Human Behaviour Change for Animal Welfare: A Mouse Handling Case Study

Farhana. A. Chowdhury

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Biosciences Institute
Faculty of Medical Sciences

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Abstract

The housing and handling of laboratory animals involved in research can affect their welfare, and potentially the quality of scientific data produced. Despite evidence-based proposals for welfare refinements, the adoption of new practices can be slow and inconsistent, highlighting the need for a deeper understanding of implementation barriers. I applied approaches from health psychology to understand the barriers to using tunnel handling when handling mice in university research facilities.

Using the Theoretical Domains Framework, I conducted a systematic exploration of potential behavioural determinants for intervention. Initial activities, including shadowing and informal interviews, provided valuable insights into preliminary barriers and facilitators at organisational and individual level. A subsequent online survey across seven universities and interviews with technicians indicated that most people working with animals in these facilities predominantly employ low stress handling methods for routine handling. However, when mice are at risk of escaping, or have escaped, participants reported feeling that tail capture is necessary. Interview participants stated that handling escapes is not addressed in their institution's mouse handling training.

Using stakeholder engagement, I designed an intervention to build technicians' confidence and knowledge of using tunnel handling in various escape scenarios. A video training was developed with an experienced handler who demonstrated how to recapture mice in a controlled setting using tunnel handling. The intervention was delivered to a sample of technicians where it was tested for acceptability and feasibility. Results indicated increased confidence and intentions to use the demonstrated methods for future escapes. As mice are the most widely used species in laboratory research, this interdisciplinary work has the potential to improve the welfare of many mice, if the intervention is further refined. Moreover, this thesis provides a blueprint for systematically exploring animal welfare concerns using interdisciplinary methodologies, whilst promoting the exploration of issues across both individual and organisational level.

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Animal welfare is a multi-faceted ethical and societal issue. Some definitions of animal welfare focus on the feelings of the animals (e.g. Duncan, 2005) whilst others relate more to their health and environment (e.g. Mellor & Beausoleil, 2015). I broadly use the term to describe the subjective feelings and physical wellbeing of an animal (Dawkins, 1990). The welfare of laboratory animals is dependent on many aspects, such as their husbandry, the procedures they undergo, the climate and environment they are in (Baumans, 2007; López-Salesansky et al., 2016). In particular, how they are handled and housed can affect their wellbeing and the quality of scientific data produced (Balcombe et al., 2004; Hurst & West., 2010), and regular procedures they undergo can also cause pain and anxiety (Harikrishnan et al., 2018). Therefore, those who care for and interact with the laboratory animals are directly responsible for their welfare. To improve animal welfare, it is crucial to change the behaviour of individuals who work with, and routinely interact with these animals.

1.1. Laboratory Animal Welfare

Animal use in research has contributed significantly to advancements in science and medicine (Grieder & Strandberg, 2002). While alternatives to using live animals in research are preferred and techniques are continually being developed to minimize their use, their involvement remains essential for treating diseases and advancing medical improvements (EU, 2010; Laimore & Ilkiw, 2015; Rai & Kaushik, 2018). Recognising the contribution of animals to scientific advancements underscores the importance to treat them humanely, with consideration and utmost respect; it is crucial that their welfare is prioritised. Animal welfare is important from a legal, but also moral standpoint. Morally, there is a duty to treat animals with compassion and respect that extends beyond the legal requirements (Montanari et al., 2024; Roe & Greenhough, 2023). Animals are sentient beings, and like humans, are reinforced by rewards and motivated to minimise stress, pain and suffering (Balcolmbe, 2009). Therefore, anyone including animals in their research has a duty to treat them accordingly. From a UK legal perspective, the use of animals in research is regulated by the Home Office under the Animals (Scientific Procedures) Act which was introduced in 1986 (ASPA, 1986). In 2013, ASPA was amended to bring UK law into line with the requirements of EU Directive 2010/63, and new codes of practice and guidance have been introduced (UKRI, 2024). ASPA currently regulates procedures that are carried out on protected animals (any living vertebrate, other than humans and any living cephalopod) for scientific or educational purposes that may cause pain, suffering, distress or lasting harm; this law is designed to ensure that animals are treated in humanely and ethically, guaranteeing they are properly housed, fed, and handled to minimize suffering and promote well-being (Dennison & Petrie, 2020). Compliance with ASPA is mandatory and reflects society's, and those involved in animal research's commitment to ethical practices (Knight & Barnett, 2008; Ormandy & Schuppli, 2014). Moreover, addressing animal welfare concerns is crucial for maintaining public trust. The public and stakeholders in scientific research often have significant ethical and moral reservations about the use of animals in experiments; by ensuring high standards of care, the research community can alleviate some of these concerns (Clemence & Leaman, 2016; Mendez et al., 2022; Petetta & Cicciocioppo, 2021). Transparent practices and a commitment to continuous improvement helps to reassure the public that the

welfare of animals in research is taken seriously, and increases support in research (Leech et al., 2023; Mendez et al., 2022).

Animal welfare is multifaceted concept, with many definitions and discussions surrounding it intersecting with ethics and morals (Carenzi & Verga, 2009). Animal welfare can be interpreted from three different perspectives- the biological functioning of the animal, its feelings and emotions, and its ability to live a natural life (Fisher, 2009; Fraser 2008; Fraser 2003). It not only involves the physical health and behaviours of the animals, but also addresses their psychological wellbeing and overall quality of life (Mellor et al., 2020; Mellor & Reid, 1994). For the purposes of the research detailed in this thesis, I apply the definition of animal welfare by Duncan (2005, p.483) which defines animal welfare as "the absence of strong negative feelings, usually called suffering, and the presence of positive feelings, usually called pleasure". Suffering has been described as a wide range of unpleasant emotional states and the experience of negative affective state, such as pain and fear (Duncan & Dawkins, 1983; Weary, 2014). This definition of animal welfare was selected as it focuses on affective states, which is most relevant to the topic of this thesis, which concerns the possible stress-inducing effects of animal handling.

There is a wealth of research exploring and evidencing how welfare can be improved across a range of species (Baumans et al., 2013; Combes & Balls, 2014; Dawkins, 2008; Stevens et al., 2021), and as such, ethical models and frameworks have been created to assess welfare. The Five Domains Model, originally developed in 1994 and updated in 2020 (Mellor et al., 2020; Mellor & Reid, 1994), is a framework used to assess and evaluate the well-being of animals. The model considers five key domains that collectively contribute to an animal's overall welfare: nutrition, environment, health, behavioural interaction and mental state, and has been applied to promote welfare in a range of species (Kells, 2022; McGreevy et al., 2018; Mellor & Burns, 2020). The purpose of each domain is to highlight areas that are pertinent to welfare assessments. The model is not intended to define good or bad welfare, but rather to facilitate systematic and coherent evaluations. Additionally, it is important to recognise that welfare is not a binary state- it can be considered a continuum. Alongside measures to assess welfare, there have been frameworks developed to improve the standards of welfare overall (see Kagan et al.,

2015; Pinillos, 2018). The Principles of the 3Rs, which underpins ASPA (1986), is most relevant to both the ethical and welfare issues of using animals in research to ensure best practice (Russell & Burch, 1959). The 3Rs are replacement, reduction and refinement. The NC3Rs build upon Russel and Burch's definitions and adapt the 3Rs as follows: replacement refers to accelerating the development and use of predictive and robust models and tools, based on the latest science and technologies, to replace the use of animals in addressing important research questions. Reduction is defined as appropriately designed and analysed animal experiments that are robust and reproducible and add to the knowledge base; the number of animals used in research can be reduced by using new technologies and using the appropriate experimental designs (Clark, 2018).

This project focuses on refinement, which is defined in a laboratory animal context as "approaches which avoid or minimise the actual or potential pain, distress and other adverse effects experienced at any time during the life of the animals involved, and which enhances their wellbeing" (Buchanan-Smith et al., 2005 p. 381). Refinements improve welfare by introducing enhancements to the environment and procedures, thereby increasing overall wellbeing of laboratory animals by reducing their fear and promoting positive affect (Mellor, 2012). Refinements in the laboratory include creating more engaging and naturalistic environments, as well as adopting practices that minimise pain and distress during scientific procedures (Cloutier et al., 2012; Panksepp & Burgdorf, 2000; Rinwa et al., 2024). Direct inhumanity refers to practices that cause immediate distress or harm, such as rough handling or inadequate housing conditions (Russell & Burch, 1959). An example of a refinement to address a direct inhumanity is using skin swabbing instead of fin clipping for the DNA sampling of zebrafish, which reduces the cumulative suffering that laboratory fish experience (Tilley et al., 2020). In contrast, contingent inhumanity refers to suffering that arises indirectly, such as stress from repeated handling or lack of proper enrichment (Russell & Burch, 1959).

Refinements aimed at improving laboratory mouse welfare can address both direct and contingent inhumanity. This project centres on a specific, proposed refinement: the use of low stress methods to handle mice (Hurst & West, 2010). This refinement is linked to the Behavioural Interactions domain of the Five Domains framework, as handling can

cause contingent inhumanity through repeated human-animal interactions, and direct inhumanity by using methods that induce stress (Mellor et al., 2020). The Behavioural Interactions domains measures welfare and highlights the importance of addressing stress in handling practices (Mellor et al., 2020). Despite the original scientific evidence supporting the benefits of low stress methods being published over a decade ago, these methods are still not fully implemented (Henderson et al., 2020; Waters, 2019; Young et al., 2022). This thesis sought to explore the barriers to implementation and developed strategies to overcome them.

1.2. Handling Methods and Laboratory Mouse Welfare

Mice are the most widely used species in laboratory research, due to their anatomical, physiological and genetic similarity to humans (Bryda, 2013). Data from the UK Home Office revealed that in 2022, 2.76 million regulated procedures involving live animals were carried out in accordance with The Animal Scientific Procedures Act (ASPA) in Great Britain. Of these, 59% used mice. From a global perspective, Carone (2021) estimated that 111.5 million rats and mice were used in scientific research between 2017 and 2018 in the United States. In the EU, of the 8.6 million animals used in research in 2020, 49% of these were mice (Hobson, 2023). Given the widespread use of mice in biomedical studies, it is the responsibility of those who care, use, or produce animals for research, testing or teaching to assume responsibility for their wellbeing (EU, 2010). Consequently, refinements aimed at enhancing the quality of life for mice can significantly improve welfare for a large number of mice, both within the UK and globally.

There have been many evidence-based refinements introduced to improve mouse welfare in the laboratory environment, such as refined dosing and sampling techniques and methods for restraint (Davies et al., 2022; Lee et al., 2023). Perhaps one of the best studied is environmental enrichment, where objects and materials are added their cages such as nesting materials, toys and tunnels (Olsson et al., 2002; Sztainberg & Chen, 2010). Captive and barren environments that prevent natural behaviours can cause frustration, stress, depression and behaviours indicative of poor welfare (Bracke & Hopster, 2006; Lecorps et al., 2021). Enriching the cage encourages mice to display more natural behaviours (Würbel, 2001), and can also improve cognitive performance in mice (Arendash et al., 2004). Enriching their caged environment can also be achieved by providing more complex cages (Makowska et al., 2019; Whittaker et al., 2012), or through social housing and providing cage mates to encourage social exploration in their cage (Olsson & Westlund, 2007).

A well-publicised intervention that aims to improve mouse welfare are the methods used to handle mice. Traditionally, mice have been picked up by the base of their tail when they are handled in a laboratory, a method that will be referred to as tail capture throughout

this thesis. However, in a key study published well over 10 years ago, Hurst and West (2010) used an experimental approach to show that this handling method could cause stress and anxiety in laboratory mice. Using behavioural measures (including approaching a handler, performance in an elevated plus maze, and defaecation/urination frequency when handled), they compared how mice behaved when they were tail captured to when they were handled using a tunnel (tunnel handling) or in cupped hands (cupping). They found that tunnel handling and cupping significantly reduced anxiety and stress compared to tail handling. The mice that were handled using tunnel handling or cupped hands were more willing to interact with the handler and showed fewer signs of anxiety. Tail capture induced greater urination and defecation, indicative of anxiety and stress (Hurst & West, 2010). Therefore, the researchers concluded that tunnel handling and cupping enhance the wellbeing of laboratory mice. As prey species, mice instinctively seek enclosed spaces for safety and security (Balcombe, 2006). Tunnel handling can help the mice to feel more secure and safer, as it avoids triggering the anti-predation responses that tail capture can induce., which may cause them to feel as though they may be being captured by a predator.

Since the publication of Hurst and West (2010), a wealth of research shows that there are benefits to low stress handling methods, like tunnel handling or cupping, as these methods reduce stress, anxiety and depression in mice, and increase exploration and performance in standard behavioural tests (Clarkson et al., 2018; Gouveia & Hurst, 2017; Ghosal et al., 2015; Gouveia & Hurst, 2013; Hurst & West, 2010; Novak et al., 2022). However, although the evidence for its benefits was first established over 10 years ago (Hurst & West, 2010), it is still not universally adopted (Henderson et al., 2020; Young et al., 2023).

Some of the common barriers to implementation have been identified and include: time it takes compared to traditional methods, perceived incompatibility with experimental or routine laboratory procedures, lack of resources, and a lack of support from senior leaders (Henderson et al., 2020; Waters, 2019; Young et al., 2023). Moreover, some stakeholders report scepticism of the evidence relating to the benefits of tunnel handling (Henderson et al., 2020), or that the positive effects from tunnel or cup handling would be meaningless

because restraining the mice is required for procedures (Henderson et al., 2020). Some of these barriers to implementation have been specifically addressed, for example, Gouveia and Hurst (2019) showed that experience of repeated restraint and subcutaneous injections did not reverse the positive effects of tunnel handling. In addition, it has been widely promoted at conferences in order to bring awareness to the benefits to both mice and scientific research (Medical Research Council LMB, 2020; Waters, 2019). Despite the evidence and resources, tunnel handling is still not fully adopted (Henderson et al., 2020; Waters 2019). Henderson et al. (2020) conducted an international survey study in 2019 and explored the uptake of different mouse handling methods. They found that of their sample of 390 people, 35% use tail handling exclusively, 43% use a combination of tail and a low stress method, whereas 18% use low stress methods exclusively. Young et al. (2023) also conducted a survey to benchmark the prevalence of tunnel handling. 215 participants, from a predominantly US-based sample, reported the methods they used to handle mice. Of these participants, only 10% used low stress methods. 37% of individuals used a mixture of tail capture, forceps and scruffing. 55% reported using tunnel handling as one of their preferred methods for picking up mice, with 41% preferring cupping. However, it is unclear from both studies how often these methods are used and to what degree. It can be concluded that the exclusive use of low stress methods is not yet widespread with tail capture still being used.

Refinements taking a long time to be adopted is not a problem that is unique to tunnel handling. While anecdotal evidence suggests that previous welfare refinements have taken considerable time to be consistently adopted despite demonstrated benefits, the reasons may be multifaceted. Barriers to adoption may include regulatory constraints, institutional culture, or limitations in funding. Additionally, minimum standards set out in codes of practice may influence the extent to which new welfare practices are implemented. Senior management, researchers and animal care staff play a crucial role in animal welfare decisions, but their actions are often shaped by these broader factors. There is now increasing recognition of the importance of understanding human behaviour to facilitate good welfare practices (Carroll et al., 2021; Glanville et al., 2020; Pickering et al., 2022). However, demonstrating that an intervention is effective does not necessarily lead to widespread implementation (Squires et al., 2022). The process of implementing

new interventions can be challenging, as knowledge of a new intervention does not automatically result in immediate behaviour change (Grimshaw et al., 2012). Whilst evidence of an intervention's benefit is a good starting point, the process of dissemination and adoption may involve barriers related to organisational, cultural, and structural factors (Correa et al., 2020).

1.3. Understanding Human Behaviour

1.3.1. Behaviour Change Frameworks

There are many models and frameworks designed to systematically understand human behaviour. Such models and frameworks provide structured methods for identifying the factors that drive behaviour, designing interventions and evaluating their effectiveness. Such approaches have been widely used in a variety of contexts, and predominantly in human health behaviour (Beenstock et al., 2012; Breuer et al., 2015; Pelly et al., 2023). These models help researchers and practitioners to develop targeted strategies to promote desired behaviours and overcome barriers to change.

The Behaviour Change Wheel (BCW) developed by Michie et al (2011), is a framework that is widely used, and had been designed from a synthesis of 19 different behaviour change frameworks (see Figure 1). It consists of three layers in the wheel. In the centre is the COM-B model, which helps the user to understand behaviour. There are three essential overarching predictors of behaviour and behaviour change the user must consider, which are “capability” (physical and psychological), “opportunity” (physical and social), and “motivation” (automatic and reflective) (Michie et al., 2011). Surrounding the centre of this framework is a layer of nine intervention functions to choose from that can be used to address capability, opportunity, or motivation of the behaviour. These include the functions such as education, persuasion and training. The final outer layer identifies seven types of policy that can be used to deliver the intervention functions such as guidelines, regulation and communication marketing (Michie et al., 2014). The BCW has been successfully applied in healthcare settings, for example, reducing obesity rates in low socio-economic communities (Coupe et al., 2021), and to increase attendance at healthcare service (Fulton et al., 2016).

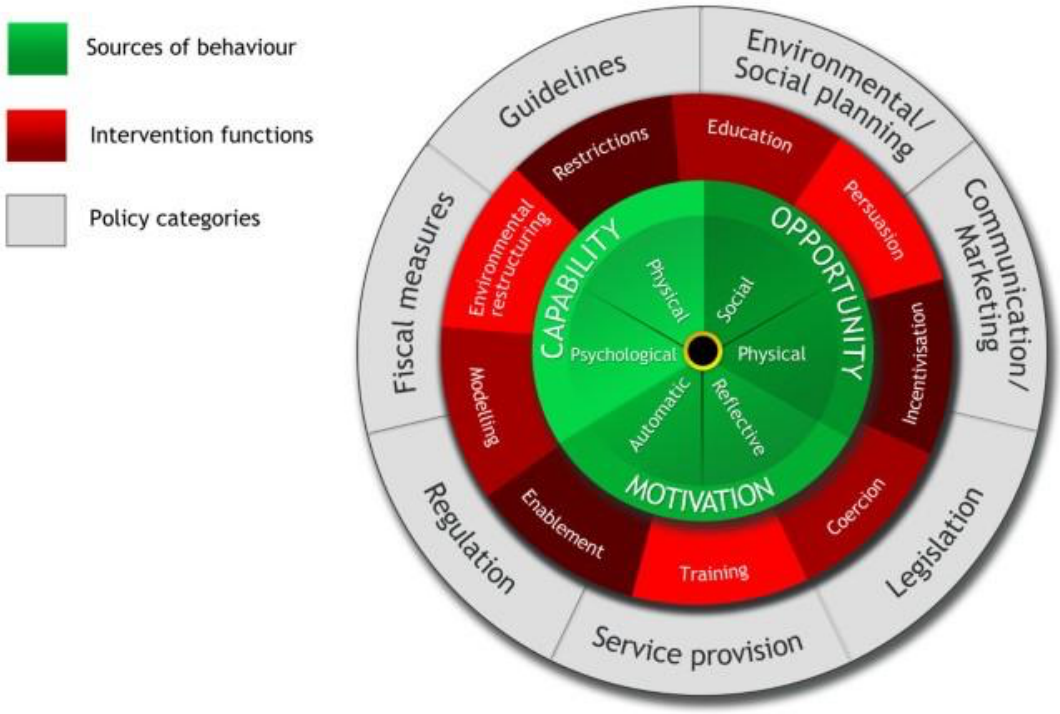

Figure 1: Behaviour Change Wheel

The Theoretical Domains Framework (TDF) encompasses 14 domains ranging from environmental to individual-level factors (Atkins et al., 2017; Cane et al., 2012; Michie et al., 2005). This framework can take into consideration individual and environmental factors, laying the groundwork for in-depth evidence-based interventions grounded in implementation science principles. The TDF was developed to address the complexity of behaviour change by integrating multiple theories of behaviour change into a single, coherent tool. It can provide a structured method for identifying and addressing the psychological, social and environmental factors that influence behaviour and is useful in complex settings where multiple factors interact to influence behaviour. Therefore, a comprehensive understanding of the interactions between individual perspectives and environmental factors is necessary to create an intervention for the desired behaviour change.

A commonly applied framework to understand and change behaviour is the Theory of Change (ToC). ToC definitions can vary, but Weiss (1995) defines ToC as a theory of how and why an initiative works. Breuer et al (2015) define it as an approach which describes

how a programme brings about specific long-term outcomes though a logical sequence of intermediate outcomes. ToC approaches are also commonly known as “logic models”, which represent processes through which an intervention produces outcomes (Mills et al., 2019). ToC, or logic models, are often used during a planning stage of a change project but can also be used for monitoring and evaluation. They are often developed using a backward-mapping approach which starts with the long-term outcome, and then maps the required process of change and the short and medium-term outcomes needed to achieve this (Anderson, 2004). ToC has been used globally in the development and evaluation of public health interventions (Bell et al., 2018; Breuer et al., 2015). However, for the purpose of this work, it was not deemed an appropriate choice of framework due its focus on outcomes. ToC is not specifically designed to analyse behaviour in the same way that frameworks such as the Behaviour Change Wheel or Theoretical Domains Framework are.

In exploring the factors that may influence behaviour within a laboratory context, models of human behaviour change can play a crucial role in identifying predictors that shape the target behaviour under study. These models can provide a framework for understanding the complex influences on human behaviour, which can ultimately help with intervention development. The research in this thesis applied a combination of the TDF and the BCW. The TDF offered a systematic method for identifying a wide range of factors that influenced behaviour in a specific context. In addition, as it is an amalgamation of multiple behaviour change theories, it assists in understanding the complexity of behaviour change from multiple perspectives (Cane et al., 2012). The BCW complemented this by using these insights into an actionable intervention that was systematic and evidence based. Combining the BCW with the TDF enhanced rigour of this research, allowed it to be tailored, flexible and adaptable in my approach. Using a combination of theories has been done successfully to identify barriers to behaviour change in other contexts (see Fahim et al., 2020; Mather et al., 2022).

1.3.2. Behavioural Predictors

Understanding behaviours and the context in which they occur is essential for any human behaviour change project. However, this can be challenging, as there are many factors which influence human behaviour which can be explored using behaviour change frameworks. For example, there are covert influencers of behaviour that are not observable, such as emotion (Ferrer et al., 2018; Lerner et al., 2015), attitudes (Van Doorn et al., 2007) and biological factors like genetics (Johnson, 2007; Yoshimasu & Kiyohara, 2003). Other important external factors which may influence behaviour include culture and social norms (Matsumoto, 2007; Schultz et al., 2007).

An organisation's culture is the set of values, beliefs, attitudes, systems and rules that outline and influence behaviour within an organisation (Cooper, 2000; Furnham & Gunter, 2015; Schein, 2010). Therefore, people within an organisation can influence each other by modelling behaviour, a well-documented behaviour change technique described by Bandura in his Social Learning Theory (Bandura, 1977). Bandura theorized that behaviour is acquired through observational learning, where individuals can learn new practices by watching others. In the context of laboratories and mouse handling, social factors may play a role in shaping behaviour; for example, individuals can adopt different mouse handling techniques by observing their peers. A laboratory setting has a lot of potential for learning through peer observation due to the teamwork required in the role, which may lead to behaviour that enhances or that compromises animal welfare standards. Other environmental factors such as workplace guidelines for handling mice could also be considered a determinant of behaviour, as they may shape how individuals behave (McGaw et al., 2012). For example, an individual may be less likely to use tail capture for general handling if their workplace does not permit it.

There may also be temporal, short-term factors in a laboratory context which could be predictors of behaviour. For example, believing there are time constraints and tight deadlines could impact the quality of care given to laboratory animals. Time constraints can be a factor influencing quality of care in the healthcare field (Beenstock et al., 2012; Mosadeghrad, 2014), but is also raised in the laboratory setting, whereby individuals feel

they do not have time to implement refinements to improve the welfare of laboratory animals, for example, rat tickling (LaFollette et al., 2019). In addition, recognition and reward from the organisation could also reinforce positive behaviour, which may inspire individuals to sustain their positive behaviours and influence others (Victor & Hoole, 2017).

Furthermore, habit is theorized to be a determinant of behaviour (Gardner & Lally, 2023; Hall & Fong, 2007). It has been studied widely in many different contexts, such as health behaviour and sustainable behaviour (Verplanken & Orbell, 2022). The Reflexive Impulse Model (Strack & Deutsch, 2004) may provide insight into how people may act by habit within laboratory environments by describing the distinction between reflective and impulsive determinants of behaviour. In a laboratory setting, individuals such as technicians, who often work in familiar or repetitive patterns may exhibit habitual responses due to the automatic activation of previously learned behaviour. The model suggests that environmental cues or situational triggers may cause automatic, reflexive responses without deliberate conscious processing. This can explain the role of habits in handling practices, and therefore, it must be considered how easy or difficult it may be to establish new habits in laboratory contexts.

Evidently, behaviours are complex and influenced by a range of individual and external factors. Furthermore, these factors may be connected, and this is where the application of a framework, like the TDF, helped dissect these interactions and understand them better. The TDF encompasses psychological, social and environmental domains, which helped to analyse how organisational polices (environmental context and resources domain) interacted with social influences (social/professional role and identity) and habits (behavioural regulation domain). This allowed factors that had not been previously investigated in this context to be robustly explored.

1.3.4. Implementation Science

Implementation science is the study of methods to increase the adoption, implementation, and maintenance of evidence-based practices, programmes, policies,

and guidelines (Eccles & Mittman, 2006). It has predominantly been used in the field of health innovation and health promotion (Fernandez et al., 2019), but my research applied this approach because the scaling of tunnel handling across individuals and settings was clearly, at least partially, an implementation problem. By combining the BCW and TDF frameworks, nuanced insights could be gained into the barriers and facilitators of tunnel handling, leading to the development of a targeted and well-planned intervention built on theory. Effective planning when developing an intervention is imperative because many implementation strategies risk failure and face challenges due to poor or absent use of theory in planning or selecting strategies, and a lack of understanding of the determinants of the behaviour (see Fernandez et al., 2019). The absence of a theoretical framework increases the risk of addressing behaviours without considering the context or oversimplifying the approach by, for example, assuming that increased knowledge alone will result in behaviour change (Heimlich, 2008; Ryan, 2009).

Part of the effective planning involved a thorough justification for the selection of theories and interventions. A systematic review of the use of theory in implementation research concluded that researchers must clearly justify the need for an intervention and use theory to understand barriers and design interventions to advance implementation research. In their review of 235 studies, only 23% of interventions developed, tested and used theory to inform design of implementation strategies (Davies et al., 2010). Using such theories added significant value by providing a structured framework to systematically address challenges and enhance the likelihood of successful implementation.

1.3.5. Stakeholder Engagement

Stakeholders are people who are affected by or can influence the research activities of others (Currie et al., 2022; Franklin & Franklin, 2020). This can encompass a wide range of people, including but not limited to: the public, decision makers, clients, patients, or any interest groups (Byrne, 2019; Franklin & Franklin, 2020). Stakeholder engagement is essential when designing any behaviour change intervention (Currie et al., 2022), and describes the activities that the stakeholders are involved in relation to the research. For

example, stakeholders may be involved and engaged in research via focus groups, interviews or workshop activities. Stakeholder engagement gives the researchers the opportunity to work with end-users and others that have a stake in the problem and design an intervention that is based on the lived experiences of the people intended to enact the behaviour, rather than based on any assumptions. “One-size-fits-all” interventions and those designed using a top-down approach risk having limited efficacy (Byrne, 2019; Vargas et al., 2022). Involving end-users when designing an intervention is a commonly used practice in health intervention and implementation sciences (Currie et al. 2022; Leask et al., 2019). Stakeholder engagement may also highlight additional barriers to behaviour change that must be addressed and considered, for example, communication patterns and workplace dynamics between different stakeholder groups (Byrne, 2019). Effective communication between groups such as animal care personnel and researchers contributes significantly to the welfare of the animals (Nuyts & Friese, 2023). Understanding such dynamics by involving stakeholders is an important part of intervention development.

Stakeholder engagement has previously been used to successfully change human behaviour in an animal welfare context. For example, Reed and Upjohn (2018) conducted in depth consultations with local stakeholders such as community groups to understand their individual perspectives when developing their Theory of Change (ToC) framework for canine welfare. McDonalds and Clement (2019) also involved the community from the outset for their intervention to assist unowned cats, by conducting focus groups with various stakeholders and organisations to determine the acceptability of their project within the community. Working with a variety of stakeholders ensures that different needs are met, and that all angles and contextual constraints are considered (Currie et al., 2022; Greenhalgh et al., 2016).

1.4. Human Behaviour Change for Animal Welfare

Human behaviour change is essential to improving animal welfare. An increasing number of studies have applied various methods and approaches from health intervention and implementation sciences to animal welfare contexts (Glanville et al., 2020; Pickering et al., 2022). While these models and frameworks are starting to be used to enhance animal welfare, their applications have predominantly focussed on farm, domestic settings and zoo settings (Coleman et al., 2000; Descovich et al., 2019; Mcleod et al., 2020; Reed & Upjohn, 2018; Watters & Krebbs, 2019). However, the application of these models in this context is still very limited. Glanville et al. (2020) reviewed 47 human behaviour change studies in animal care and interactive settings and found only eight had applied a framework.

Moreover, the use of behaviour change frameworks and models could be improved. Glanville et al. (2020) found that in many studies, it was unclear which behaviours were targeted for change, which ultimately made it difficult to determine if aspects of the welfare interventions worked. Additionally, descriptions of the interventions (what was included and how it was delivered) were not clear, which makes it difficult to replicate for future researchers, and for readers to understand. Moreover, the reviewers found that only a minority of studies used an intervention design framework in their planning, which may limit their potential for acceptability and feasibility (Currie et al., 2022). However, in terms of facets which are more likely to make an intervention successful, Glanville et al. (2020) concluded that a clear understanding of the desired behavioural outcome of an intervention is not only important for designing and implementing the intervention, but also for evaluation and replication.

A small number of animal welfare studies have successfully applied approaches from health intervention sciences, promoting the use of such methods. For example, Utami et al. (2019) applied the ToC and used stakeholder engagement for a community-based dog welfare intervention, which was deemed a success with increased vaccination rates. In addition, Baatz et al. (2020) applied ToC to their research and created a causal framework in a dog welfare intervention study in a sample of children. However, these studies did

not do an in-depth analysis of behaviour to identify barriers, and inherently focussed on short-term outcomes. This may impact the scalability of the work and make it difficult to determine if the change is sustainable, as it may only be relevant in very specific contexts.

Using stakeholder engagement alongside a behaviour change framework for understanding the context of a behaviour has previously led to the development of interventions in domestic animal settings (McDonalds & Clements, 2019; Utami et al., 2019). McDonald and Clements (2019) used the COM-B model to understand participants' attitude and knowledge about unowned cats and find out their barriers to helping the cats, in addition to using stakeholder engagement focus groups with various community groups and key workers. However, their methods for how they applied the model to their work was unclear. Nonetheless, the combination of using the COM-B model and stakeholder engagement likely provided valuable insights into the psychological and contextual factors influencing behaviour. This approach helped identify barriers, but also increasing the likelihood of the intervention being accepted by the target audience. Their results suggested that residents were more likely to report unowned cats two years after the intervention was launched than before. Utami et al. (2019) created and evaluated a community-based multifaceted project to increase dog vaccinations to reduce rabies and maintain herd immunity in a village. They used ToC to control rabies via community-led improvements, aiming for owners to provide better care for their dogs and ensure their presence during vaccinations. However, the target behaviours can be considered vague, making it difficult to evaluate the success of a ToC-driven intervention with unclear aims and outcomes. The researchers also did not articulate the mechanisms of change or specify how the intervention would specifically alter behaviours. In summary, while the project showed potential, the lack of clear articulation of target behaviours and mechanisms of change limits the ability for in-depth evaluation of the intervention's success beyond determining vaccination rates. This highlights the need for more precise definitions of desired outcomes and clear details of how the intervention aims to achieve the behavioural changes. However, the inclusion of stakeholders proved to be beneficial, as it increased openness and appreciation for the community services, leading to greater support for the costs of project activities.

While human behaviour change frameworks and models are increasingly being used to improve animal welfare, their use remains limited and often lack clarity in defining target behaviours and mechanisms of change. The inclusion of stakeholder engagement has shown potential in increasing the acceptance and effectiveness of these interventions (McDonalds and Clements, 2019; Utami et al., 2019). Although human behaviour change for animal welfare is a growing area of study, it has mostly been applied in domestic and farm settings (Coleman et al., 2000; Glanville et al., 2020; McDonalds & Clements, 2019; McLeod et al., 2020), with only one example in a laboratory environment (LaFollette et al., 2020).

1.5. Human Behaviour Change in the Laboratory Environment

Domestic, farm and zoo settings are very different from a laboratory setting, with each having their own distinct complexities. In a laboratory, there are multiple stakeholders with different roles and needs to consider, requiring a highly controlled environment focussed on ethical oversight and experimental integrity. A typical set of stakeholders includes animal care technicians, researchers in various roles, veterinarians, training and competency officers, Animal Welfare Ethical Review Body (AWERB) committee members, regulators, and welfare organisations. All stakeholders must be considered when designing an intervention to improve laboratory animal welfare, so that all (potentially competing or conflicting) needs are met where possible, and all perspectives are considered in its design (Currie et al., 2022). In a laboratory setting, animal care staff are likely to have different perspectives, constraints and needs compared to researchers because of the different roles they have. Additionally, within a laboratory environment, organisational practicalities like training, animal care policies and guidelines play a pivotal role in influencing how animals are cared for. People within the organisation may have been exposed to these policies and guidelines in differing ways, resulting in variation in their understanding and consequent practice. These differences should be accounted for when developing behaviour change interventions for a laboratory environment to ensure consistency and effectiveness in the application of welfare practices.

To date, only one study appears to have investigated if an intervention can change human behaviour and improve animal welfare in the laboratory environment. LaFollette et al. (2020) used targeted training programmes with the aim of improving rat welfare through tickling, based on the evidence of the benefits of this refinement (see LaFollette et al., 2017). Drawing on evidence that a lack of training and knowledge could be a barrier to rat tickling (LaFollette et al., 2019), the training programme increased implementation of tickling and increased levels of staff self-reported self-efficacy, knowledge and familiarity with the technique. This study demonstrates the effectiveness of targeted training interventions in improving the implementation of welfare handling refinements. It suggests that targeted intervention approaches for laboratory personnel hold significant

promise for improving the adoption of refinement practices, with similar barriers (such as lack of time) reported.

However, a clear limitation of LaFollette et al.'s (2020) rat tickling intervention was the absence of tailoring the training programme to accommodate diverse participant roles, skill sets, and perspectives. Specifically, the training intervention did not appear to be tailored to particular roles or responsibilities within the laboratory setting. An alternative approach would involve tailoring the training to address the needs of different groups, ensuring the content is relevant and applicable. The researchers may benefit from conducting a thorough needs assessment for future intervention work, developed using a behaviour change framework. This approach would create a nuanced understanding of the specific needs of people in different roles to create a targeted intervention. To summarise, given the lack of other intervention work in this area, it is vitally important that additional research (specifically, the research described in this thesis) is based on a detailed and systematic understanding of the behaviours and the individuals expected to perform them.

Whilst some studies have explored the impact of skills development on changing behaviour (e.g. Coleman et al., 2000; LaFollette et al., 2020), these have not explicitly drawn on a specific behaviour change framework or any intervention development frameworks (for a summary of available frameworks see Araújo-Soares et al., 2018). The absence of such frameworks limits the potential for interventions that are tailored to the specific needs of the target population. The effectiveness of these interventions may have been enhanced if they had used a structured framework, allowing for a more targeted approach. The researchers could have gained deeper insights and uncovered unexpected barriers and underlying mechanisms driving behaviours. Using a framework takes an ecological approach to understanding a problem (Bartholomew et al., 2016), and could enrich intervention design by first establishing a structured and systematic foundation. In addition, not using a comprehensive evidence and theory-based protocol creates a missed opportunity. Kok (2004) supports the integration of a design protocol, as it enhances the credibility of an intervention, but also facilitates the adaptability and replication of the intervention for future researchers. Applying a structured framework could have provided

valuable insights and learnings that the researchers could leverage for future projects, fostering continuous improvement and refinement of intervention strategies. Approaches such as Intervention Mapping (Bartholomew et al., 2006) or the Behaviour Change Wheel (Michie et al., 2011) could have played a role in systematically guiding the researchers through the intervention development process.

1.6. Conclusions and Thesis Aims

I examined the complexities of the barriers surrounding the implementation of low stress handling techniques in laboratory settings with mice, then developed and tested an intervention to address them. Through stakeholder engagement, I comprehensively examined the contextual factors that influenced mouse handling decision-making, providing nuanced insights into the decision-making processes. This involved exploring staffing structures, hierarchies and the impact of policies and guidelines alongside individual-level factors within a laboratory setting, building upon the work by Henderson et al. (2020) which identified barriers to tunnel handling in a UK context.

There was a clear gap in the literature for a project that used health intervention sciences to improve laboratory animal welfare for mice, with no existing interventions designed specifically to improve mouse handling by changing human behaviour. Using behaviour change frameworks and stakeholder engagement provided a systematic and integrated approach to this issue. Although previous literature had identified the barriers to tunnel handling in animal facilities (Henderson et al., 2020; Waters, 2019; Young et al., 2023), my research was novel in that it contextualised these barriers and combined different techniques to understand the problem. This project aimed to advance animal welfare by promoting the use of contextual understanding in implementation problems through stakeholder engagement and behaviour change frameworks. Drawing on multiple theories, as relying on one theory risks oversimplifying complex behaviours (Kok, 2018), this research provides a comprehensive approach to understanding and addressing these challenges.

The overarching aim of my thesis was to identify and actively address the multilateral barriers affecting the full-time adoption of low stress methods such as tunnel handling, with the objective of developing an evidence-based pilot intervention. By creating an intervention that increases the use of tunnel handling, this project has the potential to improve the welfare of the most commonly used species in animal research and could have a large impact on mouse welfare. This would also lead to better scientific outcomes and encourage the practices of good welfare refinements.

My thesis is a series of steps that includes initial scoping with stakeholders (Chapter 2), a survey to explore current use of different handling methods in seven UK universities (Chapter 3) with follow-up interviews (Chapter 4), the development and delivery of an intervention (Chapter 5) and a test of its acceptability and feasibility (Chapter 6). By applying human behaviour change theories to identify determinants of behaviour, using stakeholder engagement and intervention development frameworks, this thesis not only identified barriers, but also established a promising approach to drive change in laboratory practices to improve mouse welfare.

Chapter 2. Exploratory Study of Laboratory Environments

Abstract

This exploratory phase of the project initially explored the working of laboratory animal facilities, focussing on stakeholder mapping and the extent to which low stress handling methods had been adopted for laboratory mice. Over a period of six months, informal conversations and shadowing with a range of stakeholders at various UK university research facilities were conducted to understand the implementation of tunnel handling, including barriers and facilitators. The research revealed the impact of organisational culture and hierarchy on decision-making processes, particularly in relation to staff psychological safety and communication barriers between researchers and animal care technicians.

The reflections from stakeholders highlighted the need for openness between colleagues and collaboration to prioritise animal welfare and facilitate the uptake of welfare refinements. Moreover, individual-level factors such as resistance to change, habits, and misconceptions around low stress handling emerged as barriers to tunnel handling. This exploratory phase laid the foundation for the further investigation of the relationships between organisational culture, hierarchies, individual behaviour and their implications for laboratory mouse welfare, shaping subsequent research questions and potential areas of interest.

2.1. Introduction

In laboratory animal research, standards of welfare and expectations of behaviour are continually evolving (Broom, 2011). For research facilities, being open to change ensures that those who work with laboratory animals contribute to the progression of ethical and responsible research. Therefore, a thorough understanding of the people, and of the context in which these changes occur becomes important to be successfully implemented. It is important to explore the contextual factors before developing and implementing interventions, which is a common strategy in educational and healthcare interventional research (Araújo-Soares et al., 2018; Beenstock et al., 2012; Coles et al., 2017; Swain-Bradway et al., 2015).

In the context of this project, animal research facilities can vary in terms of their size, the animal species used, and their staffing structures. Overlooking specific contexts, environments and population characteristics can leave behaviour change projects open to unpredictable challenges; understanding the laboratory animal setting will ensure relevance and help to anticipate any potential issues and tailor the research to the target audience (Cottrell et al., 2015; Glanville et al., 2020). Furthermore, understanding the environment where the change will take place provides a valuable opportunity to identify stakeholders. In addition to identifying them, stakeholders can be mapped, and their individual needs, perspectives and role within the environment can be explored through formal research methods. This approach not only offers insights into the culture, but also delves into the dynamics among individuals in the environment and the factors that may influence behaviour. Incorporating stakeholder perspectives is an inclusive approach which aims to ensure that the diverse needs and concerns of stakeholders are considered (Currie et al., 2022; Pappas et al., 2023). Stakeholder engagement provides a valuable opportunity to involve individuals in any future programmes, whilst simultaneously gaining insight throughout the development process. It can foster a collaborative research culture and encourage open communication among the research team, research personnel and animal care colleagues, and facilitate the process of co-creating a potential intervention (Muff, 2017, Chapter 2).

