

Behavioural Insights commissioned literature review. Subject: Dogs and livestock worrying. What do we know?

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About Natural Resources Wales

Natural Resources Wales' purpose is to pursue sustainable management of natural resources. This means looking after air, land, water, wildlife, plants and soil to improve Wales' well-being, and provide a better future for everyone.

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Title: **Behavioural Insights commissioned literature review. Subject: Dogs on leads worrying livestock. What do we know?**

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Crynodeb Gweithredol

Mae'r adolygiad llenyddiaeth hwn yn archwilio ymyriadau ymddygiadol sydd â'r nod o wella sut y rheolir cŵn o amgylch da byw, yn benodol i leihau digwyddiadau ac effeithiau poeni da byw. Cynhaliwyd yr adolygiad fel rhan o'r Rhaglen Diwygio Mynediad a gychwynwyd gan Lywodraeth Cymru, sy'n ceisio mynd i'r afael â diwygiadau deddfwriaethol posibl a champau gweithredu ategol. Mae un o'r diwygiadau arfaethedig hyn yn ymwneud â rheoli cŵn yng nghyd-destun mynediad at ddibenion hamdden, yn benodol ar gyfer rhoi cŵn ar dennyn byr o hyd penodol o amgylch da byw bob adeg o'r flwyddyn. Y ffocws cyffredinol y gofynnwyd amdano ar gyfer yr adolygiad hwn oedd 'negeseuon'. Fodd bynnag, mae'r math o negeseuon sydd eu hangen yn gofyn am ystyried y math o Ddealltwriaeth Ymddygiadol sydd wedi dangos addewid o ran mynd i'r afael â phoeni da byw yn ehangach. Y canlyniad y gofynnwyd amdano ar gyfer yr adolygiad oedd llywio gweithdai Dealltwriaeth Ymddygiadol a gomisiynwyd gyda rhanddeiliaid i nodi gwaith peilot ac ymyriadau posibl y gellid eu cynnal.

Yn gyntaf, mae'r adolygiad yn tynnu sylw at gwmpas a natur gymhleth y problemau, gan gynnwys effeithiau ariannol ac emosiynol poeni da byw ar ffermwyr, tirfeddianwyr eraill a pherchnogion cŵn, gan bwysleisio'r angen i bob parti dan sylw newid ymddygiad. Nodwyd bod deuddeg papur perthnasol i'w dadansoddi.

Nod **ymyriadau gwybyddol**, megis addysg, tarfu ar arferion, a chiwiau cyd-destunol, yw gwella ymwybyddiaeth, cyfle a chymhelliant ar gyfer perchnogaeth gyfrifol ar gŵn. Mae **ymyriadau gorfodi**, pan gânt eu defnyddio'n gyson ac yn effeithiol, yn gweithredu fel arfau ataliol ac yn darparu data gwerthfawr ar gwmpas ac effaith y broblem. Mae **ymyriadau anghymhellol**, fel cosbau ariannol a'r posibilrwydd i berchnogion golli eu cŵn, yn gwella ymwybyddiaeth o ganlyniadau posibl. Mae **ymyriadau ymgysylltu** trwy ymgyrchoedd a chydweithio â rhanddeiliaid yn meithrin atebion cyd-gynhyrchiol a datblygiad norm cymdeithasol. Yn olaf, gall **ymyriadau ffisegol**, gan gynnwys ffensys, wahanu da byw oddi wrth gŵn, ond mae eu dichonoldeb yn amrywio ar draws lleoliadau a sefyllfaoedd.

Mae'r drafodaeth yn awgrymu bod y gweithgareddau canlynol yn hanfodol i weithredu ymyriadau effeithiol mewn modd effeithiol yn y cyd-destun hwn. Mae'r rhain yn cynnwys negeseuon clir, addysg barhaus, gorfodi cyson, ymwybyddiaeth o ganlyniadau posibl, ymgysylltu â rhanddeiliaid, ac arwyddion wedi'u targedu. Daw'r adolygiad i'r casgliad bod mynd i'r afael â'r mater cymhleth o boeni da byw, lle mai cŵn sy'n ei achosi, yn gofyn am fabwysiadu dull amlweddog ac mae'n tynnu sylw at yr angen am ragor o dystiolaeth a mewnbwn gan rhanddeiliaid i ddatblygu atebion cynhwysfawr. Mae canfyddiadau'r adolygiad hwn yn sylfaen ar gyfer trafodaeth ac yn sail i'r gweithdai dealltwriaeth ymddygiadol sydd ar y gweill, gyda'r nod o flaenoriaethu ymddygiadau targed a datblygu strategaethau effeithiol i wella sut y rheolir cŵn o amgylch da byw.

