KANTAR PUBLIC

Department for Business, Energy & Industrial Strategy

BEIS Public Attitudes to Science
Public dialogues - Wave 4
Public attitudes to the use of genome editing and other technological solutions to the issue of food security

Report

July 2019

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1.
Executive summary

Wave 4: Food security and genome editing

Public dialogue brings together members of the public, policy makers, and expert stakeholders on a subject to deliberate, reflect and come to conclusions about a policy issue; e.g. on new technologies and complex, sensitive, political or difficult issues. This dialogue has explored public perceptions of and attitudes towards food security and technological solutions to this issue, including genome editing.

The aims of the dialogue were to:

- Understand awareness of, and attitudes towards the issue of food security
- Understand participants' understanding of a range of different technological solutions to issue of food security
- Understand public perceptions of acceptability of a range of different technological solutions to the issue of food security
- Understand public perceptions of the benefits and risks of genome editing when used in agriculture
- To understand public acceptability of genome editing as a response to the issue of food security

One week digital dialogue

- 33 participants reflecting a range of demographics, 3 stakeholders, and 3 policy makers observing
- 7-day dialogue - 3 waves of materials were released and 2 homework tasks were completed between waves
- 22nd - 28th January 2019

Four focus groups

- 4 focus groups with 29 digitally excluded participants in Bristol and Glasgow
- 90 minutes - a reduced version of the dialogue guide and materials were used
- 30th January

Background: what is food security and genome editing?*

Food security

A community enjoys food security when all people are able to access enough safe and nutritious food to meet their requirements for a healthy life, in ways the planet can sustain into the future. Four elements contribute to this:

Food availability

Quality food can be grown, produced domestically or imported to the country

Food access

People can access quality food when they can afford to buy it, or when they are able to produce it themselves

Utilisation

People's bodies can use food most efficiently where they also have access to clean water, sanitation and healthcare

Stability

Food is available throughout the year regardless of conflict, natural disasters or season

Genomics

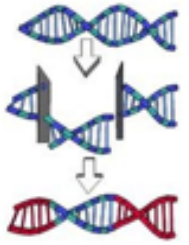
A genome is a plant or animal's complete set of DNA – it contains all the information needed for it to live. Genomics is the study of the structure and make-up of genomes, and how they change over time

Editing genes within a single species

Scientists can identify natural changes in plant and animal DNA that produce desired traits (e.g. disease resistance). They can replicate natural changes by editing genes **within the species**, very precisely, in the same way

Editing genes across species

Scientists can also edit a plant or animal's DNA in ways that would not normally happen in nature. This could involve selecting a desired characteristic in a plant or animal, cutting out the gene responsible, and inserting it into an **another species**



** These definitions reflect the information provided to participants in the dialogue.*

Key Insights: Perceptions of and attitudes to food security

Awareness of food security

Awareness of the issue of food security was generally low:

- Those who had heard of the issue of food security were more commonly older with higher levels of education
- Those who had heard of food security had more commonly done so through news sources such as documentaries and newspapers

Perceptions of food security

Prior to hearing the definition of food security, participants commonly associated it with either:

- Food safety – including packaging, allergens and hygiene
- Food access – access to safe nutritional food
- After food security was defined (see Appendix D), younger participants and those with higher education levels related it to the UK context, whereas others tended to see it as an issue for 'developing' countries

Responses to food security

Responses to the issue of food security fell into three groups:

- **Interested responses (interest, curiosity):** Generally, participants knew little about the subject, and were curious for more information to form an opinion
- **Emotional responses (sad, angry):** Some participants associated the issue with starvation or drought in other countries and said they felt guilt and/or anger about the issue
- **Detached responses (neutral):** Others did not see the issue as relevant to their own circumstances and saw it as 'scaremongering' (notably the digitally excluded)

Key Insights: Acceptability of technological responses to food security

MOST ACCEPTABLE

Changing our diets

Benefits: Acknowledged the increased sustainability of a plant-based diet, and welcomed the reduction in cost of living without buying meat

Concerns: Some concerns over diet being dictated, and how possible this would be to achieve at global level

Use of satellite data

Benefits: Welcomed the use of existing technology, and recognised that this would drive efficient practices

Concerns: Minority concerned about this practice promoting continued pesticide use

Editing genes within a single species

Benefits: Welcomed the increase in disease resistance and environmental adaptability. Positive that no 'foreign' DNA introduced

Concerns: Uncertainty over long term impacts, and satisfactory regulation

Growth hormones and antibiotics

Benefits: Welcomed greater levels of disease resistance in animals

Concerns: Health implications for consumers, and animal welfare issues over increases in muscle mass

Editing genes across species

Benefits: Recognised that this method would improve yields of crops

Concerns: Worried about this leading to a 'slippery slope' of the technology being used on humans. Commonly associated with creating 'alien' species