This initial exploratory work used elements of Intervention Mapping (Bartholomew et al., 2006). Intervention Mapping is a framework which considers implementation throughout the process of developing an intervention, which made it a suitable choice for my project. It is a systemic process that engages stakeholders in the development of an intervention, which makes it more effective and targeted to the end-users (Fernandez et al., 2019). This exploratory phase was modelled on Step 1 in the Intervention Mapping framework, conducting a needs assessment or a problem analysis, identifying what needed to be changed and for whom. It was an opportunity to learn about the context of the behaviours and understanding the population and setting.

This early phase of the project was dedicated to mapping the stakeholders in the context of an animal research facility in a university in the North of England. I identified the groups of people who worked with laboratory mice and conducted preliminary conversations and shadowing them to begin to characterise the nature of their relationships and interactions. I also gathered information about different universities' journeys to adopt tunnel handling, including seeking information on barriers and facilitators from various staff members' perspectives. This allowed me to gain insight into additional aspects of the process, barriers and facilitators and consider differences between settings.

The specific aims of this exploratory work were to:

- Identify potential stakeholders associated with laboratory animal research facilities.
- Characterise the nature of working relationships among stakeholders.
- Gather insights from stakeholders on the adoption journey of tunnel handling within university animal research facilities.
- Identify the barriers and facilitators encountered during the implementation of tunnel handling practices.
- Identify potential determinants influencing decision making with regards to tunnel handling adoption and practice.

2.2. Stakeholders

There were 13 stakeholders in total (see Table 1 for a summary), with different levels of engagement in this exploratory phase. They either agreed to a conversation or be shadowed while carrying out their usual tasks. Stakeholders were directly contacted and invited to share their experiences in this exploratory stage of the project. Of the four informal observations (two men, two women), technicians agreed to speak with me and show me their daily activities. An informal approach was taken for the informal conversation participants (three men, six women), in order to enable the stakeholders to speak freely. All four institutions that were involved in this part of the project had implemented low stress handling in their animal research facilities, which may have led them to feel more open in engaging with this project.

Table 1: Characteristics of Stakeholders

Conversations	**Shadowing**
North-East University *Adopted tunnel handling* • 1 Senior Staff Member in Animal Research Facility • 1 Training Officer • 2 Principal Investigators • 1 Research Associate	*North-East University* *Adopted tunnel handling* • 1 Animal Care Technician • 1 Research Technician • 1 Specialised Senior Technician
North-West University *Adopted tunnel handling* • 1 Professor • 1 Animal Care Technician	*North-West University* *Adopted tunnel handling* • 1 Animal Care Technician
NC3Rs • Senior Staff Member	
Midlands University *Adopted tunnel handling* • 1 Assistant Director of Animal Research Facility	

2.3. Activities

2.3.1. Shadowing

I carried out four shadowing sessions to start to understand the working environment in university laboratory animal facilities. I initially shadowed one Animal Care Technician, one Specialised Senior Technician and one Research Technician at a North-East university. The Specialised Senior Technician was observed on two occasions. In order to gain a broader understanding of the roles, people play across different facilities, I also shadowed an Animal Care Technician in another university in the North-West of England. All participants were contacted directly via email.

During my observations, I had informal conversations with each technician, asking them about their role, their working relationships and who they interact with, and their experience of handling mice. I did not use an interview guide to facilitate organic conversations without preconceived ideas, and to build trust to allow stakeholders to speak freely. Each observation lasted up to an hour, and technicians performed their day-to-day activities, such as cage cleaning.

2.3.2. Informal Conversations

I invited stakeholders for informal conversations to understand their perspectives of the rollout of tunnel handling at different universities. I wanted to understand the journey of tunnel handling and hear individuals' experiences of the barriers and facilitators of its implementation. The conversations purposefully targeted a wide range of stakeholders and perspectives (see Table 1). Some of the conversations were carried out using Zoom, as at times it was not possible to meet in person due to Covid-19 and social distancing measures. They all lasted up to an hour, without an interview guide to facilitate organic conversations.

2.4. Stakeholder Insights

From the collected notes derived from shadowing and conversations, I systematically identified and grouped common ideas, insights and perceptions. Workplace hierarchies and culture; psychological safety; assumptions and misconceptions; impact of Covid-19; openness and facilitators to change were common reflections from stakeholders. This also led to mapping the determinants of behaviour and create tables which grouped the stakeholders.

2.4.1. Stakeholder Table

While the observations and interviews were taking place, I started to develop a stakeholder table (see Table 2). This outlined who works at a typical animal unit.

Table 2: General Animal Research Facility Stakeholder Table

Animal Care and Technical Roles	Research Roles	Management and Welfare Structures
• Animal Care Technicians • Senior Technicians • Named Persons • Veterinarian	• Research Technicians • Research Assistants • PhD Students • Principal Investigators	• Director of Animal Facilities • Technical Managers • AWERB

2.4.2 Determinants of Behaviour Mind Map

The data enabled me to create a comprehensive mind map outlining potential determinants of behaviour that were discussed. These determinants ranged from individual factors, such as personality types, to organisational factors such as training, policies and guidelines (see Figure 2). The development of the mind map was further informed by literature on behavioural influences, providing a well-rounded perspective. The mind map offered a visual structure categorising determinants at various levels: individual, organisational, and societal. Through conversations and shadowing sessions, I was able to identify the prominence of specific determinants and understand how they interacted to influence handling behaviour. The visual representation helped illustrate the complex interplay between factors, highlighting key areas for further exploration. It is

important to note that the mind map represents only a selection of possible behavioural determinants and serves as a provisional model for the laboratory welfare context. While it may have evolved as the project progressed, it provided an initial framework for considering behavioural theories and identifying key areas for exploration for subsequent research.

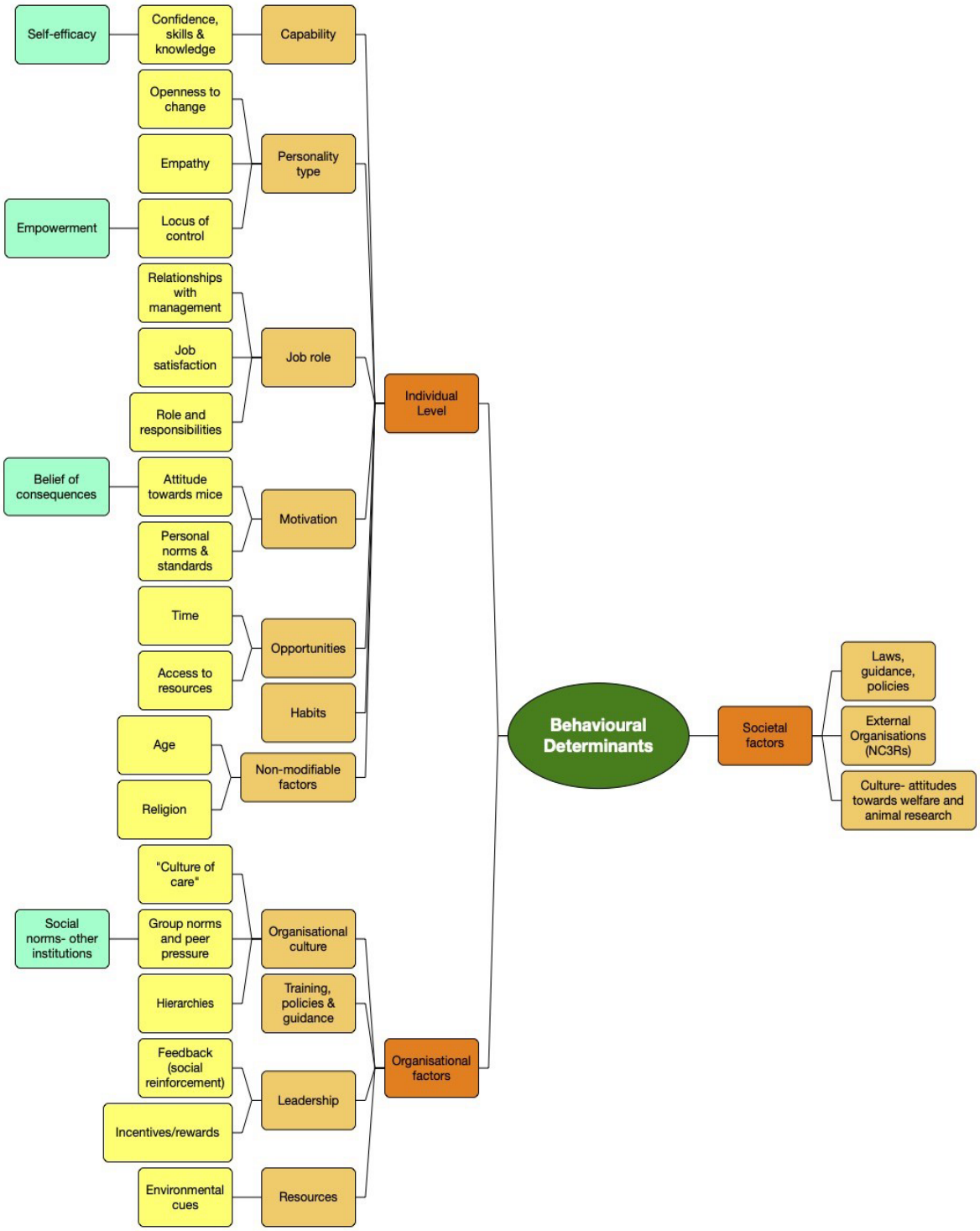

Figure 2: Mind map of the determinants of behaviour, showing factors which may influence and interact to impact behaviour in a laboratory context.

2.4.3. Insight 1: Workplace Hierarchies and Culture

Meetings with stakeholders in all three universities revealed that there is a clear hierarchical culture across roles in the animal laboratory workplace, whereby researcher's perspectives and needs are placed above those of laboratory personnel. Technicians described not feeling empowered to speak up and feeling unable to disagree with researchers when it came to handling methods and other aspects of their work. They provided examples of how this could ultimately impact animal welfare negatively, for example, if technicians feel unable to call out tail capture, or bring awareness to new welfare interventions. This ultimately led to some technicians feeling undervalued and unmotivated.

Technicians from multiple institutions identified that they would be more likely to be persuaded to try a new welfare intervention if the suggestion came from another technician. This is because they felt another technician would understand the pressures of their role and would be able to relate to their experiences. One conversation with a technician revealed that there is a perception that technicians do not like being told what to do by researchers, and vice versa. They feel that researchers do not understand their role and the pressures they are under, and researchers do not appreciate the work they do.

Stakeholders also revealed that hierarchical structures, particularly from senior staff members, can hinder progress in advancing animal welfare. For example, one technician revealed that a senior member of staff would not allow the facility to change to tunnel handling simply because they did not believe in the benefits, and the change to tunnel handling was only implemented after the senior staff had left the institution. This highlighted how senior members of staff can be a significant barrier to implementing advances in welfare because of the influence they have more decision-making authority that impacts on large numbers of people in an organisation.

2.4.4. Insight 2: Psychological Safety

However, the shadowing and conversations revealed indicators of good psychological safety at some institutions. For example, some technicians described working in a culture of honesty where any accidents or near-misses get reported to the Home Office. A technician revealed that this is important in the unit, and everyone is encouraged to speak out if there are any errors to help improve things in the future. Moreover, there is a reassessment process to retrain technicians or researchers if mistakes are made in order to ensure that all mice handling is done correctly, and both staff and students feel confident in their skills.

This exploratory phase also indicated that, in some universities, decision-making can be a collaborative process, for example, via discussions in formalised groups and forums. Some of the groups described including members with different roles, to gain wider representation and views. This indicated a desire to neutralise the impact of hierarchies and promote psychological safety and an open culture.

2.4.5. Insight 3: Impacts of Covid-19

The Covid-19 pandemic was described by stakeholders as having changed the dynamics of some relationships. For example, technicians reported that due to changing working patterns and access to facilities as a result of university policies, researchers have needed to rely more on animal technicians to help them conduct their research, such as performing procedures and checking on animals. This has led to increased communication and more trust between researchers and technicians, reported at multiple institutions. Moreover, technicians revealed that the new reliance on technicians has led researchers to gaining a better understanding of their role, which in turn, could positively influence the working relationships.

2.4.6. Insight 4: Assumptions and Misconceptions

Some people made assumptions and held beliefs about tunnel handling and the logistics around the method that might deter them from piloting or adopting it. For example, some

technicians report that some researchers and technicians believe that tunnel handling takes more time than tail handling or that it is not compatible with other laboratory procedures. The most common misconception that appeared in the conversations is the belief that any benefits of tunnel handling are overshadowed or erased by invasive experimental procedures that are carried out with the mice. From the conversations, there was speculation among technicians that researchers may be reluctant to change their handling methods, as it could be a threat to their professional identity. This was because it could be difficult for researchers to accept that the tail handling method that they have been using their entire careers may have increased anxiety in their animals or influenced their data collection. Changing methods now could have repercussions if they replicated their work or conducted any further research.

2.4.7. Insight 5: Openness to Change and Habits

Another factor that emerged in conversations with stakeholders was openness to change. One technician discussed their experiences where, anecdotally, they found older colleagues appeared to be more reluctant to change, and less open to trying new techniques. Multiple technicians reported that senior members of staff they have worked with were not open to trying tunnel handling as they had tail handled their entire career.

The role of habit emerged as a strong barrier to adopting tunnel handling. Both researchers and those in technical roles disclosed the difficulties they faced in breaking their ingrained habit of using tail capture. Technicians particularly reported difficulty in the technical community in breaking the habit of tail handling, especially if this was a method they had used for a long time in their career. Some reported it being difficult to persevere with tunnel handling. However, one technician reflected that the role requires being able to adapt to changes quickly, as changes in policy happen frequently. For one technician, it took them two weeks to adapt to tunnel handling and be able to do it with ease, whereas for the principal investigator, they reported that they still slip back into habits of using tail capture.

2.4.8. Insight 6: Facilitators of Change

In terms of persuading individuals to adopt tunnel handling, various methods have been identified. People in different roles reported that they were more inclined to change to low stress handling methods after observing their peers in similar roles promoting it. For example, one technician was convinced by the methods after seeing another technician present at an IAT Congress conference. Another technician became more receptive to tunnel handling after watching an external technician demonstrate the method in person.

For researchers, the primary driver for adopting tunnel handling was often due to workplace guidelines mandating its use, highlighting the influence of institutional policies. This underscores that different facilitators are effective for different roles: technicians are often influenced by peer demonstrations and hands-on examples by people understand their pressures and nuances of their roles, whereas researchers respond more to formal institutional guidelines.

Another common approach that was reported was appointing champions within facilities. These champions worked as points of contact for anyone who needed help with implementing tunnel handling and overcoming any difficulties. Conversations revealed that technicians and researchers were often surprised by the simplicity of tunnel handling, often commenting, “Is that all I have to do?” A professor noted that researchers are persuaded by data and evidence, a view that was supported by an animal technician at another university. They believe that researchers are motivated by speed, efficiency and “getting the job done”. In contrast, there is the perception that animal technicians are primarily motivated by animal welfare, along with techniques that make their jobs easier and more efficient.

These insights illustrate that effective facilitators for adopting tunnel handling can vary between technicians and researchers, emphasising the need for tailored approaches to encourage the adoption of low stress handling methods.

2.5. Conclusions

This exploratory phase of the project revealed that organisational culture had a substantial influence on psychological safety within laboratory settings. Psychological safety describes individuals' perceptions about the consequences of interpersonal risks in their work environment (Edmondson, 2004). Turner and Harder (2018) defined it as a feeling or climate where the individual can feel valued and comfortable yet still speak up and take risks without fear of retribution, embarrassment, judgment or consequences either to themselves or others, promoting learning and innovation. Hierarchical structures in place often make up part of organisational culture (Tear et al., 2020), but can inhibit open communication and prevent individuals from voicing concerns or disagreeing with senior colleagues (Edmondson, 2018; Ge, 2020; Pacheco et al., 2015). In this context, technicians reported they were on the "lower" end of the hierarchy, with researchers above them. The separation of levels in the hierarchy may lead to a lack of empowerment, and technicians may feel that they cannot voice their concerns and or disagree with senior colleagues or researchers. For instance, in situations where a researcher engages in tail capture, a technician may feel uncomfortable and unable to challenge the behaviour, leading to the use of tail capture continuing. This would ultimately lead to poor mouse welfare.

The link between hierarchy, psychological safety and innovation was explored by Chen et al. (2021), who found that when employees feel free to express concerns, or suggestions, they are more likely to engage in innovative behaviours. Additionally, their perceptions of hierarchy influence this relationship. Specifically, if employees view their position in hierarchy positively, they are more likely to voice new ideas. Employees who feel valued and respected are more likely to speak up to suggest innovative ideas, highlighting the relationship between hierarchy, psychological safety and innovation. In a laboratory context, good psychological safety is necessary to make advancements in welfare, as poor psychological safety may prevent individuals from calling out bad welfare behaviours or suggesting new refinements for future implementation. Therefore, it is essential to explore the link between culture and psychological safety in more depth, and how it affects implementation of refinements.

In this study, participants from some institutions described a hierarchical structure that limits open communication, particularly for technicians. The separated structure was very visible when I identified the stakeholders and grouped them. This perception was also evident in the literature; the Brown Report (Brown et al., 2013), an investigation into failures in laboratory animal care at King's College London, which noted the physical and social separation between researchers and animal care technicians. Nuyts and Friese (2023) conducted a qualitative study exploring the communication patterns between scientists and animal care technicians and found that scientists communicate with technicians about operational issues and speak to fellow scientists about experimental design and moral concerns. This hesitation to discuss animal welfare and moral concerns with technicians may stem from scientists' fear of being critiqued, as this exploratory work identified that technicians are the primary caregivers for the animals. Additionally, technicians expressed that they are more receptive to new refinements when these suggestions come from other technicians, who understand the pressures of their role. This suggests that technicians may feel others do not fully grasp the pressures they face or may feel isolated from researchers. These findings highlight significant communication issues between researchers and technicians, which could negatively impact animal welfare. However, as the insights from this work indicate, the divide may be shifting due to the new reliance on technicians from researchers due to working patterns changing since Covid-19.

Moreover, the wider literature and this exploratory work illuminates that there is a hierarchical structure across the industry; it is not specifically evident in one institution. Ineffective communication and reluctance to address welfare concerns may lead to the persistence of inadequate practices, ultimately affecting the wellbeing of the animals in the laboratory. The link between organisational culture and animal welfare requires deeper exploration, as this exploratory phase identified it as a key determinant. Understanding the relationship more thoroughly would provide crucial insights for improving laboratory practices across the field. Does a good culture lead to better implementation of tunnel handling?

The implementation of tunnel handling in three universities revealed a dependency on senior leadership support. Without their support, it is evident that introducing new welfare interventions becomes challenging. In various instances, stakeholders shared their experiences of leaders opposing an intervention, which delayed the advancement of new refinements. It was only when these staff members left, that changes could take place and new refinements advanced, which highlights the impact of hierarchy and innovation (Chen et al., 2021). On the other hand, senior staff members shared the significance of junior colleagues in the successful implementation of welfare interventions. For example, while senior management may initiate the rollout of tunnel handling, the reluctance of experienced, trusted personnel like animal care technicians could cast doubt on its appropriateness. This scepticism could influence junior colleagues, impacting their adherence to the intervention. These dynamics highlight the complex interplay between the hierarchical levels in shaping decisions about welfare interventions. The reluctance between researchers and animal care technicians to openly discuss animal welfare may contribute to a lack of transparency and collaboration within laboratory settings (Nuyts & Friese, 2023), which may ultimately hinder welfare for the animals and result in slow progression of the implementation of new refinements. However, participants from other institutions described a very different situation: a culture of openness, where colleagues are encouraged to speak up about errors and embrace a culture of learning from mistakes. In these settings, there was a willingness to learn from mistakes, creating a culture where welfare is prioritised. This could be explained by the institutional values and policies that could be in place. Institutions that explicitly prioritise welfare and have policies that encourage open communication and error reporting may be more likely to create a positive culture regarding animal welfare (Hawkins et al., 2014). These findings from this exploratory work highlight the connection between workplace culture and animal welfare.

In addition to uncovering the impact of hierarchy and organisational culture, individual-level factors that may be determinants of handling behaviour have been identified as possible avenues for future exploration. Specifically, the varying levels of individuals being open to change. They shared their experiences where, anecdotally, colleagues with a longer employment history appeared to be more reluctant to change, and less open to

trying new techniques. This observation is supported by the literature on human personality, where across the lifespan, openness as a personality trait decreases with age (e.g. Donnellan & Lucas, 2008; Srivastava et al., 2003). This may also be explained by the role of habits, which are behaviours that are often performed without conscious deliberation with a degree of automaticity can be grouped under the concept of habit (Jager, 2003; Smith & Graybiel, 2016). The participants in this exploratory phase admitted difficulty in breaking habits, especially those with a long career of mouse handling. It may be that older individuals have worked in laboratories for many years and have developed stronger habits of using tail capture, which they may find difficult to break, leading to a reluctance in changing behaviour. The role of habits is important for changing behaviour and was considered an important determinant explored further in Chapter 3.

In addition, participants' narratives demonstrated misconceptions about the practicalities of using low stress mouse handling methods. A continuing misconception identified in this study is the belief that any benefits of tunnel handling are overshadowed by invasive experimental procedures that are carried out with the mice, therefore deeming any low stress efforts as void (also reported in the survey studies by Henderson et al., 2020; Waters, 2019; Young et al., 2023). However, research aimed at addressing this found that only brief tunnel handling is sufficient to reduce anxiety in mice (Gouveia, 2014), which demonstrates that even minimal intervention can have significant welfare benefits, despite experimental procedures. The implications of these misconceptions are significant for mouse welfare, as if perceptions among technicians and researchers do not change, it may lead to the under-use of low stress methods to handle mice, reducing opportunity to improve mouse welfare. Future studies should explore why these beliefs are still prevalent, despite the evidence disputing the misconceptions.

This explorative study aimed to understand the laboratory environment and working relationships in it and provide insights into the journey of different institutions when adopting tunnel handling. Beyond the reports of individual behaviour and challenges, the research revealed decision-making of processes of implementing refinements in institutions, highlighting the factors that facilitate or act as barriers. This provides an interesting context in which to consider the implementation of welfare refinements and

the complexities around it. Furthermore, this work has contributed valuable insights into the workplace culture and hierarchical structure within different laboratory environments; it enabled me to identify the key stakeholders and potential determinants of behaviour. This exploration not only gave insights into the factors that influence mouse handling behaviours and decision-making for both researchers and technicians, but also shed light on organisational nuances that affect the welfare practices within institutions. The impact of hierarchy and organisational culture on mouse handling needed further investigation, as these factors could be both facilitators and barriers to the implementation of good welfare practices. Notably, this stage of the project played a pivotal role in shaping subsequent research questions and areas of interest. These findings provided a foundation for exploring the complex relationship between organisational culture, workplace hierarchy, and their impact on laboratory animal welfare. However, further research was needed to explore how these factors are interconnected and potentially influence handling decisions.

Chapter 3. Exploring Barriers and Facilitators to Low Stress Mouse Handling: Addressing the Impact of Culture of Care and Workplace Guidelines

Abstract

Low stress handling methods in animal research can enhance animal welfare and the quality of scientific data. However, increasing the widespread implementation of such methods is a challenge, due to a range of barriers. Building on the stakeholder identification and findings reported in Chapter 2, the work reported here further investigated the factors influencing the adoption of low stress handling methods, addressing both individual and organisational level aspects. An online survey was used to assess the current adoption of low stress handling and traditional tail capture within a sample of seven universities in the UK. The survey examined key factors including culture, habit and psychological safety, in a larger sample of 141 participants (animal facility staff and researchers), using the Theoretical Domains Framework (TDF) as a guide. Quantitative data were analysed using descriptive statistics and correlations, while qualitative data from free text responses were analysed using descriptive thematic analysis.

The findings revealed a range of barriers and facilitators at both individual and organisational levels that were associated with the frequency of use of low stress handling methods. Individual-level factors associated with frequency of low stress handling included knowledge, beliefs, and the role of habits, awareness of policies, whilst organisational-level factors included the perception of workplace culture (a 'culture of care'). Perceptions of a stronger culture of care were associated with stronger tunnel handling habits. This study offers a more comprehensive perspective on the diverse challenges faced by individuals in various roles and highlights the need for targeted educational and training initiatives to support individuals with the necessary skills to use low stress handling in different contexts.

3.1. Introduction

Given the widespread use of mice in biomedical studies and the numbers of procedures being performed under the Animal Scientific Procedures Act (ASPA, 1986), refinements aimed at improving the quality of life for mice can improve welfare for a vast number of animals, both in the UK, and internationally (see Chapter 1). Lloyd (2008) defines a "refinement" as any method which minimise pain, suffering, distress or lasting harm that may be experienced by research animals, and which improves their welfare. As well as the scientific procedures that mice undergo, the welfare of laboratory mice can also be affected by their housing and husbandry. For example, refinements such as social housing, adapting cage sizes and adding enrichment to cages benefits mouse welfare (Olsson & Dahlborn, 2002; Würbel, 2001). Such improvements can contribute towards a better environment for mice, promoting their physical and psychological well-being.

In 2010, the first evidence was published showing that traditional handling methods for mice were a welfare concern and could be improved (Hurst & West, 2010). Traditionally, mice have been picked up by their tail, a method known as 'tail capture' (Hurst & West, 2010; Prescott & Lidster, 2017). However, experimental evidence showed that despite being widely accepted and used by generations of researchers and laboratory personnel, alternative methods, such as cupping or using a tunnel, could be an important refinement to improve mouse welfare. Tunnel handling, a refined method of handling known as a "low stress handling method", involves guiding a mouse into a tunnel and picking them up with the tunnel with minimal contact, rather than capturing them by the tail. "Cupping" is another refined method of handling mice, which involves picking up the mice with cupped hands and does not require any equipment (Davies et al., 2022). Since then, there have been many studies that have found benefits to low stress handling methods, such as reducing anxiety and depression in mice, reducing chronic stress, improving research outcomes, and increasing exploration and performance in standard behavioural tests (Clarkson et al., 2018; Clarkson et al., 2020; Ghosal et al., 2015; Hurst & West, 2010 Nakamura & Suzuki, 2018).

Despite the large evidence base in support of adopting low stress handling, these methods are not yet fully adopted. Henderson et al (2020) conducted an international survey to identify the handling methods being used by individuals who work with and/or conduct research using laboratory mice, in addition to exploring the common barriers that prevented the uptake of low stress handling. Their findings revealed that some technicians and researchers perceive tunnel handling as too time consuming and incompatible with standard procedures or specific types of mice. Similar perceptions were reported in an international survey study by Young et al. (2023) which examined beliefs about tunnel and cup handling and benchmarked handling practices.

The literature indicates that barriers to using low stress methods, such as tunnel handling or cupping, persist and many laboratory personnel continue to use the standard method of tail capture for mice (Henderson et al., 2020; Waters, 2020; Young et al., 2023). Similar to the approach taken in studies involving mice, surveys have also been utilised to examine the reasons behind the choice of handling methods for laboratory rats. Burn et al. (2023) conducted an international survey to explore the use of different handling methods for lifting laboratory rats, alongside handlers' reasons and concerns. Interestingly, similar to findings in the mouse handling literature (Henderson et al., 2020; Young et al., 2023), the most frequently cited reason for using tail lifting was its perceived speed and convenience. However, like Henderson et al. (2020) and Young et al. (2023) they also did not enquire the degree to which each handling method was used, and why. It would be valuable to determine the frequency of each handling method to better understand their prevalence. For instance, individuals may only resort to tail capture to handle mice in specific situations where they feel it is feasible, which may suggest it is only used rarely. The survey study described in this chapter not only systematically identified the uptake of methods and draw out the barriers, but crucially, it explored the potential determinants of behaviour at organisational and individual levels that may influence handling decisions, and how they interacted.

3.1.1. Determinants of Handling Practices

Workplace Culture

In the context of laboratory animal research, the term “Culture of Care” is used to describe an establishment-wide commitment to improving animal welfare, scientific quality, care of staff and transparency for all, such as stakeholders and the public (Bacon et al., 2021; Robinson et al., 2020). Therefore, the degree to which a Culture of Care is found in an animal unit could influence how individuals prioritise and place importance on welfare refinements such as tunnel handling, and potentially impact the welfare of the animals and the scientific quality of the data collected. This draws parallels from the healthcare literature, where a good Culture of Care has been linked to improved patient medical outcomes (Braithwaite et al., 2017; Hahtela et al., 2017). It is anticipated that a similar dynamic may exist in animal research facilities, where the welfare of laboratory animals benefits from a workplace that has a good Culture of Care.

The culture in which researchers and technicians do their work is coming increasingly under the spotlight (Nuyts & Friese, 2023; Wellcome, 2021). Psychological safety describes an individual's perception about the consequences of taking interpersonal risks in their work environments (Edmondson et al., 2004; Edmondson, 1999). A psychologically safe environment would mean that researchers and technicians feel like they can express concerns, suggest new ideas, and communicate openly. These are all important components in ensuring a good workplace culture and good welfare for mice. For example, it is important that a handler feels secure in communicating if they struggle to use low stress handling, and not fear repercussions. Moreover, handlers should feel confident to suggest new refinements and be supported to try them, if appropriate. Considering both Culture of Care and psychological safety allows us to explore how a supportive environment can advance animal welfare.

Social Influences and Handling Guidelines

Chapter 2 revealed that laboratories are complex environments - workplace dynamics can also influence handling practices. The variation in handling behaviour in organisations could be explained by different models of human behaviour. For example, social learning

theory (Bandura & Walters, 1977) could play a factor in how handling practices may be inconsistent - a researcher may copy the handling techniques of another researcher, but technicians may use a different method, which can lead to inconsistent methods of handling within a unit. In addition to social influences, there may be environmental factors. For example, there is limited consideration in the literature on how perceptions of the existence of workplace guidelines affects decisions in handling behaviour. As discussed in Chapter 1, previous studies have enquired if there are handling guidelines but have not explored this in depth (Henderson et al., 2020; Young et al., 2023). For example, they did not explore if there were guidelines at the institutions in which their surveys were shared and the content of any guidelines, or how these guidelines had been interpreted by comparing with participant responses. Organisational factors such as culture and the presence of workplace guidelines can influence individual behaviour and the degree to which someone uses certain methods. There currently remains a gap in our understanding, as the interplay between perceptions of guidelines and actual guidelines could significantly impact decision-making in handling behaviour. Understanding the real-world impact of guidelines on individual behaviour can inform how to standardise behaviour in animal facilities. Workplace guidelines are an important environmental aspect to consider, as it may be overlooked as a determinant of behaviour as highlighted in Chapter 2. Moreover, the interpretation could be an interesting finding for organisations, as it may encourage them to consider how to disseminate any guidelines for implementation and whether current methods are effective.

Habits

In Chapter 2, stakeholders highlighted that it may be difficult for people to break their habits of using tail capture, especially if it is a method that they had used for their whole career. Habits are a social construct with varying definitions and characteristics associated with the phenomenon (Gardner & Lally, 2023). For the purposes of this study, the definition of habit by Gardner and Lally (2023) was chosen; they define habit more broadly, as the process by which a context-response association, learned through repeated behavioural performance in a specific context, triggers an impulse to do the associated response when exposed to context cues. When repeating a behaviour in a

particular context, implicit associations in memory between contexts and responses are formed (Carden & Wood, 2018). In a laboratory setting, technicians and researchers often perform routine tasks, which contribute to the development of habits (Verplanken & Orbell, 2022), for example, the daily routine of changing mouse cages, which requires many mice to be handled. The repetitive nature of such tasks facilitates the formation of habits over time, and those who have handled mice using tail capture may have developed strong habits during those recurring tasks which might be difficult to change (Jager, 2003; Verplanken & Orbell, 2022).

Habits may lead to a resistance to change, particularly if learning new habits require time and dedication (Lally et al., 2010). In an animal laboratory setting, difficulties in breaking familiar habits could slow the implementation of new welfare refinements. Outdated methods and habits may ultimately be passed onto the next generation of researchers and technicians, thereby slowing the advancement of new welfare practices (Lloyd et al., 2008). However, those more recently moving into research and technical roles may only have ever been taught to use low stress handling and developed strong habits of these methods of handling. Furthermore, different job roles may require the individual to handle mice to varying degrees- an animal care technician may handle mice daily, compared to a principal investigator who may only handle mice on rare occasions, leading to varying strengths of habits. To date, this is an understudied area as there are no studies which examine the role of habits in laboratory handling practices. It is unclear how habits affect handling behaviour or intersect with other determinants of behaviour in a laboratory setting.

Career

It is important to consider how a person's current role and preceding career path may influence their behaviour. For example, technicians who handle mice daily with a long history of tail capture may report difficulty with using tunnel handling consistently, due to the formation of strong habits. On the other hand, a newly recruited researcher with no history of mouse handling may join an institution which only delivers low stress handling training and be given the opportunity to develop habits which enhance mouse welfare.

In addition, an individual's job is likely to shape how individuals perceive their role and responsibility towards the mice under their care. For example, those who work as animal care technicians may have direct involvement with the animals and be responsible for their care and welfare, often forming close bonds with the animals (O'Malley et al., 2022; Randall et al., 2021). They may lead to a strong sense of responsibility for delivering the best practices for animal welfare. However, researchers may primarily view them as experimental animals necessary for advancing scientific knowledge (Birke et al., 2007), perhaps leading to a more detached perspective towards them. While they recognise the importance of ethical treatment and welfare standards, their primary focus may lie in the careful implementation of research procedures in the pursuit of knowledge (Nuyts & Friese, 2023; Sharp, 2019). However, this view oversimplifies the complexities of the laboratory environment. For example, technicians may find that the caring responsibilities conflict with the demands of their role (see Chapter 2), and researchers can develop genuine concern for the animals involved with their work.

Theoretical Domains Framework

Behaviour change has been a topic of study in a variety of fields such as organisational psychology, public health and animal welfare (Atkins et al., 2017; Dyson & Cowdell, 2021; Glanville et al., 2020; Shumla et al., 2024). The Theoretical Domains Framework (TDF) is a comprehensive theoretical framework which was developed to understand and address behaviour change in a range of contexts (Michie et al., 2005). It provides a systematic way to identify factors influencing behaviour, which can help in the development and implementation of effective interventions (Cane et al., 2012; French et al., 2012). The TDF integrates constructs from multiple theories and is derived from 33 theories of behaviour. It resulted in a framework that consists of 14 theoretical domains, each representing a distinct set of factors that influence behaviour change (Cane et al., 2012). The 14 domains are:

1. **Knowledge**: Awareness of the behaviour, including procedural knowledge.
2. **Skills**: Ability or proficiency acquired through practice.

3. **Social/Professional Role and Identity**: A coherent set of behaviours and displayed personal qualities of an individual in a social or work setting.
4. **Beliefs about Capabilities**: Acceptance of the truth, reality or validity about an ability that a person can put to constructive use.
5. **Optimism**: The confidence that things will happen for the best or that desired goals will be attained.
6. **Beliefs about Consequence**: Acceptance of the truth, reality, or validity about outcomes of a behaviour in a given situation.
7. **Reinforcement**: Increasing the probability of a response by arranging a dependent relationship, or contingency, between the response and given stimulus.
8. **Intention**: A conscious decision to perform a behaviour or a resolve to act in a certain way.
9. **Goals**: Mental representations of outcomes or end states that an individual wants to achieve.
10. **Memory, Attention and Decision Processes**: The ability to retain information, focus selectively on aspects of the environment and choose between two or more alternatives.
11. **Environmental Context and Resources**: Any circumstance of a person's situation or environment that discourages or encourages the development of skills and abilities, independence, social competence and adaptive behaviour.
12. **Social Influences**: Those interpersonal processes that can cause individuals to change their thoughts, feelings or behaviours.
13. **Emotion**: A complex reactive pattern, involving experiential, behavioural and physiological elements, by which the individual attempts to deal with a personally significant matter or event.
14. **Behavioural Regulation**: Anything aimed at managing or changing objectively observed or measured actions.

The TDF can be applied in different ways, for example in intervention design, diagnosis, evaluation and implementation (Atkins et al., 2017; Little et al., 2015; McGowan et al., 2020; Philips et al., 2015). In the context of this work, the TDF is used to identify barriers

and facilitators to using low stress handling methods by systematically using the framework of the domains.

3.1.2. Rationale for the Current Study

Following the publication of Hurst and West (2010), there is now a strong initiative in the UK to implement low stress handling. It is also supported by scientific organisations such as the NC3Rs, who champion the method by providing resources and promoting it. However, recent survey data show that it is still not fully implemented in the UK (Henderson et al 2020), and exploratory work also supported this view (see Chapter 2). In this study, my aim was to evaluate the use of low stress handling methods, focussing on specific UK universities that had committed to implementing low stress handling to varying degrees. I wanted to better understand the variation in implementation within and across institutions and apply approaches that would provide new insights into beliefs and behaviours towards tunnel handling. Focussing only on UK universities allowed me to explore nuances and variations in mouse handling practices between different university laboratories.

The survey study set out to identify the current adoption of various mouse handling methods and identify specific contexts in which these methods are used among a sample of animal care professionals and research personnel in seven UK universities. This study extends previous work by Henderson et al. (2020) and LaFollette et al. (2021) in the assessment of adoption of refinements, by exploring how people understand and interpret any existing mouse handling guidelines in their workplace. Additionally, it identified factors which may have the potential to impact tunnel handling, such as perceptions of culture of care, habit strength and psychological safety, measured using validated tools. The survey also aimed to identify psychological, social and contextual determinants of behaviour. To do this, the Theoretical Domains Framework (Cane et al., 2012) was used to provide a comprehensive approach for understanding barriers and facilitators, and to serve as a framework for developing a meaningful intervention by identifying key behavioural predictors in this case of mouse handling behaviour (Araujo-Soares et al. 2019; Atkins et al., 2017).

3.2. Method

3.2.1. Participants

Individuals were eligible to participate in this study if they were currently employed in research or animal care roles, working and/or conducting research with mice at any one of seven specified UK universities from a convenience sample. They were told the purpose of the study was to explore their current mouse handling habits and perceptions of their workplace culture. This approach was chosen to minimise potential sources of bias: a focus on mouse handling would differentially attract people with interests in/strong opinions on the matter, whilst stating the project's welfare-related objectives risked activating demand characteristics in participant response patterns (e.g., social desirability bias). Of course, such biases cannot be fully eliminated. Each university had its own separate survey link to allow us to compare data across universities. The survey link was shared with researchers and technicians working in these units via email lists and posters with QR codes in the units. In total, I received 168 responses. Five respondents reported that they did not handle mice and were not invited to proceed with the survey. One University inadvertently shared their link externally, and consequently 22 participants were removed because they were not from one of the seven invited universities (identifiable by location). Responses that were over 90% completed were included in the final sample. In total, there were 141 usable responses from participants meeting the original inclusion criteria. The data collection period was 4 weeks at each university: University B from the 24th June 2022, Universities A, C-F from the 7th November 2022 and University G from 14th November.

3.2.2. Ethics

This study received ethical approval from Newcastle University Ethics Committee (REF:18371/2021). Participants read an online information sheet providing background information about the study, assuring them of their anonymity, setting out data storage and retention policies, and informing them of their right to withdraw and ask questions. After reading this, they provided online consent to participate using a tick-box consent form. See Appendix A for a copy of the information sheet.

3.2.3. Materials and Design

The survey was delivered and hosted online using Qualtrics. It assessed a range of factors potentially associated with handling practices, with quantitative and qualitative free text questions (see Appendix B for a full copy of the survey). The main variables of interest and their corresponding scales or questions are summarised below.

Demographic & Employment Information

Participants provided information on their job role, demographics (gender and age), and how long their work had involved handling mice. They indicated whether or not they were aware of the existence of workplace guidelines for handling mice and, if so, briefly described their contents. Participants were asked about their attitudes towards their workplace guidelines. They were asked if their animal-related activity is related to research activity, or animal care and husbandry.

Tunnel Handling Habit Strength

The Self-Report Behavioural Automaticity Index (SRBAI) was used to measure tunnel handling habit strength. The SRBAI is a shortened version of the SRHI, a 12-item measure of habits, and has been found to have good reliability and validity (see Gardner et al., 2012). The SRBAI has 4 items, measured using a 5-point Likert scale ranging from strongly agree to strongly disagree. Participants are asked if the behaviour is something they do automatically, without having to consciously remember, without thinking, and whether they enact behaviour without consciously thinking of it. A score for each participant was created by calculating the mean from the 4 items. In the current sample, the internal reliability of the 4-item habit strength scale was 0.92 (Cronbach's alpha), indicating excellent reliability.

Mouse Handling Methods

Participants were asked to choose the type of handling methods they currently used, from the following options: tunnel handling, tail capture, or other low stress handling method. They also specified the frequency with which they handled mice and were asked to indicate why they used their chosen method(s) using free text responses and in which situations. Participants were also asked if they sometimes used a method that they knew they should not, and why- this was also addressed with free text responses.

Participants were also asked whether they had *changed* their mouse handling methods during their career. Participants who answered yes to this question were then asked to describe the change (e.g., from tail handling to tunnel handling). Additional questions about the process of change and how they were supported and motivated change were included as part of the Theoretical Domains Framework analysis.

Culture of Care

The Culture of Care barometer was used to measure perceptions of workplace culture. After reviewing the limited number of available tools available to measure Culture of Care in the animal welfare literature. It was found that many were not validated and limited in their depth of questions, like the Capability Maturity Model (Amarasekara et al., 2022) and a survey by Beterlesen & Øvlisen (2021). I decided to use a barometer by Rafferty et al. (2015). Rafferty et al. (2015) developed a validated reflective tool to measure Culture of Care in healthcare settings, demonstrating good reliability and validity. It contains 30 items to which participants respond using a 5-point Likert scale ranging from strongly agree to strongly disagree scale. For the purpose of this study, the word “organisation” was altered to “unit”. A score for each participant was obtained by calculating a mean (from the 30 items). In the current sample, the internal reliability of the 30-item Culture of Care Barometer was 0.96 (Cronbach’s alpha), suggesting excellent reliability.