Executive summary

This literature review examines behavioural interventions aimed at improving dog control around livestock, specifically to reduce incidents and impact of livestock worrying. The review was conducted as part of the Access Reform Programme (ARP) initiated by the Welsh Government, which seeks to address potential legislative reform and supporting actions. One of these proposed reforms is about the control of dogs related to recreational access, specifically for placing of 'dogs on a short-fixed length lead around livestock at all times of year. The requested overarching focus for this review was 'messaging'. However, the type of messaging needed, requires a consideration of the range of Behavioural Insights that have shown promise in addressing livestock worrying more broadly. The requested outcome of the review was to inform commissioned Behavioural Insight workshops with Stakeholders to identify pilot work and potential interventions that could be undertaken.

The review firstly highlights the complex scope and nature of the problems including financial and emotional impacts of livestock worrying on farmers, other land owners, and dog owners, emphasising the need for behaviour change by all parties involved. Twelve papers were identified as in scope for analysis.

Cognitive interventions, such as education, habit disruption, and contextual cues, aim to improve awareness, opportunity, and motivation for responsible dog ownership. **Enforcement interventions**, that when used consistently and effectively, act as deterrents and provide valuable data on the scope and impact of the problem. **Disincentive interventions**, such as financial penalties and the potential loss of dogs for owners, enhance awareness of potential consequences. **Engagement interventions** through campaigns and collaboration with stakeholders fosters co-productive solutions and social norm development. Finally **Physical interventions**, including fencing, can separate livestock from dogs, but their feasibility varies across locations and situations.

The discussion suggests the following activities as elemental to the effective implementation of effective interventions in this context. These include clear messaging, ongoing education, consistent enforcement, awareness of potential consequences, stakeholder engagement, and targeted signage. The review concludes that addressing the complex issue of livestock worrying, where dogs are involved, requires adopting multi-faceted approach and highlights the need for further evidence and stakeholder input to develop comprehensive solutions. The findings of this review provide a foundation for discussion and inform the upcoming behavioural insights workshops, aiming to prioritise target behaviours and develop effective strategies to improve dog control around livestock.

Introduction

Background

As part of its Access Reform Programme (ARP), Welsh Government (WG) requested that Natural Resources Wales (NRW) provide advice and possible options for associated actions, for a number of the reforms. Options were requested specifically regarding changes to legislative requirements and supporting actions to provide for: 'Dogs to be on a short-fixed length leads in the vicinity of livestock at all times of the year'.

Within this was consideration for the UK Animal Welfare Bill, which was introduced to the UK Parliament on 8th June 2021 and is currently being considered. Amongst other provisions, the Bill as currently drafted proposes new legislation aimed at reducing livestock worrying across England and Wales. This includes revising the legislative requirements for the control of dogs in the vicinity of livestock. Welsh Government will be considering if the Bill will deliver the legislative changes they envision as part of their 'Dogs on Leads Reform'.

Since then, Natural Resources Wales have submitted an advice & recommendations paper to Welsh Government for the Dogs on Leads (DoL) reform area, which was formed from collaborative working with external stakeholders. As well as covering legislative requirement advice, there were a number of non-legislative recommendations put forward for consideration. This work will support the implementation of UK legislation, as it will apply across England and Wales and additionally is an opportunity to deliver a self-standing piece of work.

Within the Access Reform advice and recommendations paper, a recommendation was made that "There is an opportunity to utilise a Behavioural Insights (BI) evidence-based approach to identify where and how effective messaging for improved dog control in the countryside around livestock could be implemented. By collaborating with partners such as Natural England (NE) this would also expand on Countryside Code Behavioural Insights work already undertaken. Natural Resources Wales and Natural England have a statutory duty to issue and publish the Countryside Code.