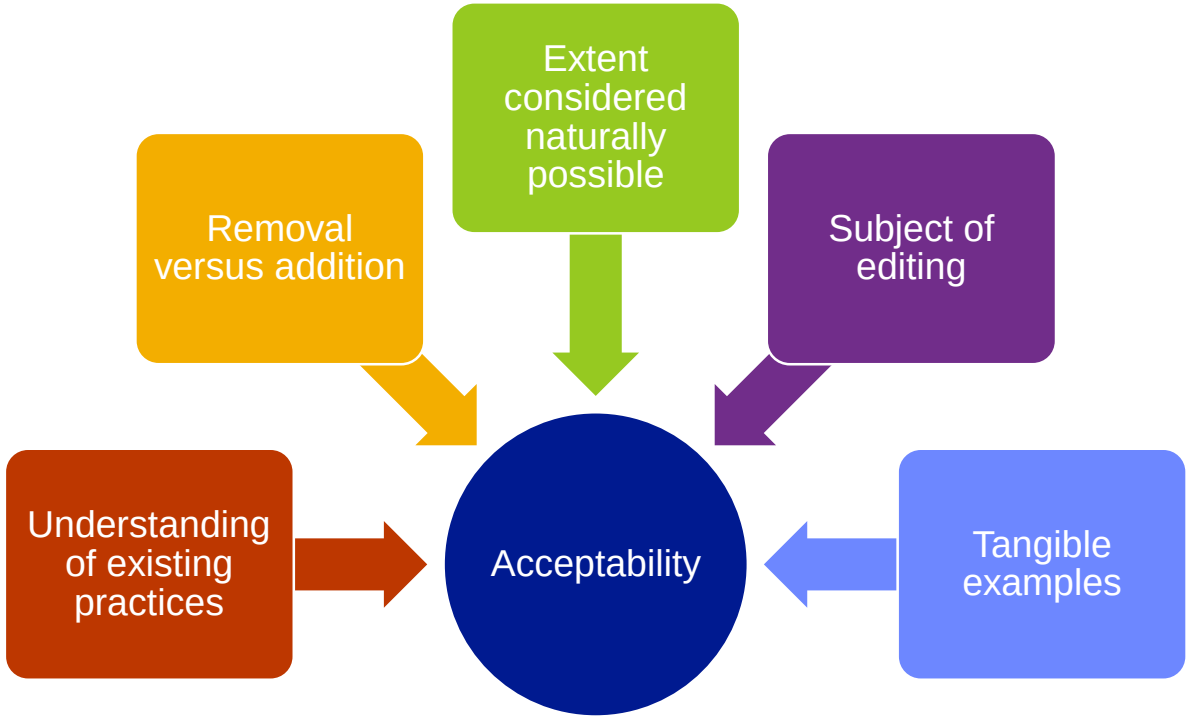
Lab grown meat

Benefits: Reduces animal welfare concerns and seen by some as an alternative, sustainable meat production

Concerns: Emotional responses that the concept did not feel 'natural'

LEAST ACCEPTABLE

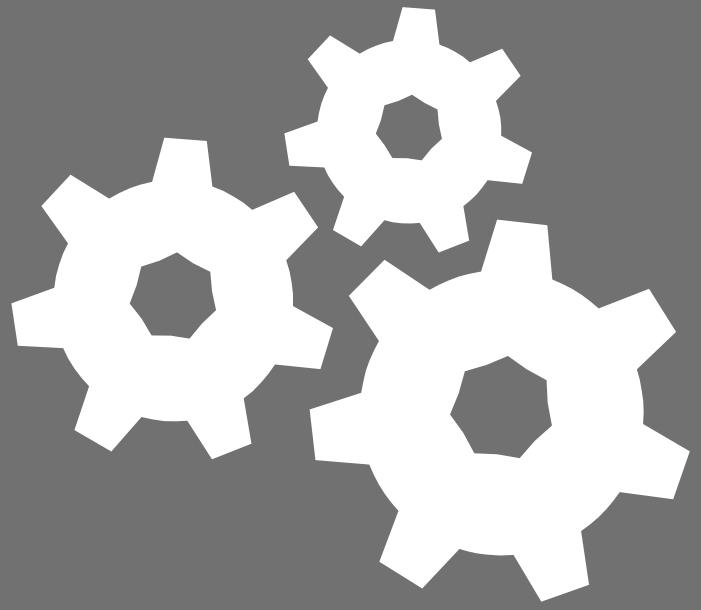
Key Insights: Drivers of acceptability of genome editing in food production



Acceptability was driven by five key factors:

1. **Understanding of existing practices** – whether participants were aware of and understood the link with previous farming practices such as selective breeding
2. **Removal versus addition**– participants were more comfortable with undesirable characteristics being removed, rather than something new being added to a species
3. **Extent considered naturally possible** – whether the changes were seen to have been possible without human intervention
4. **Subject of editing** – how 'biologically close' the subject of editing was seen to be to humans i.e. genome editing in animals was considered to be less acceptable than in plants
5. **Tangible examples**– tangible examples enabled participants to understand the reality of genome editing, reducing their uncertainty and associations with sci-fi examples

2.
Research design



The purpose of dialogue is to inform government decision making, better facilitate two-way discussions about science, and contribute to open policy making

Digital deliberative dialogue

1

Public dialogue brings together members of the public, policy makers, and expert stakeholders on a subject to deliberate, reflect and come to conclusions about a certain policy issue; e.g. on emerging technologies and complex, sensitive, political or difficult issues.

2

Deliberative dialogue goes beyond exploring people's top of mind views about complex issues, to uncover how they form these views, and to debate issues in more depth using different information sources.
They have more time and space to develop more informed and considered views.

3

Committed stakeholders who can communicate with non-technical participants and invest time in the research are crucial to the success of a dialogue. Their involvement allows participants to ask questions and witness stakeholder interest in the two-way dialogue process.

4

Digital deliberative dialogue brings participants and stakeholders together in an online community for a week rather than in a traditional workshop. The forum brings people together from across the UK and allows us to conduct the dialogue at a faster pace.

This dialogue explored perceptions and acceptability of a range of technological responses to the issue of food security, with a particular focus on genome editing within and across species

This dialogue forms part of the qualitative work to support BEIS's 2018-19 Public Attitudes to Science Survey

In total, we conducted four waves of qualitative research, each focused on a specific topic of interest and consisting of:

- One week digital dialogue with 33 individuals
- Four focus groups with digitally excluded individuals
- Supporting social media analysis for each wave

The focus of Wave 4 is on responses to a range of technological solutions to the issue of food security

- *Awareness and understanding of food security*
- *Responses to a range of potential technological solutions to the issue of food security*
- *Exploration of any differences in acceptability of genome editing within a single species and between species*

The aims of this digital dialogue were to:

- Understand awareness of, and attitudes towards, the issue of food security;
- Explore participants' understanding of a range of different technological solutions to the issue of food security;
- Understand public perceptions of the acceptability of a range of different technological solutions to the issue of food security;
- Understand public perceptions of the benefits and risks to genome editing;
- Understand public acceptability of genome editing as a response to the issue of food security;
- Understand any differences in acceptability between genome editing within a single species and genome editing between species.