Psychological Safety

An established Psychological Safety Survey (Edmondson, 2018; Edmondson, 1999) was used to measure participants’ perceptions of psychological safety in the workplace. It is a

7-item tool with high reliability (Cronbach's alpha was 0.94 in Edmondson, 1999) which is designed to measure the extent to which participants can make mistakes, communicate any issues, take risks, and feel accepted and valued for their skills in the workplace (Edmondson, 2018; Edmondson & Lei, 2014). A score for each participant was created by calculating the mean from responses to the 7 items. For the current sample, the internal reliability of the 7-item psychological safety survey was 0.83 (Cronbach's alpha), which indicated good reliability.

Theoretical Domain Framework Questionnaire

The TDF provides a theoretical lens through which to view the cognitive, affective, social, and environmental influences on behaviour (Atkins et al., 2017). Many questions were designed to map onto the relevant 14 domains of the TDF related to the target behaviour (for a full list of questions and their domain, please see Appendix A). The number of questions per domain ranged from two to seven, with an average of four questions per domain.

3.2.4. Piloting

The survey was tested by a small group of three technicians, two researchers and a professional working in industry for comprehensibility and readability. This was to ensure the questions were perceived in the way the I intended, and to check that it was relevant to both researchers and technicians. All had experience working with mice: some volunteered to take part after hearing about the project, whereas others were directly contacted by the researcher.

Each person was asked to complete the survey whilst thinking out loud for note taking purposes. These sessions took thirty minutes to one hour. As a result of the testing, the wording of a few questions was adapted. For example, in the Psychological Safety section of the survey, one question ("It is safe to take a risk on this team") was adapted, because in the context of animal welfare, "risks" were not perceived to be positive by two technicians. Therefore, the question was changed to "It is safe to try new things"

Following this, the survey was first distributed to University B between 24th June - 22nd July 2022. I decided to initially collect data at one university to check the reliability of the TDF domains (with Cronbach's alpha) in a subset of the dataset. Survey responses from 23 participants were collected. After the initial piloting phase at University B, the domains underwent reliability testing. Subsequently, the survey was refined, which involved the addition or removal of questions within certain domains after discussion with the research team. Furthermore, three questions were incorporated into the Optimism domain. Table 3 provides an overview of the alterations. Following this, the survey was distributed to the remaining six universities and the domains were tested for reliability.

Table 3: Alterations made to TDF Domains

Domain	**Items Removed**	**Items added**
Memory, attention and decision making	*No changes*	Thinking about times when you handle mice following unit guidelines, to what extent do you agree which the following statements? - I consciously remind myself to handle mice following workplace guidelines.
Beliefs about consequences	Thinking about the method you use to handle mice, to what extent do you agree with the following? - Using tail capture will not have a negative impact on mouse welfare.	*No changes*
Goals	*No changes*	*No changes*
Emotion	*No changes*	*No changes*
Optimism	*No changes*	To what extent do you agree with the following statements? - I am optimistic about tunnel or other low-stress handling methods. - I am optimistic that tunnel or other low-stress handling methods will be widely adopted in the future - I am pessimistic about the current rate of uptake of tunnel or other low-stress handling methods
Skills	Thinking about the process to changing to tunnel or other low-stress methods of handling, to what extent did the following apply to you? - I strongly believed I had the skills to make the change	*No changes*
Social influences	*No changes*	*No changes*
Beliefs about capability	*No changes*	Thinking about the process to changing to tunnel or other low-stress methods of handling, to what extent did the following apply to you? - I strongly believed I had the skills to make the change

Intentions	To what extent did you support the change to tunnel handling or other low-stress methods?	*No changes*
Reinforcement	*No changes*	*No changes*
Behavioural regulation	Thinking about times when you handle mice following unit guidelines, to what extent do you agree which the following statements? - I consciously remind myself to handle mice following workplace guidelines.	*No changes*
Knowledge	To what extent did the following factors influence your handling behaviour over your career? - Learning new methods as a result of changes in role and/or responsibilities.	*No changes*
Social, professional role and identity	*No changes*	To what extent did the following factors influence your handling behaviour over your career? - Learning new methods as a result of changes in role and/or responsibilities.
Environmental context and resources	Please indicate the extent you agree with each of the following statements by ticking one box on each row. This tool is intended to encourage self-reflection, so take your time to consider each statement. "Unit" refers to the animal facility in your place of work. - I have the resources I need to do a good job - I feel respected by my co-workers - I have sufficient time to do my job well - I am proud to work in this unit - My line manager treats me with respect - The unit values the service we provide - I would recommend this unit as a good place to work - I feel well supported by my line manager - I am able to influence the way things are done in my team - I feel part of a well-managed team - I know who my line manager is - Unacceptable behaviour is consistently tackled	*No changes*

	- There is strong leadership at the highest level in this unit - When things get difficult, I can rely on my colleagues - Managers know how things really are - I feel able to ask for help when I need it - I know exactly what is expected of me in this job - I feel supported to develop my potential - A positive culture is visible where I work - The people I work with are friendly - My line manager gives me constructive feedback - Staff successes are celebrated by the unit - The unit listens to staff views - I get the training and development I need - I am able to influence how things are done in this unit - I am kept well informed about what is going on in our team - I have positive role models where I work - I feel well informed about what is happening in the unit - My concerns are taken seriously by my line manager - The unit has a positive culture	

3.2.5. Procedure

After the piloting, the survey was disseminated across six universities that had animal research facilities. I reached out to a contact at each university who had previously agreed to share the survey. Each contact sent out reminder emails two weeks after they first shared it.

3.2.6. Data Analysis

Computed Variables

Mean scores were calculated for each participant from their answers to questions on their habit strength, perceptions of culture of care, perceptions of psychological safety and each of the 14 TDF domains. Any missing data points for question groups for any TDF domain was treated by calculating the average for the question set and inputting this number for the missing data point using valid mean substitution (Dodeen, 2003).

A single measure of behavioural frequency was required for analysing the use of low stress methods. A variable was created based on questions regarding how often participants use each method, resulting in a single score. The scores were: always, most of the time, some of the time, rarely or never. Where participants provided inconsistent information about handling method frequency in their quantitative and qualitative data, the qualitative comments were used to determine their low stress frequency score. A second researcher verified the scoring, and a third researcher assisted in cases of disagreement between the first two coders (N=2). See Tables 4 and 5 for example scoring, and Appendix C for full examples of scores.

Table 4: Example of Consistent Responses with Low Stress Frequency Score

Tail Capture	Tunnel Handling	Other Low Stress Methods	Low stress frequency score
Never	Most of the time	Rarely	**Always**
Rarely	Most of the time	Never	**Most of the time**
Some of the time	Some of the time	Never	**Some of the time**

Table 5: Examples of Inconsistent Responses with Low Stress Frequency Score

Tail Capture	Tunnel Handling	Other Low Stress Methods	Low stress frequency score
Never	Always	Rarely	**Always**
Rarely	Most of the time	Most of the time	**Most of the time**
Most of the time	Never	Never	**Never**

Quantitative data

All data were analysed using IBM SPSS statistics software (version 29). To assess the impact of habits on handling method, I used Spearmans' rank to correlate habit score with low stress frequency score. Using the same method, I also examined whether the number of years of working with mice was associated with stronger habits. To explore the relationship between psychological constructs, perceptions of culture of care and tunnel handling habits, non-parametric correlation analyses were conducted to test associations between Culture of Care, Habit Strength, Psychological Safety, and each of the 14 TDF domains. I did not calculate the correlation between habit strength and the behavioural regulation domain because the habit scale was mapped onto this domain. Non-parametric analyses were chosen due to the distribution of the data. Inferential analyses were not conducted because the aim was to describe in detail the extent to which the chosen factors were associated with frequency of low stress handling, rather than to determine the 'best' predictor based on purely statistical processes of modelling and inclusion/exclusion. This approach was suited to informing the process of intervention development reported in Chapter 5 because it did not atheoretically exclude potential intervention targets. Therefore, regression analyses were not conducted.

Qualitative data

Qualitative data were provided in response to free text questions about:

- Situations in which participants used each type of handling method
- Why participants used each type of handling method
- The details of participants' workplace mouse handling guidelines
- Situations in which participants used a handling method they knew they should not

Responses were analysed with descriptive thematic analysis, utilised within an overarching 'small q' approach (Braun & Clarke, 2019). Workplace guidelines were analysed using content analysis (Cole, 1988; Elo & Kyngäs, 2008). Firstly, the data were analysed by the primary researcher, who then formed a codebook. A second researcher double coded the data using the coding framework. Qualitative data analysis necessarily involves subjective interpretation, so having a second person for analysis helps to ensure that findings are reliable, reduces subjectivity and minimises bias when such issues are paradigmatic concerns, as in the (post)positivistic 'small q' approach (O'Conner & Joffe, 2020; MacPhail et al., 2016). Both researchers independently coded data and then met to discuss their individual coding. If there were any disagreements, it was discussed with a third researcher who provided their input.

3.3. Results

3.3.1. Participants

Of the 141 participants included in the final sample, 72% were women and 28% were men. The mean age of participants was 36.92 years (SD: 9.95), and the average participant had handled mice for 7.62 years (SD: 4.05). Most participants reported that they currently worked in research roles (67%), and were PhD students, Research Assistants, Research Technicians, Postdoctoral Researchers, or Principal Investigators. Technical roles included, but were not limited to, Animal Care Technicians, Named Persons, and Technical Assistants, which made up 33% of the sample.

3.3.2. Reliability

The reliability scores for the TDF domains from University B were all high except for Intentions, Optimism and Memory Attention and Decision Making (see Table 6).

Table 6: Cronbach's Alpha Scores for TDF domains for pilot and full data set following changes to survey

Domain	University B piloting Cronbach's Alpha Scores	Cronbach's Alpha Scores for Full Data Set
Memory, attention and decision making	0.471	0.168
Beliefs about consequences	0.764	0.839
Goals	0.870	0.846
Emotion	0.622	0.206
Optimism	0.521	0.541
Skills	0.676	0.724
Social influences	0.719	0.736
Beliefs about capability	0.725	0.596
Intentions	0.384	0.572
Reinforcement	0.622	0.697
Behavioural regulation	0.754	0.867
Knowledge	0.713	0.783
Social, professional role and identity	0.752	0.613
Environmental context and resources	0.927	0.814

3.3.3. Current Practices and Adoption of Handling Methods

Participants were asked how often they used tail capture, tunnel handling and other low stress methods (see Figure 3). Tunnel handling methods were the most frequent methods of handling among this sample, with 28% of participants reporting using tunnel handling all the time, and a further 60% most of the time. Combining tunnel handling and other low stress methods shows that a low stress method is widely used by participants most or all of the time, as shown in the graph in the bar labelled "low stress frequency". In contrast, only a minority of participants reported using tail handling for the majority of the time; only 1% participants always used tail handling, with a further 6% using it most of the time. Interestingly, a high proportion of participants reported using tail handling in some cases or on rare occasions, which I further explored in the qualitative analyses below.

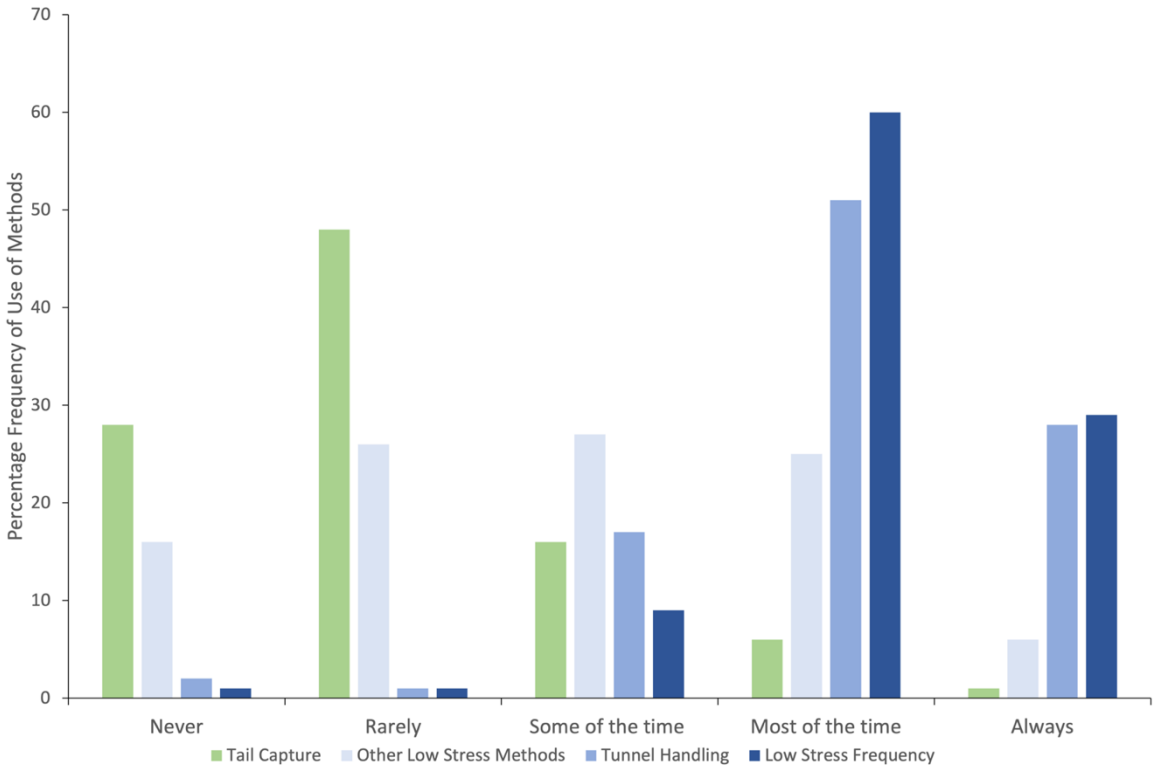

Figure 3: Frequency of use of handling methods, with combined low stress methods.

The frequency of low stress handling was not related to how often participants handle mice (Spearman's Rank correlation; $\rho(139)=.06$, $p=.50$) or the number of years of spent handling mice ($\rho(139)= -.10$, $p=.26$). Therefore, there was no evidence that the amount of time spent handling mice was associated with participants' reported frequency of low stress handling.

3.3.4. Reasons for using Handling Methods

Participants explanations for why they used different handling methods were analysed using descriptive thematic analysis, resulting in several themes (Braun & Clarke, 2006).

Reasons for Tail Handling

Problematic Mouse Behaviour

This theme described any active mouse behaviour, including jumpy mice, mice attempting to escape or having escaped, and mice described as fast. In this situation, participants justified the use of tail capture with the expressed wish to avoid any harm to the animal and minimise further risk. Participants who took this perspective considered that tail capture was the quickest and easiest method to use in such situations:

> *"When a mouse escaped onto the floor, any capture, even by the tail is done so that the mouse does not escape the animal room."*- Woman, Technical Assistant, University F, uses low stress methods most of the time.

> "*If a mouse has escaped and I need to catch it quickly or if it is too fast to cup or manoeuvre into a tunnel."*- Woman, PhD student, University E, uses low stress methods most of the time.

> *"During situations where the mice are jumpy, and it is beneficial to restrain the mice as quickly as possible to prevent escape."*- Woman, Postdoctoral researcher, University F, uses low stress methods most of the time.

The perception that tail capture was the easiest method to use in situations where the mouse was at risk suggests that the participants were not confident that low stress methods are efficient under these circumstances. Participants report using tail capture for speed and ease. This appears to also be the case where the mouse is active, but not at risk of escaping the cage:

"*If the animal is running around the cage actively avoiding tunnel capture, I will grab the tail if it is quick and easy to do so."*- Woman, Postdoctoral researcher, University C, uses low stress methods most of the time.

"If a mouse is skittish and runs through or in and out of the tunnel rapidly."- Man, Postdoctoral researcher, University C, uses low stress methods most of the time.

This suggests difficulty using low-stress methods with active mice, specifically those that do not enter the tunnel or, after doing so, run out of it again.

Time Pressure and Workload

This theme did not relate to the characteristics of the mice, but rather to beliefs about the efficiency of tail capture given the time constraints of the laboratory. Some participants who used tail capture reported the view that tail capture was an easier and faster method:

"It's easier to rapidly dart in and grab a mouse."- Woman, Postdoctoral researcher, University A, uses low stress methods most of the time.

"Quicker and easier for me to catch them." - Woman, Principal Investigator, University F, sometimes uses low stress methods.

The need to be efficient was linked by some to high workload, where both researchers and technicians reported feeling the need to work quickly:

"Quickest method of changing cages when transferring mice- usually 1-2 seconds in transferral when shifting through hundreds of mice per room in a ten-room facility."- Man, Animal Husbandry Technician, University E, sometimes uses low stress methods.

"I would be there for even more hours if I didn't."- Woman, Postdoctoral Researcher, University E, uses low stress methods most of the time.

Some participants reported the belief that quickly using tail capture was for the mouse's benefit. They explained that using tail capture would reduce stress, or prevent any risks, precisely because it is fast:

"So that the risk of the mouse escaping the animal room is minimized."- Woman, Technical Assistant, University F, uses low stress methods most of the time.

> *"If the tunnel handling is taking too long, it might cause stress to the mouse. Quickness."*- Man, PhD student, University A, uses low stress methods most of the time.

Overall, participants saw working quickly (by tail handling) as important to their productivity but also as important to minimise mouse stress. Underlying both these sets of beliefs was the premise that tail capture remains the fastest and easiest method and was the 'default method' to use when participants believe the mouse is at risk.

Reasons for using Low Stress Methods

Mouse Safety and Welfare

The majority of respondents described being motivated by mouse welfare when it came to their choice of handling methods. Many respondents linked this to mouse behaviour, and suggested that mice handled by low stress methods show fewer behaviours indicative of stress:

> *"It is much better for the mice and reduces their stress levels. There is less behaviour indicative of stress, most notably for my work is biting and escape attempts."* - Woman, Technical Assistant, University F, uses low stress methods most of the time.

> *"It is easier to capture the animal and less stressful for the animal, e.g., they never squeak during these handling methods."*- Man, Postdoctoral Researcher, University G, uses low stress methods most of the time.

> *"Low stress for the mice, calmer"*- Woman, Named Person, University E, uses low stress methods most of the time.

Participant narratives indicated that they actively attributed the calm mouse behaviour to their handling method, creating a virtuous circle in which participants were more likely to continue using low-stress methods to handle the mice.

Enforced and/or Encouraged in the Workplace

Some respondents reported using low stress methods because it is expected of them:

> *"Pragmatically, because it's mandated; but the mice are calmer this way and the data are very supportive of this being a better technique."*- Woman, Principal Investigator, University E, always uses low stress methods.

This researcher reported positive experiences of mouse behaviour and referred to the evidence base alongside their adherence to guidelines. However, some respondents' answers suggested that the guidance in their workplace was the primary reason for low-stress handling:

> *"I was taught that way and it conforms to local guidelines*."- Man, PhD student, University F, always uses low stress methods.

> *"Now [when tunnel handling]- because I have to, and before [when tail handling], because it was an effective way to capture the mice. Techniques are stress so method of capture maybe irrelevant to animal welfare if done proficiently."*- Man, Principal Investigator, University A, uses low stress methods most of the time.

This participant's response suggests that they are not fully convinced of the benefits of low stress handling and the impact of tail capture, given the impact of other stressful procedures on the mice. However, overall participant responses within this theme conveyed the importance of guidelines in determining handling method.

Scientific Data

There were a few comments relating to using tunnel handling for better quality scientific data:

> *"To minimise stress and thereby promote welfare and avoid confounding effects on my experimental data"* Woman, Principal Investigator, University F, uses low stress methods some of the time.

> *"Recommended. Evidence that there is less stress, so better data."* –Man, Principal Investigator, University B, uses low stress methods most of the time.

Given the high proportion of researchers in the sample, it was expected that data quality would be mentioned more frequently as a reason for using low stress handling.

Summary of Handling Reasons

In summary, participants reported use of tail capture in more stressful and/or risky situations, such as escapes or jumpiness. This implies a lack of confidence in employing low stress methods in these situations. Participants also reported that time pressure and workload drove the use of tail capture, with participants reporting that it was the quickest and easiest method, particularly when dealing with a high number of mice.

Participants reported that their use of low stress handling methods was largely based on beliefs about its benefits for mouse welfare and safety. Many participants reported actively observing that these methods reduced stress levels in mice, leading to calmer behaviour and making the participant more likely to continue using the method. However, others reported using it because it is the recommended practice in their place of work, indicating the influence of institutional guidance on handling practices. Only two comments were related to the data quality.

3.3.5. Factors associated with Tunnel Handling Habit Strength

Experience with Mice

Spearman's rank correlations were used to assess the relationship between participants' experience of handling mice and the strength of their tunnel handling habits. There was no significant correlation between habit strength and years of experience of handling mice ($\rho(139) = -.07$, $p = 0.41$), or frequency of handling ($\rho(139)=-.06$, $p<.52$).

Domains of the Theoretical Domains Framework

Spearman's correlation analyses were conducted to test associations between habit strength and the 13 of the 14 domains, in order to explore if any of the domains are an important influence on habit strength (Table 7). I did not calculate the correlation between habit strength and the behavioural regulation domain because the habit scale was mapped onto this domain.

Table 7 is provided to facilitate interpretation of Tables 8 and 9. Each domain has been assigned a shortened name to enhance clarity. The key table lists each domain alongside their abbreviations.

Table 7: Key Table for Interpretation of Correlation Tables

Domain	**Key**
Memory, Attention and Decision Making	MADM
Beliefs about Consequences	B-CO
Goals	GO
Emotion	EM
Skills	SK
Beliefs about Capability	B-CA
Social Influences	SI
Intentions	INT
Reinforcement	REIN
Knowledge	KNW
Social, Professional Role and Identity	SPRI
Optimism	OPT
Environmental Context and Resources	ECR
Habit	HBT
Culture of Care	COC

Table 8: Rho Values of correlations between Habit Strength and TDF Domain Scores

Variables	MADM	B-CO	GO	EM	SK	B-CA	SI	INT	REIN	KNW	SPRI	OPT	ECR	HBT
Memory, attention, decision making	1													
Beliefs about consequence	.424**	1												
Goals	.331**	.550**	1											
Emotion	.289**	.433**	.373**	1										
Skills	.290**	.295**	.190	.330**	1									
Beliefs about capability	.190*	.286**	.269**	.334**	.342**	1								
Social influences	-.008	-.007	-.067	-.208*	.165	-.223*	1							
Intentions	.434**	.560**	.457**	.426**	.265*	.351**	-.184	1						
Reinforcement	.499**	.617**	.546**	.376**	.357**	.342*	.091	.592**	1					
Knowledge	.315**	.609**	.220*	.404**	.209*	.280**	.062	.296**	.351**	1				
Social, professional role and identity	.506**	.574**	.478**	.454**	.428**	.203*	.075	.574**	.651**	.383**	1			
Optimism	.374**	.501**	.369**	.328**	.308**	.257**	.110	.422**	.406**	.349**	.560**	1		
Environmental context and resources	.325**	.283**	.187*	.160	.348**	.194*	-.007	.297**	.422**	.252*	.302**	.127	1	
Habit	.493**	.578**	.405**	.301**	.231*	.390**	-.094	.434**	.434**	.305**	.550**	.414**	.287**	1

**Correlation is significant at the 0.01 level (2-tailed). *Correlation is significant at the 0.05 level (2 tailed)

These correlations show that the affective domains (Beliefs about Consequences, Beliefs about Capability, Emotions, Goals and Optimism) are strongly associated with Habit Strength. This suggests that emotions are strongly associated with how tunnel handling habits are formed. Furthermore, the strong significant associations with the environmental domains (Environmental Context and Resources and Reinforcement) suggest that the workplace environment and feedback systems also play a role in developing stronger habits.

Culture of Care

To explore the relationships between Culture of Care and low stress handling practices, I correlated the mean Culture of Care score with mean habit strength as well as with frequency of low stress handling. Culture of Care was positively correlated with habit strength ($\rho(139)=.21$, $p=.013$) (see Figure 4), and frequency of low stress handling ($\rho(139)=.28$, $p=.002$). Perhaps not surprisingly, the Culture of Care score was strongly positively associated with that for psychological safety ($\rho(139)= .81$, $p<.001$) (see Figure 5). Psychological safety positively correlated with frequency of low stress handling ($\rho(139)= .192$, $p=.02$), but did not correlate with habit strength ($\rho(139)= .06$, $p=.510$)

Spearman's Rank correlational analysis was used to examine the association between Culture of Care and participant scores on the 14 domains of the Theoretical Domains Framework (TDF) (see Table 3). The aim was to identify the factors within the TDF associated with perception of a positive Culture of Care in the context of a laboratory animal welfare setting.

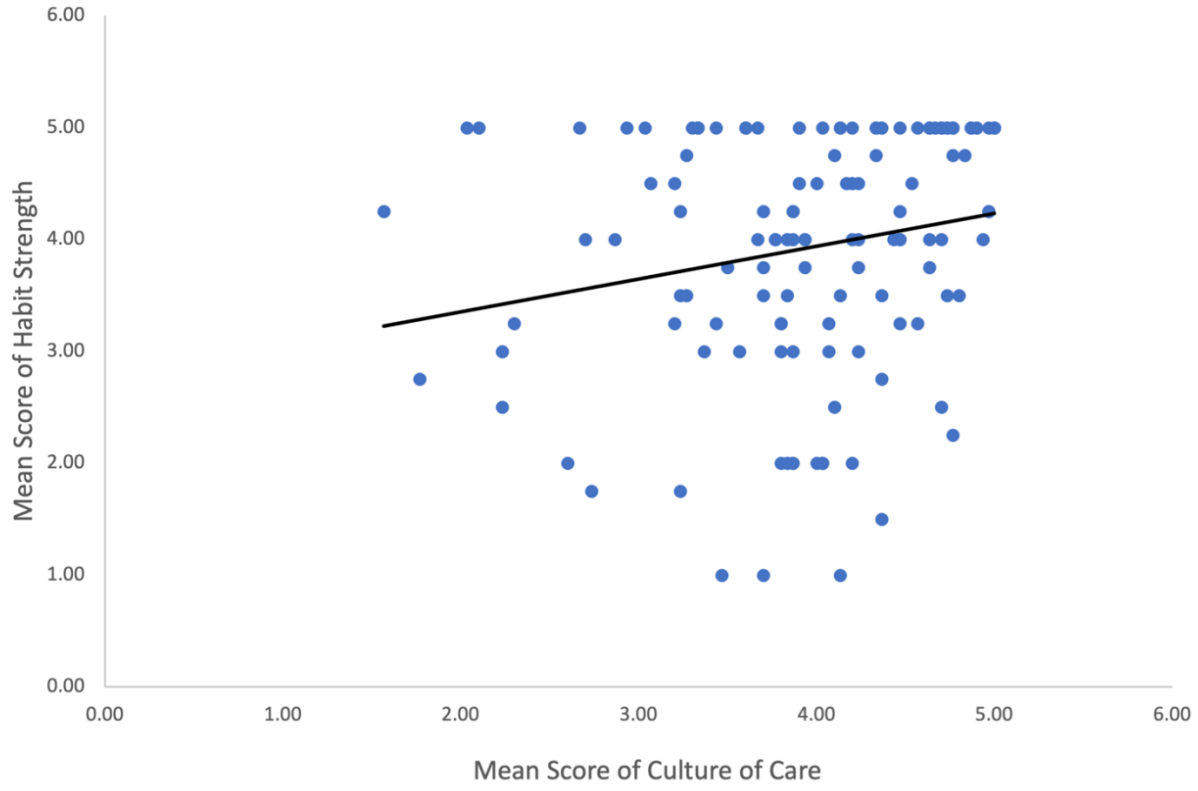

Figure 4: Scatterplot displaying correlation between Culture of Care and Habit Strength

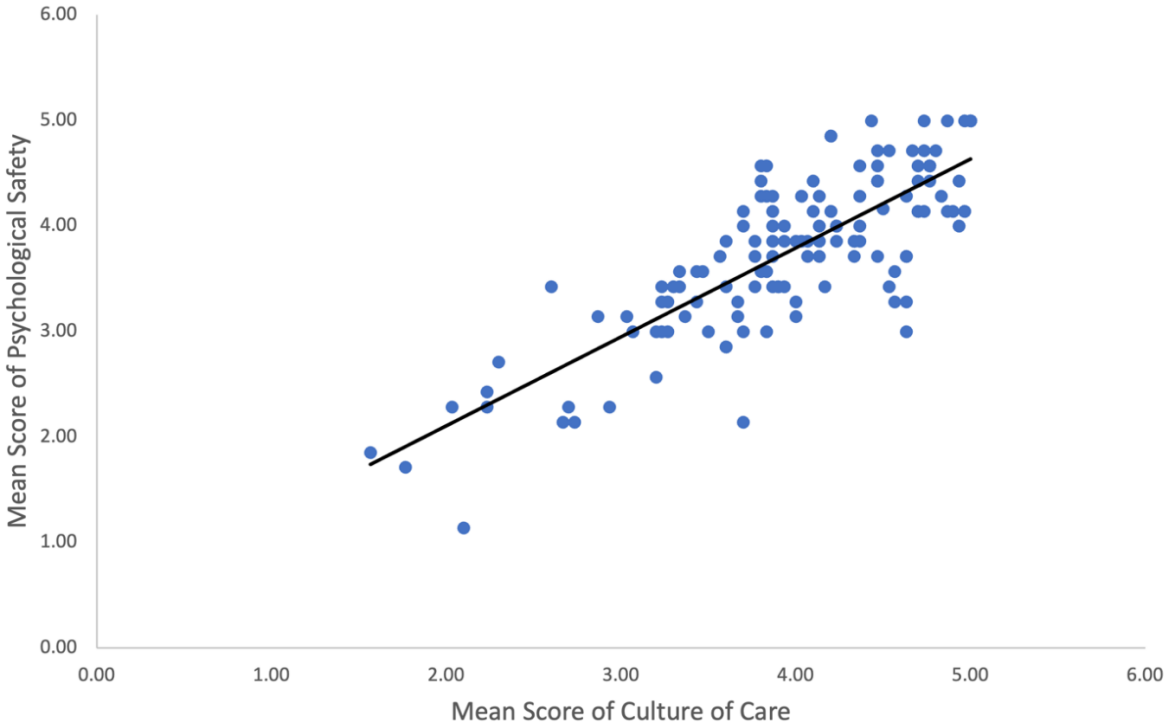

Figure 5: Scatterplot displaying correlation between Culture of Care and Psychological Safety

Table 9: Rho Values of correlations between Culture of Care and TDF Domain Scores

Variables	MADM	B-CO	GO	EM	SK	B-CA	SI	INT	REIN	BR	KNO	SPRI	OPT	ECR	COC
Memory, attention, decision making	1														
Beliefs about consequence	.424**	1													
Goals	.331**	.550**	1												
Emotion	.289**	.433**	.373**	1											
Skills	.290**	.295**	.190	.330**	1										
Beliefs about capability	.190*	.286**	.269**	.334**	.342**	1									
Social influences	-.008	-.007	-.067	-.208*	.165	-.223*	1								
Intentions	.434**	.560**	.457**	.426**	.265*	.351**	-.184	1							
Reinforcement	.499**	.617**	.546**	.376**	.357**	.342**	.091	.592**	1						
Behavioural regulation	.517**	.605**	.421**	.299**	.202	.352**	-.046	.411**	.351**	1					
Knowledge	.315**	.609**	.220*	.404**	.209*	.280**	.062	.296**	.370**	.370**	1				
Social, professional role and identity	.506**	.574**	.478**	.454**	.428**	.203*	.075	.574**	.651**	.583**	.383**	1			
Optimism	.374**	.501**	.369**	.328**	.308**	.257**	.110	.422**	.406**	.435**	.349**	.560**	1		
Environmental context and resources	.325**	.283**	.187*	.160	.348**	.194*	-.007	.297**	.422**	.271**	.252*	.302**	.127	1	
Culture of care	.287**	.254**	.147	.154	.437**	.270**	.097	.275**	.391**	.213*	.247*	.245**	.171*	.754**	1

** Correlation is significant at the 0.01 level (2-tailed). * Correlation is significant at the 0.05 level (2 tailed)

The significant correlations indicate that Culture of Care is associated with high cognitive capacity to enact tunnel handling, as indicated by the significant correlations with the domains Behaviour Regulation, Intentions, Knowledge, Skills, and Memory, Attention and Decision Making. In addition, Culture of Care appears to be linked with environmental factors, as evidenced by the strong correlation with Reinforcement, and Environmental Context and Resources domain. It does not appear be associated with Social Influences, which could suggest that individuals may act in the best interest of their role, rather than their peers.

3.3.6. Interpretation of Workplace Guidance on Handling Methods

Among the seven institutions that participated and at the time of the survey, three did not have formal guidelines on mouse handling (University D, F and G), three did have formal guidelines (University B, C and E), and there was no response from one university regarding the existence of such guidelines (University A), despite requests for clarification. See Table 10 for a summary of the university's guidelines and participant numbers.

Table 10: Summary of University Policy and Participant Numbers

University	Guidelines	Number of Participant
A	No response regarding guidelines	3
B	Has formal written guidelines, and training in low stress handling methods.	23
C	Has formal written guidelines, and training in low stress handling methods.	14
D	No formal guidelines, but training involves using low stress handling methods.	6
E	Has formal written guidelines, and training in low stress handling methods.	37
F	No formal guidelines, but training involves using low stress methods.	49
G	No formal guidelines, but training involves using low stress methods.	9

Content analysis (Cole, 1988; Elo & Kyngäs, 2008) was used to examine the variation in participants' understanding of their workplaces' stance on handling. Although three of the universities do not have formalised, written guidelines, participants from these

institutions referred to training when asked to describe their workplace guidelines. For example, a participant from University D answered "yes" to the question enquiring if there were workplace guidelines, and when asked to describe, they responded:

> *"Training involves the use of handling tunnels and is strongly encouraged for all users and staff."*- Woman, Manager, University D, uses low stress methods most of the time.

This comment implies that training was regarded as a workplace guideline. However, the use of the words "strongly encouraged" suggests that tunnel handling was not mandatory. The perception of training being a workplace guideline was also present in responses from participants who worked at University F, where the participants perceived there to be workplace guidelines. They described them in the following way:

> *"During PIL teaching and training, we have been shown different handling videos including tail, tunnel and cupping."*- Man, Research Assistant, University F, always uses low stress methods.

> *"Low stress handling methods are taught to incoming staff and students and encouraged to be used by all mouse handlers."*- Woman, PhD researcher, University F, uses low stress methods most of the time.

While formal guidelines may not be in place, participants' emphasis on training, in particular the strong encouragement to use low stress methods, indicates their perception of an informal, yet significant, set of behavioural expectations.

However, even in institutions where there are written, formal guidelines, there was still variation in the interpretation of the extent to which respondents should follow specific methods. For example, in University A where there are written formal guidelines participants described them as follows:

> *"Low stress methods are strongly preferred."*- Woman, PhD researcher, University A, uses low stress methods most of the time.

> *"I think there are guidelines for me to follow."*- Woman, PhD researcher, University A, sometimes uses low stress methods.

However, other participants from University A provided a more accurate description of the policy:

> *"Low stress handling methods to be used unless animal has escaped/ it is an emergency or there is a scientific justification for using tail capture."*- Woman, Senior Animal Care Technician, University A, uses low stress methods most of the time.

The previous participant's use of the term "strongly preferred" suggests that a low stress method is not mandated. In University C, where there are also formal guidelines, another participant interpreted guidance as encouragement:

> *"Tail capture is frowned upon, everyone is encouraged to use cupping or tube handling to move mice."*- Woman, Technical Assistant, University C, uses low stress methods most of the time.

Participants were also asked if they sometimes use a handling method that they know they should not. People responded "yes", regardless of if there were formal guidelines in place. Respondents from Universities D and F, who *do not* have formal guidelines, responded "yes" to this question, i.e., there appeared to be an expectation of low stress handling methods in these universities that individuals perceived themselves to occasionally violate. Overall, 20% of participants reported using a handling method that they knew they should not. I conducted descriptive thematic analysis of the content of responses to this question, and my interpretation resulted in the following themes:

Mouse Safety and Welfare

Participants reported being concerned that their techniques of using low stress methods may induce further stress in some circumstances:

> *"Tunnel method should be used, but chasing the mouse with the tunnel also induces stress, and arguably more stress than gently picking up a mouse by the base of its tail and placing it on your hand/arm."*- Man, Postdoctoral Researcher, University F, rarely uses low stress methods.

> *"It's very rare, but if I feel the mouse is getting more stress by trying to get it into a tunnel, I will cup. And if I'm not successful I will use tail but make sure feet are placed on a structure very quickly to reduce stress- e.g., tunnel or igloo."*- Woman, Postdoctoral Researcher, University F, uses low stress methods most of the time.

These comments may highlight a need for more training in using low stress methods to develop skill and techniques, to ensure that mice are not chased with a tunnel or becoming stressed by low stress handling methods. Whilst these comments came from a university where there were no formal guidelines, a participant from University C, where guidelines exist, reported using tail handling in response to similar difficulties:

> *"I move by the tail when the mice are not getting in the tunnel despite continuous efforts."*- Woman, PhD student, University C, uses low stress methods most of the time.

Time Pressure and Workload

Participants whose responses contributed to this theme reported having to act quickly due to heavy workloads or situations where the mice may be at risk. Participants described tail capture as occasionally preferable when they felt they needed to work or act quickly:

> *"When I am pressed for time, and I quickly have to weigh one I might lift it by the tail."*- Man, Postdoctoral researcher, University E, uses low stress methods most of the time.

> *"If I have a lot of mice to cull and I have a huge experimental day in the lab."*- Woman, Principal Investigator, University F, sometimes uses low stress methods.

> *"Time constraints"*- Man, Technical Assistant, University C, uses low stress methods most of the time.

As indicated above, participants from institutions where guidelines did, and did not, exist reported using tail capture in these circumstances.

Problematic Mouse Behaviour

Participants also described some mouse behaviours that they found incompatible with low stress handling, where they found it appropriate or necessary to use tail capture.

> *"Some strains of mice I use are particularly jumpy from the moment we open the cage lid. In these cases, it seems more appropriate to capture the mice quickly using the tail to prevent mice jumping from the cage."*- Woman, Postdoctoral Researcher, University F, uses low stress methods most of the time.

> *"If a very difficult mouse refuses to get into a tube, I have had to revert to tail handling to remove it from its cage. This is rare, however."*- Woman, Postdoctoral Researcher, University E, uses low stress methods most of the time.

These quotes suggest that the researchers primarily use low stress methods, but resort to tail capture when they feel it is necessary due to specific mouse behaviours.

3.4. Discussion

These findings shed light on the current adoption of mouse handling methods, with survey participants from seven UK universities reporting that they predominantly use low stress handling methods, albeit with a significant proportion not using it all the time. Intriguingly, a fifth of the participants reported that they use tail capture when they know they should not, and their responses provided insights on the situations in which this occurs. One possible cause was the variability in understanding of workplace guidelines, both within and between facilities. Habit strength also varied, and positively correlated with perceptions of a Culture of Care. Culture of Care also correlated with the frequency of low stress handling. This study is, to date, the first to find a measure of welfare to correlate with Culture of Care. Additionally, many domains of the TDF correlated with habits and with Culture of Care. I will discuss these findings in turn.

The participants in this study predominantly use low stress methods, indicating a shift towards increased use compared to the findings of previous studies. Henderson et al. (2020) conducted an international survey on the barriers to tunnel handling, but their data from the UK is identifiable and can be compared directly to the data in this study. The proportion of participants reporting that they only use tail capture is lower in my study: 13% of the sample in Henderson's study used tail capture exclusively, compared to only 1% in this study. Young et al. (2023) also collected data from an international sample of 261 people, but their UK data cannot be extracted and compared. Nevertheless, their results indicate that 37% of participants exclusively use tail capture, compared to 10% only using low stress methods. These comparisons suggest a shift in the UK towards more refined handling methods, with increased awareness and adoption. A possible reason for this shift could be the universities involved in this study, with a higher proportion of guidelines in place. The results from this study may not reflect such a change in UK handling practices if the universities did not have formal guidelines in place. The increased adoption, however, may not be reflected internationally, where laws, regulations and cultural practices vary.

A significant proportion of the sample in this study indicated that they do not always use low stress methods, and occasionally resort to methods they know they should avoid. The qualitative responses provided deeper insights into the reasons for this. A common reason was when mice are at risk of escaping or have escaped; the participants believe that tail capture is the quickest and safest way to recapture the mice. This aligns with previous findings, where individuals reported difficulties using low stress methods with jumpy mice, although the specific challenges were unclear (Henderson et al., 2020). Another reason for not always using tunnel handling is concerns about the time it takes, with a belief that tail capture is quicker. This concern was also evident in the data by Henderson et al. (2020) and Young et al. (2023). The findings indicate that the barriers to adopting low stress handling methods identified in recent years are still prevalent and must be addressed.

