gas[24] and farming.[25] Research suggests that fatigue is significantly associated with reduced levels of situation awareness.[24] The current study indicates that some farmers were aware of the consequences of that effect.

Stress was viewed differently, with the majority of farmers indicating they would continue to work while stressed. This may be linked to reports of chronic stress among

farmers, caused by exposure to ongoing issues based on policy, poor weather or finances.[10] Chronic stress persists over time, unlike fatigue or illness which could be expected to reduce or dissipate. Farmers may view stress as an ongoing factor which could influence their response, leading to them continuing to work. This is a concern as research indicates that stress can be a causal factor in farming accidents.[3,10,26]

4.3 Safety equipment

Safety equipment such as PTO shields and seatbelts are designed to reduce tractor-based risks.[6] Within the current study, farmers reported concern about failures in warning lights and a missing PTO shield, but appeared less concerned about a missing seatbelt. A missing shield means a farmer could come into contact with the PTO shaft, which can cause serious injury.[27] Despite this 20% of the current sample indicated they would probably proceed without a PTO shield in place, though they would take additional care. This is problematic as research shows the majority of PTO injuries often occur during a busy period.[27] Thus, despite starting a task with the intention to compensate for the lack of shielding, external factors may cause the farmer to engage with the machinery.

Tractor rollover protection is designed to include the use of a seatbelt. Without a seatbelt the operator risks being thrown from the cab, or may collide with the rollover bars.[28] The perception of a lack of seatbelt was variable across the current sample, with some farmers citing the risk of ejection from the cab while others reported that seatbelts were non-essential, and not fit for purpose. Previous research examining seatbelt use corresponds with this finding, with only 30% of operators involved in a rollover incident reported as wearing a seatbelt.[29] This suggests a disparity to how farmers view the importance of different pieces of safety equipment.

4.4 Equipment malfunction

The HSE guide to using tractors safely highlights a working handbrake and regular maintenance as two important safety elements.[16] In comparison the majority of the current sample indicated that a faulty handbrake and lack of maintenance were relatively low risk issues. An unidentified fluid leak was viewed with more caution, mainly due to the potential for damage to the tractor. This indicates farmers assess the consequences of risk in broader terms than simply the risk of injury to themselves, they also evaluate the risk in terms of potential costs (e.g. repair bill) and losses (e.g. delay). This consideration of financial costs corresponds with previous research indicating farmers are risk averse in financial situations.[11]

4.5 Environmental hazards

Environmental factors that might influence the safe operation of a tractor include slopes, poor ground conditions, wet surfaces, poor visibility, ditches, drains and obstacles.[16] Each hazard is associated with the risk of rollover; sideways rollover into a ditch, backwards rollover driving up a slope, rollover on wet ground.[30] Within the current study the majority of farmers reported caution when considering an eroded ditch, but the opposite was the case for a slope or wet conditions. Farmers were generally confident their tractor was capable of traversing a slope, or continuing to function in the rain. This may indicate a lack of awareness of the risks associated with such activities, alternatively past experience of regularly dealing with such hazards may have resulted in farmers judging the potential negative consequences to be relatively low.[6]

5. Implications

Risk framing research suggests that altering the way in which a risk message is presented can influence decision making and behaviour.[31] For example, health based research indicates that framing a risk positively leads to risk aversion, whereas framing a risk negatively leads to risk taking.[32] The current results indicate that farmers exercise caution when an activity might

result in financial costs. By framing tractor risks in terms of financial costs, rather than risk of injury, organisations such as the HSE might be able to encourage farmers to engage in risk avoidance behaviours through communications such as information leaflets and web-based messages.

Farmers indicate there may be issues with the usability of current seatbelts. Research in other fields has utilised ergonomic assessment and developed usability techniques to enhance user-product interactions.[33] There could be scope here to develop similar design tools, based on farmer experience and the context of use,[33] to aid manufacturers in enhancing seatbelt usability.

Research within other domains suggests that situation awareness training can be an important aspect of improving individual and team-based safety.[23] Situation awareness training might also be of use within agriculture, perhaps provided as an educational intervention, as part of a safety day, or a workshop for farmers.[34]

6. Conclusion

Farmer perception of risk appears to vary according to the stated parameters of that risk, with hazards related to personal injury generally perceived as less risky than the possibility of damage to a machine. This has potential ramifications for the framing of risk, and associated communications and interventions, by organisations such as the HSE.