As there has been an indication that no primary legislation will be enacted on Access Reform in this Senedd term, there is an imperative to develop, learn and test approaches so that any future legislative change be better informed and more likely to succeed. Therefore, this phase of the Access Reform Programme offers an opportunity to carry out piloting and action learning activity through a Behavioural Insights (BI) optic.

Aim

As part of its Access Reform Programme (ARP), Welsh Government (WG) requested that Natural Resources Wales (NRW) provide advice and possible options for associated actions, for a number of the reforms. Options were requested specifically regarding changes to legislative requirements and supporting actions to provide for: 'Dogs to be on a short-fixed length leads in the vicinity of livestock at all times of the year'.

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Scope of the presenting problems

Livestock worrying and attacks by dogs can have a major financial and emotional impact on all parties involved (APGAW, 2017). Farmers suffer from not only the potential loss of their livestock but also the resulting stress, anxiety, increased concerns about the welfare of their animals and financial loss (National sheep association, 2016 – in Oxley, 2017). Dog owners may also suffer from anxiety and stress that their dog may be shot at.

Alternatively, the owner may be requested to have the dog put to sleep, the financial costs of which may fall to the inevitably distressed owner. In addition, owners may have to pay compensation to farmers (Oxley, 2017) for any loss or health damage to effected livestock. In worse cases owners have lost their lives walking dogs near livestock (BBC News, 2011).

It is worth clarifying at this point, that although the word livestock covers a wide range of animals including cows, sheep, horses, camelids, goats, pigs, poultry, and lama (Animal Welfare Bill, 2022), most of the literature around livestock worrying focuses on sheep.

A number of national rural stakeholders including the National Farmers Union NFU, Farmers Unions of Wales FUW and National Sheep Association (NSA) describe livestock worrying as a major concern to our rural communities (NPCC, 2018).

The National Sheep Association (NSA) reports a general increase in the annual incidents of dog worrying as recorded by police forces (from 691 in 2011 to 1069 in 2015). However, they note that these figures are likely to be lower than the actual occurrence due to underreporting by farmers and in police reports. The National Police Chiefs' Council (NPCC, 2018) looked closely at incidents in 5 police force locations in the UK and found 1705 recorded incident of livestock worrying and attacks over a four-year period (Sept 2013 to Sept 2017) in the five force areas. In these incidents, 1928 livestock were killed, and 92 recorded incidents of an offending dog being shot. 11.6% of recorded incidents involved reoffending owners/ walkers. The NPCC suggest a conservative estimate of total loss for killed and injured livestock over these 4 years across the 5 forces was in excess of £250,000.

The All Parliamentary Group for Animal Welfare (APGAW) suggest that livestock worrying is a very complex problem to solve and not one for which a single solution can be provided (APGAW, 2017). However, many solutions demand that attention be given to interventions that prompt behaviour change by all parties involved.

This review aims to look at the range of solutions and interventions that have been presented in the literature to provide some recommendations for possible inclusion in a Behavioural Insights based pilot project targeting specific behaviours (to be determined) by stakeholder workshops facilitated by Behaviour Change specialists (JDS Research).

Research methodology

The research methodology was agreed through discussions with the Natural Resources project team members identified at the beginning of this document. The term literature used in the context includes papers, reports, and articles.

To explore literature on general interventions designed to tackle livestock worrying, a range of searches were conducted through Google and Google scholar using the following terms:

- “Livestock worrying”
- “Sheep worrying” and “intervention”
- “Dog attacks” and “behaviour change”
- “Dog attacks” and “responsible ownership”

The author adopted a snowball approach to identifying possible additional papers, reports, and articles by reviewing the references of initially identified literature. In addition, experts within the field were also consulted to identify any possible references not captured by the above searches.