Examining how workplace guidelines are interpreted by individuals working with mice provides a novel perspective on the application of handling methods, which is an area that has not been previously explored. My results suggest that there is strong variation within and between institution in peoples' perceptions of workplace guidelines. Moreover, even without formal policies, participants highlighted the significance of training on their use of low stress handling. This indicated a strong internalised perception of preferred handling practices. Training can be viewed as a technique aimed to evoke a specific set of unspoken, mutual attitudes and behaviours (Mathew & Zacharias, 2016; Sparrow, 1998), and in this context, it appears that low stress handling training can indeed be used to communicate the expected standard of behaviour, without written formal policies. However, it seems likely that formalising workplace guidelines could further enhance rule following: written workplace rules achieve more rule following than unwritten workplace rules, suggesting that formal structure is a powerful determinant of behaviour (Borry et el., 2018). How training and guidelines are interpreted and set expectations would be interesting areas for future research. Qualitative responses suggested that the workplace guidelines can be a strong facilitator of changes of how mice are handled, in addition to handling training. This is a new finding, as to date, no other literature has explored which institutions the participants are taking part from, in addition to considering what their workplace guidelines is and how they are perceived. Therefore, the results highlight the

need for consistency in sharing the workplace guidelines to reduce variability in behaviour, but also, increase the people's understanding of guidelines. However, in the healthcare literature, the examination of workplace guidelines has been conducted to explore compliance to guidance to avoid risks of infections. For example, McGaw et al. (2012) found that healthcare workers were selective in the practices they adhered to despite knowledge of policies. Only 17% of the sample complied with all aspects of the infection control policies, highlighting that even when formal guidelines are in place, adherence can be selective and inconsistent, which was also evident in this study. The examination of workplace guidelines could be applied to other areas in animal welfare, to explore knowledge and how it relates to compliance. The survey results also highlight the complex interplay between knowledge of handling guidelines and handling behaviour. Despite guidelines and training, participants report occasionally straying from recommended practices, providing reasons that focussed on concerns about mouse safety, time pressure, workload, and challenging mouse behaviour. This highlights that implementation of practices is not only at organisational level, but also individual, and exploratory work is necessary to examine the individual-level implementation issues.

Another organisational factor that was studied for the first time in a refinement context was Culture of Care. The results found a strong association between Culture of Care and psychological safety. This could suggest that a positive Culture of Care and high psychological safety can create an environment where staff feel comfortable sharing their concerns and suggestions, without fear of consequences (Edmondson, 2018; Morrison, 2014), which in this context, could be around animal handling practices. When people feel psychologically safe, they are more likely to suggest new practices, without fear of negative consequences (Bernards et al., 2023; Morrison, 2014). Additionally, Culture of Care was strongly associated with tunnel handling habit strength. This could indicate that when a positive Culture of Care is present, staff may receive regular feedback and recognition for using the preferred methods like tunnel handling (Robinson et al., 2022). This positive reinforcement helps to solidify these practices as habits, making them more likely to be repeated (Dezfouli & Balleine, 2012; Lally & Gardner, 2013). However, the strong correlation may also be due to the questions in the Culture of Care barometer that was used, some of which related to feeling able to ask for help when needed and feeling

valued, which are important facets of psychological safety. The findings and literature suggest that a supportive Culture of Care enhances psychological safety, allowing staff to practice and refine their handling technique without fear of judgement or reprimand. This safe environment encourages experimentation and repetition, which are key components in habit formation (Carden & Wood, 2018; Lally et al., 2010).

Many of the TDF domains correlated highly with both Culture of Care and tunnel handling habit strength. This emphasises the multifaceted nature of handling behaviour, and the factors which may affect them. The findings indicate that a good culture can lead to many positive outcomes and attitudes towards refinements, which aligns with previous literature which discuss the expectation that Culture of Care is likely to improve animal welfare outcomes (Combes & Balls, 2014; Hawkins, 2013; Lilley & Hawkins, 2014; Smith & Lilley, 2019). Based upon this literature, I expected to find a strong positive correlation of tunnel handling habit strength and Culture of Care. To date, there are no animal welfare literature that assess this link. However, in the healthcare field there is a plethora of literature which displays the link between positive culture and improved health outcomes for patients. In a healthcare setting, Dawson et al. (2011) found a strong relationship between staff satisfaction and commitment and patient satisfaction. The more positive staff were about their working conditions, the more positive patients were about their care. This may also translate into laboratory settings, related to animal care. LaFollette et al. (2020) found that laboratory personnel who reported to have higher burnout provided less frequent and less diverse enrichment to their laboratory animals. The findings from both Dawson (2011) and LaFollette et al. (2020) display the link between staff well-being and the quality of care provided in both healthcare and laboratory settings.

In terms of the TDF domains, the results provided evidence of the affective and cognitive factors that are associated with stronger habits of tunnel handling. For example, there were strong correlations between the Knowledge domain and tunnel handling habit strength, suggesting that knowledge of the benefits of methods is associated with stronger habits which can highlight the importance of training to inform skills and benefits of techniques. However, it is important to note that education and knowledge alone is not sufficient for behaviour change (Arlinghaus & Johnston, 2018). Reinforcement is also

important for habit formation (Dezfouli & Balleine, 2012; Lally & Gardner, 2013), which may also explain why the Reinforcement domain correlated with both habit strength, and Culture of Care. Moreover, the Beliefs about Capability domain significantly correlated with both habits and Culture of Care, suggesting that a positive culture can lead to individuals feeling more confident in their capabilities, which supports stronger habits.

Although an online study provides anonymity, and the ability to involve participants from several university laboratories in the UK, there are limitations associated with using a survey method. Surveys can be affected by common method bias, which can occur when both the independent and dependant variables are measured using the same method (Kock et al., 2021). In this survey study, the participants were asked to complete several rating scales, increasing the potential for common method bias. This risk arises because participants may start to answer questions in patterns, either consciously or unconsciously, rather than providing thoughtful responses (Podsakoff et al., 2024). However, to reduce this risk, reverse-coded questions were included, encouraging participants to engage more thoughtfully in their answers.

Due to the nature of the topic, the results may also be impacted by social desirability bias (Meagher, 2009). Participants may be reluctant to disclose if they use tail capture, or how often they use it, due to low stress methods being the more socially acceptable methods of handling mice. Therefore, there may be under-reporting of tail capture. Self-report data has the potential for subjective biases to occur, or misunderstandings to take place, or inaccuracies in reflection (Paulhus & Vazire, 2007), and this was reflected in places in my own data. For example, one qualitative comment suggested that the question referred to “tail handling” rather than “tail capture”, suggesting misinterpretation despite the provision of definitions. Another limitation is the self-selecting nature of the study. The people who took part may already have strong views about mouse handling and wish to share them or avoid taking part in the study altogether. This could mean the views expressed in the survey are not representative of the wider population, and there may be biases in who engaged with the study. Therefore, the reported tail capture may be underreported. It should also be acknowledged that one limitation of survey methods is that participants may experience survey fatigue (Jeong et al., 2023; Roberts & Allen,

2015), leading to a reluctance to provide detailed responses to qualitative questions. The cognitive load associated with the requirement for more in-depth information in qualitative questions may lead to participants providing only minimal details. Finally, my work highlighted the need for a specific tool to measure Culture of Care in the context of laboratory animal welfare, as the tool in this study had adapted one from the healthcare field and may not have been the most accurate measure for laboratory Culture of Care.

This study makes a valuable contribution to the animal welfare literature by identifying factors that could increase the adoption of welfare refinements. This study has found evidence that a provision of training actively promotes welfare-oriented handling practices can create an implied guideline in the workplace. While Henderson et al. (2020) and Young et al. (2023) identified barriers to tunnel handling, such as lack of time or difficulties with mice, they did not explore the factors that might support uptake at individual or organisational levels, such as workplace guidelines. My study highlighted that despite a high level of motivation and commitment to mouse welfare among individuals, they often feel unable to consistently implement low stress handling methods. My results suggested that when a specific welfare refinement is not widely adopted, animal facilities might benefit from exploring a number of options or interventions, including:

- Improving staff perceptions of their Culture of Care.
- Implement training and guidelines for all, ensuring they are well communicated to maintain consistency in handling practices.
- Examining if training covers all scenarios.

This work has demonstrated the importance of recognising formal policies as well as the impact of training in the workplace. It provided further depth by examining the interpretation of workplace guidelines, and ways that this may influence behaviour, which is added context that Henderson et al. (2020) and Young et al. (2023) did not report. However, from this work I concluded that mouse behaviour is a common barrier to full time low stress handling method adoption, supported by previous literature. Further research is necessary to explore why low stress methods are not deemed feasible in situations where mice are at risk of escaping or have escaped.

Chapter 4. Examining Behaviour Change Challenges: An Interview Study

Abstract

Low stress handling methods enhance the welfare of laboratory mice, but there are a range of barriers influencing the consistent adoption of these methods across research institutions. One of these is 'challenging mouse behaviour', indicating a lack of knowledge of applying low stress handling methods under specific circumstances, or being concerned that their application would cause potential harm to a mouse. To date, there are no interview studies exploring barriers to tunnel handling in such depth from the perspectives of those who work with mice daily in an animal care capacity, and sharing the challenges that they face. In addition, there are no studies comparing the variation in individual perception of workplace guidelines and how these link to animal handling. Therefore, this study highlighted where adjustments to protocols should be made to ensure consistency, leading to better welfare.

In a follow-up to my survey (Chapter 3), this interview study aimed to explore the barriers in more detail and understand the practical challenges from the perspective of those who work in animal care roles, due to their role in training researchers and frequent contact with the laboratory mice. The interviews were also structured to explore how participants perceived their workplace guidelines and training, and the impact this had on how they handled mice. I used a semi-structured interview method with key laboratory technical personnel from a university animal research facility. Nine participants were volunteers and were invited to take part based on their role and experiences in relation to mouse handling. Interviews were conducted using a phenomenological approach, which enabled participants to discuss their lived experiences, opinions and reflections.

The interviews revealed more context to the barriers identified in my survey. Participants discussed their personal experiences of situations such as mice escaping, a commonly reported situation whereby people struggle to use low stress handling. Moreover,

participants shared their understanding of the workplace guidelines and their exposure to them. Understanding was inconsistent across the participants, despite them being employed by the same university. Participants also revealed their personal experiences of barriers to low stress handling (for example, the lack of openness when the approach was first introduced), and shared common misconceptions. Participants shared what they believed should be included in an intervention designed to increase the adoption of low stress handling. The study findings indicated a need for more training on low stress handling in specific situations, and in particular, in the event of a mouse escaping. This appeared to be a current training gap in this animal research facility. Training would enable handlers to feel confident and able to use low stress handling during high-risk situations, whilst reducing the anxiety and stress associated with handling for the mice. The findings from this study informed intervention strategies and training that could be deployed in this and other research facilities, as the experiences shared by the technicians are likely to be relevant in other facilities.

4.1. Introduction

How laboratory mice are handled is important for their wellbeing and welfare. Lifting mice by the tail can induce stress and anxiety, and reduce social interaction (Gouveia & Hurst, 2017; Gouveia & Hurst, 2013; Hurst & West, 2010). However, despite the extensive literature supporting the use of low stress methods to handle mice to improve mouse welfare (Clarkson et al., 2018; Hurst & West, 2010), barriers remain.

My survey (as reported in Chapter 3) indicated that the awareness of tunnel handling has increased, especially among the UK research community since the publication of an earlier international survey (Henderson et al., 2020; see Chapter 3). However, several of my key survey findings raised questions requiring a more in-depth exploration through qualitative interviews. One area requiring such clarification was the reported difficulty in using low stress methods when a mouse escapes or might escape. Participants reported their belief it is not possible to use tunnel handling for escapes, which suggests a lack of knowledge applying the technique in this scenario. Moreover, participants reported that it is easier to use tail capture as it does not require the use of any equipment, and there is often no time to get a tunnel as it is important to act quickly. However, some low stress techniques, such as cupping, do not require equipment, so this cannot be the full reason. This contradiction needed further exploration to understand the underlying factors influencing the choice of handling methods in certain situations, such as an escape or when a mouse is very jumpy.

The survey uncovered inconsistencies in how different participants understood the guidelines that exist in their animal research facilities. However, in a quantitative survey question it is difficult for participants to provide detailed insights, and interviews provide a good opportunity to probe what the guidelines are, how often participants are exposed to them and how they understand them. The interviews not only provided the opportunity to clarify participants' understanding, but also potential challenges they face in adhering to them which could lead to inconsistent application of low stress methods.

An extensive exploration of barriers and facilitators is a crucial first step in intervention development (Araújo-Soares et al., 2018; Bartholomew et al., 2015; Michie et al., 2014), in order to inform the intervention design, maximise the effectiveness and enhance the acceptability and feasibility. To date, there are no existing studies exploring barriers and facilitators technicians face in implementing low stress methods in different contexts, in addition to discussing their understanding of workplace guidelines. Workplace guidelines can play a crucial role as a facilitator in implementing low stress handling methods. Clear and consistent communication of workplace guidelines can reinforce the expected standard of behaviour (Killingsworth, 2012; Williams et al., 2023), which may lead to more consistent behaviours.

Moreover, psychological safety was found to be linked with Culture of Care in Chapter 3, potentially serving as a facilitator of behaviour change. According to Carmeli et al. (2009), high-quality relationships in the workplace are associated with psychological safety and contribute to an environment conducive to learning and innovation. Therefore, understanding perceptions of psychological safety may provide insights into how handling behaviours can be learned and adopted by colleagues, reflecting the Culture of Care. The survey study indicated that a positive Culture of Care is associated with strong tunnel handling habits. Therefore, it is important to explore factors that enhance a good Culture of Care, such as psychological safety.

This study provided insights into how contextual factors, such as the organisational culture, workplace guidelines, and communication channels shape the implementation of handling methods in research facilities, leading to potential inconsistencies in adoption. This contextual understanding was crucial for tailoring the intervention to meet the needs of the target audience. This study used a qualitative semi-structured interview method and a phenomenological approach to understand participant's reflections and allow them to share their experiences in depth (Eatough & Smith, 2017). Phenomenology is a qualitative approach that is used to explore and understand how individuals make sense of a lived experience, whether it be an event, process or relationship (Smith & Osborne, 2003).

This study focused on the lived experience of technicians, as they often have extensive expertise and experience handling laboratory mice due to their frequent day-to-day interactions. Interventions based on the experiences of technicians are contextually relevant and tailored specifically to the challenges faced in laboratory settings. Their insights into mouse behaviour and handling techniques provided valuable perspectives for understanding the barriers with implementing tunnel handling. In addition, depending on the facility and training structures, technicians play a pivotal role in training research personnel on mouse handling techniques and procedures. By targeting technicians, the study addressed knowledge gaps, misconceptions and training needs that affect the consistent adoption of tunnel handling in all circumstances. By empowering and educating technicians with skills and knowledge, they can train the researchers with the same practices. This could then facilitate the widespread adoption of tunnel handling, and in turn, create better welfare standards for mice in laboratories. Due to the nature of the topic, it was important to take a participant-oriented approach which allowed participants to express themselves freely (Alase, 2017). The insights from this study helped to create an intervention based on the findings of technicians who handle mice on a regular basis, who understand and experience the real-life barriers that handlers face. In addition, the intervention could be more widely applicable to researchers. Ultimately, the outcomes of this interview study highlight the gap between knowledge and practice.

4.2. Method

4.2.1. Participants

Participants were recruited through convenience sampling. The study was advertised via email mailing lists, and adverts posted in newsletters from one university in the North of England. There were nine participants, six women and three men, with varying levels of seniority: two Veterinary Surgeons, two Named Training and Competency Officers (NTCO), two Specialised Technicians, one Senior Technician, one Animal Care Technician, and one Named Animal Care and Welfare Officer (NACWO). The unit can be described as medium sized, with written policies for using low stress handling methods. Recruitment ended once data saturation was reached (Francis et al., 2010). In order to take part, participants needed to be in a role where they handle mice in a technical capacity. They were informed that the purpose of this study was to gain further insights from individuals in technical roles, following a survey study that explored barriers to the full-time adoption of low stress methods to handle mice. This qualitative approach was selected to reduce the risk of social desirability bias if discussed in a public group setting such as a focus group. However, it must be noted that the risk of social desirability bias cannot be fully eliminated due to the sensitive nature of the topic. This study received ethical approval from Newcastle University Faculty of Medical Sciences' Ethics Committee (Ref: 30201/2022).

4.2.2. Design

This semi-structured interview study took a phenomenological approach, allowing participants to describe and reflect on their lived experiences (Smith & Osborn, 2003).

4.2.3. Materials

An interview guide (see Appendix D) was developed to enable consistency and focus, gather relevant information and explore specific areas of interest (Rubin & Rubin, 2011).

A semi-structured approach was selected to allow some flexibility to adapt questions or probe based on participant's responses or emerging themes.

The interview guide was developed based on the insights gained from my survey (Chapter 3). The guide included questions regarding the participant's job roles, and their historical and use of different handling methods throughout their careers. Participants were asked to elaborate on the circumstances in which they use tail capture, if they did. Subsequently, they were asked about their perspectives on implementing tunnel handling during escape scenarios and whether they perceive any potential stress induced by repeated attempts of tunnel handling. Additionally, questions delved into each participant's understanding and perceptions of workplace guidelines, training protocols and available support.

Interviews were transcribed using Otter Ai after recording them on the OtterAi phone application (Version 3). The three interviews that were conducted via Zoom were transcribed using Zoom transcription.

4.2.4. Procedure

Six interviews were conducted in person, in the unit where the participant worked. They were conducted in private meeting rooms, where they could speak freely. Three interviews were completed on Zoom, for the convenience of these participants. First, they were given information sheets and were asked to sign a consent form (see Appendix E for ethical documents). I explained the objective of the interviews, and all participants consented to the interviews being recorded for the purpose of transcription and analysis. They were assured that no one beyond the supervisory team would have access to the transcripts, and that the data of all participants would be anonymised. Once consent was given, the interview began. All interviews lasted between 45 minutes to an hour. Participants received a £15 gift voucher to thank them for their time.

4.2.5. Data Analysis

The data was analysed using descriptive thematic analysis (Braun & Clarke, 2006) on NVivo (Version 24) to generate initial themes. In order to increase validity, the data was analysed with another analyst (Richards & Hemphill, 2018; Roberts et al., 2019). We began by familiarising ourselves with the data by reading each transcript multiple times. We then analysed two transcripts together, by discussing codes and forming an agreed codebook.

4.3. Results

4.3.1. Theme 1: Barriers to Low Stress Handling

This theme encapsulates the barriers that participants faced when changing to, or using, low-stress handling. This includes perceptions around lack of openness and knowledge, misconceptions, habits and large workloads.

Lack of Openness for Low Stress Handling

Most participants reported that they immediately were not open to the idea of changing to low stress handling or had experienced the attitude of others who were not open. There were a few reasons for this. For example, the perception that it would take much longer, an expectation that was experienced by all participants, which is not ideal for those with heavier workloads:

> *"I remember while being at [redacted], I first talked about the research with low stress handling, and I went 'it will slow me down. I can't do it, it will slow me down, we're in quite a high-pressured environment.' You know, there was a lot of commercial work happening and things like that. So that was my blocker, initially."*- Participant 4, Specialised Technician

> *"Because a lot of the technicians originally said, 'well it's going to take us more time for us to do our tasks.' The same excuses that I'd given, back when I was originally going, 'but we've always done it this way. So why would we do it any differently?'"*- Participant 8, Senior Technician

However, participants reported that they believe that those who had a long career of using tail handling were not open to change. This could be due to habits developed over a long career, and encounters they had experienced:

> *"And also, because most of the people, they don't like change. And after so many years of doing something. We probably have some technicians, as well, at the beginning that have 20, 30, 40 years of doing the same handling."*- Participant 1, NTCO

> *"Like sometimes the researchers will have the thing of 'I've done this for 10 years, who are you to tell me that I shouldn't do it this way?'"*- Participant 5, Specialised Technician

However, the participants have had second-hand experienced others who simply do not want to change their behaviour, and acknowledged this can be rare:

> *"I've heard of rare circumstances where people just continuously do it their own way and they refuse to shift. But again, I think that's quite rare. I think that's very person dependent as well. That might be a problem with the individual's overall attitude to working with animals and stuff, rather than actually, like, the training or the actual technique."*- Participant 3, Veterinary Surgeon

> *"The older ones are hard to train, they've had the training and everything and it's sometimes more difficult for them to engage, basically*."- Participant 2, Veterinary Surgeon

This can impact those who are in supporting roles:

> *"But yeah, you will always get stubborn people who are just like, well, and they're the most frustrating, because if you get somebody that can't do it and needs extra help, then it's fine. Like you can work with that. But if you get people that are just unwilling to do it, but do it when they're with you? It means they know how to do it. They're just choosing not to."*- Participant 5, Specialised Technician

Despite the benefits of low stress handling techniques, it is evident that participants perceived other people to cling to the traditional tail handling practices that were used for so many years and were established working habits. These quotes revealed the perception of some resistance to change, driven by the assumption that low stress methods would be time-consuming.

Misconceptions

A common misconception that appeared in data from Chapter 3, in research from Young et al. (2023), and in the interviews is the perception that people believe the tail cannot be touched at all when using low stress methods. There is also confusion between tail capture and tail restraint:

> *"And I know a lot of people, when I'm training them, they worry because we'll talk about how we use tunnel handling and how we don't do that [tail capture] anymore. When I say it's absolutely fine to hold on to the tail to support other things, people always say 'oh, I did worry about that, that I couldn't use the tail at all.' So, maybe it is a thing that people worry about."*- Participant 4, Specialised Technician

> *"It's just figuring out what terminology to use, because I think as soon as you mention the tail people go, 'oh, I'm not allowed to do anything with that', when actually, if we could find a different way to explain it, it might make it easier for people to see the difference between the two."*- Participant 8, NTCO

Moreover, there was a lack of consistency in how people describe "tail capture" and "tail restraint". Interestingly, one participant contradicted themselves in during the interview, while describing their own perceptions of what "handling" and "capture" is:

> *"I think that probably is because you know, a lot of people say capture and handling. If you say if the mouse is running past you, and you hold its tail and then pick it up. I would say that that is capture."*- Participant 6, NACWO

> *"Yeah, it is terminology, really. It's just what people will call it you know. In my eyes, and the way that I've been working and things for years, is if you're picking up that animal by the tail that's handling. That's handling by the tail. That's not capture."*- Participant 6, NACWO

Despite information available on the NC3Rs (NC3Rs, 2022) website suggesting otherwise, there appeared to be a prevailing belief that tail restraint, which involves holding the base of the tail to manipulate the mouse, should not be used if you use low stress handling. Tail restraint may be considered essential for certain husbandry tasks and procedures, such as health checks, dosing, and blood sampling (Davies et al., 2022). If people believe that restraint is unacceptable, it leads them to feel more reluctant to adopt low stress handling methods. Therefore, this is a very important misconception to clarify. However, it could be addressed in initial training stages for new starters in research facilities, to prevent it from being a long-term barrier.

Lack of Knowledge

Lack of knowledge appeared to be a barrier across different stages of the participant's career and in different situations. For example, in the event of an escaped mouse:

> *"I would be very surprised if a mouse has jumped onto the floor, and anyone bends down with a tunnel in hand. I can't see how you would actually be able to get it into the tunnel."*- Participant 7, Senior Technician

> *"We haven't actually thought about another method for an emergency like that [escapes]. So that would be… if there is a specific way to do it, then yes, of course*

that is better for the animal and for me, because at the end of the day, I also stress about the escaping mouse."- Participant 1, NTCO

Although participants were open and willing to using low stress methods in the event of an escaped mouse, their inability to do so appeared to stem from a lack of knowledge of the technique.

However, added to this lack of knowledge, some participants recalled being (or had observed others being) nervous to try low stress methods, acknowledging their own perceived lack of skills:

"At the beginning, I was quite apprehensive because I didn't know how to do it."- Participant 1, NTCO

"I always get baffled when people who have transitioned over or have come from other facilities where they haven't moved to low stress handling, and we then say, 'right, you're gonna have to do tunnel handling or cupping at [redacted].' And they go, 'I've never done that.' But, like, people naturally were doing it, they just don't realise it's formally a thing."- Participant 8, NTCO

Habits

The role of habits was alluded to in all 9 interviews, without prompting with interview questions. Participants described how habits affected their handling throughout their career. For example, some participants had strong formed habits of tail capture before changing their methods, and had experienced their colleagues struggling to form new habits of low stress techniques:

"I don't know, something really difficult to complete. Especially for me that I had been using it [tail capture], I don't know, 15 years at the time. And for me, it was obviously, I was used to picking them up."- Participant 2, Veterinary Surgeon

"I've seen people who have slipped back into their old habits. Probably by accident, like they've been trained to do it in a new way and then they're doing it another way."- Participant 3, Veterinary Surgeon

However, some participants reported breaking tail capture habits and forming strong low stress handling habits now, as they have had to use it consistently:

> *"I think it will actually take longer for me to use tail handling now because I haven't used it in such a long time. That will probably take me longer to do than tunnel handling."*- Participant 2, Veterinary Surgeon

Participants described the impact of habits in high-stress situation, for example if a mouse escapes:

> *"That is, the times if I've seen it kind of happen in the area where people have tried to tunnel handle and then mouse pings away at them with the tail to kind of… they almost revert back to what they know when they're in that slight panic situation."* – Participant 4, Specialised Technician

This indicated that in high stress situations which demand swift actions, participants default to familiar behaviour. Yet, some participants reported that they now have strong habits of using low stress methods and felt they would now struggle to use tail capture. This indicated that shifts towards permanent use of stress handling is achievable.

In summary, this theme described the multitude of barriers participants have faced when changing to, or using, low stress handling methods. This resistance stemmed from multiple factors, such as the perception that these methods will lead to increased time to complete tasks or disrupting established tail handling habits. The reluctance to change appeared to come from some people not wanting to change their familiar habits. This theme described the complex nature of resistance to low stress methods. It demonstrated how preconceptions, habits, and inadequate knowledge and skills collectively contribute to the hesitancy to fully transition to using low stress methods. Addressing these barriers could go a long way to assist people in adopting low stress methods fully.

4.3.2. Theme 2: Facilitators

In addition to discussing the barriers, participants shared what assists them in facilitating the use of low stress methods, both for themselves and others. This theme described the numerous facilitators participants discussed.

Evidence

The majority of participants report that research and evidence helped them be more open to using low stress handling methods:

> *"We watched the seminar and came out thinking, 'actually we can't argue with that.' It's presented with all the data, with the stress and everything."*- Participant 7, Senior Technician

> *"We brought it in on the back of research done by Jane Hurst. We had a couple of researchers here that were interested in the effects here. We trialled it out."*- Participant 6. NACWO

Some were convinced by seeing the change in the mouse's behaviour themselves:

> *"And also seeing that it has a good effect on the mice. Like, the mice are calmer and easier to deal with."*- Participant 3, Veterinary Surgeon

> *"I've seen the impact on our mice, they're so much calmer. We have some on a daily study at the minute and they're getting a gavage every single day. And usually, it's the mice, you know, they stress- not okay. And they are so chilled out. They just sit in our hands and it's amazing. Yeah they're definitely- we had some strains that used to jump at you. They don't do that anymore. I've definitely seen the impact on the mice as well."*- Participant 4, Specialised Technician

This underscored that people's willingness to adopt low stress handling methods was significantly influenced by research findings and personal observations of positive changes in mouse behaviour from the use of these techniques.

Ease of Use

Participants described that another facilitator for using low stress methods was the ease with which it they could be carried out:

> *"With the tunnel handling, it's kind of self-explanatory, in that you're just trying to get the mouse into the tunnel. So, I found it quite easy just to be taught that way*."- Participant 9, Animal Care Technician

However, others noted that the ease might be a result of mice becoming habituated to low stress handling:

> *"I find it's probably quicker to tunnel handle now with our animals because they are habituated to it, than it would be to tail pick."*- Participant 8, NTCO

> *"And then now I think the mouse are habituated to it as well. They're so used to it. They're always in the tunnels and they're always there*."- Participant 4, Specialised Technician

Moreover, easiness of a method was also described as a facilitator for tail capture:

> *"It's [the tail] is usually the closest and rapid thing that you actually see. And it's easy to catch with the tail."*- Participant 1, NTCO

This highlighted that ease-of-use acts as a facilitator for different mouse handling methods. Moreover, the mice's habituation to low stress techniques further amplified how convenient low stress methods can be, which could help facilitate its use.

Good Training

Good training for skills development is a facilitator to confident low stress handling:

> *"It's training at the end of the day. If I don't know how to do it, if I'm not confident to do it, it's very difficult to create a habit to make the change. I think that the technicians have the most experience for the day-to-day of the animals. So, to receive the support during the training, during that time… I think it was very important for the process."*- Participant 1, NTCO

> *"I think here, they are very good with their training. So, when I came straight away, they're like, 'do you need anything?' They're very open, if I want extra training, they would just be able to give it to me. So, I don't see that as a barrier."*- Participant 3, Veterinary Surgeon

A lack of good training could result in using poor techniques, and not developing the proper skills to use low stress handling techniques competently. This could then affect confidence, and handling techniques in the long term:

> *"At the beginning, I just didn't have a clue how to do it. So, I just try to chase them [with the tunnel] all the time."*- Participant 1, NTCO

Comprehensive training can help people develop confidence, but also the knowledge on how to correctly apply low stress handling techniques. By empowering individuals with the right skills, good training can be an excellent facilitator in helping develop new habits.

The survey data revealed that many participants struggled with low stress handling and found themselves "chasing the mouse with the tunnel". The interview participants attributed this to poor training, and lack of skill development:

> *"The only time [tunnel handling could cause stress], I would say is if you've got someone who is maybe not as competent. It's that they're not as competent, people using the incorrect technique where they are chasing the mouse around the cage. That's where you get the stress."*- Participant 4, Specialised Technician

> *"I think if you're having the issue of having to chase the animal with the tunnel, you should probably go back and get some retraining, because it should be taking you that long to catch an animal using a tunnel. Most people should be able to pick up a mouse in a tunnel from probably a few seconds of opening that cage lid. And I think there's more of a retraining problem because they clearly haven't quite picked up the technique fully. Or maybe they've not refined their technique enough to do in a quicker timepoint"*- Participant 8, NTCO

Their comments highlighted the necessity for comprehensive training for skill development, technique refinement, and building confidence.

Welfare

All nine participants reported being motivated by the welfare concerns of the mouse:

> *"I was open because of welfare. So, even though I didn't know how to do it, I knew that it was the best way after we saw all the research about it. That we need to move forward to better their housing and better ways to handle animals. So, I was okay with it."*- Participant 1, NTCO

> *"I was taught at college that I could use tail handling, but I never felt comfortable doing that. So I've always used tunnel handling or scoop method just using my hands. I just feel like it's better for the animals."*- Participant 9, Animal Care Technician

The participants recognised the importance of mouse welfare and were willing to prioritise methods that reduce stress. In the case of Participant 9, this meant a willingness to go against the use of standard tail capture methods.

Workplace Policies

Workplace policies could be a strong facilitator for those who are resistant to using low stress methods, and indeed to their colleagues in encouraging them to use such methods.

> *"We know that we have the NACWOs, the vets, the NTCO team, or the AWERB standards to back us up. If we need to raise these things, they don't really have anywhere to go."*- Participant 4, Specialised Technician

> *"And now, because I know that I have the back-up of the policy. It's like a regulation that it's not acceptable anymore."*- Participant 1, NTCO

Having the policies provided a solid foundation and helped the staff to advocate the use of low stress methods. It provided the ability to assert that low stress handling is mandated and must be used, which made it difficult to argue otherwise. The presence of policies empowers staff to confidently advocate for change whilst having the support of senior members of staff.

4.3.3. Theme 3: Mouse Escape

One critical situation where some participants did not feel comfortable using low stress methods is in the event of a mouse escaping. Although participants report that this does not happen very often, it is important for people to be able to use these methods in all instances for the mouse's wellbeing.

> *"So, if it's small- the problem is- if it's escaped as well, you're a little bit scared about it because you don't want to lose the animal out of the room. Usually in a pinch, you try to catch it as soon as possible. So, I don't even think that I tried the cupping, because it was pretty jumpy. Some of the strains are very, like, excitable animals. So, I just try to pinch as quickly I can on the tail. The tail is usually the one that is quickest to actually get."*- Participant 1, NTCO

Participants feared losing the mouse, and the risks associated with it. In this situation, they reverted to the quickest method they knew to avoid any risks. Or they may revert to old habits of tail capture when they feel stressed:

> *"The only times I would ever do tail capture would be if I literally have a mouse that has somehow left from the hood, and in an absolute panic I go back to my natural*

muscle memory of just trying to pick it up as quickly as possible."- Participant 8, NTCO

However, some participants did feel confident using low stress methods during an escape, proving it is possible to use in high-stress situations where quick action is needed:

"No, even if I get escapees or something I'll grab… I always think a tunnel is my go-to. What I might do, is if I did have an escapee, I would hold it by the tail, but then not pick it up until I've got a tunnel. So, I would sort of like, if I'm with somebody and one escapes, I'll put my hand over the mouse and like hold the base of the tail but I wouldn't pick it up by there. Then somebody get me a tunnel, so I put it in front and then put the mouse in and pick it up."- Participant 5, Specialised Technician

This theme revolved around mouse escapes as a high-pressure scenario where individuals often hesitate to apply low stress methods due to their own stress and feelings of time constraints. The fear of losing the mouse and unfamiliarity with these techniques in this context lead to some people reverting to old habits of tail capture. However, some individuals were confident in using low-stress methods in such situations. This suggests that targeted training could equip people with the skills needed to handle escape situations confidently and safely for the mouse.

4.3.4. Theme 4: Workplace Culture and Hierarchies

Perceptions of Colleague Support

Workplace cultures were explored, and participants felt the workplace culture was generally positive. They reported having the support of colleagues in low stress handling. Although all participants were confident with low stress handling for routine circumstances, they felt they would be able to get more assistance if needed:

"So, all the techs kind of support each other as well. So, if there was an issue, we talk to each other, or if, like we verbalise, basically we communicate and just kind of… So, nobody's checking on you, per se, but like, we're always talking to each other and saying, "how's it going?" And we can see how each other do basically."- Participant 9, Animal Care Technician

"I feel like if I needed it, I could go and get support. And we like, as the training team, we support each other, as well. So, if I was like, "this person's really not

> *getting this", like we could discuss why or somebody else could work with them. But actually, like, I don't feel like I sort of need support with tunnel handling now."*- Participant 5, Specialised Technician

Even those in more senior training roles reported that they want to be supportive, but considered that people might be hesitant to ask for help in case there are negative consequences:

> *"So that we try and be a bit more supportive and I would prefer somebody to come and be like, "Oh, I struggle to do that. Can you show me different methods?" But I think they'd be worried that we might try and stop the work, or that we think negatively of them [researchers]."*- Participant 5, Specialised Technician

They reported even though they try to create a supportive environment, other technicians and researchers might not ask for help when they need it:

> *"Some people might feel judged, or insecure."*- Participant 3, Veterinary Surgeon

> *"[I think researchers don't ask for help because of] Ego, probably, a lot of times? It's kind of people, you know, impostor syndrome can be a big thing. And maybe if someone's worked with mice for years, and then they're thinking, "well, I want to get this but if I ask someone, will I look silly?" Or when, you know, often it's maybe younger technicians who have taken this on board sooner, and then for someone to be able to think, "well, I've been in the industry for 40 years, can I ask someone for help who's been in the industry five years?"'*- Participant 4, Specialised Technician

> *"The only thing that could possibly get in that way is perhaps not wanting to feel stupid. Because although it seems simple on paper, like just get the mouse in the tunnel, like, it's not particularly easy."*- Participant 9, Animal Care Technician

In summary, there was a positive perception of colleague support. Participants felt able to ask for support if needed, however, they were concerned that others may not ask for help in fear of looking incompetent, or there being consequences.

Culture of Openness and Honesty

The participants reported a culture of openness and honesty that they try to contribute to:

> *"I think it's part of the culture that we're happy to say when we make mistakes, and just try to find solutions and correct something."*- Participant 1, NTCO

> *"I'll own up to mistakes always because then my conscience gets the better of me. So yeah, if I've done anything wrong, I'll always say something."*- Participant 9, Animal Care Technician

Senior colleagues expected colleagues to be aware of their own competency. If there were skills that individuals felt they needed to work on, it was expected that they be open and ask for support if needed:

> *"We do have some scheduled periods, so we generally say that people should try and retain that skill. So, if you haven't done it for 6 to 12 months, you should be looking at getting a refresher. But that's down to an honesty policy at this point- we have no way to police that."*- Participant 8, NTCO

The Impact of Hierarchy

Those in senior roles who were interviewed were aware of the impact of implicit hierarchy. When a participant was asked if technicians ever check in and ask how they're doing, they responded:

> *"I don't think so. Or at least I haven't heard anything. I don't know. Because I haven't heard anything that someone is correcting me when I'm doing it. Having said that, maybe for the technicians it could be difficult, because I'm the [insert senior role]."*- Participant 1, NTCO

This participant speculated that because of their role, it may be harder for technicians to correct them due to their position as a technician. Technician roles are perceived to be "low" on the hierarchy, as reported in Chapter 2 during exploratory stages and in Brown (2013). The technicians reported it was difficult to call out those who are in senior positions if they handle mice incorrectly:

> *"We've seen it a couple of times and we have to flag that, but that's quite a hard thing to do. Usually, the people that have been caught doing it are kind of well-established kind of, they've been here for ages, like yeah, like, kind of more influential people."*- Participant 5, Specialised Technician

> *"[I would] Probably not [call out a senior researcher] at this stage of my career, at least."*- Participant 9, Animal Care Technician

This displays the difficulties those who are not in senior roles face, and the reinforcement of the hierarchy structure. However, two participants were aware that they could use

their power and influence the behaviour of researchers to positively empower technicians:

> *"I think if you use it correctly, it can have a… I don't like when they [researchers] diminish them [technicians] because they are in a lower hierarchy. But I think if you do it properly, sometimes you can influence that, you know, that reassurance that they are in the right. You can kind of influence that they listen to the technician. We have had examples of people coming to us, for a lot of time, you just start seeing that the more, obviously, you back up the technicians, the more you give them that power, they end up like, trusting them. So, you can use that hierarchy to influence in a positive way. Although, it can be negative at the beginning, because they want to come to the higher up and check with the higher up. But then if you use that position to influence, in a way you end up giving them more power. Because, I mean, you know, they gain that power because you have given them the back up."*- Participant 2, Veterinary Surgeon

> *"I am always receptive of ideas, and I think they see that because of my position, I will support them through those changes, or if they can give me evidence of it, we'll then look at it, and then try and roll it out more and I'll support them with that change to get it out to the researchers."*- Participant 9, Animal Care Technician

The hierarchical structure with laboratory settings significantly affects low stress handling practices. It appeared that although senior technical staff are aware of their positions, animal care technicians can hesitate to challenge them due to their roles. This power dynamic can affect communication (Nuyts & Friese, 2023; See Chapter 2). However, some senior members of staff leveraged their positions to support technicians and help to empower them by validating their expertise to researchers and reinforcing their statements. The role of hierarchy can shape interactions both positively and negatively.

Social Influences

Participants discussed how others affected and influenced how they handle mice.

> *"It's probably more them [the technicians] than me now, to be honest, because they're doing it every day. So, they come up with their own little quirks and things that "oh, that might work a bit better." Or "that seems to have a really good positive effect." So that tends to filter this way to me."*- Participant 6, NACWO

The participants discussed how it was the technicians who pushed for the change in the university to low stress methods, and influenced this change:

> *"Probably I think the change was really more from the technicians, really, I think they played a really, really important role in this case. They were actually the ones that wanted really to, you know, push it and make the change. So, we kind of give them all the support like, "yeah, come do it." No. So I mean, we were more now in a supportive way. And it like, "What do you need? What do you need to have for it to happen?" And that's the support that we gave, really. Because I mean, they were the main force for it, really."*- Participant 2, Veterinary Surgeon

Social influence played a pivotal role as technicians successfully drove the adoption of low stress handling practices across the university. This could have empowered them within their status in the hierarchy, but also highlighted that new refinements can be introduced by technicians. Moreover, technicians have the most hands-on experience handling mice and will have developed skills and techniques that they can share with their colleagues. Their expertise can be shared and appreciated across the whole hierarchical system.

4.3.5. Theme 5: Interventions

This theme summarises the suggestions participants made for interventions to increase the use of low stress methods to all time and in all instances.

Evidence as Motivator

As discussed in Theme 2, evidence in the form of research data can be a powerful facilitator. Participants suggested using evidence in the intervention, and providing information of the benefits:

> *"Data as well. Like data always helps."*- Participant 5, Specialised Technician

> *"I think from a researcher point of view, they probably need more evidence, if you know what I mean? Probably, in that sense. Because I think once they're convinced, we have all the resources to support them and drive them into using the tunnel handling, if they haven't used it. But my feeling is, they need that evidence. They need to see or to have that something that reassures them that it actually has the benefits."*- Participant 2, Veterinary Surgeon

Using research data and evidence can provide individuals with knowledge of why it is beneficial.

Addressing Common Misconceptions

Participants suggested an intervention with content addressing common misconceptions. For example, that using low stress methods take a lot more time:

> *"But I think if you did it sort of industry wide, I think the biggest misconception is time. So, I think that that's where I would say you need to really focus. If you have the good training, if you said 'we're gonna do this 100%' is you need to convince people it doesn't take more time."*- Participant 6, NACWO

Another misconception is that it does not make a difference if you use tail capture for pre-weaned mice:

> *"Those key points where people do tend to do tail handling… weaning for me is a big one where previously it was taught that people don't need to do it at weaning. So, a lot of people when I've said don't tail handle there and they've said, 'Oh, it's okay, because they're pre-weaning.' And it's still a mouse."*- Participant 4, Specialised Technician

> *"I think it would be worth showing the different scenarios of what people say. And kind of, show those scenarios of how you could deal with it. So, like the weaning mice, and how we deal with weaning mice."*- Participant 5, Specialised Technician

These comments suggested that there is scope to address commonly held misconceptions. Moreover, in the case of weaning, perhaps training to develop skills using low stress methods for weaning mice if they are commonly picked up by their tails.