7. References

1. Douphrate, DI, Stallones, L, Lostrup, CL, Nonnenmann, MW, Pinzke, S, Hagevoort, GR, Lundqvist, P, Jakob, M, Xiang, H, Xue, L, Jarvie, P, McCurdy, SA, Reed, S & Lower, T. Work-related injuries and fatalities on dairy farm operations – a global perspective. *J Agromed*. 2013; 18: 256-264.

2. Reynolds, SJ & Groves, W. Effectiveness of roll-over protective structures in reducing farm tractor fatalities. *Am J Prevent Med*, 2000; 18: 63-69.
3. Kogler, R, Quendler, E & Boxberger, J. Accident at work with fertilizer distributors in Austrian agriculture. *Agri Eng Int: CIGR J*, 2014: 16; 157-165.
4. National Institute of Occupational Safety and Health (NIOSH). Worker safety on the farm. 2009. NIOSH, USA.
5. Health and Safety Executive (HSE). Health and Safety in Agriculture, Forestry and Fishing in Great Britain, 2014/15. 2015; Health and Safety Executive, London, UK.
6. Sorensen, JA, Tinc, PJ, Weil, R & Droullard, D. (2017). Symbolic Interactionism: a framework for understanding risk-taking behaviors in farm communities. *J Agromed*. 2017: 22; 26-35.
7. Flin, R, Mearns, K, Gordon, R & Fleming, M. Risk perception by offshore workers on UK oil and gas platforms. *Safety Science*, 1996: 22, 131-145.
8. MacCrimmon, KR & Wehrung, DA. Assessing risk propensity. *Recent developments in the foundations of utility and risk theory*, 1986: 47; 291-309.
9. Byrnes, JP, Miller, DC, & Schafer, WD. Gender differences in risk taking: A meta-analysis. *Psych Bull*, 1999: 125; 367-383.
10. Elkind, PD. Perceptions of risk, stressors, and locus of control influence intentions to practice safety behaviors in agriculture. *J Agromed*, 2008: 12; 7-25.
11. Meuwissen, MP, Huirne, RBM & Hardaker, JB. (2001). Risk and risk management: an empirical analysis of Dutch livestock farmers. *Livestock Production Sci*, 2001: 69; 43-53.
12. Feder, G. Farm size, risk aversion and the adoption of new technology under uncertainty. *Oxford Economic Papers*, 1980: 32; 263-283.

13. Clay, L, Hay-Smith, J, Treharne, G & Milosavljevic, S. (2016). "There are risks to be taken and some just push it too far": how farmers perceive quad-bike incident risk. *Aus NZ J Pub Health*, 2016: 40; 55-61.
14. Jadhav, R, Achutan, C, Haynatzki, G, Rajaram, S & Rautiainen, R. Review and meta-analysis of emerging risk factors for agricultural injury. *J Agromed*, 2016: 21; 284-297.
15. Jadhav, R, Achutan, C, Haynatzki, G, Rajaram, S & Rautiainen, R. Risk factors for agricultural injury: a systematic review and meta-analysis. *J Agromed*, 2015: 20; 434-449.
16. HSE. Using tractors safely. 2013; HSE. London, UK.
17. Greig, PR, Higham, HE, Darbyshire, JL & Vincent, C. Go/no-go decisions in anaesthesia: wide variation in risk tolerance amongst anaesthetists. *BJA*, 2017: 118; 740-746.
18. Civil Aviation Safety Authority. CAAP 37-1(4): Minimum Equipment Lists (MEL). Canberra: Civil Aviation Safety Authority, 2011.
19. Hughes, R. Considering the vignette technique and its application to a study of drug injecting and HIV risk and safer behaviour. *Soc Health & Illness*, 1998: 20; 381-400.
20. Braun, V & Clarke, V. Using thematic analysis in psychology. *Qual Res Psychol*, 2006: 3; 77-101.
21. Landis, JR & Koch, GG. The measurement of observer agreement for categorical data. *Biometrics*, 1977: 33;159-174.
22. Lyman, S, McGwin, G, Enochs, R, & Roseman, JM. History of agricultural injury among farmers in Alabama and Mississippi: prevalence, characteristics, and associated factors. *Am J Indust Med*, 1999: 35; 499-510.