Inclusion criteria were as follows:

- Papers reporting on the evaluation of interventions tackling livestock worrying
- Papers with suggestions as to possible interventions to tackle livestock worrying

Papers on the following themes were excluded as not considered relevant through NRW team discussion to the current project:

- Use of electronic collars
- Focussed on poaching
- Characteristics of people who choose to walk dogs off lead (may be of value further into the overall project)
- Sustainability
- Development of off lead parks
- Use of on lead walks to prevent spread of disease

Results

Included literature

Twelve papers were identified by the project team as agreed for inclusion applying the above method and meriting analysis.

Table 1: Descriptive Data summarising the 12 included papers, reports, and articles

Reference	Type paper	Interventions suggested	Case studies	Location	Evaluation of intervention data included?
Case (2021)	Journal news article	<ul style="list-style-type: none"> • Better prosecution • Homeowner responsibility for securing dogs within their properties to prevent escape 	-	UK data	Not applicable
Fearon (2017)	Journal news article	<ul style="list-style-type: none"> • Signage • Education for owners • Training for dogs • Stronger penalties 	-	UK data	Not applicable
Hampshire CC (2008)	Guidance report	<ul style="list-style-type: none"> • Education • Communication to owner – appealing to welfare of their dogs • Informal & formal dog owner clubs • Having some off lead areas • Signage 	Includes case study examples	Hampshire UK	Yes
Heath (2017)	Inquiry report	<ul style="list-style-type: none"> • Dog training • Legislation changes • Information for owners • Assistance with prosecution • Traffic light system for signage – e.g., green = off 	Includes case study examples	UK – 3 sites	Yes

		<ul style="list-style-type: none"> lead, amber dogs = dogs on leads red = dogs not allowed Campaigns - including education, videos, car stickers, social media 			
Jennens (2002) (2 references)	Conference presentation and PhD Thesis	<ul style="list-style-type: none"> Fencing Help with prosecution Education programmes 	-	Australian	Not applicable
John (2021)	PhD Thesis	<ul style="list-style-type: none"> Signage 'Creating a norm' 	Includes case study example	Brecon Beacons UK	Yes
Mills (2019)	Journal news article	<ul style="list-style-type: none"> Changing attitudes 	-	Based on UK RSPCA survey results	Not applicable
NPCC (2017)	Incident report	<ul style="list-style-type: none"> Increased powers for police 	-	UK data	Not applicable
Nurse (2021)	Research Report – legal	<ul style="list-style-type: none"> Better prosecution 	-	UK data	Not applicable
Oxley (2017)	Literature review	<ul style="list-style-type: none"> Signage Providing information via Kennel Clubs etc Education Better reporting - to inform education Encourage compliance with social norms 	-	UK data	Not applicable

Interventions and Behavioural Insights identified

To develop a Behavioural Insights based intervention requires stating in clear and specific terms, the target behaviour(s), and its anticipated outcome. This paper now moves on to describe in more detail the interventions highlighted in the literature above examining them through the optic of typical Behavioural Insights intervention areas. Please note that there is overlap between these areas.

Cognitive interventions

Cognitive interventions in this context focus on triggering behaviour change based on improving awareness and knowledge as well as targeting emotions and thoughts that can help people to act on their 'changed' intentions. This can happen through directly influencing individuals or by changing contextual cues.

Table 2: Cognitive interventions located in the identified literature

Intervention:	Target Behaviours:	Behavioural insight
Education for dog owners	Dogs on Lead as appropriate Securing dogs at home	Motivation Changing attitudes

- Continuing education to improve awareness and compliance is needed for dog owners to ensure that dogs are kept on leads when near to livestock and that owners are aware of where their dogs are at all times. (Oxley, 2017).
- All dog owners need to accept that their dog should never be unaccompanied outside of their home (Heath, 2017).
- There is a critical need for owners to understand that many dogs will show an interest in, or chase, livestock which places farm animals at potential risk and that means owners need to manage that behaviour. (Heath, 2017).
- The messaging around definitions, advice and information to all dog owners need to be clear and consistent (Heath, 2017).
- Currently, prevention materials tend to predominantly focus on the dangers of fines and prosecution, and on sheep welfare (NFU, 2015; National Sheep Association, n.d.-c).
- Increased focus on the dangers to the dog in terms of being shot or having a destruction order placed on them may be beneficial in increasing owner concern (Oxley, 2017).