Developing Training

Participants also suggested general training for developing good low stress techniques, so people do not chase the mice with the tunnel. Moreover, general training can empower individuals with the skills to handle confidently, but also the space to provide information for why it is important.

> *"It would be training because that's the kind of direct link between saying it and then it kind of coming to fruition. So just making sure training is spotless."*- Participant 9, Animal Care Technician

> *"Yeah. Probably, just the training and understanding why you need to do it. So, people also know there's a reason behind it, rather than, 'this is something that I have to do because…'."*- Participant 3, Veterinary Surgeon

Although handling training was already provided, there could be avenues for improvement, for example, specific training for different scenarios, such as weaning and escapes (see Theme 3).

4.3.6. Theme 6: Understanding Workplace Guidelines.

Inconsistencies

All participants were aware that there are guidelines and policies in place. However, there was some inconsistency between participants and their understanding if guidance were written AWERB policies, and what exactly is in the policy:

> *"I mean, that went through our AWERB. So, we have, in a way that influence came through from AWERB. And that guideline or that advice or support came from AWERB. So yeah, I mean, we don't have some something written."*- Participant 2, Veterinary Surgeon

> *"So, it is written as an AWERB standard, which was really good because when we first brought the standard out, it was like written information that we could present them like "this is why," and like the specific that you have to do it. But it doesn't actually say tunnel handling though, it's just says a low stress method, which doesn't include tail handling."*- Participant 5, Specialised Technician

Some participants were unaware about the written guidelines, and referred to a poster:

> *"There is a poster, that is… I'm not totally sure if it's actually the official guideline, but it's a poster that is in the room that actually shows you how to handle the animals with the tube. So, I see them time to time. I probably haven't fully read for a little while, but at that, like a document that says guidelines? Probably I haven't seen it, but I recognize the poster."*- Participant 1, NTCO

Moreover, some participants were involved with the development of the policies and had a good understanding of what they included:

> "*I'll be honest, it was probably when I contributed to the writing of it. Probably about two or three years ago."* Participant 6, NACWO

However, there was also a lack of clarity around what is and is not allowed in the policies, with regards to holding the tail, and whether or not it is okay to use tail capture in the event of an escape:

> *"I would say that's kind of a grey area because … we're talking about day-to-day stuff. As in handling the animals. I think it's possibly something that we should clarify or something that we should specifically say whether it's an exception or not, I don't know whether it's an exception."*- Participant 6, NACWO

> *"I would imagine so because as I'm talking, it seems like a grey area, to be fair. If people are getting mixed up with tail restraint and tail handling, or at least by my definition, then I imagine, it's probably quite easy."*- Participant 9, Animal Care Technician

Moreover, one participant who was involved in the writing of the policy claims it is a "grey area" and the policy doesn't state if tail capture is allowed during escapes:

> *"Yeah, probably I'd say yeah, because we don't specify that it is okay- yes or No. If that makes sense?"*- Participant 6, NACWO

However, the policy did state that in the event of an escape, there is an exemption from using low stress handling. Even though this participant was involved in the development of the policies, they were not clear on what is and is not allowed. This lack of certainty could affect the understanding of the policies for their colleagues and in this case, it also revealed the need to revise the content of these policies from time to time, considering that new people are joining the lab all the time.

4.4. Discussion

This study shed light on the complexities of laboratory animal handling practices, and the influence of workplace culture on technician behaviour. It revealed the importance of ensuring consistency in the implementation of workplace guidelines and fostering a supportive environment for collaboration and knowledge-sharing. Participants in this study were acutely aware of the advantages of low stress handling methods, which is in line with the findings by O'Malley et al., (2022) who disseminated a survey to explore attitudes towards tunnel handling for mice and found that technicians and researchers understood the benefits of this method. In my study, the awareness of benefits may be explained by the training in this university, or possibly the availability of the wide literature on tunnel handling. However, as discussed in Chapter 3, participants still face barriers to full time adoption of low stress handling. Despite individual-level barriers causing challenges, the study identified opportunities for targeted interventions. Specifically, there was a notable opportunity to create a training program addressing the consistent use of tunnel handling, especially in scenarios involving mouse escapes- a common obstacle reported in the adoption of tunnel handling practices.

The interview results suggested that there are incongruities in how workplace guidelines are received and understood within institutions, which could lead to inconsistencies within the workplace for how people handle mice. For example, one technician who has a different understanding of the policies may influence another technician when discussing what methods they use to handle mice. This may also extend to the research community. As the mapping of determinants in Chapter 2 identified, social influences can be a strong determinant of behaviour (Bandura & Walters, 1977; Koutroubas & Galanakis, 2022). The results demonstrate the importance of consistent dissemination of workplace guidelines, to avoid misinterpretation. Inconsistencies in perceptions can occur through informal communication, as the results from this study suggest that technicians rely on peer discussions for support. Therefore, it is important for universities to establish robust induction and training to ensure everyone receive the same information. This not only supports the technicians in their roles, but also leads to better outcomes in both mouse welfare and research integrity through consistent behaviour across the research

community. To my knowledge, there are no studies within animal welfare that explore the use of standardised training despite a clearly identified need due to reported variations in handling methods and differing interpretations of guidelines (see Chapter 3).

This study provided a broader contextual understanding of how factors such as workplace culture can affect handling behaviour. The findings suggest that despite the technicians feeling there is a culture of openness and honesty, they have concerns that sometimes researchers may not ask for help when needed out of fear of appearing incompetent and facing negative consequences. This hesitation could lead to researchers struggling with handling and indicates poor psychological safety among the research community from the technicians' perspective. Despite these concerns, Nuyts and Friese (2021) found that researchers tend to communicate with other researchers about moral questions and concerns, whereas they communicate with technicians about operational issues. This suggests that the culture of openness may be confined to the technical community, rather than encompassing the broader research community. Additionally, Brown et al (2013) also discovered an "us versus them" dynamic between technicians and researchers in another university animal research facility. These findings indicate a significant communication gap, which may lead to misunderstandings and inefficiencies in research practice. Future work could assess psychological safety between technicians and researchers and explore ways to promote open communication without fear of repercussions. Bridging the gap between different groups in the animal research community may also ensure that guidelines are consistently understood and applied.

Moreover, the participants discussed a supportive environment where colleagues are willing to help each other, and senior technical colleagues embrace new ideas. In terms of barriers, predominant themes emerged at the individual-level. For example, not being open to change, having strong tail capture habits, and having misconceptions. The barriers that were discussed were similar to ones identified by Henderson et al. (2020) and Young et al. (2023). However, this study found that having a lack of knowledge and skills on the correct methodology in certain instances can be a barrier to consistent, full-time adoption. Although the data by Henderson et al. (2020) and Young et al. (2023) concluded that jumpy mice can be a barrier to using tunnel handling, they did not explore specifically

how this specific behaviour can prevent the use of tunnel handling. In this study, participants shared that they would not feel confident or know how to re-capture the mouse using low stress methods. This was not covered in the training for this specific university, indicating that there was scope for this to be covered in the training curriculum. Robust training is essential; not only can good training impart knowledge, increase skills and build confidence in techniques through practice, but it can also address misconceptions and help individuals to form new habits.

It is evident that there are situations where tailored training programmes could be designed to address the specific needs and challenges identified by technicians. The training could be a video which incorporates an experienced technician demonstrating low stress techniques to recapture mice in situations where they have escaped. To date, there are no resources in the university in which the interviews took place that address escape training; moreover, the NC3Rs do not cover escape situations in their mouse handling training online. A video could be a successful mode of delivery for skills development, with demonstrations of how to apply techniques. A systematic review by Youssef et al. (2023) evaluated the efficacy of educational videos in the field of healthcare and found that 63.6% of studies demonstrated significant improvement in knowledge and skills following a video-based teaching intervention. Furthermore, interventions which used virtual reality and simulation-based education proved more effective than standard videos. Srinivasa et al. (2020) also found that online videos are a valuable tool for procedural skill knowledge acquisition and retention. Videos offer advantages such as standardising the information for all viewers, reducing variability, and enabling the information to be delivered consistently to all viewers (Youssef et al., 2023).

This study was not without limitations. There may have been inherent biases in the participant selection process. As participants volunteered to take part, they may have had strong opinions on the topic and be more engaged, or may have avoided taking part altogether. Furthermore, the study relied on self-reported data, which may have been subject to social desirability bias (Paulhus & Vazire, 2007). Participants may have provided responses that they felt are more socially acceptable or align with the researcher's expectation, rather than disclosing their true experiences, emotions, or opinions. This

could have potentially influenced the reliability of the data, and may limit its generalisability. However, qualitative studies do not rely on the same positivistic philosophical stance as quantitative studies. The aim of qualitative studies is to ensure that a variety of points of view are represented through data saturation, not generalizability (Francis et al., 2009). In addition, this study had focussed primarily on the experience of those who work in animal care roles and excluded those who worked in mice in other capacities, such as research. Future research could involve interviewing researchers to investigate if they encounter similar challenges and perspectives regarding mouse handling practices. Additionally, I did not enquire with participants the methods they would prefer for learning how to apply low stress methods to recapture escaped mice. Although the literature suggests that videos are an effective learning tool for practical skills, there is a possibility that there is a different approach which could be more effective in standardising training within this audience, such as hands-on training. However, this could be mitigated with co-designing the intervention to ensure relevance. Despite the limitations discussed, the implications of this work were significant for advancing animal welfare by identifying challenges and offering potential solutions that can be developed further with stakeholder engagement.

The implications of this work were multifaceted; the study highlighted that there are incongruities in how guidelines are received and understood within institutions, therefore there is a necessity for ensuring consistency in the dissemination and implementation of workplace guidelines, as this may affect handling behaviour and lead to inconsistencies. Moreover, the findings emphasised the value of fostering a supportive workplace environment, whereby colleagues are willing to help each other and embrace new ideas. This culture of openness can facilitate collaboration and skill sharing, which can create continuous improvement in animal care practices. In addition to organisational-level determinants, this study identified individual-level barriers, such as resistance to change and misconceptions about handling methods, as well as facilitators such as good training and confidence-building techniques. Future studies could create interventions which target these barriers and promote the adoption of low stress methods and improve animal welfare outcomes. However, the findings indicated that technicians did not know how to use tunnel handling for mouse escapes, even among those who are consistent

users of low stress handling. Therefore, there was potential for a targeted training intervention which addressed this gap. Introducing educational resources, such as a video demonstrating such techniques could have a wider reach in other universities where handlers experience the same challenges (Henderson et al., 2020; Young et al., 2023).

Chapter 5. Intervention Development

Abstract

This chapter describes the stepped approach for the development of a novel intervention aiming to promote the adoption of tunnel handling in situations where a mouse escapes in research facilities. By addressing the challenges faced by technicians in situations like mice escaping, this novel intervention can contribute to a gap in training, and to the development of effective, tailored training materials. The intervention design process involved a comprehensive approach, integrating the findings from previous studies, stakeholder engagement and user feedback from interviews. The intervention was co-designed with mouse handling trainers to increase accuracy, relevance and credibility for the target audience in addition to acceptability and feasibility. Interviews with potential end-users provided valuable insights into the format, content and language preferences for the intervention. Interview participants expressed enthusiasm for the video format, and suggested additional materials and opportunities, such as summary take-home messages and opportunities for discussions with training staff. The practical implications of this work are important, as the intervention has the potential to build confidence and skills among technicians, and therefore improve mouse welfare across research facilities.

5.1. Introduction

5.1.1. What is Intervention Development?

This chapter outlines the process of integrating and triangulating the findings of the survey and interview studies and using stakeholder engagement to develop an evidence-based pilot intervention. An intervention can be defined as a coordinated set of activities and techniques introduced at a given time and place to change the behaviour of individuals, communities and/or populations through a hypothesised or known mechanism (NICE, 2014). Intervention sciences stem from health research; a public health intervention is defined as planned actions to prevent or reduce a particular health problem, or the determinants of the problem, in a defined population (Wight et al., 2015). Intervention development is typically a systematic process, grounded in behavioural theories and models, which aims to design and refine strategies to address specific issues and can be applied in various contexts (Hankonen et al., 2020). Intervention development is important for addressing complex issues to improve outcomes, such as public health challenges, social inequalities and environmental issues. Therefore, it is a suitable approach to improve laboratory mouse welfare by adapting the behaviour of their human handlers.

There are a number of theories and frameworks designed to guide the process of developing an intervention, each with their own strengths and limitations. Using a framework for intervention development helps to ensure that the intervention is well-designed, evidence-based and tailored to the needs of the target population and increasing their efficacy for positive change (Araújo-Soares et al., 2018; Fernandez et al., 2019). A commonly used framework is the Intervention Mapping approach (Bartholomew et al., 2015), which uses six steps to take an ecological approach to assessing a problem and using theory and evidence to create an intervention. Another approach, the PRECEDE-PROCEED model (Green & Kreuter, 2005) provides a structure for planning interventions by identifying predisposing, enabling and reinforcing factors, as well as environmental and policy considerations.

For this study, the intervention was developed with the Behaviour Change Wheel (BCW), which allows more of an iterative approach with more flexibility, rather than working through a sequential process. In addition to breaking down the behaviour and its determinants in terms of capability, opportunity and motivational factors, it also considers the intervention functions and policy categories accordingly. The Behaviour Change Wheel (Michie et al, 2011) integrates theory and evidence and brings together stakeholders in making intervention design decisions, and can be used alongside the Theoretical Domains Framework, which heavily influenced the design of the survey in Chapter 3. The Theoretical Domains Framework is instrumental in supporting the analysis of behavioural determinants, so it is complementary to the BCW. While these frameworks share common elements, they differ in their methods and emphasis on different aspects of intervention development. For example, Intervention Mapping has a focus on theory-based intervention designs, whereas the Behaviour Change Wheel focusses on a systematic analysis of behavioural determinants and intervention functions.

5.1.2. Features of Intervention Development Frameworks

There are several common features in the intervention development frameworks that allow them to serve as tools for systematically designing effective strategies to change behaviour. For example, they suggest a structured approach, with a series of steps or stages that ensure the intervention is systematically planned and implemented. For example, a common initial stage is conducting a needs assessment of the behaviour under study (Bartholomew et al., 2015). Chapter 2, 3 and 4 can be considered a detailed needs assessment exploring the barriers to tunnel handling by using different methodologies. Moreover, they recommend using evidence-based practices to increase intervention effectiveness. In this chapter, I applied evidence-based practices by engaging with the target audience throughout the intervention development process, through interviews and consulting with experts to develop materials. While promoting a structured approach, intervention development frameworks also provide a degree of flexibility as some of the frameworks highlight the iterative nature of intervention design, where it is acceptable and often encouraged to revisit earlier steps as the evidence-base evolves (Bartholomew et al., 2015; Eldredge et al., 2016). This allows the intervention designer to tailor

interventions to meet the needs of specific populations and contexts. In addition, stakeholder engagement is an important feature of many intervention design frameworks and models to ensure stakeholder needs are met while the intervention is in developmental phases (Bartholomew et al., 2011; Majid et al., 2018; Michie et al., 2014).

5.1.3. Stakeholder Engagement and Co-design

Research measuring the effectiveness in the behaviour change intervention literature in the health domain often find that interventions show promise but can fail to meet expectations in terms of reach and impact, or findings can be inconsistent and inconclusive (Arnott et al., 2014; Free et al., 2013; O'Hara et al., 2017). Similar limitations can be found in the behaviour change literature within the context of animal welfare, where studies have failed to deliver interventions that measure differences in behaviour (Morrongiello et al., 2013). A possible limitation could be lack of stakeholder engagement in behaviour change research.

Stakeholder engagement is increasingly recognised as important for intervention development, as it can improve the quality of research by ensuring the outcomes are more closely aligned with specific needs and priorities of the end user (Currie et al., 2022). For example, in intervention development, stakeholder engagement could improve the acceptability of the outcomes to a wider audience by ensuring the design of the intervention and any materials are appropriate for the stakeholders and their needs (Brett et al., 2014; Currie et al., 2022). Stakeholder engagement can be successfully conducted in the context of animal welfare; Reed and Upjohn (2018) conducted in depth consultations with local stakeholders to understand their individual perspectives when developing their theory of change framework for canine welfare. Machila et al., (2007) effectively used stakeholder engagement in every stage of their intervention development, an educational programme designed for farmers in Kenya. They involved the farmers in focus groups to discuss proposed content and involved them in prototyping and deliberating dissemination techniques. This can be considered as co-creation, which is a powerful tool in stakeholder engagement and can be defined as the collaborative approach to creative problem-solving between diverse stakeholders (Vargas et al., 2022),

and emphasises stakeholders from the beginning with determining and defining the problem, through to the final stages of a project.

This intervention development involved co-creation but also used elements of co-design. Co-design describes active collaboration between stakeholders in designing solutions to address a prespecified problem (Vargas et al., 2022). In this thesis, the identified problem- based on surveys and interviews- was that laboratory personnel do not use tunnel handling when dealing with difficult mice that are at risk of escaping or have escaped. There is a notable lack of training in this area. The publicly available NC3Rs mouse handling training course focuses on general handling and husbandry for routine situations and does not cover emergency scenarios involving difficult mice or escapes. Additionally, the comments from surveys conducted at seven universities (see Chapter 3) indicates that their staff mouse handling training does not include low stress handling training for dealing with mouse escapes. This highlights a significant gap in the current training programmes that needed to be effectively addressed. By using a co-design approach, which involved active collaboration with individuals who had the relevant experience in developing and delivering mouse training, the intervention had increased likelihood of being deemed feasible and acceptable to the target audience when implemented.

In this chapter, animal care technicians supported the development of elements of the intervention to maximise efficacy, acceptability and feasibility. I used stakeholder engagement to ensure the intervention was developed in alignment with the diverse needs and perspectives of key stakeholders (Araújo-Soares et al. 2018). By fostering a collaborative approach and co-create where possible, I aimed to enhance the relevance and effectiveness of the intervention (Currie et al., 2022). I applied the Behaviour Change Wheel (Michie et al., 2014) to design the intervention, including identifying specific behaviour change techniques from the Behaviour Change Technique Taxonomy version 1 (BCTTv1) (Michie et al., 2015). I used the BCTTv1 as it improves the clarity and consistency of the intervention by ensuring the intervention components are clearly described (Glanville et al., 2020; Kok et al., 2016). Ultimately, this makes it easier to evaluate the efficacy of the intervention. Furthermore, selecting BCTs appropriate to mouse handling

led to the development of a robust, evidence-based intervention. Each BCT is evidence-based and rooted in behavioural sciences (Michie et al., 2011).

5.1.4. Aims and Objectives

This chapter has two parts. Triangulation from the data from previous chapters, and a stakeholder interview study. Therefore, I had the following aims and objectives:

Aims:

1. To develop a training video intervention demonstrating low stress mouse recapture techniques, using stakeholder engagement, based on triangulation of findings from exploratory work, survey and interview studies.

Objectives:

1. Identify Needs:
    - Conduct discussions with relevant experts to identify key concerns and needs based on survey and interview findings.
2. Design the intervention and incorporate Behaviour Change Techniques:
    - Use the Behaviour Change Wheel and Theoretical Domains Framework to design a training intervention that addresses identified barriers in skills and knowledge.
    - Implement specific Behaviour Change Techniques (BCTs) such as Demonstration of Behaviour (BCT 6.1), Instruction on how to Perform the Behaviour (BCT 4.1), and Information about Social and Environmental Consequences (BCT 5.3) into the video.
3. Qualitative Development Interviews:
    - Conduct qualitative interviews with the target audience to gauge their perceptions and ensure the video content resonates with their experiences and needs.
4. Co-creation of Intervention:

- Collaborate with experts and the target audience to co-create a tailored intervention that effectively increases their ability to use tunnel handling for escapes.

5. Develop a Logic Model:
    - Create a logic model to guide the systematic planning, implementation and evaluation of the intervention, ensuring the resources and outcomes are aligned and measurable outcomes are defined.

5.2. Step 1: Triangulation, Logic Model Development and Stakeholder Engagement

5.2.1. Data Triangulation and Integration

Triangulation involves using multiple methodologies to study the same phenomenon (Denzin 1970). It can be a process of studying an issue using mixed methods to gain a more complete understanding of the issue in question (O'Cathain et al., 2010), and increase the ability to interpret findings (Thurmond, 2001). Using mixed methods to study a particular issue has advantages (Hussein, 2009). For example, generating new knowledge through a synthesis of the findings from different approaches (Foss & Ellefsen, 2002), richer insights from multiple methods of inquiry than using only one (Bradbury et al., 2015). This intervention development was based on triangulation by theoretical integration (Denzin, 1978; Denzin, 1970), whereby data is generated by different methods and separate analyses occurred (Moran-Ellis et al., 2006). This approach does not combine the method or analyses but takes each set of findings and brings them together into one explanatory framework (Moran-Ellis et al., 2006). Integrating findings from different research studies can lead to a more comprehensive interpretation of the results and can be valuable when understanding complex phenomena. Qualitative analysis from the interviews conducted can add context and understanding to quantitative research data from the survey and adds a depth which may not be achieved by relying only on quantitative methods alone (Malina et al., 2011). The findings can then inform the overall design and content of the intervention.

The data from each stage of this project can be combined to develop an evidence-based intervention. Data from exploratory work (see Chapter 2), a survey study (see Chapter 3), and an interview study (see Chapter 4), suggested that tail capture is still used in certain situations. For example, there are mouse handlers who are very motivated by mouse welfare and use low stress handling routinely, but in situations like mouse escapes, they do not feel confident using low stress handling. This prevents them from using low stress handling for these circumstances, due to a lack of skills, knowledge of techniques and confidence. The integration of findings across these studies enabled the development of

a comprehensive and nuanced understanding of the circumstances in which individuals experience a lack of confidence employing low stress methods. This approach allowed me to pinpoint specific situations and use qualitative methods to explore barriers in more detail. See Table 11 for a summary of findings triangulated to develop the logic model.

Table 11: Summary of Findings Triangulated for Integration

Phase of Research	Research Aim	Research Methods	Summary of Key Findings	TDF Domain associated
Exploratory phase.	● Identify potential stakeholders associated with laboratory animal research facilities. ● Characterise the nature of working relationships among stakeholders. ● Gather insights from stakeholders on the adoption journey of tunnel handling within university animal research facilities. ● Identify the barriers and facilitators encountered during the implementation of tunnel handling practices. ● Identify potential determinants influencing decision making with regards to tunnel handling adoption and practice.	Four shadowing sessions. Nine conversations	There is an implicit hierarchical structure in animal research facilities. Facilitators of change identified- for example, technicians are more likely to try something new if the suggestion comes from another technician who understands the pressures of their role.	Environmental Context and Resources Social Influences
Investigative phase.	● Identify the current adoption of various mouse handling methods and identify specific contexts in which these methods are used ● Identify factors which may have the potential to impact tunnel handling, such as perceptions of culture of care, habit strength and psychological safety	Online survey completed by researchers and animal care staff. 141 participants from nine different universities in the UK.	Low stress methods are the preferred methods for handling mice among both researchers and technical colleagues. People use tail capture when mice are jumpy, have escaped, or are at risk of escape, or if they need to act quickly. People believe that rare tail capture is not harmful to the mice.	Environmental Context and Resources Intentions Behaviour Regulations

	• Explore how people understand and interpret any existing mouse handling guidelines in their workplace		People use low stress methods because they are motivated by mouse safety and welfare, or because they are encouraged by workplace guidelines. Individuals may believe that the handling training they are given functions as guidelines in their workplace.	Beliefs about Consequences
Investigative phase.	● Explore the difficulties surrounding the use of low stress handling when mice escape. ● Explore, in depth, participants' understanding of their workplace guidelines.	9 interviews with animal care staff from one university in the North-East of England.	Good training is a positive facilitator of low stress handling methods. Participants feel they must act quickly and therefore resort to tail capture. In escapes, tail capture is perceived to be quicker, as participants know how to do this (some with long ingrained habits), and it can be a reflex. Participants don't know how to use low stress methods for escapes or very jumpy mice.	Knowledge Skills Behaviour Regulation Beliefs about Consequences Beliefs about Capability

Based upon the triangulation of findings, an APEASE analysis was conducted to assess if a training intervention would be the best mode of delivery for the intervention. Understanding the context within which interventions are to be delivered is key to their successful delivery. To guide this process, the APEASE criteria was developed by Michie et al., (2014) to provide a framework for selecting and shaping interventions. The components are Affordability, Practicality, Effectiveness and cost-effectiveness, Acceptability, Side-effects/safety, and Equity. By conducting an APEASE assessment, I could design and select an intervention that is most likely to be successfully implemented, but also meet the needs of the target audience effectively. Table 12 displays the assessment, which concluded that education, training and modelling would be the most effective intervention functions in this context.

Table 12: APEASE Assessment for Intervention Development, with mapping onto BCW (Intervention Function) TDF Domains, COM-B Component and Behaviour Change Techniques

Intervention Functions	Does the intervention function meet the APEASE criteria in the context of increasing tunnel handling use for escaped mice?	TDF Domain and COM-B Component Addressed	Behaviour Change Technique
Education	Not practical on its own, as the target population needs support with techniques.	Knowledge, psychological capability	Information about Social and Environmental Consequences (BCT 5.3)
Persuasion	Unlikely to be effective, as the target population knows of benefits but lacks knowledge and skills.	N/A	N/A
Incentivisation	Providing rewards and recognition may not be affordable or practical in the scope of this project. Escape scenarios may not be reported; therefore it would be difficult to provide rewards.	N/A	N/A
Coercion	Coercion is impractical and not equitable, as it does not address underlying barriers and may create unintended consequences, such as discouraging handlers to seek help.	N/A	N/A
Training	Yes- training to increase knowledge and skills via the use of demonstration in training mode of delivery. Would be affordable, practical, can be tested for efficacy and acceptability, with no risks anticipated.	Knowledge, skills, beliefs about capability and reflective motivation	Instruction of how to perform behaviour (BCT 4.1) Demonstration of Behaviour (BCT 6.1)

Restriction	Not effective as it is not possible to make changes to guidelines in the scope of this project, which would be a viable restriction. Participants in this project have also reported deviating from guidelines, so restriction alone would not be enough to change behaviour.	N/A	N/A
Environmental restructuring	Not appropriate as the environment can't be restructured- target population can only be encouraged to have tunnels on hand, alongside demonstration of skills.	N/A	N/A
Modelling	Methods would need to be modelled by experienced handlers in training format.	Knowledge, skills, reflective motivation	Demonstration of Behaviour (BCT 6.1)
Enablement	Enablement alone would not increase skills for key barriers such as escape scenarios, therefore it is not practical or effective.	N/A	N/A

5.2.2. Development of Preliminary Logic Model

A prerequisite of a good intervention is whether its effect can be robustly evaluated (Araújo et al., 2018). Therefore, interventions with clear definitions and a logic model are easier to evaluate. A logic model is a visual representation that outlines how the intervention is understood to contribute to a chain of intermediate results that eventually produce the intended outcomes (Smith et al., 2020). Using the triangulated findings, a logic model was developed to highlight the pathway from the intervention to increased knowledge and intentions to use tunnel handling for future mouse escapes (see Table 13).

It should be noted that this project identified numerous potential avenues for intervention, such as interventions aimed to enhance perceptions of Culture of Care, as this has been found to be related to stronger habits of tunnel handling. However, given the limited timeframe, changing organisational culture was not seen as a realistic goal. Instead, addressing specific scenarios such as mouse escapes was deemed to be more feasible, focussed and potentially impactful. Existing literature had already highlighted that handlers often struggle to use low stress handling techniques during mouse escape incidents (see Henderson et al., 2022; Young et al., 2023), which was also found in this project (see Chapters 3 and 4). To date, no targeted interventions or resources exist to support mouse handlers in these situations. This gap was an opportunity to create a practical and widely applicable intervention.

Assumptions: It is apparent from the data that participants expressed a significant lack of confidence, knowledge and skills surrounding mouse escapes, which evidently is not covered in mouse handling training in institutions. This leads to handlers using tail capture if a mouse is at risk of escaping, or has escaped. Moreover, the triangulated data suggests that some individuals feel that occasional tail capture may not be harmful, if the mice are usually handled using low stress methods.

Resources: Therefore, the next stage of logic model development determined the resources needed to address this issue. Using the Behaviour Change Wheel, it is evident that a training intervention function would suit this context well. A training video would

be a cheap and sustainable resource to create and can be easily disseminated if it were to be shared more widely. Moreover, it would be easily accessible- individuals can re-watch the video if it is hosted on training sites if they want to revisit the content at their leisure.

Activities: The video can be used as part of formal mouse handling training, in a facilitated session with mouse handling trainers.

Mechanisms: The video included footage of recreated mouse escapes and can involve experienced handlers who demonstrate how to perform tunnel handling during escapes (BCT 6.1) and instruct how to do it with a voiceover (BCT 4.1). This shows participants that such techniques are feasible and create a shift in their knowledge and skills. Moreover, a voiceover for the video relayed to the viewers that occasional tail capture can be harmful, which may increase their knowledge of the harm of tail capture (addressing BCT 5.3) with information about the consequences of this method.

Expected short-term outcomes: Intentions to use tunnel handling in the future and increased beliefs about capability to use it for future mouse escapes. They will understand that rare tail capture is still harmful to the mouse, even if it is routinely handled with low stress methods.

Expected long-term outcomes: In the long-term, it was expected that if a mouse escapes, participants may be more open to trying to use tunnel handling to recapture the mouse, rather than defaulting to tail capture, and eventually feel comfortable to use it for all future escapes.

Table 13: Preliminary Logic Model of Video (Mode of Delivery) Intervention

Assumptions	Resources	Activities	Mechanisms	Short-term Outcomes	Long-term Outcomes
Limited knowledge and skills in using low stress methods in the event of a mouse escape. This affects confidence, so participants resort to tail capture when escapes arise. Some believe rare tail captures from escapes are not harmful.	Training video demonstrating low stress techniques for escapes	The video can be used for escapes training and be part of future formal mouse handling training	The video includes footage of recreated mouse escapes and involves handlers who demonstrate how to perform tunnel handling during escapes (BCT 6.1) and instruct how to do it with a voiceover (BCT 4.1). Will also discuss the harm associated with rare tail capture (BCT 5.3).	Technicians would feel more confident in their abilities and skills to try and use low stress handling the next time a mouse escapes. The video will increase their knowledge on techniques they can try to safely recapture the mouse. They will be able to access the video anytime.	If a mouse escapes, participants may be more open to trying to use tunnel handling to recapture the mouse, rather than defaulting to tail capture, and eventually feel comfortable to use it for all escapes.

5.2.3. Stakeholder Engagement and Co-design

During the initial phases of developing the training video, stakeholders from a university in the North-East were actively involved through a series of meetings. These stakeholders included members of the mouse handling training team and a Named Information Officer, crucial for resource development. These meetings served as a platform to involve key stakeholders in the design and planning process, with the purpose being to gather insights and perspectives from them with their diverse experience and expertise related to mouse handling and training. Additionally, discussions centred on the logistics and their capacity for filming the content for the video.

During the meetings, I presented the concept of a video focussing on escapes and featuring trainers demonstrating low stress techniques. The stakeholders deliberated on various aspects, such as specific training needs and the potential challenges associated with filming. Their input helped guide the next stages, including developing a video outline for presentation to the target audience for feedback, which would also serve as a storyboard/script for the video. Furthermore, the stakeholders collaborated in co-designing a voiceover script for the video. This ensured that the script used the correct terminology and accurately represented and described what would be included in the video footage. This collaborative approach helped to foster a sense of ownership and investment among stakeholders, enhancing the likelihood of successful implementation and acceptance from the target audience. Overall, the meetings with the mouse handling training team and other stakeholders played an important role in shaping the intervention development process, ensuring that the video would meet the needs of the target audience, but also be logistically feasible to create.

5.3. Step 2: Stakeholder Interviews

5.3.1. Method

Participants

Those who work with mice in a technical care capacity were the target audience for this intervention in the developmental stages. Therefore, animal care staff who reported using tail capture in the event of mouse escape in the previous interview study (see Chapter 4) were directly contacted and invited to take part in an interview. There were 3 participants (2 males and 1 female) of various roles (a Named Person, a Veterinarian, and a Senior Animal Technician). The technicians were informed that the purpose of the interviews was to gather their perspectives on developing an intervention for those who do not use low stress methods during escape scenarios. This approach was selected to provide a space where stakeholders can share their views in a qualitative format and reduce social desirability biases and risk of conformity in a group setting, like a focus group. The interviews were conducted between November and December 2023. This study received ethical approval from Newcastle University Faculty of Medical Sciences' Ethics Committee (Ref: 40793/2023).

Design

This semi-structured interview study took a phenomenological approach (Eatough & Smith, 2017), allowing participants to describe and reflect on their lived experiences when asked about different mouse handling situations. The interview guide was developed with phenomenology in mind, designing questions which allowed participants the space to share their experiences.

Materials

An interview guide (see Appendix F) was developed and used to gather relevant information and give participants the opportunity to reflect on materials presented during the interview. A semi-structured approach was selected to allow some flexibility to adjust questions or probe based on participant's responses. Interviews were transcribed using

OtterAi Inc after recording them on the OtterAi phone application (Version 3). All three interviews were conducted via Zoom.

A video outline (see Appendix G) was developed with feedback from a mouse training technician, to ensure relevancy and appropriateness. This was used to present to participants to gain their feedback and see if they had any concerns before the video was made for the intervention. The outline presented the scenarios that would feature in the video, alongside a draft script.

Procedure

Participants were directly contacted by the researcher and invited to take part in a 30-minute interview. The researcher explained that they had been selected as they had previously disclosed that they did not feel comfortable using low stress methods in the event of a mouse escaping. Upon agreeing to take part, participants were sent an information sheet and consent form to sign. See Appendix H for copies of ethical documents. They were also given the video outline to read on the day of the interview. After meeting on Zoom, participants were told of the purpose of the interview and asked if they were happy for the meeting to be recorded for the purpose of transcription and data analysis. They were assured that no one beyond the supervisory team would have access to the transcripts, and that all participants would be anonymised. Once consent was given, the interview began. All interviews lasted up to 30 minutes. If the participant had not read the video outline before the interview, they were given a few minutes to read it during the interview before they were asked questions about it. Participants received a £15 voucher to thank them for their time.

Data Analysis

The data was analysed using descriptive thematic analysis (Braun & Clarke, 2006) and coded by hand by one researcher. A period of time was dedicated to familiarising with the data. This involved reading and re-reading the transcripts from the interviews to gain in-depth understanding and take initial notes on ideas and key patterns. Following this, the initial codes were generated based on interesting features of the data across the entire

data set. Segments of data were highlighted that appeared relevant to specific codes, that were collated into overarching themes. The final descriptive themes were reviewed and named. When no new information emerged and data saturation was reached, recruitment ended.

5.3.2. Results

From the data collected from three participants, the following themes were perceived: "concerns", "responses", "audience" and "suggestions for improvement". Overall, the participants expressed positive and enthusiastic reactions to the idea of a training video for mouse escapes. They also provided valuable feedback and suggestions for enhancing the video and intervention format.

Concerns

Participants shared potential challenges and concerns regarding certain scenarios the video would cover:

> *"I think the one, for me, that would be the most interesting one would certainly be recapturing from under a rack. Just because of the logistics of what it is. The one under a rack, I do still think it would be difficult."*- Participant 1

> *"There are times, 100%, where the mouse is so quick. There's a time where you cannot… this is very rare, but you can't go to grab a tunnel and then try to get it into the tunnel on the hood which is quite wide. It's not like in a cage, where it's a confined space so it's easy to manoeuvre it into… It's just that real-life situation where you're putting them in a clean cage and they're so… again, this is fairly rare, but they're so jumpy. You know the minute you lift the lid, a couple of them are going to ping."*- Participant 2

> *"See, that recapture from under a rack. That's one I'm not sure how we'd go around getting the mouse we've lost."* -Participant 2

Participants seemed intrigued to see how these situations would be tackled in the video. It emphasised the necessity of these scenarios to be included, as participants need strategies for dealing with such situations. One participant highlighted "real-life situations", where behaviour can be unpredictable. It was evident that the video should address the unpredictability of mouse behaviour in situations that are not controlled.

Moreover, it was important to recognise and address the impulse people may have to grab the tail as it is deemed to be easier:

> *"So those are the trickier scenarios because when you have an animal running around on everything. And that's why people use the tail, because I mean obviously if you have the mouse passing by and you see the tail, it's kind of like easy to say, "I just grabbed the tail, and you know and pull the animal" so that's why people usually do that."*- Participant 3

Response

Overall, participants responded positively to the video format, especially since it would safely demonstrate mouse recapture in risky situations:

> *"A video would be great. For new starters and that, that would be brilliant. Seeing a video- how we do it- is better for them and better for us, because they've seen it and we're just, sort of, adding to that."*- Participant 2

> *"I think the video would be better than having to read about it. And we don't really want to have to demonstrate putting the mouse on the floor, and this is how you pick it up. So, I think it would probably- certainly for new users- be very, very good… Certainly, a lot of people when they do animal work and things, they want to see how it's supposed to be done, rather than read how it's supposed to be."*- Participant 1

These comments support the idea of visual aids as a form of vicarious learning and of conveying information safely. It means that trainers will not have to recreate the scenarios in person to demonstrate, which would be less controlled and riskier for both the handler and the mice. Furthermore, they would not have to read how to do it, which can be difficult to visualise or explain clearly in written format.

> *"I think it's absolutely fine. Because, you know, you sort of say, 'it does happen, but we want to try and reduce it even more or eradicate it. You know, there's nothing in here that says, 'you are bad, you are bad, you are bad'. And I think that's the key thing. So, it's coming across in a way that we know that those things stress the animal out, and we know these occasions do happen. But here are some tools to do it in a better way."*-Participant 1

> *"This sort of reads like an SOP, where it's like 'if this happens, you will do this'. So, I suppose that's a good way of doing it."*- Participant 2

> "*I like that you guys have included a "what if I panic?" Because I mean, that's really difficult, especially if you're not used to having a mouse running around. Oh, my God, you start panicking. So, I think that's great. And it has a language that is kind of like connecting with a person. So, in a level that is kind of like, "this happens to all of us. This is like normal", so I think, I think yeah, I don't think I would add anything."*- Participant 3

Participants responded encouragingly to the video outline which included a script of the voiceover commentary. They highlighted the importance of framing the messaging with the correct tone, and they believe it will be received positively, as there is no sense of assigning blame. They feel the approach focuses on acknowledging challenges that occur when handling mice and providing tools and practical solutions for improving handling. This positive approach may be crucial in the video being received well from its intended audience.

Audience

Participants were asked how they think other technical colleagues would respond to the intervention:

> *"I don't think a technician would find it sort of, well, anything other than what it is, which is a training tool. You know, I think certainly our techs, they'll see it as "right, this is how we're going to be doing it". I don't think the technicians you'll have too much of a problem with. The ones [senior members of staff] that are here, I think they'll just respond to it positively. You know, I'm not saying you would get that from the whole industry. You know, in certain establishments you're going to get "I've been doing it for forty years this way, and it's not a problem". So, I think you're going to get that in certain establishments. I don't think you'll get that here."*- Participant 1

These comments highlight that within this institution, this participant expects there to be a positive response, and does not anticipate any difficulty from members of staff accepting the content of the video. They expected it to be accepted by all members of staff, regardless of role. However, they were not sure if there would be variability in the industry, as there are always people who are resistant to change.