23. Endsley, MR & Robertson, MM. Training for situation awareness in individuals and teams. *Situation Awareness Analysis and Measurement*, 2000: 349-366.
24. Sneddon, A, Mearns, K & Flin, R. Stress, fatigue, situation awareness and safety in offshore drilling crews. *Safe Sci*, 2013: 56; 80-88.
25. Irwin, A & Poots, J. The human factor in agriculture: an interview study to identify farmers' non-technical skills. *Safe Sci*, 2015: 74; 114-121.
26. Thu, K, Lasley, P, Whitten, P, Lewis, M, Donham, KJ, Zwerling, C & Scarth, R. Stress as a risk factor for agricultural injuries: Comparative data from the Iowa Farm Family Health and Hazard Survey (1994) and the Iowa Farm and Rural Life Poll (1989). *J Agromed*, 1997: 4; 181-191.
27. Narasimhan, G, Crowe, TG, Peng, Y, Hagel, L, Dosman, J & Pickett, W. A task-based analysis of machinery entanglement injuries among Western Canadian farmers. *J Agromed*, 2011: 16; 261-270.
28. Jinnah, HA., Stoneman, Z., & Rains, G. Involving fathers in teaching youth about farm tractor seatbelt safety—a randomized control study. *J Adolescent Health*, 2014: 54; 255-261.
29. Myers, ML., Cole, HP & Westneat, SC. Seatbelt use during tractor overturn. *J Agri Safe & Health*, 2006: 12; 43-49.
30. DeGroot, JM, Isaacs, C, Pickett, W & Brison, RJ. Patterns of fatal machine rollovers in Canadian agriculture. *Chronic Disease Injuries Can*, 2011: 31; 97-102.
31. Tversky, A & Kahneman, D. The framing of decisions and the psychology of choice. *Science*, 1981: 211; 453-458.

32. Veldwijk, J, Essers, BA, Lambooij, MS, Dirksen, CD, Smit, HA & de Wit, GA. Survival or Mortality: Does risk attribute framing influence decision-making behavior in a discrete choice experiment?. *Value Health,* 2016: 19; 202-209.

33. Chamorro-Koc M, Popovic V, & Emmison M. Human experience and product usability: Principles to assist the design of user–product interactions. *App Ergonomics*. 2009;40:648-56.

34. DeRoo LA, Rautiainen RH. A systematic review of farm safety interventions. *Am J Preventive Med*. 2000;18:51-62.

Tables

Table 1: Participant characteristics (mean or frequency).

Personal characteristic	Category	Mean (sd)	Frequency (%)
Gender	Male		123 (83.1)
	Female		25 (16.9)
Age		45.3 (11.7)	
Years of farming experience		29.2 (12.8)	
Training level	On farm training		53 (35.8)
	Certificate / diploma		60 (40.5)
	Undergraduate degree		34 (23)
	Postgraduate degree		1 (0.7)
Farm purpose	Animals		82 (55.4)
	Crops		28 (18.9)
	Mixed		38 (25.7)
Farm size (acres)		776.6 (1715.5)	

Table 2: Frequency (percent), mean and standard deviation for each go / no-go tractor risk scenario.

Scenario	Yes definitely	Yes probably	Not sure	No probably not	No definitely not	Mean	Standard deviation
Tiredness	17 (11.5)	42 (28.4)	17 (11.5)	45 (30.4)	27 (18.2)	2.84	1.33
Illness	7 (4.7)	28 (18.9)	28 (18.9)	55 (37.2)	30 (20.3)	2.51	1.15
Stress	61 (41.2)	76 (51.4)	5 (3.4)	3 (2.0)	2 (1.4)	4.30	0.75
Warning light malfunction	9 (6.1)	17 (11.5)	52 (35.1)	43 (29.1)	26 (17.6)	2.59	1.10
Seatbelt missing	20 (13.5)	41 (27.7)	25 (16.9)	31 (20.9)	30 (20.3)	2.93	1.36
PTO shield missing	8 (5.4)	23 (15.5)	17 (11.5)	39 (26.4)	61 (41.2)	2.18	1.27
Handbrake faulty	33 (22.3)	78 (52.7)	16 (10.8)	13 (8.8)	7 (4.7)	3.80	1.04
Lack of maintenance	8 (5.4)	64 (43.2)	38 (25.7)	21 (14.2)	14 (9.5)	3.21	1.08
Fluid leak	5 (3.4)	12 (8.1)	37 (25.0)	36 (24.3)	58 (39.2)	2.12	1.12
Gradient 20%	45 (30.4)	57 (38.4)	33 (22.3)	9 (6.1)	4 (2.7)	3.88	1.00
Thunder storm	31 (20.9)	46 (31.1)	35 (23.6)	27 (18.2)	7 (4.7)	3.46	1.16
Ditch erosion	4 (2.7)	20 (13.5)	41 (27.7)	50 (33.8)	32 (21.6)	2.41	1.06

Table 3: Mean difference in response to tractor based scenarios based on pairwise comparisons using the Bonferroni correction (* *p.* < .005).