A report by Natural England (NE) (Natural England, 2021), although it does not specifically focus on dogs worrying livestock, it does discuss dogs on leads and worrying wildlife and is therefore included here. It discusses the wider behavioural literature providing a great deal of evidence on the mixed effectiveness of education and information provision. Some common recipes for success and failure emerge. These include:

- Ensuring the information is easily comprehensible and salient (attention-grabbing).
- Including clear calls to action (rather than merely highlighting problems).
- Avoiding blame (which tends to reduce people’s willingness to engage with the information).
- Personalising the information.

To ensure people are able to act on that information, it is beneficial to:

- Provide it at (or close to) the point of decision or action.
- Carefully evaluate and if necessary, address other barriers to action to ensure newly adopted intentions to act can easily translate to action. This includes removing hassle and frictions, creating sufficient self-efficacy, and ensuring there are no strong, competing motivations (including conscious motivations, such as for profit, enjoyment or convenience, and less conscious motivations, such as social norms directing behaviour away from the desired outcomes).
- Provide the information at timely moments, when habits and non-conscious routines are momentarily disrupted or not yet established, or when the information is temporarily more salient or relevant. These might include when moving house (still creating new habits in how they use the local environment) or immediately after acquiring a dog.

Intervention:	Target Behaviours:	Behavioural insight
Training for dogs and owners	Recall when off lead Reduce chase instinct?	Capability

- A significant proportion of dog owners/ walkers will never attend training classes with their dogs or consult a dog behaviour specialist (Heath, 2017).
- Efforts should therefore be focussed in changing the attitude and behaviour of these owners such that the way in which they manage and control their dog does not pose a risk to livestock (Heath, 2017).
- Introducing puppies to a range of livestock and teaching appropriate behaviours towards them is an important part of rearing a dog to be well adjusted and friendly and should be considered a critical aspect of ownership (Heath, 2017).
- Ongoing training to teach a reliable recall in a variety of situations will ensure not only their own safety but that of other animals which they may also meet (Heath, 2017).

Intervention:	Target Behaviours:	Behavioural insight
Signage	Dogs on Leads	Effective communication based on BI principles
<ul style="list-style-type: none"> • Livestock owners may help by providing signage and warnings about livestock in fields and of their intention to protect livestock by not tolerating trespassing dogs (Fearon, 2017; Jennens). • Signage is one of the easiest ways to communicate with dog owners (John, 2021). • The factor most likely to influence behaviour is clear, friendly, and non-ambiguous signage (Hampshire CC, 2008). • Consistency in messages increases their effectiveness (John, 2021). • Signage should be placed in the most appropriate location rather than the most convenient (John, 2021). • In the case of no information, dog walkers are likely to use other cues to indicate what they are supposed to do – this may or may not be correct (Hampshire CC, 2008). • Ensure signage kept up to date (Hampshire CC, 2008). Leaving signs up for weeks at a time when there is no livestock encourages disregard by owners who see the signs as irrelevant and all too frequently misleading. This in turn reduces the compliance with the warning, (which may simply no longer be noticed) and thus increases the likelihood of incidents (Heath, 2017). • Signs showing the target behaviour and creating a norm within images is the best way to promote behaviours, (John, 2021). Good clear explanations help dog walkers to understand the reason why the behaviour is necessary but can be even more effective if references are made to the effect on the health and wellbeing of their dog (Hampshire CC, 2008). • Suggestion signage - please do not let your dog approach or chase any livestock in this field. It can cause serious harm and your dog can get lost or injured. (Hampshire CC, 2008). • One effective signage campaign including marked fields as red, amber, or green depending on behaviour required (red – no dogs allowed amber – dogs on lead, green – off lead dog exercise area) signs with paws denoting the different zones were produced and fixed to the access points. A map was produced and leaflet explaining the system and the reasons for the different zones, Evaluation suggested that the paw signs needed a little explanation rather than relying on the leaflet and this would also help those who are colour blind (Hampshire. 2008). 		