We conducted a one-week digital dialogue with 33 participants and four focus groups with 29 digitally excluded participants

One week digital dialogue

- 33 participants took part reflecting a range of demographics*
- 3 stakeholders participated**
- 3 policy makers observed
- 7 day dialogue (with a minimum of 3 hours participation)
- 3 waves of materials were released and 2 homework tasks were completed between waves
- Use of Recollective platform
- 22nd – 28th January 2019
- £75 incentive

Four focus groups

- 4 digitally excluded focus groups were conducted with those who lacked access to or confidence using the internet
- 29 participants took part reflecting a range of demographics*
- 90 minutes
- A reduced version of the dialogue guide and materials were used
- Bristol and Glasgow
- 30th January 2019
- £40 incentive

Conversation flow

- Awareness of, and attitudes towards the issue of food security
- Responses to a range of potential solutions to food security including consumer choices, farming solutions and genetic solutions
- Differences in views between editing within a single species and editing across species
- Responses to uses and risks of genome editing within a single species of plants / animals
- Responses to the involvement of a range of stakeholders in developing genome editing technology

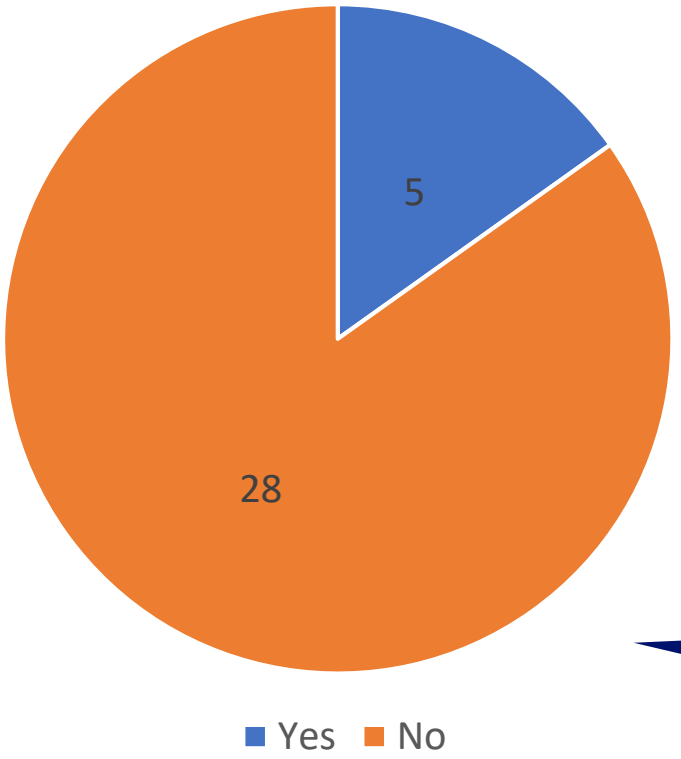
*Full details of the achieved sample can be found in the appendix

**Their names are listed in the appendix

3.
Perceptions of and attitudes to food security

Awareness of the issue of food security was low, particularly among younger participants

Have you heard of the phrase 'food security' before?*



Digital dialogue participants who were aware of the issue of food security tended to:

- Be older
- Have higher levels of formal education

None of the digitally excluded participants were familiar with the term, including older participants and those with higher levels of formal education

Where participants had heard of food security, the sources of information were:

Documentaries	TV news
Broadsheets	Friends and Family
Tabloids	Social Media
Online news	Radio

*Q2.1: Have you heard of the phrase 'food security' before? Base: All digital dialogue respondents 33

While some participants correctly ascertained that food security was related to access, a fairly equal number instead associated it with food safety

Food access

"Food security is knowing that you have access to food at all times and that will never be a point where you have to worry about where and when your food is coming from." Digital Dialogue, Female

More common view among those with higher levels of education.
Common associations were:

- Access to nutritional, affordable food
- A safe source of food
- A global issue, particularly in developing countries
- Food banks

Food safety

"The only thing I can think of for food security is, how food is packaged and transported, making sure the food we eat and buy is safe for purchase and consumption." Digital Dialogue, Male

Common associations:

- Food labelling
- Security of food packaging
- Hygiene levels at food suppliers / outlets
- Transporting food to supermarkets

After food security was defined, some participants saw it as relevant to the UK, but others saw it is an issue for developing countries

Lack of stability in the UK

- Perception that nutritious food is becoming **more expensive**, meaning those on lower incomes cannot access healthy food
- Suggested an increased **reliance on foodbanks** in the UK makes this problem seem increasingly 'close to home'
- A small number mentioned **Brexit** as a risk to food supplies

- *More commonly participants that were younger, or with higher levels of education*

"The first thing I thought of when I seen the phrase "Food Security" was food locked up and allocated only to those that needed it. e.g. food banks." Digital Dialogue, Female