Participant 3 feels optimistic that veterinarians and senior animal care staff would be open and receptive to the video:

> *"In the end you're, you know, you're doing it for animal welfare. I mean, if you highlight the animal welfare most vets will be interested, I think. In general, especially, because I mean, usually the vets that come into lab animal work are very interested in animal welfare and are very versed on animal welfare. So, if you really highlight, you know, the list of the positives for the animal welfare, I mean, that will make it more interesting for them."* – Participant 3

Participants were asked how they feel researchers would respond to the video, if it were to be shared with them. One participant anticipated challenges in implementing the intervention across to researchers, as their work patterns and schedule vary. It may be logistically easier to ensure technicians watch the video, but it could be difficult to do the same for researchers:

> *"For us [technicians] it's a bit easier because you could just say, "right, you lot. We're going to split you into half. Wednesday afternoon, you're going to watch it and be familiar with it, and the other lot, Friday afternoon." But it might be a bit difficult for researchers because obviously, they've got a day full of experiments, they're not going to stop, even if they've been told about it, watch the video. So, I'm not sure how you would implement it and move it forward. But the content for the researchers is really good. It covers every scenario really."*- Participant 2

However, the participant sees the value in researchers watching the intervention video, as there are certain situations that could be covered in the video which they may struggle with. Moreover, there are instances in which they cannot rely on technicians being available to help them with handling:

> *"If you nail that bit with the jumpy mice, that's a really good one to have. Really good one to have for the researchers, because a lot of the time they're coming in when we've got to set up breeders. They might be coming in at 5pm on their own. They've got a jumpy mouse. They've not got anyone to ask. So, they have to deal with it themselves and with confidence, you know what I mean?"*- Participant 2

The participant highlighted that it is important to empower researchers with the skills and confidence to handle situations independently. Additionally, one participant believed that the content, as it is, would not need to change in order for it to be relevant to researchers:

> *"I think the way it stands is absolutely fine because you're just explaining how to do it and how to do it in the best a way as possible. You know, you're still gonna get that old sort of batch of researcher going, "it doesn't really matter. I'm just*

gonna pick it up by the tail. I'm capturing it. I'm getting it back in the cage as quickly as I can. It's not that stressful." You're always gonna get that." – Participant 1

Suggestions for Improvement

Participants were asked if they believed the video on its own would be enough to equip people with the necessary motivation and skills to try low stress methods during mouse escapes. Two out of three participants suggested additional ideas:

> *"I don't know if you guys have considered that once you have a scenario recorded then have like a recap of what you've done. Like, "have you seen in the video?", I don't know, "first, make sure it can't escape." Kind of do a bit of recap because I think that helps people retain information. I don't know, having like a bit of a recap, it's like "okay, you've seen this scenario, see how we dealt with it, and this is kind of like recap". Because sometimes you know, when you have like a lot of information, in the end, you tend to watch the video like "yeah, yeah, yeah." You know? I mean, I know now what to do with escapes, that's why I'm thinking of the bullet points. Like getting them, at least, make sure that they take like two or three messages so they can deal with the scenario."*- Participant 3

Participant 3 suggested take-home messages, like bullet-pointed summaries for each scenario, which could be an effective way for participants to digest the information. Additionally, Participant 2 suggested an in-person forum to ask questions:

> *"I don't know if there needs to be something on top of the video like shown to all the techs in a training situation or seminar type thing. Rather than someone from animal unit saying, "we've got this training video on low stress handling. It's on the website. Have a look at your leisure", and 80% of people probably won't even look. If it's like, "right everyone, from 1 till 2, we're going to watch this video we're going to do this and do that and we're going to have a chat," I think it needs that on top of it."*- Participant 2

This would also ensure that people have watched the video, in a controlled setting and be offered the opportunity to ask questions or have a discussion with trainers. Based on these findings, the logic model was refined to add the additional activities (see Table 14).

Table 14: Refined Logic Model of Video Intervention

Assumptions	Resources	Activities	Mechanisms	Short-term Outcomes	Long-term Outcomes
Limited knowledge and skills in using low stress methods in the event of a mouse escape. This affects confidence, so participants resort to tail capture when escapes arise. Some believe rare tail captures from escapes are not harmful.	Training video demonstrating low stress techniques for escapes.	A workshop with the video and opportunities to ask a trained handler questions and discuss content of the video.	The video includes footage of recreated mouse escapes and involves handlers who demonstrate how to perform tunnel handling during escapes (BCT 6.1) and instruct how to do it with a voiceover (BCT 4.1). Will also discuss the harm associated with rare tail capture (BCT 5.3). The discussion or Q&A element of the workshop may persuade individuals further or reassure them, adding a new BCT (verbal persuasion about capability 15.1).	Technicians are expected to report increased confidence in their abilities to use tunnel handling in post-intervention surveys. Technicians are also expected to report increased likelihood to employ methods observed in the video, compared to pre-intervention scores. The video will increase their knowledge on techniques they can try to safely recapture the mouse following the intervention.	If a mouse escapes, participants may be more open to trying to use tunnel handling to recapture the mouse, rather than defaulting to tail capture, and eventually feel comfortable to use it for all escapes. Participants may report using tunnel handling in the long-term in escape scenarios, and feel confident and skilled in using techniques from the video.

5.4. Discussion

To ensure relevance and good potential for behaviour change, I invited potential users of the intervention to take part in an interview study, using their feedback to make necessary refinement/adjustments. The findings from the interviews underscored the need for the video interventions content, as participants expressed both concern and curiosity about how the scenarios would be depicted, and the methods used for recapturing the mouse using low stress methods. Participants responded positively about the mode of delivery, format, content, and language, and shared their belief it would work well for all colleagues who work with mice, whether they work with mice on a research or care capacity. In terms of suggestions to improve the intervention, participants suggested additional materials, such as a summary take-home message or a bullet-pointed list of actions to take. Moreover, a participant suggested that users of the intervention watch it together at an allocated time and be given the opportunity to ask questions and have a group discussion, as this was identified to be relevant to the typical training technicians experience. Additionally, a participant suggested we note in the video that in real-life situations, mouse behaviour could be unpredictable. Participants shared their concerns about featuring the escapes in the video, and provided recommendations on addressing the typical response a technician would have to these situations, which is the impulse to grab the tail. This was an important perspective from the participants, as they had personally experienced escapes before, and their reactions are likely to be representative of other technicians. Therefore, the voiceover script was adapted to include references to impulses and acknowledge that this may be a natural response. These insights were valuable, as it allowed me to refine the intervention before testing for acceptability and feasibility.

Using stakeholder engagement is an important step of intervention development, and essential for improving the intervention's likelihood of success. Overall, participants from the interviews were positive about the video proposal and made suggestions to increase the likelihood of a positive response from their peers. Glanville (2020) reviewed successful human behaviour change interventions in the context of animal welfare and found support for stakeholder engagement and co-creation in intervention design. Co-designing the video with experts not only ensured the video depicts scenarios accurately but also

increased its credibility. Viewers were considered to be more likely to be more receptive to the video, knowing that it was co-designed with individuals who share the same professional background, as it establishes a relatable connection with their own experiences and expertise. This was highlighted as important from participants earlier in the project (see Chapter 2) when discussing the disseminating of information and implementing new techniques. Ajzen (1991) notes that people resist change unless they are convinced of the direct benefits of making the change. Moreover, Rogers et al. (2014) noted that new ideas and innovation typically follow a series of stages before it is formally implemented by people. For instance, individuals form attitudes, make decisions about compatibility with existing values and assess complexity. Social influences play a role in shaping attitudes towards new techniques in the workplace (Talukder & Quazi, 2011). Therefore, it was crucial that the video features information communicated by someone perceived as a peer, and that the intervention embraced co-design and co-creation extensively.

While the interview with potential users has provided valuable insights, it is important to acknowledge the limitations and potential biases. As this study involve purposive sampling, and I recruited people who reported using tail capture for escapes. However, purposive sampling does have its own limitations. Due to the sample specificity, the intervention may not be fully generalisable to technicians in other institutes, as their environments may differ to the one that is represented in the training video. In addition, the data from the interviews may also be impacted by social desirability bias, as the participants may have wanted to provide favourable responses to proposed intervention ideas to avoid causing any offence. Especially as I conducted the interviews, the participants may have recognised the stake I had in the intervention, they may have downplayed any concerns and felt pressure to support it. Moreover, the selected group in this study can be considered homogenous, from their technical roles. However, as the intervention was designed for technicians, some degree of homogeneity was deemed necessary. The three individuals involved in the interviews brought diverse and specialised expertise from their various roles across their careers, each contributing uniquely to refine the intervention through a user engagement, co-design approach. Overall, the insights gained from the interview study coupled with the triangulation of previous research data

significantly shaped the development of a novel intervention. The practical implications of this work were profound, as it has resulted in a new intervention that is ready to be pilot tested for feasibility.

This process of triangulating and integrating findings from previous studies was an important step in creating a plan for the intervention, which was a training video. The insights not only influenced the initial ideas for a logic model, but also helped to identify the necessary Behaviour Change Techniques that would provide the mechanisms of change for the intervention. The intervention ideas were refined further by involving stakeholders throughout the designing process and during interviews to ensure the target audience needs would be met. As a result of the stakeholder activities, I refined the logic model and the voiceover script to reflect the learnings from this stage of the project, ready to create a final version for the intervention. The next stage of this research involved the delivery of this intervention, tested for acceptability and feasibility at a university in the North-East of England.

Chapter 6. Training Intervention for Handling Mice during Escapes: An Acceptability and Feasibility Study

Abstract

Using low stress methods to handle mice improves mouse welfare and the reliability of research outcomes. However, despite their knowledge of the benefits of using tunnel handling, technicians and researchers have shared they do not use low stress methods in some situations, particularly where a mouse has escaped, or is at risk of escaping.

This study addressed the gap in training resources for handling escaped mice by developing and evaluating an evidence-based intervention, delivered in a workshop format. Drawing on insights from previous research and stakeholder engagement, this intervention focused on promoting tunnel handling techniques for recapturing mice in various escape scenarios. The workshop, informed by the Theoretical Domains Framework and Behaviour Change Wheel, aimed to increase participants' knowledge of the negative impact of using tail capture and build their confidence in using alternative methods.

A sample of 15 technicians working in a university animal research facility participated in a workshop, where they watched a training video and completed pre-and post-intervention surveys that assessed feasibility, acceptability, and immediate impact. The participants rated themselves to be extremely likely to recommend the video and workshop to fellow technician, suggesting high acceptability among the animal care technical community. Participants reported finding it helpful and effective to view demonstrations of mice being recaptured, rating the content and delivery as excellent. They also made suggestions for improvement to increase acceptability. The structure of the intervention was deemed suitable for future piloting, with minor amendments. The participants showed an increase in confidence and likelihood to use tunnel handling to recapture mice during escapes following the workshop intervention. There was no change in their beliefs that tail capture can be harmful, even on rare occasions.

6.1. Introduction

The research presented in this thesis has highlighted that although technicians predominantly use low stress methods to handle mice, there are certain instances when they feel that it is not possible to use such methods, particularly when mice escape or are at risk of escape (a finding also apparent in a sample of technicians from an earlier survey by Henderson et al., 2020). During interviews, animal care technicians identified that training in their facility does not address how to use tunnel handling to recapture a mouse if it escapes (see Chapter 4). In addition, intervention development interviews with stakeholders indicated that technicians are supportive of a video which could demonstrate the use of tunnel handling methods during mouse escapes, or high-risk situations where mice could attempt to escape (see Chapter 5). Given the lack of publicly available training for mouse escapes online, I developed a training intervention using a video and discussion format. Using the Theoretical Domains Framework (Michie et al., 2005; Atkins et al., 2017), I aimed to increase knowledge about the negative impacts of using tail capture even on rare occasions ("Knowledge" domain) and develop skills by demonstrating how techniques can be applied ("Skills" domain). I also sought to increase participant confidence ("Beliefs about Capability" domain) and inform people that rare tail capture can still cause harm to mice ("Beliefs about Consequences" domain). With this, I aimed to measure their intentions to use tunnel handling for escapes in the future ("intentions" domain).

To date, there is only one example of a successful training intervention for a refinement in a laboratory environment. LaFollette et al (2020) tested the efficacy of two rat tickling training interventions: online-only training, online + hands-on training and a control condition (no training). They found that both online and online + hands-on training reported improved key outcomes for rat tickling, as participants reported increased knowledge, self-efficacy, and familiarity of rat tickling, in addition to higher rat tickling implementation rates. After a two-month follow up, the hands-on training group reported increased self-efficacy and familiarity with rat tickling. This study demonstrates that targeted training approaches designed for controlled laboratory environments have the potential to enhance skills and knowledge. It must be noted that the most successful

version of LaFollette's intervention included a hands-on element in addition to online training. The intervention piloted in my study did not include a hands-on component due to the risk of mice escaping, however, LaFollette's online-only intervention still showed promising results.

6.1.1. Intervention Development

This intervention was developed alongside stakeholders. Involving key stakeholders is essential to ensure relevance to the target audience and is a common process in health psychology studies and intervention sciences (Currie et al. 2022; Leask et al., 2019). It makes it more likely for the final intervention to be acceptable and result in the target behaviour to be changed. In the previous chapter, interview respondents made suggestions for the intervention to meet the needs of technicians. Suggestions included providing the opportunity for questions and/or discussion about the information presented in a video format. This collaborative approach increased the likelihood that the final intervention would be feasible to implement, acceptable to the target audience and effective in changing the target behaviour.

6.1.2. Feasibility and Acceptability Studies

Eldridge et al. (2016) describes a feasibility study as a study which focuses on conducting research to examine whether the intervention can be done, if it should be proceeded with, and if so, how? They state that a pilot study asks the same questions and is a smaller version of the main study. Both serve to identify potential refinements to the intervention, address uncertainties around the feasibility, or test any preliminary effects of the intervention (Pearson et al., 2020). In terms of "acceptability", the content, format and delivery may all have implications for the extent to which the intervention may be accepted by the target audience. Thus, if an intervention is considered acceptable, the target audience, which in case are technicians, are more likely to implement the refinement (Sekhon et al., 2017). For this study, I assessed "acceptability" by examining if the technicians responded positively to the content of the intervention and its format. I explored if the information can be relayed in the manner I intended, and if the timing of

the intervention worked. I evaluated the intervention by enquiring if the intervention would be something they would recommend to their peers.

6.1.3. Current Study

To date, there are no widely available training tools accessible for mouse escapes. The NC3Rs and 3RsC collaborated with academia and industry to develop a refined mouse handling training e-learning course in 2023. However, this extensive training does not include mouse escapes training, despite the NC3Rs promoting and championing the method.

In this study, three training workshop sessions were delivered to a sample of 15 technicians in an animal research facility and were tested for acceptability and feasibility. Using a workshop format, scheduled into the technician's timetable, had advantages. Firstly, it provided the space for technicians to take part in the activities, without worrying about their other responsibilities. In addition, it is a controlled, facilitated environment where participants have the opportunity to view the video without distraction. The intervention consisted of a pre-survey where participants shared their feelings about using tunnel handling to recapture mice, watching a video demonstrating methods, a short discussion period, and a post-intervention survey (see Figure 6)

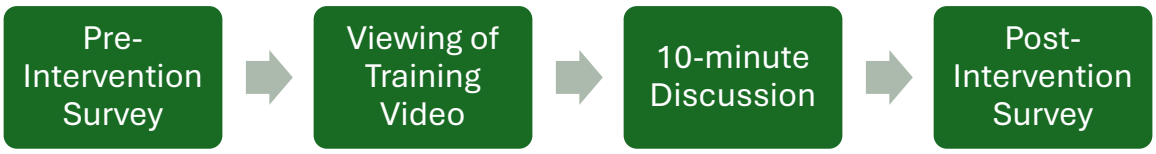

Figure 6: Structure of Intervention

The research questions this study aimed to address were determining the feasibility of implementing the intervention, and its acceptability to the target audience, as its primary outcome. Additionally, I aimed to evaluate the intervention's effectiveness in training Animal Care Technicians to use tunnel handling for recapturing escaped mice. Finally, the study examined the immediate outcomes of the intervention, particularly in terms of the

technicians' confidence and their likelihood of implementing the learned methods. Although assessing effects was not the main purpose of this study, measuring them could be insightful for future piloting. Therefore, this study had the following objectives: deliver an evidence-based pilot intervention workshop to a sample of animal care technicians to train them on how to recapture mice using tunnel handling in the event of mouse escaping by demonstrating techniques. Then, collect feasibility, acceptability and outcome data using survey methods to determine if the intervention is appropriate for future pilot studies.

6.2. Method

6.2.1. Participants

The participants consisted of a convenience sample of volunteers working in an animal care facility and who routinely handle mice. A senior member of staff from an animal research facility in the North of England scheduled a time in the diary of 15 individuals (6 Animal Care Technicians, 5 Senior Animal Care Technicians, and 4 Named Animal Care and Welfare Officers (NACWOs)). This was scheduled so that the individuals had protected time in their work schedule to participate in a way that would not interfere with their work. The inclusion criteria specified that the individuals must have a role involving the handling of mice. The participants were allocated to one of three of the workshop sessions that took place between the 20th-22nd March 2024. They were informed that the purpose of the workshops was to test a training intervention designed for technicians, intending to increase skills and confidence in employing tunnel handling for mouse escapes.

6.2.2. Ethics

This study received ethical approval from Newcastle University Animal Welfare Ethical Review Board on the 7th February. (Refs: 34866/2023, 42600/2023). Participants received an online information sheet about the study, assuring them of their anonymity in participation in any future publications, setting out data storage and retention policies, and informing them of their right to withdraw and ask questions. After reading this, they provided consent to participate using an online form. The information sheet and consent form were sent in advance of the study via email, so that participants did not feel pressured to consent to take part in a group environment among their peers in the workshop setting. See Appendix I for a copy of ethical documents.

6.2.3. Materials

Intervention Training Video

The training video was developed in collaboration with staff from the animal research facility. A storyboard was developed to represent the scenarios individuals reporting having difficulty with, to assist with filming the scenes. The following scenarios were included:

- Recapturing an escaped mouse from a hood.
- Recapturing an escaped mouse from the floor.
- Recapturing an escaped mouse from under a rack.
- Recapturing an escaped mouse that has escaped onto the handler.

Three individuals (a Senior Technician, a Training Technician and a Named Information Officer) who did not take part in the intervention as participants) were involved in recording the footage in a secure room, where there were no additional risks of losing the mouse. Over a period of two recording sessions between December 2023-January 2024, footage was filmed using a Panasonic HC-VXF990 camera mounted on a tripod. Overall, 8-10 mice were used, including CD1, C57BL6J and genetically modified strains from a C57BL6J background. The technician chose the mice at random from a selection of the youngest mice available from the surplus rack. The youngest mice were chosen, as they are typically more active and prone to sudden movements. Participants in Chapter 3 and 4 reported difficulty with fast, active mice, and therefore using the youngest mice gave me the best possible chance to represent the scenarios to reflect the technicians' experiences. A voiceover script was created in collaboration with an experienced technician to ensure that it accurately described the scenarios. The footage was edited using Adobe Premiere Pro (Version 24). The final video was 4 minutes and 28 seconds long. See Images 1, 2, 3 and 4 for stills from the video.

Image 1: Recapturing an escaped mouse from a hood.

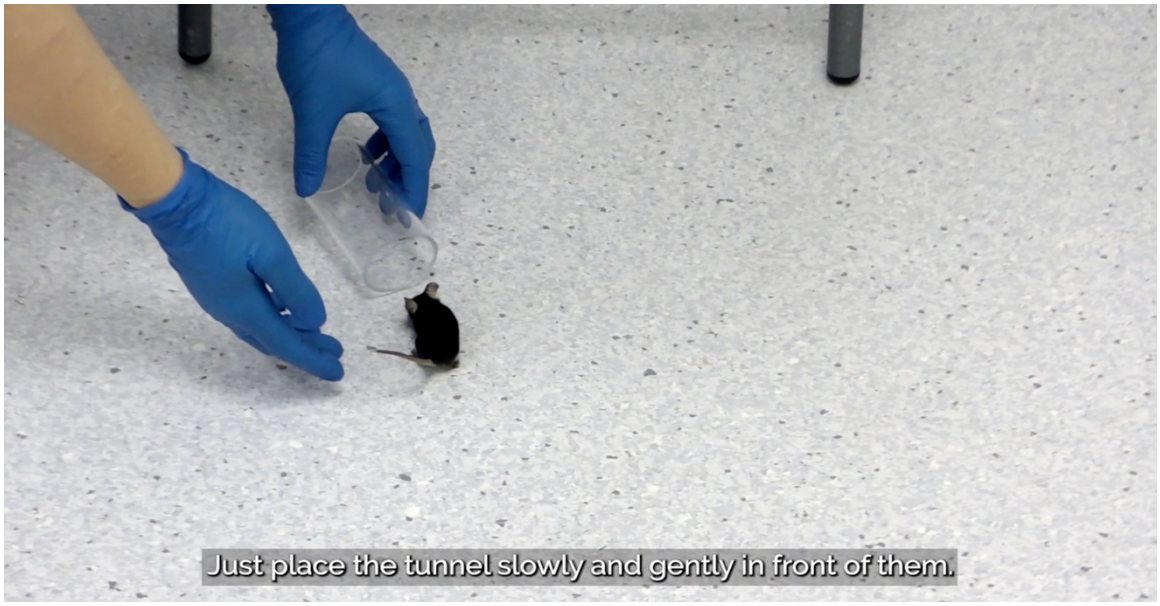

Image 2: Recapturing an escaped mouse from the floor.

Image 3: Recapturing an escaped mouse from under a rack.

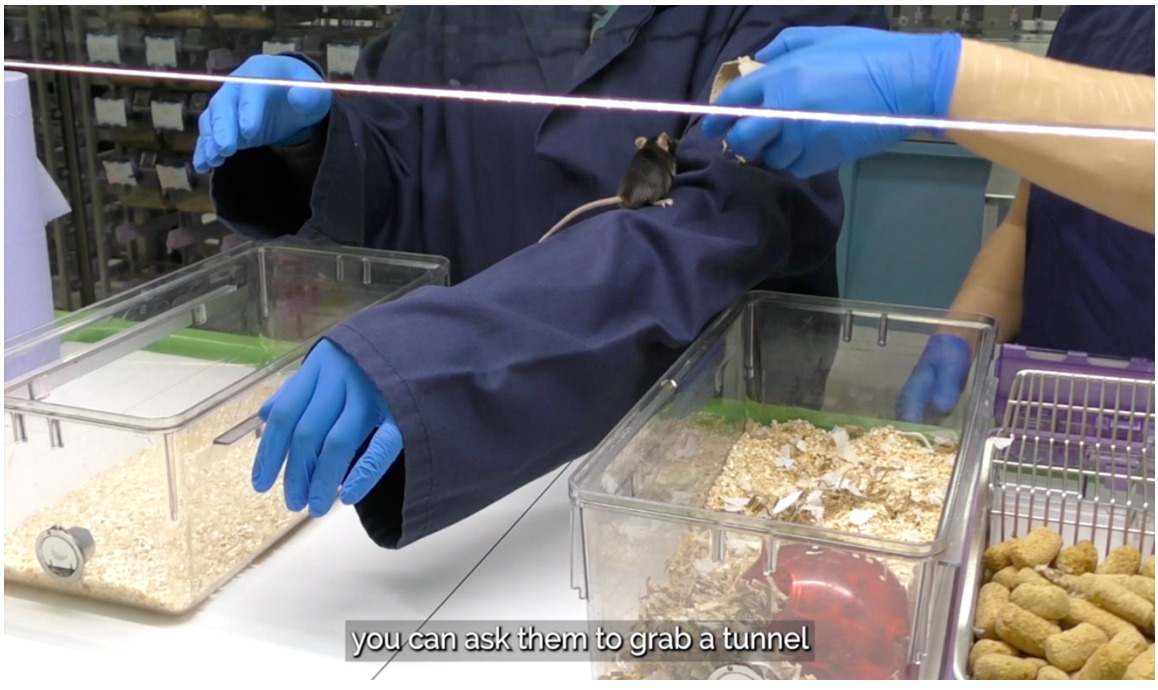

Image 4: Recapturing an escaped mouse that has escaped onto the handler.

Pre-Intervention Survey

The pre- and post-intervention survey were developed using the Theoretical Domains Framework (Michie et al. 2005). Questions were mapped onto the following domains: Intentions, Beliefs about Capability, Beliefs about Consequences, Knowledge and Skills. See Appendix J and K for a copy of both surveys.

Potential Outcome Measures

The pre-intervention survey explored if participants had ever experienced a mouse escaping, and if so, what methods currently use to handle mice when they do. Following this, using a sliding Likert scale (ranging from 0-100), participants were asked to rate their own likelihood of using tunnel handling to recapture mice in the four different escape situations (onto the hood, floor, under a rack, and onto themselves). Then, they were asked how confident they felt using tunnel handling in the same four scenarios, indicating on a sliding scale of 0-100. Using a qualitative open-response option, participants were asked to describe if they had ever experienced any challenges or difficulties when trying to apply low stress methods during escapes before. The final three questions explored participants' beliefs about using tail capture during escapes; if they believe it is harmful, if they believe it is harmful to use on one-off occasions, and if it is possible to apply low stress methods in escape situations (See Appendix F).

Post-Intervention Survey

The post-survey was completed immediately after watching the training video and finishing the discussion part of the workshop, and assessed the following:

1. Outcome Measures

The survey asked about participants' confidence and likelihood to apply the techniques after watching the training video for all four scenarios. Using a 5-point Likert scale, it also asked how motivated participants were to practice and try out the techniques, and whether participants intended to start using tunnel handling for escapes. Following this, a sliding scale (0-100) was used to measure how helpful participants found viewing the demonstration of techniques, and how effective they would rate the video as a training

tool. The same three questions from the pre-survey were presented to the participants on the post-survey to measure if there were any differences after the video and discussion about their beliefs of tail capture during escapes.

2. Feasibility and Acceptability

Qualitative open-response questions were used to ask if there were any aspects of the video that were unclear or not useful, and what part of the whole workshop they found the most useful. Then participants were asked what the key message was that they took away from the workshop, and if there are any specific areas related to handling that they would benefit from additional training on. Participants were then asked how useful they found it to be presented with the opportunity for discussion after the video, how they would rate the quality of the video, the content and delivery of the workshop, and how likely they would be to recommend the video and workshop to other technicians (all on a 5-point Likert scale). A final open-text question asked if they had any additional feedback.

6.2.4. Procedure

The workshops were facilitated by a senior technician and took place in a meeting room within the animal research facility. The meeting room contained seats and a television screen. The senior technician welcomed all the attendees and then introduced me. They explained that I had been working in close collaboration with the research facility for several years. I then provided some background information about the project, introduced the workshop and explained the purpose of the intervention, which was to test a training video which may be used as future training materials. On the television screen, I presented a Microsoft PowerPoint slide with a QR code that linked to the pre-survey, which I invited participants to complete on their mobile phones. One participant had difficulty using their mobile, so they completed the survey on the researcher's laptop. Following the completion of the pre-survey, which took around 5-10 minutes to complete, participants were asked to watch the training video which was presented on the television screen. The video lasted 4 minutes and 28 seconds. The senior technician then led the discussion, which began generally by asking them their first impressions of the video.

Following this, they were asked how they believe technicians from other institutions would respond to the video. The final question they were asked is if they thought it would work as a training tool. After the discussion, which took on average around 12 minutes, the participants were presented with another QR code which linked to the post-survey, and they completed it.

6.2.5. Data Analysis

All quantitative data was analysed using IBM SPSS Statistics software (version 29). Descriptive statistics were calculated to determine the percentage of participants who had experienced a mouse escaping. Due to the small sample size, kurtosis values, and ordinal data from Likert scales, non-parametric tests were used to analyse the data. To test if there were statistically significant differences for the pre-intervention and post-intervention measures, Wilcoxon signed-rank tests were used to compare the scores. Qualitative data from the surveys were analysed using content analysis (Neuendorf, 2017), whereas qualitative data from the discussion were analysed using descriptive thematic analysis (Braun & Clarke, 2006). The discussion element of the workshop was recorded and transcribed using Otter AI. Once the transcription was checked against the audio recording for accuracy, data analysis began using an inductive approach in a Word document. First open coding was used to identify concepts and patterns in the data, and axial coding to make connections between those patterns (Strauss & Corbin, 2015). A codebook was created following line-by-line coding. This codebook was shared with a second analyst, who used this to code the data.

6.3. Results

6.3.1. Quantitative Results

Acceptability and Feasibility

In the post-intervention survey, participants were asked a series of quantitative questions to assess the acceptability and feasibility of the study. The participants rated the helpfulness of the video demonstration and workshop discussion highly, with most finding them extremely or very helpful. Most participants would strongly recommend both the video and workshop to other technicians. Overall, the content and the delivery of the intervention were well-received, indicating high acceptability and feasibility among participants.

Participants were asked to rate how helpful it was to see demonstrations of the handling methods, on a scale of 1 to 100. Although scores were variable, overall, the video was highly rated (Mean=88.40, SD= 17.98, range 50-100). Additionally, participants rated the effectiveness of the video as a training tool for recapturing escaped mice on a 5-point Likert scale. Results show that 27% of participants found the video “extremely effective”, while 53% rated it as “very effective”. 20% rated it as “moderately effective” (see Figure 7).

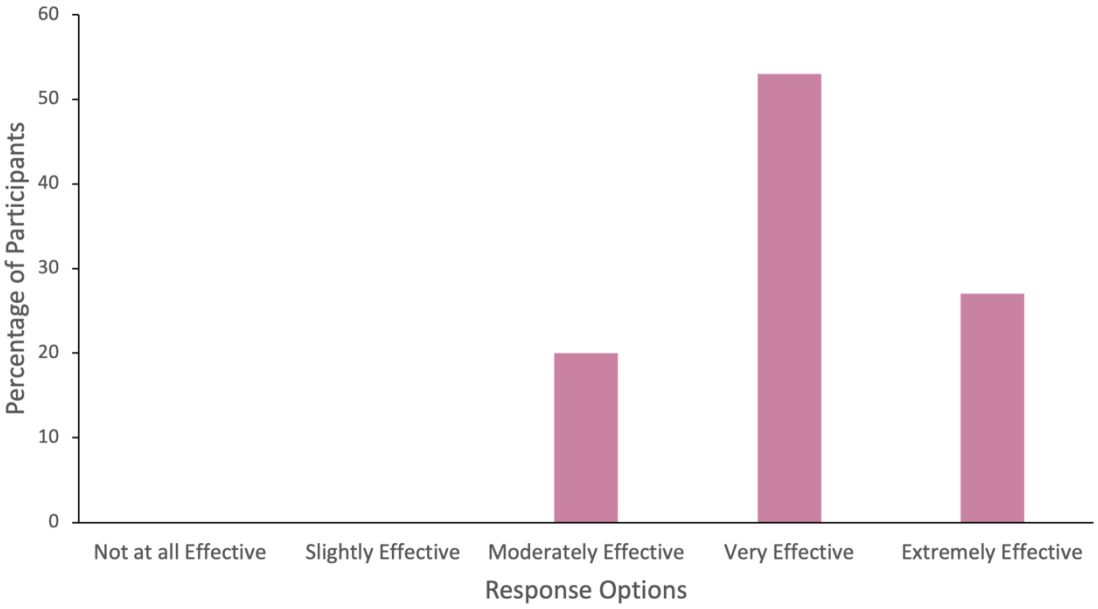

Figure 7: Participants’ rating of effectiveness of the video as a training tool

To evaluate the effectiveness of the discussion component within the intervention, participants were asked to rate its usefulness, using a 5-point Likert scale. Results indicated that 47% of participants found it “extremely useful”, while 40% rated it as “very useful”, and 13% considered it “moderately useful”. See Figure 8.

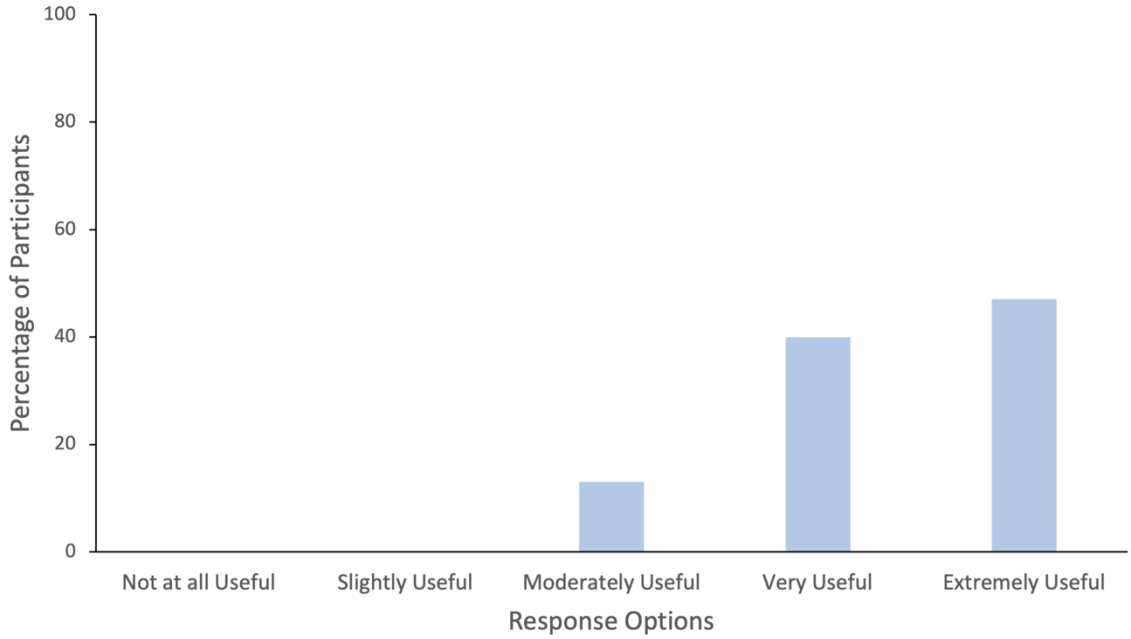

Figure 8: Participants’ rating of usefulness of the discussion after viewing the training video

Furthermore, the content and delivery of both the video and workshop were also assessed using sliding scales ranging from 0-100, representing a poor to excellent gradient. On average, participants rated the content of the video highly, with a mean score of 91.8 (SD: 9.82). Similarly, the delivery of the workshop was scored highly, with a mean score of 98.7, (SD: 3.88). The content of the workshop had a mean score of 93.3, (SD: 10.07), indicating high acceptability.

Finally, participants were asked how likely they would be to recommend the workshop and the video to other technicians on a 5-point Likert scale. 53% of participants expressed a strong inclination and reported that they would be “extremely likely” to recommend the video, with 47% reporting being “somewhat likely” (see Figure 9). Similarly, in relation to

the workshop, 53% of participants reported being “extremely likely” to recommend it, with 47% being somewhat likely. See Figure 10.

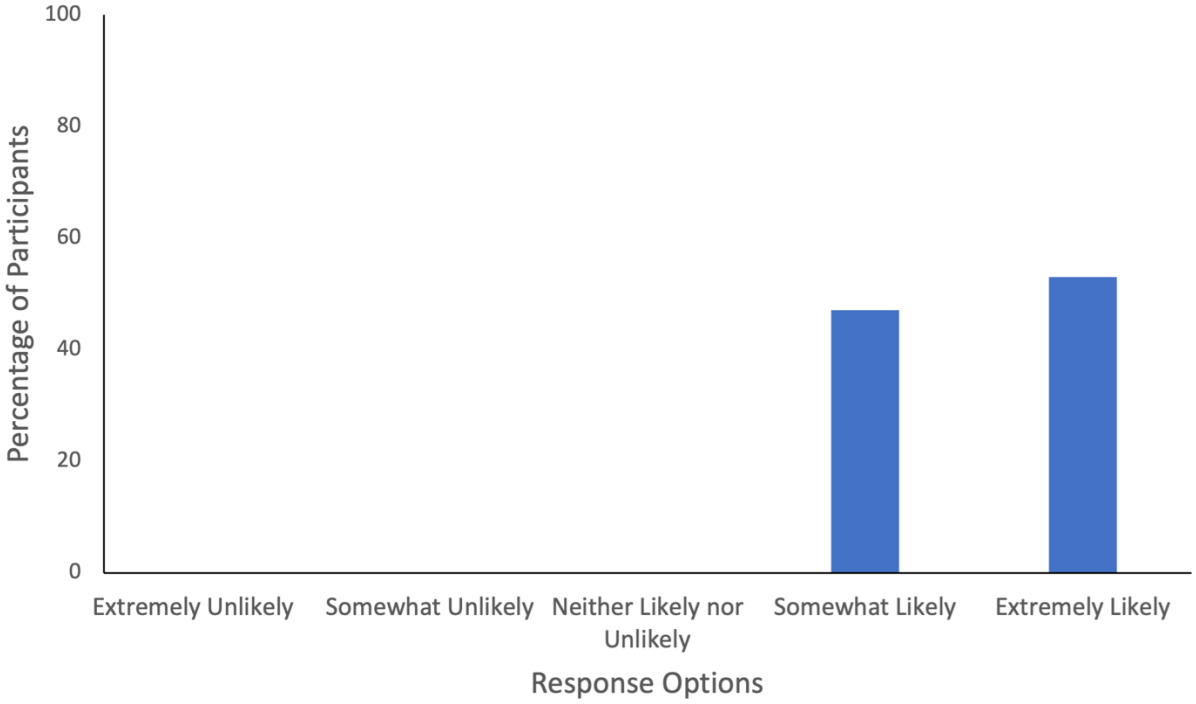

Figure 9: Participants’ likelihood of recommending the training video to other technicians

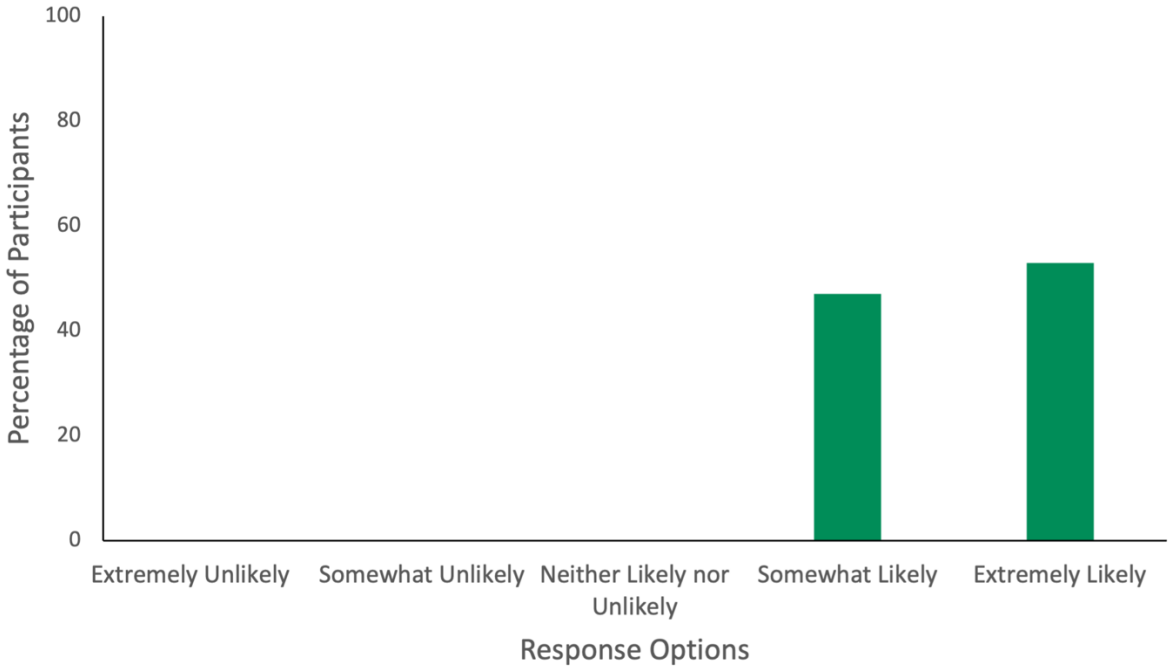

Figure 10: Participants’ likelihood of recommending the workshop intervention to other technicians

Knowledge

There was no significant difference in participants' belief before and after the intervention in the viability of using low stress methods during escapes (z = -.842, p =.400, n=15). The mean rating score before was (32.92) and after (33.07). This question was reverse-coded, a lower mean score (minimum score= 0, maximum= 100) would indicate stronger beliefs in viability. This suggests that participants already believed it to be possible that low stress methods could be used with escaped mice, and this did not change in response to the intervention.

Beliefs about Consequence

This domain was linked to the Behaviour Change Technique of Information about Social and Environmental Consequences (Michie et al., 2015). Overall, the participants maintained consistent beliefs regarding the consequences of tail capture during escapes, whether it be occasional, with no significant changes after the intervention.

The video intervention also did not significantly impact whether participants believed it is harmful to use tail capture during escapes (z = -1.453, p =.146, n=15). The mean score for the perception of harm was 76.13 out of 100 before the intervention, compared to 82.33 after, suggesting that participants already felt it was harmful to use tail capture during escapes. There was no significant difference in participants' beliefs about harm caused by occasional tail capture before and after the intervention (z = -1.695, p =.092, n=15). The mean score pre-intervention was 71.64, with 80.13 after.

Beliefs about Capability

This domain was linked to the Behaviour Change Technique of Instruction on how to perform the behaviour (Michie et al., 2015). The findings suggest that the intervention effectively enhanced participants' confidence in employing tunnel handling techniques across various escape scenarios, highlighting the efficacy of the intervention in improving practical skills from watching demonstrations of the behaviour.

The analysis revealed that there was a difference in confidence in recapturing mice from the hood (z= -2.201, p=.028, n=15). Participants reported more confidence after the intervention. In terms of recapture from the floor, the analysis revealed a significant increase in confidence (z= -2.807, p=.005, n=15) from pre-intervention. The analysis revealed a significant increase in confidence for recapturing mice from under a rack (z= -2.555, p= .011, n=15), with participants reporting increased confidence after the intervention. Finally, the analysis suggested a difference in confidence in using tunnel handling to recapture mice from a person (z= -2.371, p= .018, n=15). The participants report more confidence after the intervention. See Figure 11 for mean scores pre- and post-intervention.