Enforcement interventions

Sometimes, enforcement as shown by the literature is both necessary and effective. It can act as a deterrent provided it is used consistently and people don't feel at low risk of being caught and successfully prosecuted. It has also provided some invaluable metrics regarding the source, scope, and impact of the problem.

Table 3: Enforcement interventions located in the identified literature

Intervention:	Target Behaviours:	Behavioural insight
Regulation	Dogs on Lead Securing dogs at home	Change Motivation Norms
<ul style="list-style-type: none"> • The Ministry of Justice should review the sentencing under the Dogs (Prevention of Livestock) Act 1953 (Heath, 2017). 		

- It is recommended that the act becomes a recordable crime and triable this will allow for more accurate records to be kept so the true extent can be understood (NPCC).
- The compensation frameworks should be reviewed to ensure the suitable mechanisms are in place to appropriate funding and that any costs to police. E.g. Kennelling is included in sentencing (NPCC).
- The provisions outlined in the Dogs (Protection of Livestock) Act 1953 are outdated and no longer fit for purpose Case (2021).
- Rob Taylor and PC Dave Allen, from the NWP Rural Crime Team, have been lobbying both the Welsh Government and Defra to strengthen the laws around livestock attacks and that there is a lot of ministerial support for the issue. Suggested changes to legislation include:
 - A clear definition of “under close control” of a dog around livestock.
 - Powers of search and seizure for police of owners with a dog suspected of committing an attack.
 - The power to obtain a DNA sample from a dog suspected of committing an attack.
 - Tougher penalties for irresponsible owners, including a legal obligation to report attacks.
 - Serious cases of large-scale livestock worrying to be heard at a Crown Court.
 - A review of compensation and fines.
 - Judges to be given the ability to remove the rights of dog ownership after prosecution in the most serious cases.

Disincentive based interventions

If people are fully aware of what they could potentially lose both financially, emotionally and reputationally, they are more likely to adopt suggested behaviours even in the absence of motivation to change for other reasons for example – in the interests of the welfare of their dog.

Table 4: Disincentive based interventions located in the identified literature

Intervention:	Target Behaviours:	Behavioural insight
Fines	Dogs on Lead Securing dogs at home	Loss Aversion (financial)
<ul style="list-style-type: none"> • Scotland, MSPs are lobbying the Scottish Government to increase maximum penalties for livestock worrying to 12 months in prison and a fine of £40,000 Case (2021). • Increase in fines would ensure that if worrying or attacks occur Police have a mechanism for pursuing irresponsible dog owners to bear the costs (Heath, 2017). 		
Intervention:	Target Behaviours:	Behavioural insight
Loss of dog	Dogs on Lead Securing dogs at home	Loss Aversion (Emotional)
<ul style="list-style-type: none"> • Police should be given greater powers of search and seizure of dogs suspected of committing an attack (Case, 2021). • Judges are to be given the ability to remove the rights of dog ownership after prosecution in the most serious cases Case (2021). 		

Engagement based interventions

Engagement via campaigns and collaboration with stakeholders forms a key part of Natural Resources Wales (NRWs) commitment to ways of working around SMNR (Sustainable Management of Natural Resources). It is also an evidence process for achieving co-productive Behavioural Insight based solutions.