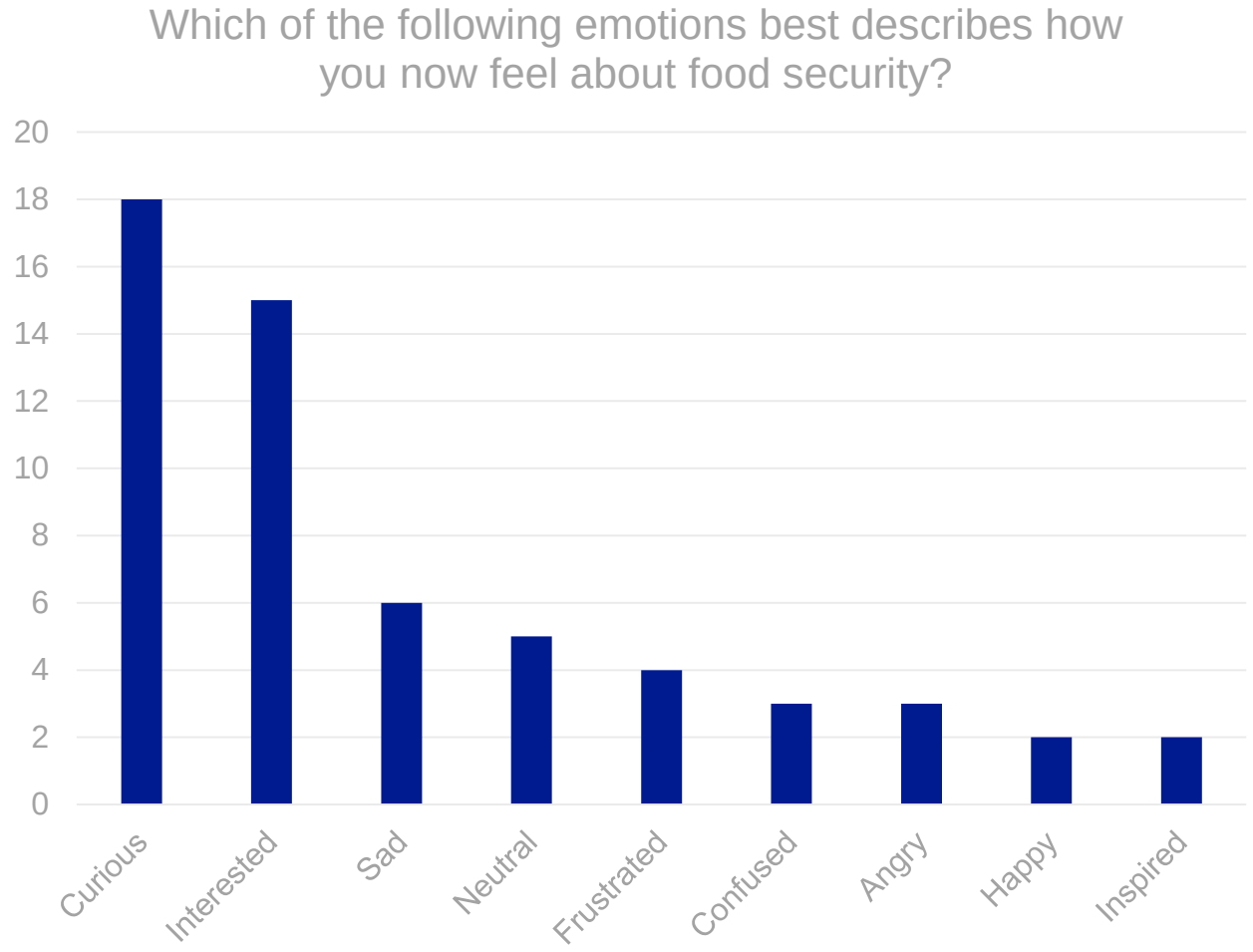
A concern for developing countries

- Perceived to only be an issue for **developing countries** rather than in the UK
- Associated with **drought, starvation**, reduced access because of **corruption and unclean sources**

- *More commonly participants that were older and/or digitally excluded*

"Third world countries don't all have the funds or access to clean water to achieve this, especially where there is droughts and the land is too hard to work with." Digital Dialogue, Female

Many participants were open and curious for more information because food security was seen as an abstract and unfamiliar concept…



"It's a much bigger problem than I thought, although I was surprised that although the population is going to grow to 11 billion, we would still be able to produce enough food." Digital Dialogue, Male

Curious

"It is a new topic I am becoming familiar with. I am not sure how the world could guarantee food security for all." Digital Dialogue, Female

Interested

… other participants responses in either an emotional or detached way

Emotional responses

- Angry
- Frustrated
- Sad
- Happy

"I'm frustrated that so many people are hungry and nothing seems to be done. Sad because no one should be hungry." Digital Dialogue, Female

- Associated with **starvation in developing countries**
- Emotional responses around the **lack of equality** and unfairness
- Considered that this is an issue that **could be resolved now**, but the right practices are not yet in place