Scenario	1	2	3	4	5	6	7	8	9	10	11
1. Tiredness	*										
2. Illness	.36	*									
3. Stress	1.46*	1.84*	*								
4. Handbrake faulty	99*	1.35*	.49*	*							
5. Lack of maintenance	.43	.79*	1.04*	.55*	*						
6. Fluid leak	.70*	.33	2.17*	1.68*	1.13*	*					
7. Gradient 20%	1.06*	1.43*	.41*	.08	.63*	1.76*	*				
8. Thunder storm	.65*	1.00*	.83*	.34	.21	1.34*	.42*	*			
9. Ditch erosion	.43*	.07	1.91*	1.42*	.87*	.26	1.50*	1.08*	*		
10. Warning light malfunction	.28	-.08	1.76*	1.27*	.72*	.41*	1.35*	.93*	.15	*	
11. Seatbelt missing	.09	.45*	1.38*	.89*	.34	.79*	.97*	.55*	.53*	.38	*
12. PTO shield missing	.65	.28	2.12*	1.63*	1.08*	.05	1.71*	1.29*	.213	.36	.74*

Table 4: Thematic analysis of reported reasoning for making a go/no go decision across three scenarios depicting self-based risks (lack of sleep, illness, stress) and three scenarios depicting safety equipment based risks (lack of seatbelt, warning lights broken, PTO shield missing)

SCENARIO: SELF	NO GO	GO
Lack of sleep	***Performance compromised*** Fatigue (49) Risk of accident (14) Adverse impact on performance (5) ***Risk management*** Fatigue management (13) Delay work (11) Delegate (4) ***No obligation*** Own boss so can manage own work schedule (2)	***Work pressure*** Need to complete task on time / during weather window (38) Work has to be done regardless (10) Unable to change plans if working as team (4) No-one else to do it; lone farmer (3) ***Coping skills*** Able to cope with tiredness (10)
Flu symptoms	***Performance compromised*** Not fit to drive (39) Not safe (10) Lowered awareness (4) ***Importance of health*** Delay job until well (11) Need rest to recover (7) Health more important than work (5) ***Task management*** Delegate task (3) Would limit jobs to necessities only (2)	***Work pressure*** Can't stop work due to illness (8) Work pressure (task time critical) (7) Would start task but stop if illness worsened (3) No-one else to do it; lone farmer (2) ***Working while ill*** Still able to work despite illness; performance not impacted (6) Illness unlikely to be severe enough to stop work (2) Take medication and carry on (2)
Stress	***Task management*** Might delay if task not critical (3) ***Safety risk*** Might be a risk (2)	***Stress management*** Work provides stress release (43) Tractor is a quiet space to think (10) Positive feeling once work is complete (6) Have to learn to deal with stress (7) Take additional care during task (5) ***Job stress*** Stress is part of the job (28) If the work is not done stress level will increase (18) ***Work pressure*** Work pressure (21) ***Stress not an issue*** Don't suffer from stress (4) Stress does not impact performance (3)
SCENARIO: SAFETY EQUIPMENT	**NO-GO**	**GO**
Seatbelt not present	***Compromises safety*** Unsafe without seatbelt (19) Risk of being ejected from the cab (16) Risk of rollover (9) ***Environmental factors*** High risk task so require seatbelt (5) High risk if land is steep (4)	***Non-essential equipment*** Many tractors do not have seat restraints (15) Lack of seatbelt is not a problem / risk (4) ***Poor usability*** Never wear belt even if one is present (frustrating and a hindrance) (14) ***Risk management*** Drive with additional care (10) Grip steering wheel in-case of rollover (6)

		Work pressure Work pressure (3) ***User fault*** The tractor would only overturn if driver made an error (3)
Warning light malfunction	***Action required*** Investigate prior to use (31) Check with dealer prior to use (13) Repair prior to use (12) If possible swap tractors (2) ***Damage to equipment*** Could damage tractor (26) Potentially costly if ignored (4) ***Safety issue*** Not safe to use (2)	***Risk management*** Investigate malfunction then proceed (7) Use dependent on scale of problem (7) ***Work pressure*** Job still needs to be done (2) ***Common issue*** Warning lights often malfunction (2)
PTO shield missing	***Required equipment*** PTO shield is a critical safety feature (30) Statutory regulation (6) Need to secure new shield before use (31) ***Risk awareness*** Represents risk to self and others (25) Danger of injury (7) Have seen PTO injuries (2) Have watched HS video of PTO injuries (2)	***Risk management*** Would avoid going near shaft during task (6) Proceed but take additional care (6) Stay in cab during job (4) Proceed but warn others of missing shield (2) ***Work pressure*** Work pressure (4) ***Common issue*** PTO shield is often missing (2)