Table 5: Engagement based interventions located in the identified literature

Intervention:	Target Behaviours:	Behavioural insight
Social Marketing Campaign – going beyond education	Dogs on Lead Securing dogs at home	Raise awareness Change attitudes Motivation Norms
<ul style="list-style-type: none"> • Dog events or walks provide positive ways of communicating key messages with dog walkers, this could be as simple as setting a table up on site with some dog biscuits (Hampshire CC, 2008). • Take the lead initiative (South Downs National Park) was designed to educate the public about the impact of livestock worrying backed by leading farming and rural organisations. The South Downs National Park evolved this to engage with dog walkers and developed a strategy with over ten partners across the Park. This included: <ul style="list-style-type: none"> - four videos of real-life dogs and their comical canine confessions to highlight issues including sheep chasing, ground nesting birds and leaving mess. - leaflets and car stickers to raise awareness of the issue. - targeted media coverage and focus on social media to target people from the urban fringe, young people and those unfamiliar with countryside code. - ambassadors programme to recruit responsible dog walking volunteers in different locations across the National Park. <p>They reached over 500,000 people with the online campaign (from March 2017 to the end of July 2017). The animation is now being used by two other national parks. Limitations: The figures do not indicate how effective the campaign was in reducing livestock worrying and it may not have addressed the stray dog issue.</p> • North Wales police set up Operation Flock, a social media-driven campaign aiming to alter behaviour patterns amongst dog owners who walked their pets in their location. The campaign through @nwpruralcrime obtained over 14,500 followers and generated 1-1.9 million impressions through the use of images and Q&A sessions. The live video investigation on a livestock attack in Flint gained 66,000 views (Heath, 2017). • It is difficult to know whether the followers on social media were dog owners, farmers and therefore measuring the level of effectiveness is not clear. • Additional prevention methods and campaigns have included the Kennel Club and the National Farmers Union collaborating to provide information to dog owners (NFU, 2015) (Oxley, 2017). • The National Sheep Association, in conjunction with the Sheep Veterinary Society and Farmers Guardian, produced a poster for veterinary surgeries highlighting that livestock worrying is a criminal offence which may result in fines or prosecution, the welfare implications for sheep, and that the dog may be shot or destroyed. • Farmers Union Wales (FUW) Deputy President comment that industry initiatives, such as the union’s “Your dog, your responsibility” campaign had had some impact in getting the message across to the public to respect the countryside, pick up after dogs, keep dogs on a lead near livestock, and ensure dogs don’t escape from home (Case, 2021). 		

- Rigorous evaluations of these initiatives similarly remain to be conducted or have not been published (Natural England report).

Natural England

- Social marketing campaigns have been effective in changing behaviour in a number of environmental settings.
- They often use a combination of interventions (such as education messages and social club creation).
- All tend to focus on finding the messages and approaches that best engage a particular audience. In the UK, a recent pilot social marketing campaign by Keep Wales Tidy used chalk-based spray and signage to tackle dog-fouling, dog-fouling rates did decline at each site.

Intervention:	Target Behaviours:	Behavioural insight
Stakeholder engagement	Dogs on Lead Securing dogs at home	Building stronger social networks Create social obligations Change motivations

Social norms

- There is quite a strong sense of community amongst dog walkers and creating informal clubs may help to develop positive social norms (Hampshire CC).
- The second most important factor to influence the behaviour of dog walkers is the good behaviour of other dog walkers – there might be the potential to create an informal club or sense of belonging that will help to encourage dog walkers to feel part of a community and make it easier to get across key messages (Hampshire CC).
- Another method that may encourage greater leashing of dogs around sheep may relate to strategies that encourage compliance with social norms or prosocial behaviour. Dog owners are also more likely to keep dogs on their leads when they believe others expect their dogs to be leashed (Oxley, 2017).
- Adapting signs to encourage prosocial behaviour may also be useful (Oxley, 2017).
- Incorporation of watching eyes images on preventative signs and posters may also be useful in this context (Oxley, 2017).

Dog Organisations

- Dog organisations should produce consistent information for dog owners which can be disseminated through veterinary practices and pet shops (Heath).
- The messaging around responsible dog ownership should be agreed by the welfare organisations and supported by government to ensure authority as well as assistance with dissemination (Heath).
- The welfare organisations should also continue to educate dog owners about choosing the right type of dog for their lifestyle to avoid very active dogs being left at home alone for long periods and often escaping out of boredom or frustration (Heath).

Professional dog walkers

- There is the potential to adopt a different approach to professional dog walkers than to the rest of the dog walking community. For example, they could be targeted more directly as often their contact details are displayed on vans or can be found in directories (Hampshire CC).

Physical interventions

Although the requested scope of this literature review was messaging, physical interventions are included here as messaging about their construction, use and intended purpose is important as with other types of Behavioral Insight interventions.