Detached responses

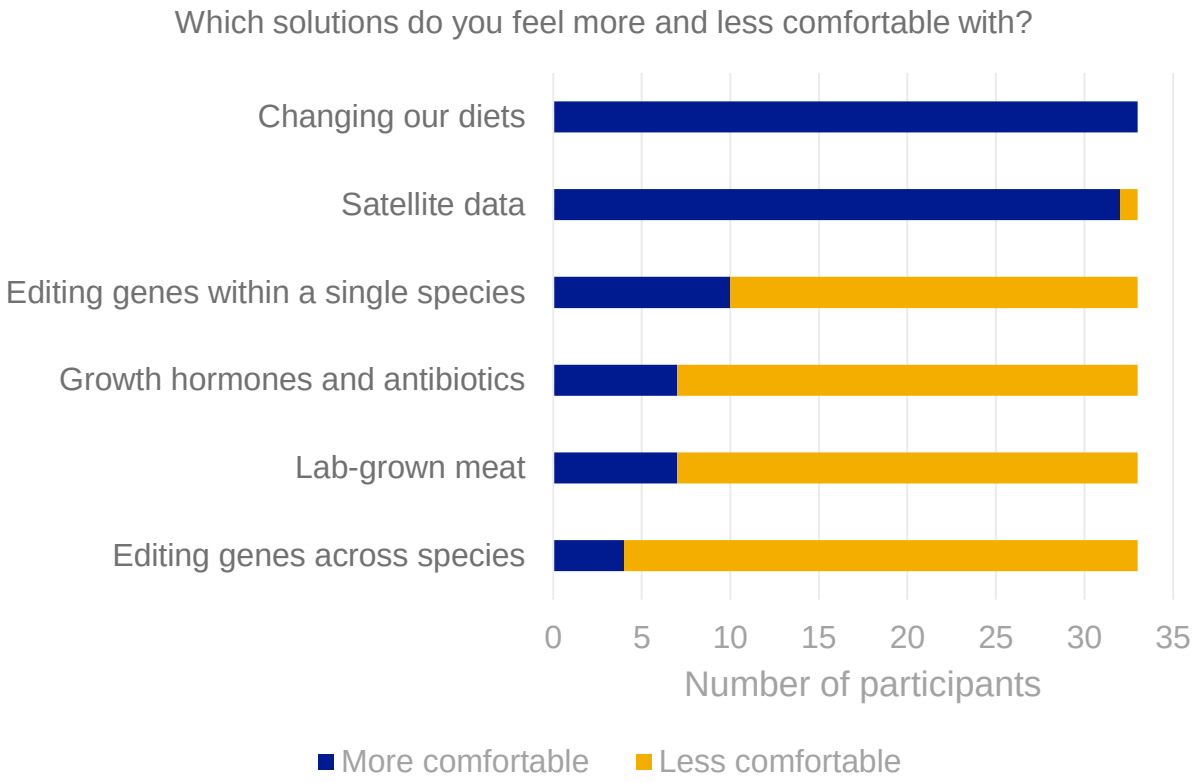
- Neutral
- Confused

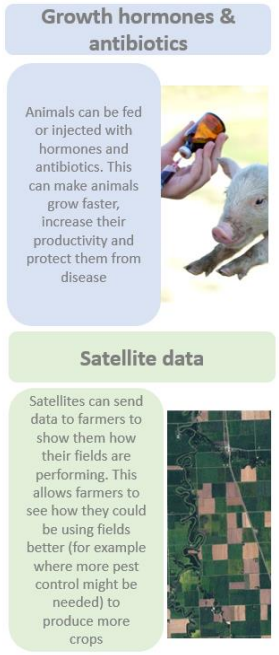
"It's not really a problem, we have a supermarket right across from us… it's all scaremongering." Focus groups, Male

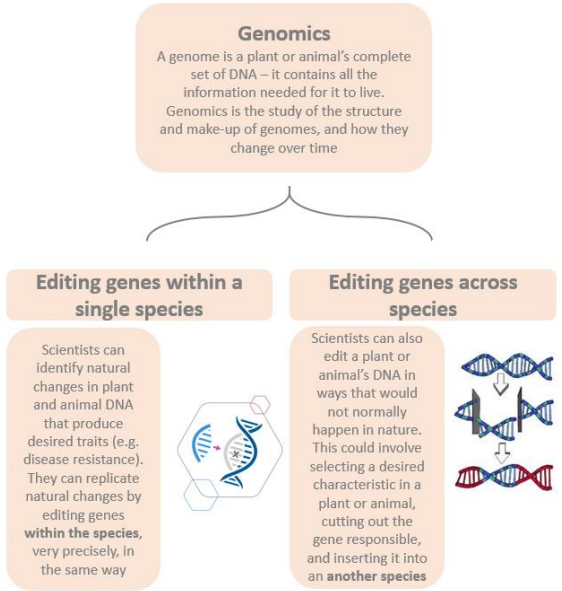
- Found it difficult to relate the issue to their own circumstances, where food was readily available and saw it as an issue that will **not impact the UK** for generations and is therefore not relevant to them
- Some saw as it as **'scaremongering'**
- More common view among **digitally excluded** participants

4.
Acceptability of technological responses to the issue of food security

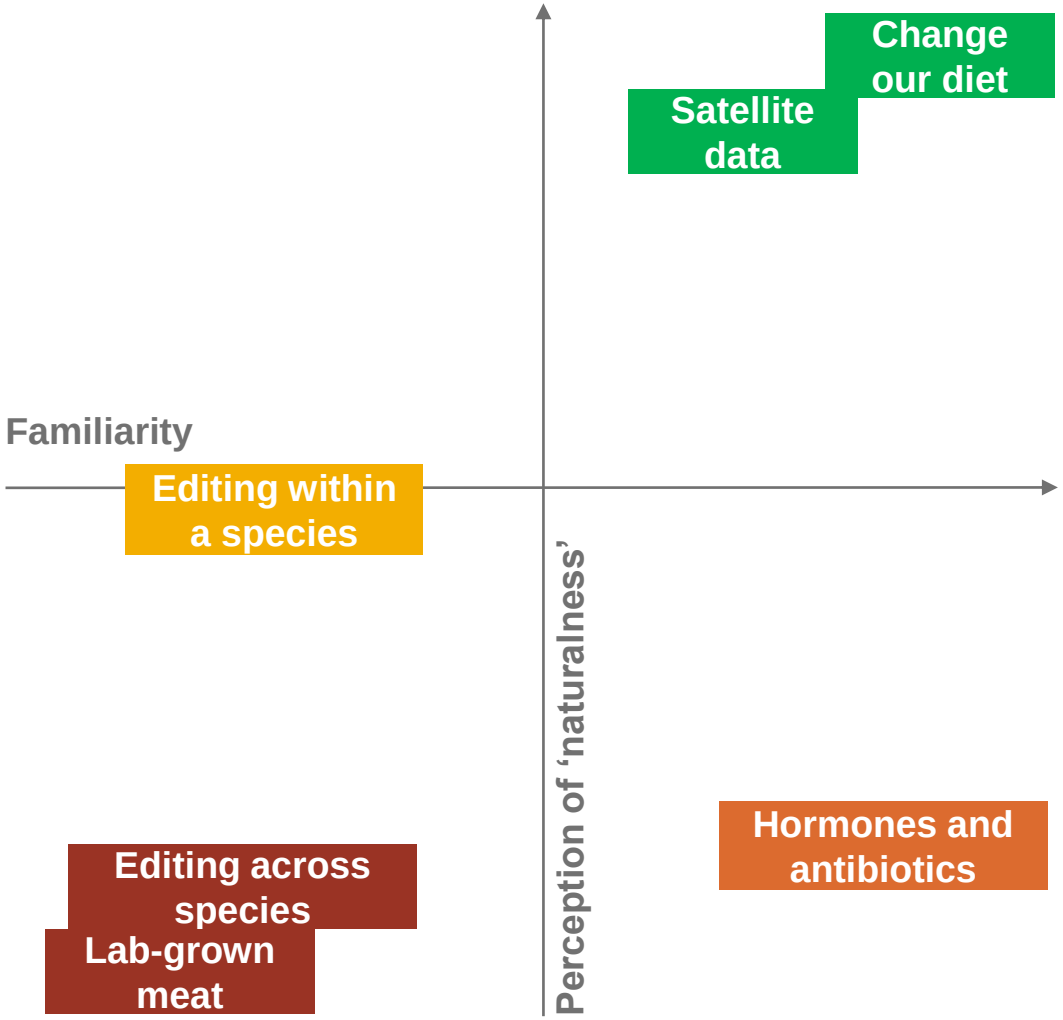
Participants were introduced to six technological solutions to food security – and were initially most comfortable with changing our diets and using satellite data