Table 5: Thematic analysis of reported reasoning for making a go/no go decision across three scenarios depicting equipment based risks (faulty handbrake, fluid leak, lack of maintenance) and three scenarios depicting environment based risks (thunder storm, ditch with erosion, gradient greater than 20%)

SCENARIO: EQUIPMENT	NO-GO	GO
Handbrake faulty	***Action required*** Investigate and fix prior to use (7) ***Risk awareness*** Accident risk (3) Danger of rolling away (2) Have experienced accident linked to faulty handbrake (2)	***Non-essential equipment*** Handbrake not required for job (31) Can use plough as handbrake (39) Don't need a handbrake on tractor (10) Use tractor park feature (11) Redundancy in tractor system means handbrake not needed (7) Low risk issue (3) ***Environmental factors*** Proceed if land flat (15) ***Work pressure*** Fix after job complete (18) Work needs to be completed (2) ***Risk management*** Maintain awareness of faulty handbrake (9) Adapt to compensate (6) Take additional precautions to minimise risk (chock wheels, park on flat) (7) Would use, but would not allow others to use (3)
Fluid leak	***Action required*** Investigate cause of leak before proceeding (71) Repair the leak before use (17) ***Damage to equipment*** Risk of further damage to the tractor (8) Want to avoid potentially expensive repair (6) ***Risk assessment*** If the fluid is brake fluid this represents a risk (8) Risk of breakdown during job (2) ***Maintenance important*** Machine maintenance is a priority (5)	***Risk management*** Proceed after confirming cause of leak (10) If no longer leaking proceed (2) Dependent on type of fluid (4) ***Common issue*** Leaking fluid is normal for some tractors, so can be ignored (4)
Lack of maintenance	***Action required*** Inspect machine, don't proceed if any faults (13) Conduct maintenance work before use (11) Get second opinion before use (2) ***Risk awareness*** Machine potentially unsafe (5) Not willing to take risk (4) Could breakdown during job (2) ***Damage to equipment*** Use could lead to potentially expensive repair (3)	***Risk management*** Check machine over then proceed (42) Proceed but take additional care during task (3) Discuss tractor with worker to determine if any faults present (3) Proceed if overall tractor condition appears good (4) ***Maintenance not required*** Use tractor if it works and no obvious faults (11) Lack of maintenance is not a problem for tractors (6) The tractor may not have needed any maintenance (3) Farm equipment is often not maintained (2)
SCENARIO: ENVIRONMENT	**NO-GO**	**GO**
Thunder storm	***Risk awareness*** Ground could become unsuitable for work (17) Potentially risky situation; slippery ground (4) Using the tractor could damage the land (2) ***Risk management***	***Weather not an issue*** Storms are not a problem for tractor function (17) Weather does not interfere with work (14) Safe in the cab during a storm (6) Can't avoid storm so may as well continue (2)

	Delay start of job until storm has passed (20) ***Individual preferences*** Don't want to get soaked in rain (3) Prefer not to work during storm (2)	***Use caution*** Proceed but drive to suit the conditions (7) ***Work pressure*** Work pressure (2)
Ditch erosion	***Risk management*** Find alternate route (25) Fix the route first (4) ***Risk awareness*** Risk of ditch collapse and overturn of tractor (20) Risk of tractor slipping into ditch (18) Erosion may have weakened the edge (10) Experienced this issue in the past with poor outcome (3)	***Action required*** Conduct visual check on foot then proceed (12) ***Use caution*** Proceed with caution (6) Proceed if ground conditions good (4) ***Common hazard*** Ditches are a common hazard, used to dealing with them (3)
Gradient greater than 20%	***Risk management*** Check route to ensure it is safe (5) ***Risk awareness*** Gradient too steep for tractor (2) Experienced previous incident with hill (2) ***Individual preferences*** Dislike driving on hills (2)	***Gradient not an issue*** This gradient is not an issue for a tractor (52) Used to driving on slopes (5) ***Risk management*** Proceed if tractor is judged to be capable (12) Proceed if road conditions are good – road dry and solid (19) Drive with additional care (7) Proceed after visual assessment of gradient (4) Proceed but take additional care with trailer (6) ***Trust advice*** Trust advice of farmer who gave directions (3)