Table 6: Physical interventions located in the literature

Intervention:	Target Behaviours:	Behavioural insight
Fencing	Preventing dogs reaching livestock	Contextual Physical Barrier that prevents the undesired behaviour however can be costly and unattractive on the land itself.
<ul style="list-style-type: none"> Exclusion methods prevent the dogs from entering the livestock owner's property or gaining access to paddocks where livestock are kept. They include internal or external exclusion fencing, penning or shedding livestock and moving livestock to a safe area or near an occupied dwelling (Jennens). Homeowners must take more responsibility to secure the borders of their properties - an estimated 89% of livestock attacks are committed by escaped dogs. (Case, 2021). 		

Discussion

This review aimed to explore the literature around interventions designed to address dogs on leads and livestock worrying. Following a search of academic and grey literature, 12 papers outlining livestock worrying interventions were identified. The interventions were analysed through a Behavioural Insights lens. Nine interventions were identified, and these were categorised into Five types of Behavioural Insight interventions including, cognitive (education for dog owners, dog training, signage), enforcement (regulation), disincentives (fines, loss of dog), engagement (social marketing campaign, stakeholder engagement) and physical interventions (fencing).

The **cognitive interventions** included education for dog owners, dog training and signage. The literature highlighted the need for continuing education to improve awareness and compliance in dog owners of the issues, both in relation to keeping dogs on leads near livestock but also to ensure that dogs are secured at home. Many owners fail to recognise that their dogs may try and chase livestock and therefore increasing awareness is vital. Messaging around the issue needs to be clear and consistent and focussed on the dangers to the dog, in some cases, the owner, as well as the livestock may be helpful. Effective and accessible dog training may help to reduce attacks. Teaching both reliable recall and appropriate behaviours by owners (in this case preventing escape of dogs from homes as well as when walking with dogs) may help to reduce attacks both when owners are, and are not, present. Clear, friendly, non-ambiguous and up to date signage placed in appropriate locations may help to get the messages out to owners who may be considering walking dogs off leads.

With respect to **enforcement**, the police and some dog organisations have recommended a review of the sentencing and police regulation in this area. This would particularly help to reduce occurrences by dogs of repeat offenders and would provide the police with the more effective application of powers of enforcement. This regulation would also help to feed into the disincentive interventions such as the increase in maximum penalties and the possible loss of the dog.

Engagement interventions were the most frequently used in the literature with a number of case studies highlighted. These included targeting dog walkers, educating the public and engaging with dog owners and clubs through the use of videos, leaflets, stickers and media coverage. Whilst the campaigns cited produced a number of followers and impressions, the behavioural impact of these has not been comprehensively evaluated. Specific groups may be targeted for example professional dog walkers or those who may wish to join an informal club and creating social norms within these groups may be productive. However, consideration needs to be given as to how to target these campaigns to the harder to reach dog owners. Evidence regarding how best to engage land owners was lacking.

Although not located in identified literature, the authors believe harder to reach dog owners may be those who find dog training expensive and appropriate dog confinement at home difficult. This area merits more exploration. In addition, those with many dogs within their responsibility i.e., professional dog walkers may find dog control more difficult simply to numbers. Again, more evidence would be helpful in this area.

Finally, the use of **physical** interventions such as the use of fences to keep livestock and dogs separate may help to reduce the frequency of attacks, either through fencing in livestock or ensuring that dogs are unable to escape from premises. However, there are a number of locations and situations where these physical interventions may not be possible or aesthetically desirable, for example in national parks where livestock may be free to roam and where dog owners wish to take their dogs for walks. In these situations, education, and engagement through campaigns and appropriate or targeted signage are necessary to ensure that dogs are kept under control, which may mean on leads and all animals (livestock and dogs) are kept safe.

Conclusion

This review has provided a 'light touch' look at what is already known broadly about activities and interventions that have been designed or proposed as likely to be helpful in addressing the issue of dogs on and off lead worrying livestock. It is not a systematic or academic review, but rather a starting point to integrate what is known about the topic and identify overlap with Behavioural Insights approaches. It is intended to be a prompt for discussion, a basis to inform upcoming Behavioural Insights workshops and a platform to identify where more evidence is needed. Feedback from different stakeholders and readers would be welcomed. Finally, it is important to recognise this work is part of a wider approach to this important issue. We concur with the literature that highlights that this is a

complex issue and is likely to require a multi-faceted approach to identifying and prioritising target behaviours.

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