Attitudes to the technological solutions were driven by how familiar they were and how ‘natural’ they were perceived to be



Participants were more comfortable with solutions they were **more familiar** with and perceived to have lower risks of adverse side effects

They were more comfortable if a solution involved bringing about a change that could, **in theory, happen naturally**

Participants were **least comfortable** with unfamiliar solutions that they perceived to be ‘unnatural’

Participants widely claimed to be open to changing their diets

*Source: http://iopscience.iop.org/article/10.1088/1748-9326/8/3/034015/pdf

Benefits

- Broadly considered to be a more **sustainable** approach
- Acknowledged that moving to a more plant based diet will increase the **overall supply** of food
- Welcomed a **reduction in the cost** of food by switching to a plant based diet
- **No ethical concerns** about impact of this solution

Concerns

- Some concerns about behaviour being **controlled** and **being made to 'feel guilty'** about their consumption choices
- Questions over how possible this would be at the **global level**

Behaviour changes

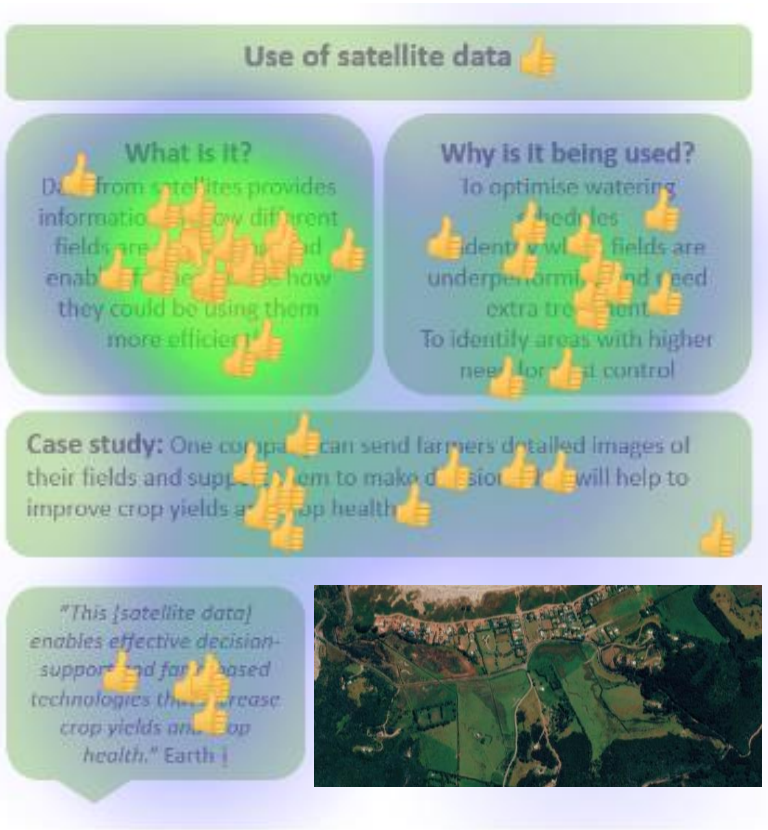
A scale of potential behaviour change emerged:

- **No change:** a large group did not want judgement about their consumption choices
- **Some change:** already considered that they had enacted some minor changes
- **High levels of change:** had already changed behaviour and suggested need for broader education

While many participants claimed to be open to making changes to their diet, others were less supportive and saw it as paternalistic

"I'm already cutting out some meat… we're being told that it's important." Focus groups, Female

Utilising existing familiar technology such as satellite data to improve farming efficiencies was an uncontroversial solution



Benefits

- Positive responses to using **existing, familiar technology** to improve efficiency in farming
- **Farmers** were seen as particular beneficiaries
- **Better use** of input resources like water and fertiliser
- More food available