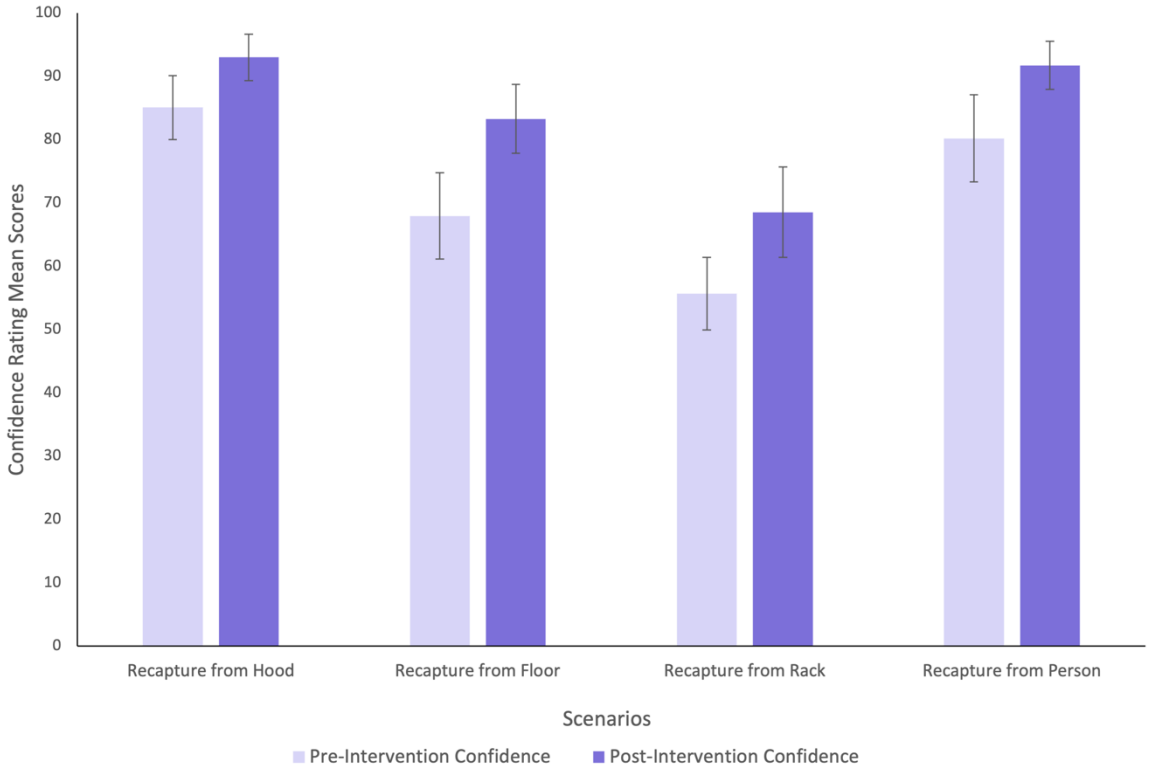

Figure 11: Mean Scores for confidence for applying tunnel handling in each escape scenario, displaying pre- and post-intervention. Error bars indicate one standard error of the mean.

Intentions and Motivation

The results indicate that the intervention led to a significant increase in the participants' intention to use tunnel handling across various escape scenarios. Most participants reported feeling extremely motivated to practice the techniques learned, with a majority expressing definite intentions to use tunnel handling in the future during escapes.

The analysis revealed a statistically significant difference in likelihood to use tunnel handling for recapturing mice from the hood (z= -2.375, p= .018, n=15). Participants reported to be more likely to use tunnel handling after the intervention. The analysis also found a significant difference in likelihood for recapturing from the floor (z= -2.847, p= .004, n=15) after the intervention. The analysis found a statistically significant difference between pre and post intervention for likelihood in using tunnel handling to recapture mice from under a rack (z= -2.731, p= .006, n=15). Participants reported being more likely to use tunnel handling after the intervention. And finally, the analysis found a statistical difference in likelihood to use tunnel handling to recapture mice that have escaped onto a person (z= -2.689, p=.007, n=15). Participants were more likely to use tunnel handling in this scenario after the intervention. See Figure 12 for the mean differences pre- and post-

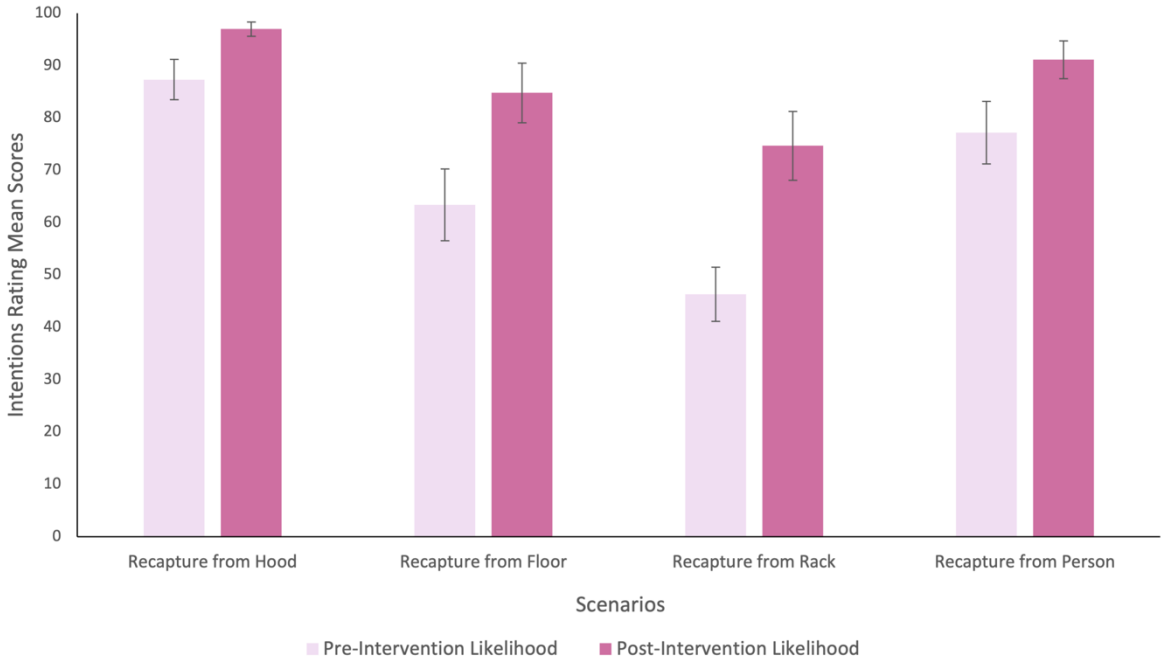

Figure 12: Mean Scores for intentions for applying tunnel handling in each escape scenario, displaying pre- and post-intervention. Error bars indicate one standard error of the mean.

After the intervention was delivered, participants were asked to rate their motivation to practise and refine the techniques learned from the video on a 5-point Likert scale, ranging from “not at all motivated” to “extremely motivated”. The majority of the sample (60%) reported feeling “extremely motivated”, while the remaining 40% reported being “very motivated” (See Figure 13).

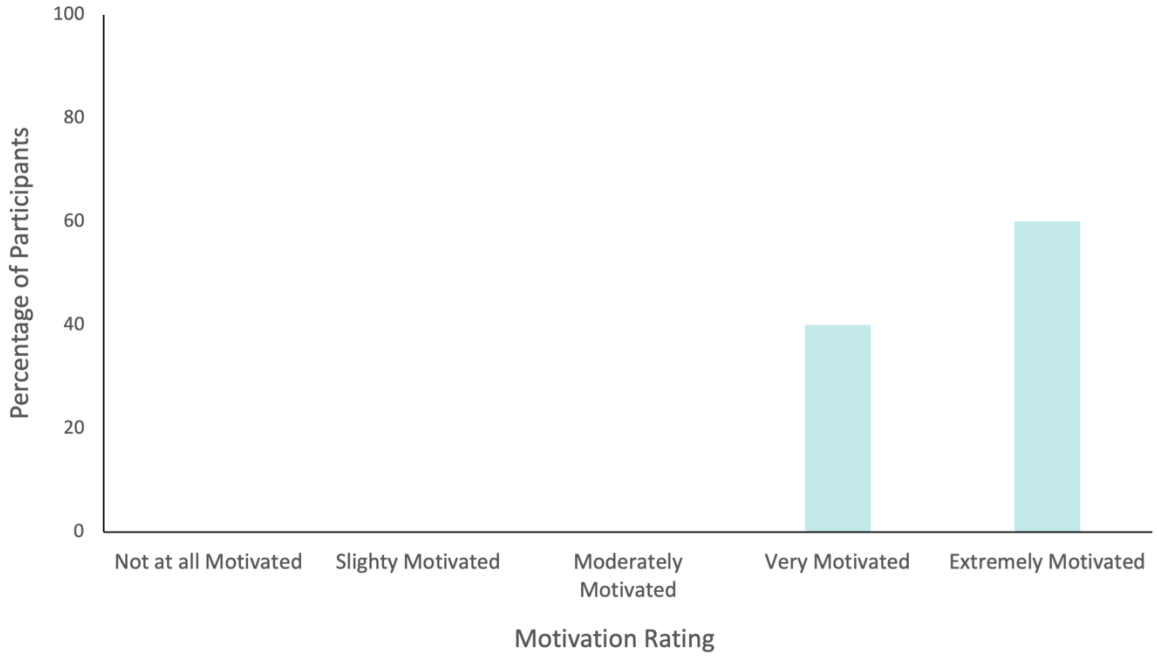

Figure 13: Participants' motivation rating to practice and refine techniques after the intervention.

Regarding intentions to use tunnel handling for mouse escapes in the future, participants were asked to rate their likelihood on a 5-point Likert scale. Results indicated that 40% of the sample expressed a definite intention to use tunnel handling, 20% selected "probably yes" and 33.3% reported that they already use tunnel handling. Only 6.7% were unsure about their future intentions (see Figure 14).

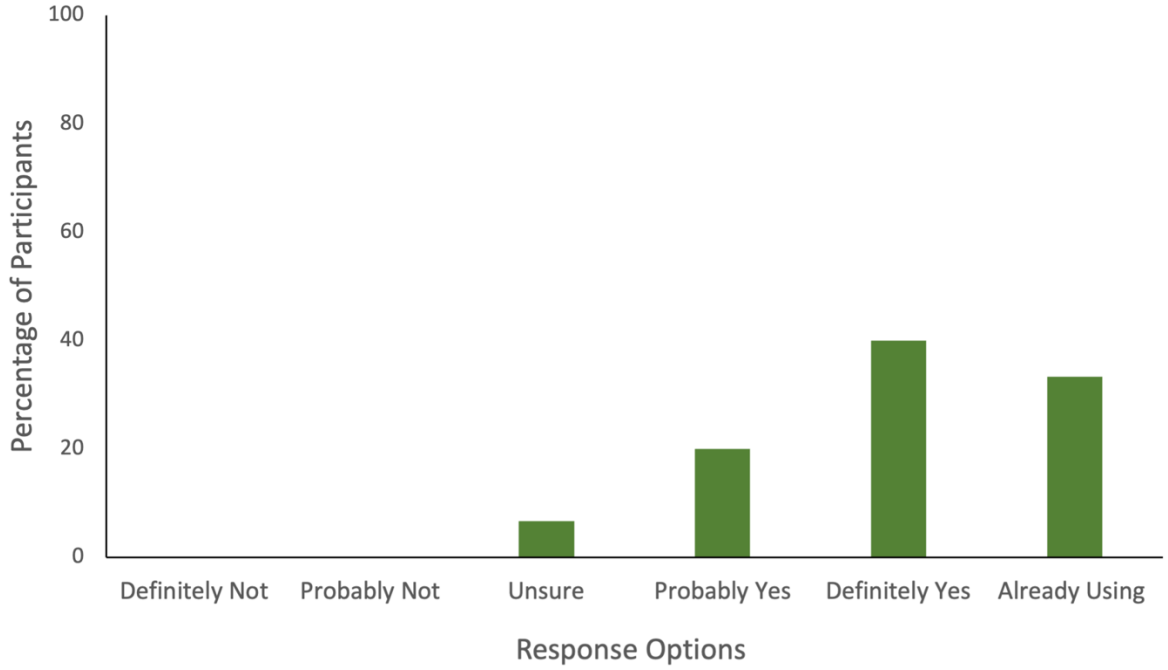

Figure 14: Participants' intention rating for using tunnel handling to manage escapes in the future

6.3.2. Qualitative Results

Survey Data

Participants were asked in the pre-intervention survey what methods they use to handle mice when they have escaped. There was a mixture of methods reported:

> *"Attempt tunnel, however, mostly tail handle."*
>
> *"Tunnel handled every time."*
>
> *"Guide them to an area where you can safely capture the mouse and scoop up with hands- cup handle."*

Ten out of the fifteen participants reported using low stress methods to recapture the mice in escape situations. The remaining five participants reported predominantly using tail capture.

Challenges and Difficulties

They were asked in the pre-intervention survey if they had ever experienced any challenges or difficulties with trying to use low stress handling with escape scenarios in the past. Six participants reported having no difficulties with using low stress methods to handle mice during escapes. The remaining nine participants reported a variety of challenges. Four participants referred to the unpredictability and speed of the mice upon escape:

> *"Hard to do low stress handling when escaped, as the mouse is too quick."*

> *"Mice are unpredictable, and you need to be as fast as you can to prevent harm to the mouse or not being able to find them."*

Other participants disclosed the difficulties they face when mice go under racks:

> *"Under a rack with fast escapees. These need to be caught and are regulated animals, stressful environment."*

> *"Very hard to convince a mouse into a tunnel when under a rack or on an open floor."*

These comments highlight the need for training for handling mice that escape under racks.

Video Clarity

In the post-intervention survey, participants were asked if there were any aspects that were confusing or unclear. Participants took this opportunity to share their concerns about the video. Some participants felt it was not representative of real-life situations:

> *"May need to use jumpy mice. Difficult to recreate 'real life' situation. Also, escapees difficult to catch under racks, long reach."*

> *"Not necessarily true to life. Difficult to capture the feeling and stress of a mouse escaping through a video with no obstacles and calm mice."*

Real Life Representation

These comments emphasised the challenges of accurately and ethically portraying the dynamics of real scenarios with mice. Furthermore, participants also shared their disappointment that the behaviour of the mice in the video did represent what they have experienced in these situations in real life:

"The mice were calmer than in real life."

This further highlighted the discrepancy between the video and real-life situations experienced. In addition, participants did not feel that the video represented racks in animal research facilities:

"The under the rack catching- wasn't done on a rack."

"No representation of mice escaping behind racks."

These comments highlight the need for accuracy in representing real environmental elements relating to animal research facilities. Participants were given the opportunity to share which aspect of the workshop they found the most useful. Primarily, participants found it valuable to view demonstrations of the handling being conducted:

"That tunnel handling from the floor is possible."

"Seeing it in action."

"That it's viable to capture a mouse underneath a rack with a tunnel."

Some participants responded briefly with less detail, and reported finding the video altogether useful:

"Actual video footage."

"The video."

This suggests that they appreciated the video in its entirety in enhancing their understanding of techniques. Other participants referred to the discussion element of the workshop:

"The group discussion about different escape scenarios."

"Very useful. Discussion was good."

Specifically, they found the exchange of ideas regarding different escape scenarios to be beneficial. This highlights the value that can be found in facilitating group conversations following the video content. These quotes illustrate the diverse perspectives on the workshop's effectiveness, emphasising the significance of demonstrations in video format and collaborative discussions with peers.

Key Messages

Finally, participants were asked what the key message they took away from watching the video. There was a variety of takeaway messages from the participants, however, the most common response was that it is possible to use tunnel handling in different circumstances:

"That tunnel handling is possible in most, if not all, situations of escape."

"That tunnel handling is always possible."

Two participants responded that their key message was to always be prepared with the resources:

"Always have a tunnel."

"Always have a tunnel in your pocket."

These responses emphasised that the participants understood the importance of being prepared by having a tunnel readily available. In addition to being prepared, some participants remarked that the handling techniques were easier than they anticipated:

"It's a lot easier and less chaotic than I originally thought."

"It's easy to tunnel handle."

"There is no major hurry to get the mouse back and tunnel handling can be done even if it takes a little bit longer to recapture."

These comments suggest that the video may have inspired some confidence in the participants by watching techniques used by the experienced handlers and accepting that tunnel handling can take a little bit more time in these circumstances. The comments reflect a positive shift in perceptions.

6.3.3. Workshop Focus Group Data Analysis

Following a screening of the video, participants were given 10 minutes to ask questions and engage in a short focus group discussion. The following themes were interpreted from the data:

Habituation

Participants conversed about the role of habituation of tunnel handling, and how using low stress methods for routine handling had made the mice used in the video calmer and easier to handle.

"If you've already got the animal used to tunnel handling in day-to-day scenarios… if- or when- they escape, it's going to be a lot easier."

Participants raised concerns about the generalisability of the video and that it may not be received well in other institutions that do not employ low stress methods, as the mice may not be as calm as the mice used in the video:

"*They [other institutions] don't handle the way we do. So, if they tried to do that… it's just not an accurate representation of what may happen."*

"You're looking at how easy would that be for somebody in a situation where they've never really used the tubes? Would they be able to actually get the mouse to go into it or be able to encourage it to go into it under a under a rack easily?"

This statement implies that the effectiveness of tunnel handling and the calm demeanour of the mice in the video may not be replicated in institutions that do not use low stress handling methods, as the mice will not have habituated to the tunnel.

However, participants mused that this may actually be a "selling point" to using tunnel handling for routine husbandry, as it may lead to calmer mice that are easier to handle during escapes:

"I suppose I would say it's an ideal thing. Like, it's an ideal thing of being like, "this is what everyone should follow. And this is why you should do it."

"Because this is what you can achieve. This does happen."

Therefore, they feel the video may have the potential to persuade those from external institutions to start using tunnel handling for general handling if they do not already:

"They're calm because of the way they're handled, so it has the knock-on effect for the escape."

In summary, the theme highlights the importance of using low stress methods such as tunnel handling in routine circumstances to allow mice to habituate such methods. Not only will it improve mouse welfare, but it can lead to easier handling in emergency situations like escapes.

Lack of Accurate Representation

Participants conveyed apprehensions that the video is not representative of real-life situations:

"I think the video shows a very empty room, so it makes it easier. When you've got a massive room with racks upon racks and then they just continually run around the edges. You can't get to them. It's really difficult. And then you do become in a panic situation."

"Obviously, a real-world situation in a mouse room is something like an IVC rack or couple of IVC racks where it'll dive underneath and it's very hard to get down to that level to get in."

This quote reflects a concern about the practical challenges of using tunnel handling in larger and more complex environments like a real animal research facility with an abundance of racks. The participant suggests that the calmness of the mice may be as a result of the artificial environment used for filming. They express the difficulty of handling mice in larger rooms where mice may run around the edges and be harder to access, leading to handlers feeling pressured and panicked to recapture.

Moreover, the participants feel that due to the mice being placed on the floor, it is not representative of the stress that mice feel when they actually escape and fall to the floor in real-life scenarios:

> *"Yeah, so it was placed on the floor. It's taken out all the stressors that the mouse is feeling."*

Placing mice on the floor may remove the environmental factors that induce stress in mice, such as falling, and this may potentially alter their natural behaviour during escapes. While the benefits of tunnel handling are recognised, the participants acknowledged the challenges of replicating real-life scenarios in controlled settings. Although filming natural behaviour would bring a more accurate representation, it would raise ethical concerns for the animals involved.

Suggestions for Improvement

During the focus group, participants discussed their concerns and simultaneously made suggestions for improvement for the video. The suggestions related to the type of mice used, and the facilities in which the video was recorded in.

> *"You need pups. Because the way they spring…"*
>
> *"And some really jumpy mice."*

The use of pups and particularly jumpy mice indicates that the behaviour of these mice may prove more challenging, and therefore be more representative of challenges faced

in real life situations. By including mice with various characteristics, the video could capture a wider range of responses that could happen during an escape.

> *"I would probably… if you're going to put it out to a wider audience, I would think about re-recording just that section just to make it a little bit more realistic under a proper rack."*

The suggestion to re-record the section of the video which shows how to recapture mice from under a rack using a more accurate representation of an animal research facility displays a need for more authenticity. The adjustment could provide the viewers with a more accurate representation of the challenges faced when mice escape in this scenario, and it may help the video be more accepted if shared more widely among the animal research community.

Scepticism

Some participants expressed some scepticism about the video and whether the techniques presented can be applied in real-life settings.

> *"But it's very well put together … But, you can obviously see it's stitched."*

This quote expresses the video's quality and the effectiveness in the messaging but feels that calm mice were deliberately used for ease of handling.

> *"And we've had it where they've been- this is pre-tunnel handling- and then under the racks and you've got three people and back and forward and yeah there's no way you can tunnel handle."*

This quote reflects the participants' fears that the methods cannot be applied in all circumstances, even with multiple people involved in trying to recapture the mouse. This person expressed that even with tail capture, retrieving the mouse in escapes under the rack were still very difficult, therefore, they are sceptical that recapture can be achieved using tunnel handling. Overall, these comments display the participants critical assessment of the video, and how it aligns with their lived experiences.

Habitual Responses

This theme encapsulates the reactions participants have when faced with an escape.

> *"Even though I've only ever done tunnel… But my instinct is… I panic. And I'm like, "Oh, my God, just grab the mouse.""*

Although this participant has only ever had experience of using tunnel handling, they report a feeling of panic and the instinct to simply grab the mouse when faced with an escape situation. Their personal experience highlight the challenges of overcoming ingrained, instinctive habits in high-pressure situations, even when individuals have been trained with low stress methods.

> *"Because I know my instinct would be go straight for the mouse rather than a tunnel."*

This quote further emphasizes the habitual response handlers can experience. It indicates a tendency to prioritise immediate action by directly grabbing the mouse, rather than taking the time to get a tunnel. This instinctive response highlights the need to train handlers to always have a tunnel easily accessible and reinforce the benefits of training themselves to get the tunnel in emergency situations to break such habits.

Practicalities in Real Life

Participants also discussed the practical limitations and challenges they face during some mouse escapes, particularly when there are physical challenges or unexpected difficulties.

> *"The other thing I was thinking I can't get on my knees, so I can't physically be able to get on the floor."*

This participant shared their physical limitations which prevents them from being able to get on their knees and accessing the floor easily. This highlights the importance of considering the physical capabilities and constraints of handlers when implementing mouse escape protocols.

> *"And then you might have two that jump at the same time. Just putting worst-case scenarios out here. Two that jump out that same time. Which one do you go for while you're in the room on your own?"*

Participants also shared potential worst-case scenarios where multiple mice escape, which can be difficult for handlers to navigate if they are working alone. This scenario can be complex, with handlers needing to make quick decisions and may not be able to adhere to tunnel handling protocols. Overall, these quotes share the practical realities and challenges that handlers may face, which may not be conducive to using the best practices that are promoted in the video.

Positive Impressions of the Video

Following the intervention, participants shared positive comments about the video. They praised the format, and their own beliefs about their capability.

> *"It's very well put together."*
>
> *"I think I probably just need to, like, not panic and then yeah, time. I think I could do it. If I just chill out a bit."*

The participant recognises their own anxiety and the importance of remaining calm. As a result of the training intervention, they have recognised that the methods are achievable, once they overcome their initial panic response and remain calm. This is a positive indicator of the impact of the intervention in building beliefs about capability.

> *"This is what you can achieve. This does happen."*
>
> *"Most techs would be happy to use them. I can't see a reason why they'd go, "no I'm not doing it.""*

This comment suggests a sense of optimism and reassurance as a result of the intervention. It indicates that the video has reinforced that the methods are possible and communicates realistic methods. Moreover, the comments suggest that the intervention and video would be perceived well across the animal technician community. The participant shares that they would be happy to use the techniques shared in the video, which indicates the methods are portrayed to be achievable.

6.4. Discussion

The aim of this study was to test the acceptability and feasibility of an evidence-based intervention, designed for technicians to build confidence by demonstrating techniques for how to recapture mice in the event of an escape. The intervention consisted of two parts: a short video demonstrating techniques for a range of scenarios, and a 10-minute discussion with a trainer, and was evaluated with pre-and post- intervention surveys. The data indicated that the intervention was deemed acceptable and feasible for use in future, suggesting that the approaches used from the health intervention sciences were successful. Participants found value in the demonstration of techniques in video format, and the ability to discuss the content with an experienced handler, but also made suggestions for improvement. The participants reported that they would recommend the video and workshop to other technicians, and the results suggest immediate impact in the form of increased confidence and likelihood to use the demonstrated methods. In addition to highlighting the immediate acceptability and feasibility of the intervention, these findings underscored the importance of continued research into the long-term effects of the intervention to determine if it leads to behaviour change.

The primary aim of this study was to determine the feasibility and acceptability of the intervention. Based upon the results, the intervention was accepted by the target audience, and concluded to be feasible for future piloting. Some slight adaptations should be made, as suggested by the participants. For example, based on the qualitative data, participants would recommend using different mice and equipment to enhance the realism of the footage, thereby increasing acceptability amongst the wider technical community. I recommend including dedicated time for discussion after presenting the video, as the literature suggests there are benefits to discussions in training scenarios, such as increased potential to committing knowledge to long-term memory (Takeucho et al., 2015). However, the focus group discussion element of the workshop would have benefitted from being longer. Due to the time constraints, the conversation had to be cut short, so that participants had time to complete the post-intervention survey. It must be noted that part of the discussion centred around improving the intervention to increase acceptability; participants were focussed on suggestions for the video. In a future

workshop pilot, the discussion would be more centred around the message and content of the video, rather than refining it, which may increase the opportunity for developing confidence and self-efficacy. Future workshops would benefit from being 45-minutes to 1-hour long to reduce the risk of cutting discussion short and allowing them to come to a more natural end.

The secondary aim of this study was to determine the immediate outcomes, specifically, if it increased the participant's belief about their capability to employ the demonstrated methods. The data suggested that participant's confidence in using tunnel handling for escapes increased significantly, in addition to likelihood to implement the methods. Participants also exhibited a high level of motivation to practice the learned techniques. As technicians work with animals in a caring capacity, this finding was not surprising as it was expected that they would have a high level of motivation to use methods that are in line with better welfare (Randall et al., 2021; Van Hooser et al., 2021).

Participants in the survey (see Chapter 3) expressed a perception that engaging in repeated attempts of tunnel handling induced more stress compared to performing a quick tail capture, and that occasional tail capture would not cause the mouse any harm. To date, there is no literature to support this claim. However, participants in this study reported their belief that occasional tail capture is harmful to the mice. This may be attributed to the training within the university that the intervention took place, which only trains and assesses handlers with low stress techniques. Furthermore, the existence of mouse handling guidelines in this facility prohibits the use of tail capture unless permission has been granted, or in escape situations. There may be more variation in staff beliefs in institutions where there are no strict handling guidelines or training, if this intervention were to be implemented elsewhere.

6.4.1. Implications

This work has the potential to improve mouse welfare by educating and supporting mouse handlers to feel confident and capable of using tunnel handling in escape situations. While the results suggested promising outcomes within the specific context of this animal

research facility, it is important to consider the potential generalisability of these findings in other institutions. Variations in organisational culture, resources and levels of experience among the animal care and research personnel could influence the effectiveness of this intervention in different settings (Green et al., 2006). As Chapter 3 found that there is an association between Culture of Care and tunnel handling habit strength, institutions with perceived poor Culture of Care may have fewer individuals who use tunnel handling for general husbandry which may limit their opportunity to build stronger habits (Lally & Gardner, 2013; Lally et al., 2010). Therefore, they may be less likely to attempt tunnel handling during emergency situations like escapes.

In the literature, training interventions have been reported to introduce tunnel handling methods, persuade animal care and research personnel to consider using them, and explore the barriers (Hohlbaum et al., 2020). However, to date there has been no published literature addressing specific barriers using training interventions. For example, Hohlbaum et al., 2020 carried out a series of training courses with a 40-minute lecture, 20-minute discussion and a survey in order to introduce tunnel handling to a facility in Berlin. Despite the participants' concerns that low stress methods techniques may increase the risks of bites and escapes, it is not clear if any specific training followed to address these apprehensions. Training to handle mice for emergency escape situations is not available on a public domain. The NC3Rs mouse handling training online omits this aspect of mouse handling, even though previous studies have identified escapes as a significant challenge. The university in which this intervention was implemented reported that escapes are not covered in their mouse handling training curriculum, highlighting that there is a gap in this area of training.

The study has provided a framework that could be applied for other laboratory animal welfare concerns. Using approaches from health interventions sciences, such as the TDF (Cane et al., 2012), facilitated an in-depth and systematic exploration of barriers and determinants of behaviour, and enabled us to identify specific behaviour change techniques to address, in addition to using the Behaviour Change Wheel to develop a targeted intervention for positive changes (Michie et al., 2015). The combination of using different frameworks is a robust approach, and may inspire future welfare scientists to

adopt similar methods. This approach can be adapted and applied to address various challenges in animal research, extending beyond husbandry practices.

Participants from this study were positive about the video format of the intervention, making it a feasible choice of information dissemination. Using a video format is conducive to wider information sharing, and this intervention can serve as a foundation for collaboration and knowledge-sharing within the animal research community. Research has shown the benefits to online instructional videos that demonstrate techniques in various contexts. For example, Seals et al. (2016) evaluated the effectiveness of instructional videos in place of live demonstrations in an osteopathic manipulative medicine course and found that students reported feeling more confident and prepared for their exams and considered the videos a valuable addition to their learning. Additionally, Noeteal et al. (2021) conducted a systematic review on the effectiveness of video in higher education settings and found that, on average, videos led to better learning outcomes compared with other methods, such as lectures. Their results were consistent across different types of videos, for example, demonstrations and recorded lectures. In this present study, the video format likely contributed to increased confidence and a higher likelihood of using tunnel handling for escapes, due to the clear messages and demonstrations conveyed. However, as this was a feasibility and acceptability study, I did not measure any behaviour change, so I cannot conclude the effectiveness of the video. Future research can evaluate whether the video intervention leads to full time adoption of tunnel handling for escapes and if it improves outcomes in this context. Nevertheless, we should be cautious about the effectiveness of videos as learning tools. While Seals et al. (2016) found that students were positive about videos as a learning tool, there were no statistically significant improvements in examination scores, demonstrating that outcomes did not change as a result of using instructional videos. However, in this study the training video was supplemented with the discussion element, which may have consolidated the knowledge through group feedback and reviewing the material (Anwar et al., 2020) and may increase the likelihood of behaviour change.

6.4.2. Limitations

There were limitations to the intervention. Participants disclosed that they felt the video did not represent mice escaping under a rack accurately, as a rack could not be used in the video due to ethical concerns, so a trolley was used in its place. Moreover, the mice did not exhibit the natural behaviours of a mouse that had really escaped, as they were placed on the floor and did not experience the stress associated with jumping off an IVC hood and landing on the floor. This could be mitigated by refilming in facilities that more routinely use tail capture to handle mice, as these mice may exhibit more natural stress responses.

Moreover, this study may be influenced by social desirability bias, where participants may have felt compelled to respond in ways that align with perceived group norms or expectations, especially in a group setting (Grimm, 2010). For instance, they may have refrained from openly expressing negative opinions about the video if they sensed that other participants held more favourable views. This dynamic could possibly shift individual attitudes, and thereby true opinions may not have been expressed in the discussion element of the intervention. However, the post-intervention survey included a qualitative question, offering participants the opportunity to share any additional thoughts about the intervention. This provided a more private space where they could express views they may have felt uncomfortable sharing in a group setting: and indeed, these opinions were shared and can be used to refine this intervention tool.

6.4.3. Future Research

Further research is needed to measure the long-term implications of this intervention. Specifically, it is essential for evaluation to explore whether participants had the opportunity to put the techniques learned from the video into practice and refine their skills and build confidence over time. Follow-up post-intervention interviews could be an appropriate method to explore this after three months; the interviews could delve into whether participants had experienced any escapes, or potential escapes, and what methods they used to retrieve the mice. This qualitative approach would provide a valuable opportunity for a comprehensive understanding of the long-term effects of the

intervention, and opportunities for feedback before wider implementation after the participants have had the chance to put the skills into practice in real scenarios. LaFollette et al. (2020) followed up with participants after a two-month period to examine if their rat tickling intervention led to wider implementation of the refinement. Their results suggested that the intervention increased the implementation of rat tickling compared to the control group, who were not part of the intervention. LaFollette et al.'s (2020) approach demonstrates the value of examining the long-term effects of an intervention and monitoring its success.

Future work should pilot the intervention in a variety of universities. Universities vary in their mouse handling guidelines and there are variations in the employees' understanding of them (see Chapter 3). Conducting comparative analyses across different institutions would provide valuable insights into the factors influencing adoption and the efficacy of the intervention in diverse settings. The piloting study would not only enhance the generalisability of the intervention, but also improve the welfare of laboratory mice if successfully disseminated.

However, before the video is widely implemented, it may benefit from being refined following the suggestions from participant feedback. For example, it could be filmed securely in an authentic mouse room with equipment, which would enhance the ecological validity and thus the credibility of the materials among the target audience. Additionally, using mice that are regularly handled with tail capture could showcase more challenging mouse behaviour, which would demonstrate that tunnel handling is still effective and doable in escape situations. To support the dissemination, the video could be hosted on websites that promote animal welfare techniques, such as the NC3Rs, where it could be widely reached by animal research personnel globally.

Chapter 7. Final Discussion

7.1. Thesis Conclusions

This thesis aimed to build an understanding of the barriers to adopting tunnel handling full time in university animal research laboratories. Following an in-depth exploration of barriers and facilitators, I developed and implemented a novel evidence-based intervention to address a specific barrier to full time use.

Exploratory work was conducted to understand the environment and dynamics in laboratories and examined how tunnel handling was implemented in different universities. These initial conversations and shadowing revealed preliminary barriers and facilitators, and the role of organisational culture, hierarchies and habits. This paved the direction for the development of a survey, distributed to seven universities in the UK, using the Theoretical Domains Framework for a structured exploration of determinants which may influence handling behaviour. Despite the participants reporting the predominant use and knowledge of low stress methods, many shared specific instances whereby they felt tail capture was the only option to use. This was explored further using interviews with a sample of technicians. Technicians were the focus of this study, as they handle mice more frequently on a day-to-day basis and are typically responsible for training researchers in new techniques. Therefore, they have more potential to disseminate the knowledge and techniques they acquire.

From the triangulation of data collected in this project, there were many possible interventions that could have been developed to facilitate the wider uptake of tunnel handling. For example, an alternative intervention could have been designed to improve perceptions of Culture of Care based on the data in Chapter 3, which found an association between tunnel handling habit strength and perception of culture. However, due to the limited timeframe, and the potential for wider impact and dissemination, I decided to develop a focussed training intervention for technicians that was more positively assessed considering the APEASE criteria. I created a training video where common escape scenarios were safely recreated, and an experienced handler demonstrated how to

recapture the mice using tunnel handling. It aimed to increase knowledge of techniques to use tunnel handling in the various escape scenarios and build confidence in technicians to practice it. The intervention consisted of a workshop facilitated by experienced training technicians, who screened the training video, with an opportunity for questions and discussion. The intervention activities were designed in line with the TDF and behaviour change theory to encourage and motivate the technicians to learn that such techniques are possible in extreme circumstances. In addition, the intervention was developed alongside key stakeholders from the technical community, to increase the likelihood of acceptability among my target audience. To measure immediate impact, acceptability and feasibility, the participants completed pre- and post-intervention surveys. The data revealed an increase in confidence and intentions to use tunnel handling among the participants for future escape scenarios, suggesting high acceptability and feasibility, and paving the way for a future pilot study.

7.2. Reflections on Approaches

Initially, this research was guided by a post-positivist approach (Fox, 2008), with the aim of systematically identifying barriers and determinants to the adoption of low stress handling methods using quantitative and qualitative methods in Chapter 3. As the research evolved, I started incorporating more phenomenological elements into my research design in Chapter 4. This shift was particularly important for understanding the subjective experiences of technicians, which highlighted the importance of context and individual perceptions.

The post-positivist stance facilitated the use of surveys to quantify the handling methods used and barriers encountered by handlers, providing a broad overview of the challenges faced. The adoption of phenomenological approach allowed for a deeper exploration of the personal experiences and nuanced insights of technicians through qualitative interviews. The approach of combining both post-positivism and phenomenology in this project allowed me to have a more comprehensive understanding of the barriers to full time adoption of low stress methods. This can be considered a novel methodological

contribution to exploring barriers to using refinements in a laboratory animal welfare context.

However, despite this comprehensive approach, the generalisability of the findings beyond the specific research context might be limited. This project focussed on university laboratory facilities and involved participants from seven UK universities. The perspectives might differ in institutions with different guidelines, or those that allow tail capture for routine handling. Including a broader range of universities, especially those without specific handling guidelines, would provide a more representative view of the barriers to adopting low stress methods. While the project focussed on seven universities that had committed to improving animal welfare by increasing the use of low stress methods, this selective approach can be considered a strength. By including universities that had undergone the process of change, the project offered a valuable lens in into the facilitators and barriers experienced during the transition to the implementation of a new handling method. This focus allowed for an in-depth exploration of the implementation challenges in animal facilities that are actively working towards adopting the best practices with regards to welfare. Although the findings may be less generalisable to universities that have not yet adopted tunnel handling, the project offers key insights into the process of organisational change in laboratory animal care practices, and common barriers that may be experienced.

It is also important to acknowledge my role as a researcher and the potential impact this may have had in my interactions with technicians throughout the project. The literature has documented the complex dynamics between technicians and researchers, which can impact the data collected (see Brown, 2013; Nuyts & Friese, 2023; Chapter 2 of this thesis). Given the nature of this project, the participants involved may have been cautious in their responses, particularly if they perceived a power imbalance or any judgement from a researcher for advocating for low stress handling methods.

Furthermore, despite efforts to include a wide range of perspectives, this project was subject to self-selection bias. Those who chose to participate may have had strong views about mouse handling or laboratory animal welfare, which may have skewed the data. For example, technicians who use tail capture for routine handling may have opted not to

participate in any aspect of this work, leading to a dataset that might not fully reflect actual handling practices in the wider university research community. Addressing these limitations in future research would involve actively seeking out a broader range of participants and contexts to gain a more balanced representation of perspectives. It is important to recognize that such challenges are common across research studies. To address these issues effectively, efforts should be made to include a diverse range of participants, ensuring that a wide array of perspectives is represented.

7.3. Next Steps for Intervention Development

According to feedback, to develop a training intervention with widespread impact, a training video with more realistic scenarios is required. I would aim to use mice regularly handled via tail capture, potentially leading to more stress-induced responses and behaviours resembling those of escaped mice. Following this, the next step should be to pilot the intervention across various animal research facilities at UK universities, including those who have already partnered this work. This would require further stakeholder engagement and travel to universities to build relationships, before the intervention delivery and evaluation takes place. In addition, long-term evaluation will be needed to determine if the intervention was successful. Evaluation would take place in the form of interviews to ascertain whether people have attempted to use the techniques learned from the video when dealing with escapes, which would serve as an indicator of success.

7.4. Implications for Laboratory Animal Welfare

The findings from this research have important implications for the adoption of low stress handling methods. While the literature demonstrates a widespread awareness of the benefits of low stress techniques, their implementation remains inconsistent. Ideally, individuals would be expected to align their handling with the evidence, but in reality, this is not the case. By thoroughly exploring the barriers to adoption, this work has made an original contribution by developing a novel intervention designed to address a specific barrier that has been commonly reported in the literature. The intervention was co-

designed with stakeholder engagement and has been tested for acceptability and feasibility.

It is evident from the data that there is a notable absence of training specifically tailored for managing mouse escapes. Given that mouse escapes are sporadic and unpredictable, this is an important gap to address as it could reduce the risk of harm to both the mice and the handlers. The developed intervention can serve as a novel training for escapes, tailored specifically for technicians who are often responsible for training researchers. Not only will the training intervention lead to more confident and skilled handlers who would be able to manage future escape scenarios, it will lead to better welfare for the mice. The intervention can serve to empower individuals to consistently use low stress handling methods for all instances. Ultimately, this will lead to skilled handlers who enhance the welfare for mice and foster a positive research environment where welfare is prioritised. Moreover, the same approach could be taken to produce an intervention specifically for researchers who have reported the same barriers, adapted for their specific needs. This thesis has also identified areas for future research; this work would benefit from a longitudinal assessment of the long-term effectiveness and sustainability of the intervention. This could involve follow-up assessments at regular intervals to measure changes in behaviour and attitudes over time, which would ultimately benefit the welfare of laboratory mice.

Implementing the workshop and video is not complex, making it feasible to introduce them across various settings. The intervention is cost-effective and scalable, which supports its ability to be implemented widely. Furthermore, the benefit of a training video is the potential for widespread dissemination, as it can be easily shared and hosted on accessible online platforms. One platform to explore is the NC3Rs website, which is considered an existing hub for best practice, and has the potential to reach laboratory animal personnel internationally, improving handling practices worldwide.

This research makes a unique theoretical contribution to the literature by applying approaches that are typically used in the health intervention sciences, to the field of animal welfare. This thesis may inspire future laboratory animal welfare intervention

developers to combine interdisciplinary approaches that are traditionally applied to health psychology fields, exploring behaviour in a laboratory context with a new lens. By using frameworks like the Theoretical Domains Framework alongside the Behaviour Change Wheel, researchers can complete in-depth assessments of behavioural determinants, which facilitates the selection of tailored techniques for intervention design in diverse settings. Using frameworks can also allow the intervention developers to align the intervention functions with the specific needs of the context where it will be delivered, increasing the effectiveness, relevance and coherent evaluation. For example, this thesis may serve as a blueprint for using health intervention and implementation sciences for other welfare concerns. While the focus in my thesis has been on mouse handling and understanding barriers to full time low stress adoption, the principles, techniques and approaches used could potentially be adapted to explore other animal welfare concerns and create interventions that are both evidence-based and context-specific. This is the first time these health intervention methods have been applied to explore barriers in relation to low stress handling methods. Moreover, this is the first time, to date, that multiple health intervention frameworks have been successfully used in a laboratory animal welfare context.