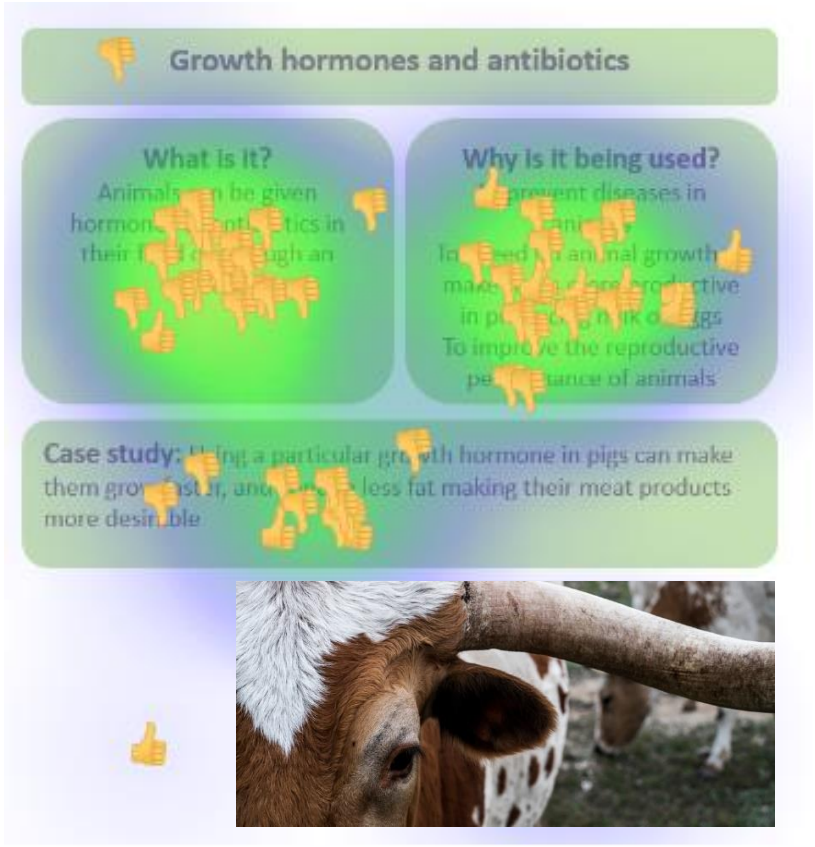
Concerns

- Concerns focused around **data misuse and hacking**
- Some questioned whether this would be **enough** to mitigate the issue of food security substantially
- A minority noted this could **increase pesticide** use
- Likely to disproportionately help and **empower wealthier farmers** rather than poorer/smaller ones

Participants generally welcomed the added efficiency to existing practices that it would bring

"The data concerning his fields would help [the farmer plan] the best crops for that field and help him in crop rotation and the best way to utilize water consumption for the crops." Digital Dialogue, Female

Participants were generally negative about growth hormones and antibiotics because of potential adverse health implications and animal welfare concerns



Benefits

- Participants welcomed greater **control over diseases** in animals both for animal welfare and for human consumption
- Some saw a high potential for **greater yields** with less input (e.g. grazing land)

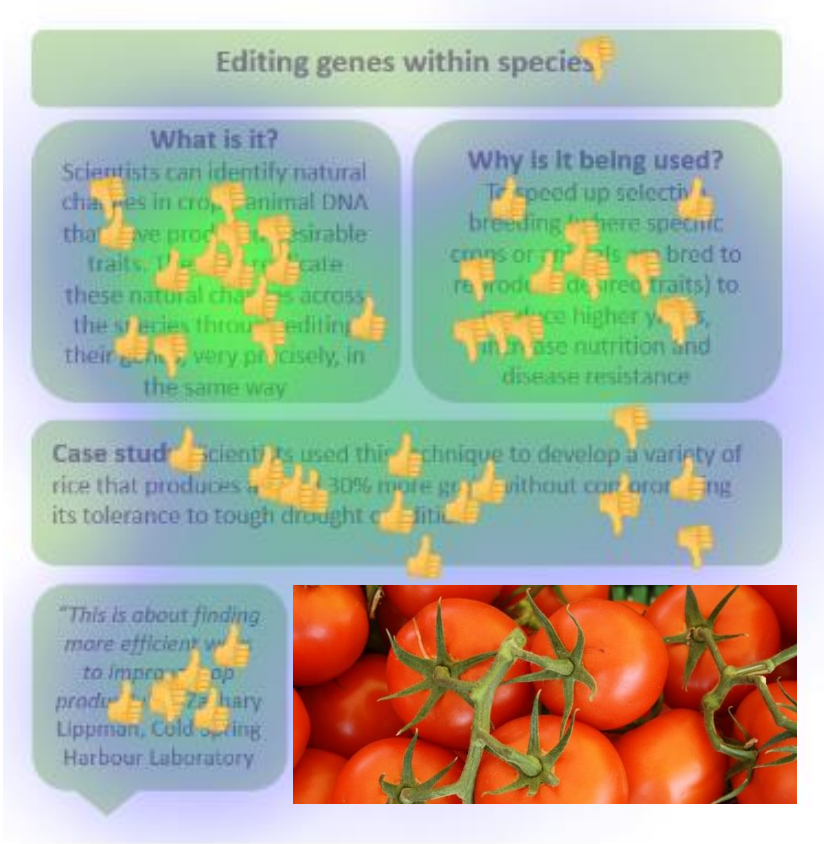
Concerns

- Concerns about **health impacts** for consumers.
- Seen as unnatural and potentially causing **unknown side-effects**
- Concerns about **antibiotic resistance**
- Some called for greater mention of hormone/antibiotic-use on **food labelling**
- Concerns about **animal welfare** with some deeming increasing muscle mass as unethical
- Concerns about impacts on **meat quality**

Participants were primarily concerned about the health impacts that consuming this meat could have. Animal welfare issues were generally secondary.

"This could be troublesome for many - certainly people are afraid of humans becoming immune to antibiotics as a result of it being in the food chain." Digital Dialogue, Male

Genome editing within a species was contentious among participants, although views varied across the sample



Benefits

- Positivity about improved **immunity to disease**, and resistance to hostile environmental conditions
- Positivity towards **resistance** to pests
- Some were positive that the process **did not involve mixing the DNA** of different species
- **Regulation** made some more comfortable, but others worried whether it would stop 'rogue' users