In exploring the factors which may influence the full-time adoption of low stress methods, I investigated workplace guidelines and their impact, which is a new approach to understanding contextual barriers to a specific behaviour in an animal welfare context. The variation of understanding of guidelines within institutions was particularly apparent across seven universities. This discovery contributes new knowledge to the field by highlighting that inconsistent interpretation of guidelines may be a barrier to the adoption of welfare refinements. Moreover, this project revealed a novel insight that individuals perceive training as a guideline, emphasising its role in establishing formal behavioural standards. This perspective was not observed, particularly in the animal welfare setting. By highlighting this view, this research has underscored the significance of training as a factor in influencing behaviour in laboratory settings. The key implication of these findings is the critical importance of senior leaders to consider effective dissemination of workplace guidelines and training. Ensuring clear communication can enhance understanding and adherence, thereby supporting the consistent adoption of new

practices. In addition, formalised training programmes may serve as influential tools for promoting low stress handling methods; a mouse escapes training video may influence compliance with using low stress methods for future escapes if it is in line with the handling standards of the animal facility.

This project enabled a novel investigation into how factors such as Culture of Care and habitual practices influence behaviour by examining the interaction between individual- and organisational-level determinants. This approach has highlighted the need to address both levels in any behaviour change initiative, as this research revealed they both shape the adoption of low stress handling methods. Unexpected determinants, such as perceptions of workplace guidelines, Culture of Care and habits, had emerged as critical influencers of behaviour. For example, the relationship between organisational culture and individual behaviour has been explored in the healthcare literature, but has not been formally explored in the context of laboratory animal welfare. This project highlights the importance of these determinants using insights from the health literature and sciences. By applying behaviour change frameworks like the Theoretical Domains Framework, this research provided a structured and systematic analysis of the barriers to adopting tunnel handling. This approach not only provided new, context-specific insights into laboratory animal welfare, but also demonstrated the value of integrating behavioural science methodologies in this field.

As we have identified that organisational factors such as workplace guidelines and Culture of Care perceptions can influence the adoption and implementation of practices, it would be interesting to explore the barriers to using tunnel handling in different research contexts. This project focussed only on UK universities, exploring this specific context in depth. However, the barriers and facilitators may be different- or relevant- in pharmaceutical companies. Therefore, the intervention could potentially be adapted and implemented in these settings to improve animal welfare and research quality on a larger scale.

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Appendix A: Survey Information Sheet (Chapter 3)

Title of Study: Examining how workplace culture impacts the development and maintenance of new habits to refine laboratory animal welfare

Invitation and Brief Summary

You are being invited to take part in a research study. Before you decide whether or not you wish to take part it is important that you understand why the research is being done and what it will involve. Please read this information carefully and discuss it with others if you wish. Take time to decide whether you wish to take part. If you do decide to take part, you will be asked to sign a consent form. However, you are free to withdraw at any time, without giving any reason and without any penalty or loss of benefits.

What is the purpose of the research?

This survey aims to find out about how workplace culture affects the formation of new behaviours, specifically tunnel handling mice. There is very limited existing research in this area, and this study builds upon previous studies by the research team exploring barriers and facilitators to tunnel handling.

What does taking part involve?

It involves completing an online survey on the Qualtrics platform. Before you start the survey, you will be given information about the study, and an online consent form to complete. You will be able to complete it on either a computer or a mobile device. It should take approximately 15 minutes; however, you are free to withdraw at any point in the survey.

What information will be collected and who will have access to the information collected?

The survey will ask you about your perceptions of the workplace culture, and your current methods of handling. It will also ask you about your experiences of tunnel handling.

You will not be asked for information on any sensitive issues. All data collected will be kept strictly confidential and you will not be identifiable. No personal information will be collected. Only the research team will have access to the data, on password-protected devices. There are no plans for the re-use of data after the completion of the project.

Why have I been invited to take part?

You have been invited as you are a researcher/technician who currently works with mice as part of your role.

What are the possible benefits of taking part?

There will be no direct benefit to the participant for taking part. However, your participation will provide the researcher an understanding of the role of workplace culture in habits for mouse handling. This will help to shape and accurately plan future research studies for the project, which aims to improve animal welfare.

What are the possible disadvantages and risks of taking part?

We do not anticipate any disadvantages arising as a result of participation in this study. You will not be asked to change the way you work, and you are free to withdraw from the study at any point.

Has this study received ethical approval?

This study has received ethical approval from Newcastle University Ethics Committee on 02/02/2022. REF:18371/2021

Who should I contact for further information relating to the research?

Farhana Chowdhury, email: f.chowdhury3@newcastle.ac.uk

Appendix B: Survey Exploring Barriers and Facilitators to Low Stress Handling (Chapter 3)

Section		Question	Response Options	TDF Domain
Consent	Q	Please tick if you consent to taking part	Tick box	
Demographics	1	What is your job role?	Animal care technician Senior animal care technician Named person Animal husbandry Technical assistant Researcher PhD student Researcher postdoc Researcher principal investigator Manager Other (please specify)	
	2	Does your role involve handling mice?	Yes No	
	3	How long has your work involved handling mice?	Scale- in years	
	4	What is your age?	Number scale	
	5	What is your gender?	Man Woman Non-binary Prefer not to say Prefer to self-describe	
Workplace guidelines	6	Are there workplace guidelines for you to follow, when selecting a handling method?	No Yes (please describe)	

	7	What is the recommended method for handling mice in your place of work?	Tunnel handling Tail capture Cupping Other low-stress method (please describe) other (please describe) Not specified	
	8	Thinking about times when you handle mice following unit guidelines, to what extent do you agree which the following statements? - I have no problems remembering how to handle mice following unit guidlelines. - It is up to me which handling method I choose to use. - I can sometimes forget to use the recommended handling method. - I sometimes use a handling method I know I shouldn't. - Using tunnel handling or other low-stress methods is part of my professional identity (i.e., the values and beliefs I share with other people in the same role as me) - Using tunnel handling or other low-stress methods is part of my job - I am confident that the animal unit sets guidelines that are in the best interest of both animals and the staff. - I choose to handle mice using the method recommended by my workplace - How I handle mice now is the result of strong, formed habits. - I consciously remind myself to handle mice following workplace guidelines.	Strongly disagree Somewhat disagree Neither agree nor disagree Somewhat agree Strongly agree	Memory, attention, decision making (Q8-1, 8-2) Memory, attention, decision making (Q8-3, 8-4) Social role professional identity (Q8-5, 8-6, 8-7) Intentions (Q8-8) Behaviour regulation (Q8-9)

				Memory, attention, decision making (Q8-10)
	9	If you sometimes use a handling method you know you shouldn't, please explain under which circumstances this can happen.	Free response	
	10	Tunnel handling or other low-stress methods are something… - I do automatically - I do without having to consciously remember - I do without thinking - I start doing before I realise I'm doing it	Strongly disagree Somewhat disagree Neither agree nor disagree Somewhat agree Strongly agree	Behaviour regulation (Q10-1, 10-2, 10-3, 10-4)
Present role	11	What animal-related activity do you engage with in your role?	Research activity- experiments and procedures Animal care and husbandry Other (please specify)	
	12	Which of the following options best describes how often you handle mice?	I have not handled mice in the last year Daily Weekly Monthly Yearly	
	13	When you are handling mice, how often do you use the following methods? - Tail capture - Tunnel handling - Other low-stress method (e.g. cupping)	Never Rarely Some of the time Most of the time All of the time	

	14	How long have you used tunnel handling or other low-stress methods to handle mice?	Scale- in years	
	15	In which situations do you use tail capture (please describe all instances)	Free response	
	16	Why do you use tail capture in these situations?	Free response	
	17	In which situations do you use tunnel handling or other low-stress methods? (Please describe all instances)	Free response	
	18	Why do you use tunnel handling or low-stress methods in these situations?	Free response	
	19	Thinking about the method you use to handle mice, to what extent do you agree with the following? - How I handle mice can have a genuine, positive impact on their welfare - I believe that using tunnel or other low-stress handling methods will help me enjoy working with mice more. - How I handle mice can positively impact the quality of scientific data - My goal with my work is better welfare for the mice - I plan to work in ways which ensures better welfare for mice. - Better welfare for mice is my main priority - Using tail capture will not have a negative impact on mouse welfare.	Strongly disagree Somewhat disagree Neither agree nor disagree Somewhat agree Strongly agree	Beliefs about consequences (Q19-1, 19-2, 19-3) Goals (Q19-4, 19-5, 19-6) Beliefs about consequences (Q19-7)

20	How confident are you in your ability to use the following handling methods? - Tail capture - Tunnel handling - Other low-stress methods (e.g. cupping)	Not at all Slightly Moderately Very Extremely	Beliefs about capability (Q20-1, 20-2, 20-3)
21	To what extent do you agree which the following statements? - People give me positive feedback for when I follow the guidelines for how mice should be handled in the unit. - There are negative consequences if I use a handling method that is not in my unit's guidelines - I feel it is worthwhile to follow the guidelines for how mice should be handled in the unit. - If the mice have better welfare, that makes me happier - The method I use to handle mice is the easiest one for me - The method I use to handle mice makes me happier - My job is more pleasant when I handle mice using methods of my choice.	Strongly disagree Somewhat disagree Neither agree nor disagree Somewhat agree Strongly agree	Reinforcement (Q21-1, 21-2, 21-3 21-4) Beliefs about capability (Q21-5) Reinforcement (Q21-6, 21-7)
22	To what extent do you agree with the following statements? - My handling methods can have a positive impact on the culture in the animal unit - I am optimistic that I can adapt to new handling methods, if needed	Strongly disagree Somewhat disagree Neither agree nor disagree Somewhat agree	Optimism (Q22-1, 22-2)

		- Stress from my role can affect my handling behaviour - It would make me unhappy if the mice don't have good welfare.	Strongly agree	Emotion (Q22-3, 22-4)
Process of change	23	Since you started handling mice, have you changed your handling method for routine circumstances?	Yes No	
	24	Please select the statement that best describes the change you have made.	From tail capture to tunnel or other low-stress handling methods From tunnel or other low-stress handling methods to tail capture From one low-stress method to another low-stress method	
	25	To what extent did the following factors influence your handling behaviour over your career? - Understanding scientific benefits of different methods - Knowledge of welfare benefits. - Learning new methods as a result of changes in role and/or responsibilities. - To improve mouse welfare. - To enhance research quality. - Belief that it's the "right thing to do".	Not at all A little Somewhat Moderately A lot	Knowledge (Q24-1, 25-2) Social role professional identity (Q25-3) Beliefs about consequences (Q25-4, 25-5, 25-6)

26	Thinking about the influence of other people, how much did the following factors influence your handling behaviour over your career? - Feeling encouraged to do it like this by colleagues/peers - Wanting to fit in with colleagues/peers - Being expected to handle mice in a certain way by my colleagues/peers - Feeling like "that's just the way it's done here" - Pressure from colleagues/peers to use similar methods	Not at all A little Somewhat Moderately A lot	Social influences (Q26-1, 26-2, 26-3, 26-4, 26-5)
27	Were you able to be open with managers about any difficulties you had during the transition to tunnel or other low-stress methods?	Yes No N/A	
28	Were you able to be open with peers/colleagues about any difficulties you had during the transition to tunnel or other low-stress methods	Yes No N/A	
29	To what extent did you support the change to tunnel handling or other low-stress methods?	I completely opposed it I somewhat opposed it I neither opposed nor supported it I somewhat supported it I completely supported it	
30	Thinking about new guidelines, how motivated do you feel to engage in changes to your handling behaviour?	Not at all motivated Rarely motivated Somewhat motivated Very motivated Always motivated	Intentions (Q30)
31	What was the main reason for changing to tunnel handling or other low-stress methods?	Free response	

	32	Did you have access to the following when changing to tunnel handling or other low-stress methods? - Practical training in low-stress handling. - Online training in low-stress handling - Opportunities to practice low-stress handling	Not at all A little Somewhat Moderately A lot	Skills (Q32-1, 32-2 32-3)
	33	Thinking about the process to changing to tunnel or other low-stress methods of handling, to what extent did the following apply to you? - I strongly believed I had the skills to make the change - I doubted my ability to change my handling method - I believed I was in control of this new method of handling - Using tunnel handling or other low-stress methods made me feel happier	Strongly disagree Somewhat disagree Neither agree nor disagree Somewhat agree Strongly agree	Beliefs about capability (Q33-1, 33-2, 33-3) Emotion (Q33-4)
Culture of Care Barometer	34	Please indicate the extent you agree with each of the following statements by ticking one box on each row. This tool is intended to encourage self reflection, so take your time to consider each statement. "Unit" refers to the animal facility in your place of work. - I have the resources I need to do a good job - I feel respected by my co-workers - I have sufficient time to do my job well - I am proud to work in this unit - My line manager treats me with respect - The unit values the service we provide	Strongly disagree Somewhat disagree Neither agree nor disagree Somewhat agree Strongly agree	Environmental context and resources

	35	I would recommend this unit as a good place to work I feel well supported by my line manager I am able to influence the way things are done in my team I feel part of a well-managed team I know who my line manager is Unacceptable behaviour is consistently tackled There is strong leadership at the highest level in this unit When things get difficult, I can rely on my colleagues Managers know how things really are I feel able to ask for help when I need it	Strongly disagree Somewhat disagree Neither agree nor disagree Somewhat agree Strongly agree	Environmental context and resources
	36	I know exactly what is expected of me in this job I feel supported to develop my potential A positive culture is visible where I work The people I work with are friendly My line manager gives me constructive feedback Staff successes are celebrated by the unit The unit listens to staff views I get the training and development I need I am able to influence how things are done in this unit The unit has a positive culture	Strongly disagree Somewhat disagree Neither agree nor disagree Somewhat agree Strongly agree	Environmental context and resources
	37	I am kept well informed about what is going on in our team I have positive role models where I work I feel well informed about what is happening in the unit My concerns are taken seriously by my line manager	Strongly disagree Somewhat disagree Neither agree nor disagree Somewhat agree Strongly agree	Environmental context and resources (Q37-1) social influences (Q37-2)

				Environmental context and resources (Q37-3, 37-4)
	38	There is a culture of openness in the unit Unacceptable behaviour with regards to animal welfare is always tackled I have sufficient time to follow the recommended practices in the unit There is a culture of honesty in the unit	Strongly disagree Somewhat disagree Neither agree nor disagree Somewhat agree Strongly agree	Environmental context and resources
Psychological safety	39	Please indicate the extent you agree with each of the following statements: - If a person makes a mistake, it is often held against them - I am able to bring up problems and tough issues - People sometimes reject others for being different - It is safe to try new things - It is difficult to ask other people for help - No one would deliberately act in a way that would undermine my efforts - My unique skills and talents are valued and utilised	Strongly disagree Somewhat disagree Neither agree nor disagree Somewhat agree Strongly agree	Environmental context and resources
Optimism	40	To what extent do you agree with the following statements? - I am optimistic about tunnel or other low-stress handling methods. - I am optimistic that tunnel or other low-stress handling methods will be widely adopted in the future - I am pessimistic about the current rate of uptake of tunnel or other low-stress handling methods	Strongly disagree Somewhat disagree Neither agree nor disagree Somewhat agree Strongly agree	Optimism
Feedback	41	Do you have any comments on this survey, or any suggestions for improvements?	Free response	

Appendix C: Scoring for Self-report Handling Method Data (Chapter 3)

Consistent Scores

Tail Capture	Tunnel Handling	Other methods	Scoring
never	most of the time	rarely	always
never	most of the time	some of the time	always
never	some of the time	most of the time	always
rarely	most of the time	never	most of the time
some of the time	most of the time	never	most of the time
rarely	most of the time	rarely	most of the time
some of the time	most of the time	rarely	most of the time
rarely	most of the time	some of the time	most of the time
some of the time	most of the time	some of the time	most of the time
rarely	never	most of the time	most of the time
rarely	rarely	most of the time	Some of the time
rarely	some of the time	most of the time	most of the time
some of the time	some of the time	most of the time	most of the time
some of the time	some of the time	never	some of the time
most of the time	some of the time	never	some of the time
most of the time	never	rarely	some of the time
most of the time	some of the time	rarely	some of the time
most of the time	some of the time	some of the time	some of the time
always	never	never	never

Inconsistent Scores

Tail Capture	Tunnel Handling	Other methods	Scoring
Never	Always	Rarely	Always
Never	Always	Always	Always
Rarely	Always	never	Most of the time
Rarely	Always	Rarely	Most of the time
Rarely	most of the time	Most of the time	Most of the time
Never	most of the time	Most of the time	Most of the time

Appendix D: Topic Guide for Interview Study (Chapter 4)

Background

This is an extension of the survey that was conducted last year which explored the barriers and facilitators to low stress handling. We understand the situations in which people use certain handling methods and why. However, some participant views and handling situations need further clarification from the perspective of a technician. For example, our survey results found differences between technical colleagues and researchers, and we need to understand how this can affect handling behaviour.

Aim of the interview

The interview can give the participants the opportunity to provide more detail than they would have been able to if presented the questions in a survey format. Moreover, it also provides the researcher the chance to ask follow-up questions if clarification or more information is needed.

Explain that the interviews will be recorded and transcribed using Zoom captioning, but only the research team will have access to the recordings and transcriptions. Assure confidentiality.

Participant details

- What is your job role?
- How long have you been handling mice?
- What method do you use? How long have you been using them?
- Why do you use these methods?
- The survey highlighted some situations where people do use tail capture. Do you find yourself in situations where you use tail capture?
- What method do you think is safest for you?

Perceptions of tunnel handling

- Do you find tunnel handling easy to do?
- Do you believe that tunnel handling can cause stress? If yes, why?
- What does a stressed mouse look like to you? (stressed human?)
- How does the time taken to tunnel handle compare to tail capture for you?
- How comfortable would you feel using cupping or tunnel handling in the event of an escaped mouse?
  (if they say they would use tail capture because of no equipment) Why would this be the preferred method over cupping, which does not require any equipment?

If they tunnel handle under every circumstance:

- Have you always tunnel handled in your whole career?
- What was your handling journey like- how did your confidence grow?
- Did you switch methods at all? How did you learn, and what was that process like?
- What about an escaped mouse? How did you build your confidence using low-stress methods in this situation?
- How does your handling style compare to your colleagues? Do you influence them/do they influence you at all?
- Do you ever get additional training, or assessments to check how you're doing?

    If no, is there any training or other needs that you have that don't get met?

    Is there anything that would help you in your work that you don't currently have access to?

    If yes, what does this look like, and how does this help you?

Perceptions of tail capture

- To what extent do you believe that tail capture, when done by someone who is very proficient at it, doesn't harm the mice?
- How do you think the stress caused by tail capture compare to the stress of repeated attempts to tunnel handle?

Workplace guidelines

- What is your understanding of the workplace guidelines in place for handling mice? Can you describe them?
    - Are they written guidelines?
- When did you last read them?
- How did you become aware of the workplace guidelines?
- How would you find out if the workplace guidelines changed?
- What would happen if you strayed from the guidelines and used a different method than is encouraged?
- What method would you use if there were no guidelines in place, and why?
- Do you feel your experience and expertise can be used to influence any changes to guidelines or policies?
    - Is there any examples of a situation where this happens?
- What are the procedures in place to learn from mistakes and avoid them in the future?

If they don't know workplace guidelines

- How does this influence your handling?
- Were you aware that there are guidelines in place?

- Have you been motivated to find out what they are?

Training/psychological safety

- How much support do you get once you've finished training?
  - Do people ask how things are going?
- If you struggle to use tunnel handling, do you ask for help?
  - Do you feel able/want to ask for help?
    - If yes or no, please can you expand?
- Do you feel like you can call out unacceptable behaviours by peers/colleagues?
- Do you personally feel able to report any mistakes, if these were to happen?
  - Would this be deemed acceptable in your workplace setting?

Conclusions

- If we did an intervention, what do you think is the most important barrier to target?
- Are there any questions you expected to be asked, or any areas you think I missed?
- Do you have anything else you'd like to add?

Thank participant for their time.

Appendix E: Ethical Documents for Interview Study (Chapter 4)

Information Sheet

Title of Study: Interviews with Technical Colleagues on perceptions of Barriers and Facilitators to Low Stress Handling.

Invitation and Brief Summary

You are being invited to take part in an interview study. Before you decide whether or not you wish to take part it is important that you understand why the research is being done and what it will involve. Please read this information carefully and discuss it with others if you wish. Take time to decide whether you wish to take part. If you do decide to take part, you will be asked to sign a consent form. However, you are free to withdraw at any time, without giving any reason and without any penalty or loss of benefits.

What is the purpose of the research?

This interview study is an extension of the survey that was conducted last year which explored the barriers and facilitators to low stress handling. We understand the situations in which people use certain handling methods and why. However, some participant views and handling situations need further clarification from the perspective of technical colleagues. This study will allow the researcher to progress with a wider project which aims to understand how welfare decisions are made within animal facilities.

What does taking part involve?

This is an interview study. You will be interviewed on Zoom for 1 hour on one occasion; however, you can withdraw from the study at any point. The researcher will ask questions from an interview guide. You will not be asked for information on any sensitive issues. The conversation will be recorded and transcribed.

What information will be collected and who will have access to the information collected?

The recordings from the interview will be transcribed via Zoom transcription. All data collected will be kept strictly confidential. Names will be removed from any transcriptions, and no personal information will be collected. Only the research team will have access to data. There are no plans for the re-use of data after the completion of the project.

Why have I been invited to take part?

You have been invited as you work in a technical role and handle mice as part of your role.

What are the possible benefits of taking part?

You will receive a £15 Amazon voucher for your time. Your participation will provide the researcher an understanding of the barriers to mouse handling. This will help to shape and accurately plan future research studies for the project, which aims to improve animal welfare.

What are the possible disadvantages and risks of taking part?

We do not anticipate any disadvantages arising as a result of participation in this study and you are free to withdraw from the study at any point.

Has this study received ethical approval?

This study has received ethical approval from Newcastle University Ethics Committee on 14.03.23, reference 30201/2022.

Who should I contact for further information relating to the research?

Farhana Chowdhury, email: f.chowdhury3@newcastle.ac.uk

Consent Form

Title of Study: Interviews with Technical Colleagues on Perceptions of Barriers and Facilitators to Low Stress Handling

Thank you for your interest in taking part in this research. Please complete this form after you have read the Information Sheet and/or listened to an explanation about the research study. You will be given a copy of this Consent Form.

		Please initial box to confirm consent
1.	I confirm that I have read the information sheet dated 10.5.2023 for the above study, I have had the opportunity to consider the information, ask questions and I have had any questions answered satisfactorily.	
2.	I understand that my participation is voluntary and that I am free to withdraw at any time without giving any reason, *[without my medical care or legal rights being affected]*. I understand that if I decide to withdraw, any data that I have provided up to that point will be omitted.	
3.	I consent to my anonymized research data being stored and used by the research team for future research.	
4.	I understand that my research data may be published as a report.	
5.	I agree to take part in this research project.	
	Participant _____ _____ _____ *Name of participant* *Signature* *Date*	
	Researcher Farhana Chowdhury. Farhana Chowdhury _____ *Name of researcher* *Signature* *Date*	

Appendix F: Topic Guide for Interview Study (Chapter 5)

My name is Farhana Chowdhury, I'm a 3rd year PhD student. You may have already been part of my research when I've conducted observations, surveys, and interviews. The purpose of this interview today is to update you on my findings so far and get your perspective on an idea I have for an intervention to increase the use of tunnel handling.

Thank you for volunteering to take part, it's important for me to get the opinion of those who work with mice in a technical capacity. You are also the target demographic for the intervention, so it is important that you are involved in the process of developing it. I'd really like for you to be honest, as you have been invited here for your expertise and knowledge.

The interview is recorded, but you will remain anonymous. The transcript will not use your name. When I conducted the survey last year, it seemed that people are more aware of low stress handling and their benefits. Most participants are motivated by mouse safety and welfare. However, there are certain situations where people don't feel comfortable in using low stress handling. One of these situations is when a mouse escapes- people are not sure how to use low stress handling and feel under pressure to act quickly and resort to using tail capture.

Intervention proposal

We propose to create a video demonstrating how to recapture a mouse using low stress methods during an escape. It will cover the following scenarios:

- Recapture from a hood
- Recapture from floor
- Recapture from under a rack
- Recapture from person

[ACTIVITY 1- PERSONAL EXPERIENCES] Before we begin, can you tell me how you would handle a mouse if it escaped, and why you would use that method?

At this point, I'll give you the video outline to read and the storyboard to look at. After that, can you share any initial thoughts you have?

[ACTIVITY 2- SHARING INITIAL THOUGHTS]

Prompting questions:

Content

- Is there anything missing in the outline or the storyboard? Are there any other scenarios that you think should be included?
- Is there anything in the script you think we should add?
- Is there anything we haven't considered?
- What are your thoughts on the scenarios we've chosen to include in the video?
- Is there anything that could make it better?
- Would the video on its own be enough to make you feel confident to use low stress handling during an escape, or with jumpy mice?

Technical perspective

- How do you think technicians will feel after watching it?
- Would it speak to you as a technician?
- How can we make it more targeted to our audience?
- Would it work for researchers?

Wider sharing

- If this video were to be shared with technicians outside of Newcastle University, is there anything we would need to consider?
- Are there any common places that technicians go to for information where it would be hosted?

Finishing thoughts

- Are there any concerns you have?
- Are there any final comments you would like to share?

Appendix G: Video Outline for Intervention Development (Chapter 5)

Scenarios video will cover- maybe around 30 seconds per scenario?

- Recapture from hood
- Recapture from floor
- Recapture from under a rack
- Escapes onto a person

Introduction

"This tutorial will show you how to use low stress methods, such as tunnel handling, in situations where a mouse is at risk of escaping or has escaped. A recent survey and interview study has found that in these situations, people often use tail capture as they think it is quicker and easier, or they don't know how to use low stress methods. However, using tail capture in these situations is still harmful to the mice. This tutorial will show you practical ways of using low stress methods in different scenarios you may experience. You may not have escapes very often, but it is important to know what to do and be prepared for if it does happen."

Why is it important?

"There is a lot of evidence which suggests that using low stress methods is better for the mice. When mice are captured using low stress methods, it can reduce their stress, anxiety and depression. Even using tail capture in rare circumstances can still be harmful to the mice. So it's best to feel confident in using low stress methods in different situations. It is also safer for the handlers- you are less likely to be bitten when using low stress methods when a mouse escapes."

What will this video show me?

"This video will show you how to use tunnel handling in different situations that are associated with a need to act quickly. For example, when a mouse is at risk of escaping, or has escaped. We will also show you how to handle jumpy mice, using a strain that is known to be jumpy."

What if I panic?

"It's natural to panic and stress when faced with an escape, or a potential escape. Just Try to remember to stay calm, avoid sudden movements and chasing of the mouse. Let's others in the room know that a mouse has escaped and they can help you to secure exits if the animal is near a route such as an open door. It may be your natural instinct to pick up the animal by the tail, but this video will help you to see alternative strategies."

Scenario 1- Recapture from hood.
Scenario 2- Recapture from floor.
Scenario 3- Recapture from under a rack.
Scenario 4- Escapes onto person

Other notes

- PPE for any colleagues handling mice in the videos.

End subtitles: This work was completed using excess stock animals under approval of Newcastle University AWERB with an aim of improving animal welfare for laboratory mice.

Appendix H: Ethical Documents for Interview Study (Chapter 5)

Information Sheet

Title of Study: Interviews with technical colleagues on perceptions of proposed Video Intervention

Invitation and Brief Summary

You are being invited to take part in a research study. Before you decide whether you wish to take part it is important that you understand why the research is being done and what it will involve. Please read this information carefully and discuss it with others if you wish. Take time to decide whether you wish to take part. If you do decide to take part, you will be asked to sign a consent form. However, you are free to withdraw at any time, without giving any reason and without any penalty or loss of benefits.

What is the purpose of the research?

This interview study extends a project investigating the barriers and facilitators to low-stress handling. Our goal is to understand the contexts and motivations behind the use of specific handling methods. Notably, handlers have expressed difficulty in employing low-stress techniques when mice escape. To address this, the researcher is developing an intervention to provide support. To ensure this intervention is relevant and effective, we seek the input and opinions of handlers during its development.

What does taking part involve?

This is an interview study. You will be interviewed on Zoom a maximum of hour on one occasion; however, you can withdraw from the study at any point. The researcher will ask questions from an interview guide. You will not be asked for information on any sensitive issues. The conversation will be recorded and transcribed.

What information will be collected and who will have access to the information collected?

The recordings from the interview will be transcribed via Zoom transcription. All data collected will be kept strictly confidential. Names will be removed from any transcriptions, and no personal information will be collected. Only the research team will have access to data. There are no plans for the re-use of data after the completion of the project.

Why have I been invited to take part?

You have been invited to take part as you currently work with laboratory mice in an animal care role and have previously reported that you have difficulty recapturing escaped mice using low stress handling methods.

What are the possible benefits of taking part?
This study has the potential to help develop training for mouse escapes and build confidence for mouse handlers to use low stress handling in these situations. This, in turn, will benefit mouse welfare and benefit research integrity if found effective and distributed widely.

What are the possible disadvantages and risks of taking part?
We do not anticipate any disadvantages to taking part in this research.

Who is the sponsor and data controller for this research?
Newcastle University is the sponsor for this study based in the United Kingdom. Newcastle University will be using information from you in order to undertake this study and will act as the data controller for this study. This means that Newcastle University is responsible for looking after your information and using it properly.

The lawful basis for carrying out this study under GDPR is Task in the Public Interest, (Article 6,1e) as research is cited as part of the University's duties.

Your rights to access, change or move your information are limited, as Newcastle University need to manage your information in specific ways in order for the research to be reliable and accurate. If you withdraw from the study, Newcastle University will keep the information about you that has already been obtained. To safeguard your rights, the minimum personally-identifiable information will be used.

You can find out more about how Newcastle University uses your information by contacting their Data Protection Officer [DPO name, rec-man@ncl.ac.uk].

Has this study received ethical approval?
This study has received ethical approval from Newcastle University Ethics Committee on the 20th December 2023. Reference: 40793/2023

Who should I contact for further information relating to the research?
Farhana Chowdhury (f.chowdhury3@ncl.ac.uk)

Consent Form

Title of Study: Interviews with Technical Colleagues on Perceptions of Proposed Video Intervention

Thank you for your interest in taking part in this research. Please complete this form after you have read the Information Sheet and/or listened to an explanation about the research study. You will be given a copy of this Consent Form.

		Please initial box to confirm consent
1.	I confirm that I have read the information sheet dated 3.11.2023 for the above study, I have had the opportunity to consider the information, ask questions and I have had any questions answered satisfactorily.	
2.	I understand that my participation is voluntary and that I am free to withdraw at any time without giving any reason, *[without my medical care or legal rights being affected]*. I understand that if I decide to withdraw, any data that I have provided up to that point will be omitted.	
3.	I consent to my anonymized research data being stored and used by the research team for future research.	
4.	I understand that my research data may be published as a report.	
5.	I agree to take part in this research project.	
	Participant _____ _____ _____ *Name of participant* *Signature* *Date*	
	Researcher Farhana Chowdhury. Farhana Chowdhury _____ *Name of researcher* *Signature* *Date*	

1

Appendix I: Ethical Documents for Intervention Study (Chapter 6)

Information Sheet

Title of Study: Evaluation of Technician's Training: Mouse Handling during Escapes

Invitation and Brief Summary

You are being invited to take part in a research study. Before you decide whether you wish to take part it is important that you understand why the research is being done and what it will involve. Please read this information carefully and discuss it with others if you wish. Take time to decide whether you wish to take part. If you do decide to take part, you will be asked to sign a consent form. However, you are free to withdraw at any time, without giving any reason and without any penalty or loss of benefits.

What is the purpose of the research?

A previous survey and interview study found that although technicians predominantly use tunnel handling and other low stress methods to handle mice, there are certain instances where they don't feel confident in using low stress methods. This includes situations where a mouse is at risk of escaping or have escaped. This is a feasibility study to assess the acceptability of a training intervention designed for technicians.

What does taking part involve?

This study will involve you to take part in a group training session with other technicians and complete a pre-intervention survey, which should take around 5 minutes to complete. It will ask you about your current handling habits for when a mouse escapes. You will then watch a 5-minute training video. Then there will be the opportunity to ask questions to an experienced mouse handler- this will be recorded for note taking purposes. Following this, you will be asked to complete another survey which should take around 5 minutes to gain feedback on the video. You will be asked if you consent to the researcher reaching out in a month's time to follow up with you to measure the effectiveness of the intervention. This will entail another 5-minute survey. If you decide to take part in the whole study including the follow-up, your involvement will take no longer than 45 minutes.

What information will be collected and who will have access to the information collected?

Your involvement will be anonymous and remain confidential, as no personal information will be collected. You will be asked to create a code to use on your surveys so your responses can be kept together for analysis purposes. The recording from the discussion

part of the session will not be shared beyond the supervisory team. You will not be asked for information on any sensitive issues. Only the researcher and their supervisory team will have access to the data. No participants will be identifiable from the study.

Why have I been invited to take part?
You have been invited to take part as you currently work with laboratory mice in an animal care role.

What are the possible benefits of taking part?
This study has the potential to help develop training for mouse escapes and build confidence for mouse handlers to use low stress handling in these situations. This, in turn, will benefit mouse welfare if found effective and distributed widely.

What are the possible disadvantages and risks of taking part?
We do not anticipate any disadvantages to taking part in this research.

Who is the sponsor and data controller for this research?
Newcastle University is the sponsor for this study based in the United Kingdom. Newcastle University will be using information from you in order to undertake this study and will act as the data controller for this study. This means that Newcastle University is responsible for looking after your information and using it properly.

The lawful basis for carrying out this study under GDPR is Task in the Public Interest, (Article 6,1e) as research is cited as part of the University's duties.

Your rights to access, change or move your information are limited, as Newcastle University need to manage your information in specific ways in order for the research to be reliable and accurate. If you withdraw from the study, Newcastle University will keep the information about you that has already been obtained. To safeguard your rights, the minimum personally-identifiable information will be used.

You can find out more about how Newcastle University uses your information by contacting their Data Protection Officer [DPO name, rec-man@ncl.ac.uk].

Has this study received ethical approval?
This study has received ethical approval from Newcastle University Ethics Committee on 07.02.2024

Who should I contact for further information relating to the research?
Farhana Chowdhury (f.chowdhury3@ncl.ac.uk)

Consent Form

Title of Study: Evaluation of Technician's Training: Mouse Handling during Escapes

Thank you for your interest in taking part in this research. Please complete this form after you have read the Information Sheet and/or listened to an explanation about the research study. You will be given a copy of this Consent Form.

		Please initial box to confirm consent
1.	I confirm that I have read the information sheet dated 4.3.24 for the above study, I have had the opportunity to consider the information, ask any questions and I have had any questions answered satisfactorily.	
2.	I understand that my participation is voluntary and that I am free to withdraw at any time without giving any reason. I understand that if I decide to withdraw, any data that I have provided up to that point will be omitted.	
3.	I consent to my anonymized research data being stored and used by the research team for future research.	
4.	I understand that my research data may be published as a report.	
5.	I agree to take part in this research project.	
	Participant _____ _____ _____ *Name of participant* *Signature* *Date*	
	Researcher FARHANA CHOWDHURY Farhana Chowdhury. _____ *Name of researcher* *Signature* *Date*	

Appendix J: Pre-Intervention Survey (Chapter 6)

Q1 Please enter a code name. Use the two last letters of your postcode, followed by the last two digits of your phone number. For example, DH92

_____

Q2 Have you ever experienced a mouse escaping?

- ○ Yes
- ○ No
- ○ Unsure

Display This Question:

If Have you ever experienced a mouse escaping? = Yes

Q3 What method do you use to handle mice when they have escaped?

_____

Q4 In the following situations, please rate how **confident** you would feel using any low stress handling methods, such as tunnel handling or cupping:
(0= not at all confident, 100= very confident)

	Not at all / Very Confident 0 25 50 75 100
Recapturing an escaped mouse from a hood.	
Recapturing an escaped mouse from the floor.	
Recapturing an escaped mouse from under a rack.	
Recapturing a mouse that has jumped onto you.	

Q5 In the following situations, please rate out of 10 how **likely** you would be to use any low stress handling method:
(0= not at all likely, 100= very likely)

	Not at all likely 0	25	50	75	Very likely 100
Recapturing an escaped mouse from a hood					
Recapturing an escaped mouse from the floor					
Recapturing an escaped mouse from under a rack					
Recapturing a mouse that has jumped onto you					

Q6 Have you experienced any challenges or difficulties with trying to use low stress handling with these scenarios in the past?

_____

Q7 To what extent do you agree with the following statements?

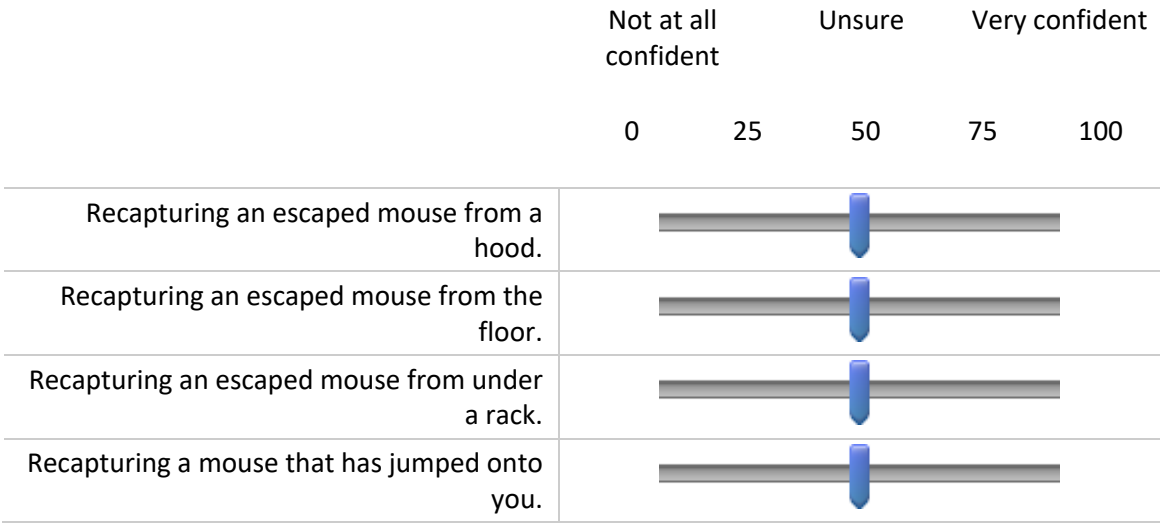
	Strongly disagree 0	Somewhat disagree 25	Neither agree nor disagree 50	Somewhat agree 75	Strongly agree 100
It is harmful to use tail capture during escapes.					
It is still harmful to the mouse to use tail capture on one-off occasions.					
It is not possible to use low stress handling methods in escape situations.					

Appendix K: Post-Intervention Survey (Chapter 6)

Q1 Please enter **the same code name** that you entered on the first survey.
(Last two letters of your postcode, and the last two digits of your phone number. For example, DH92)

_____

Q2 After watching the video, please rate how **confident** you would feel using low stress handling methods in the following scenarios:
(0= not at all confident, 100= very confident)



Q3 After watching the video, please rate how **likely** you would be to use low stress handling methods in the following scenarios:
(0= not at all likely, 100= very likely)

Not at all likely Neutral Very likely

0 25 50 75 100

Recapturing an escaped mouse from a hood.	
Recapturing an escaped mouse from the floor.	
Recapturing an escaped mouse from under a rack.	
Recapturing a mouse that has jumped onto you.	

Q4 How **motivated** are you to practice and refine the techniques learned in this session?

- ○ Not at all motivated
- ○ Slightly motivated
- ○ Moderately motivated
- ○ Very motivated
- ○ Extremely motivated

Q5 Do you **intend** to start using tunnel handling for mouse escapes from now on?

- ○ Definitely not
- ○ Probably not
- ○ Unsure
- ○ Probably yes
- ○ Definitely yes
- ○ Not relevant- I already use tunnel handling

Q6 Please rate how **helpful** it was to see demonstrations of the handling methods? (0=not at all helpful, 100= very helpful)

0 10 20 30 40 50 60 70 80 90 100

0	

Q7 To what extent do you agree with the following statements?

	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
	0	25	50	75	100
It is harmful to use tail capture during escapes.					
It is still harmful to the mouse to use tail capture on one-off occasions.					
It is not possible to use low stress handling methods in escape situations.					

Q8 How **effective** would you rate this video as a training tool for recapturing escaped mice?

- ○ Not effective at all
- ○ Slightly effective
- ○ Moderately effective
- ○ Very effective
- ○ Extremely effective

Q9 Were there any aspects of the video that were confusing or unclear? If so, please specify.

_____

Q10 Were there any aspects of the video that weren't useful? If so, please specify.

_____

Q11 What part of this workshop did you find the most useful?

_____

Q12 What is the key message you took away from watching the video?

_____

Q13 Are there any other specific areas related to handling that you feel you would benefit from additional training?

_____

Q14 How useful did you find the opportunity to ask questions and have a discussion with the training leaders after watching the training video?

- ○ Not at all useful
- ○ Slightly useful
- ○ Moderately useful
- ○ Very useful
- ○ Extremely useful

Q15 Overall, how would you rate the following in relation to the workshop?

	Poor		Neutral		Excellent
	0	25	50	75	100

Content of video.	
Delivery of workshop.	
Content of workshop.	

Q16 How likely are you to recommend this **video** to other technicians?

- Extremely unlikely
- Somewhat unlikely
- Neither likely nor unlikely
- Somewhat likely
- Extremely likely

Q17 How likely are you to recommend this **workshop** to other technicians?

- Extremely unlikely
- Somewhat unlikely
- Neither likely nor unlikely
- Somewhat likely
- Extremely likely

Q18 Do you have any additional feedback about the video or this session?

_____

THE END