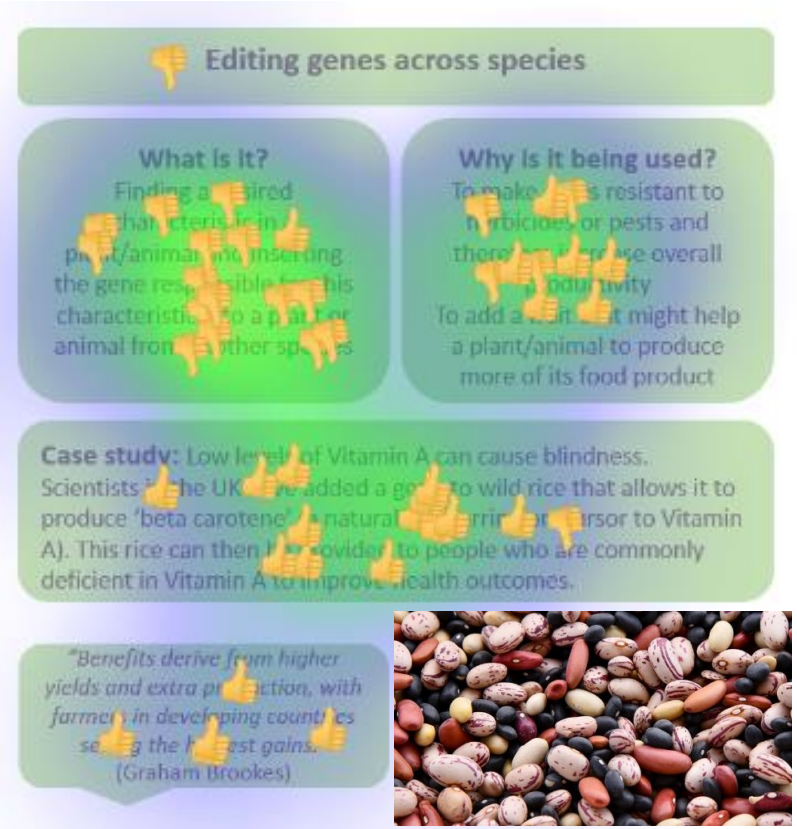
Concerns

- Concerns that changes to genomes may **weaken the gene pool** increasing susceptibility to disease
- Concern about small farmers' **access to this technology** – supermarkets, large-farm owners and technology companies seen as main beneficiaries
- Uncertainty over **long term health** impacts
- Uncertainty over how widely this is used today and what the **health effects** are
- Concerns over a **'slippery slope'** towards use in humans

While some participants welcomed more resistant organisms, others were concerned about how this technology would be regulated

"Gene editing within a species sits a tiny bit more comfortably with me than gene editing across a species, but I think there would have to be very strict controls to it." Digital Dialogue, Female

Genome editing across different species made people more uncomfortable and was seen to be 'riskier' and less natural



Benefits

- Again, some respondents focused on the positive impact this could have for **food yields**
- Welcomed tangible benefits for **health conditions** (i.e. increasing Vitamin A provision)
- When talking about **specific examples** respondents were more warm to this idea
- Seen as **less contentious in plant species** than animals

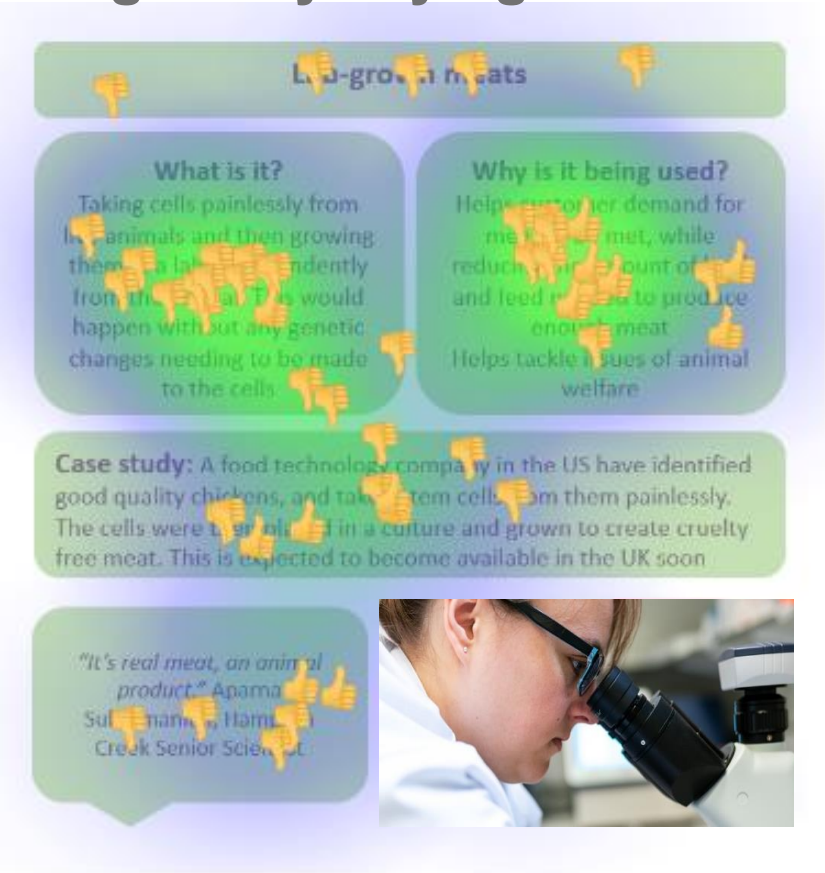
Concerns

- **More discomfort** than with editing within a single species
- Crossing genes of different species associated with creating **'alien' and hybrid** species.
- Ethical concerns over humans **'playing god'** more common among those aged 55+
- Worried about potential damage to **ecosystems** and food chains

Participants were largely more negative towards editing across species than editing within a single species – a minority did not differentiate between the two

"I fear that we may end up with 'super crops' that kill off existing plants and unbalance the eco-system…I suppose I would be more comfortable if the products are clearly labelled so we can avoid them and if we didn't cross animal with plant." Digital Dialogue, Male

Lab-grown meat was polarising, but the majority instinctively responded negatively saying it was unnatural and would not feel like eating 'real' meat



Benefits

- Provides meat-eaters with the **protein** they want **without animal suffering** or welfare issues
- A minority were positive about the **environmental** implications

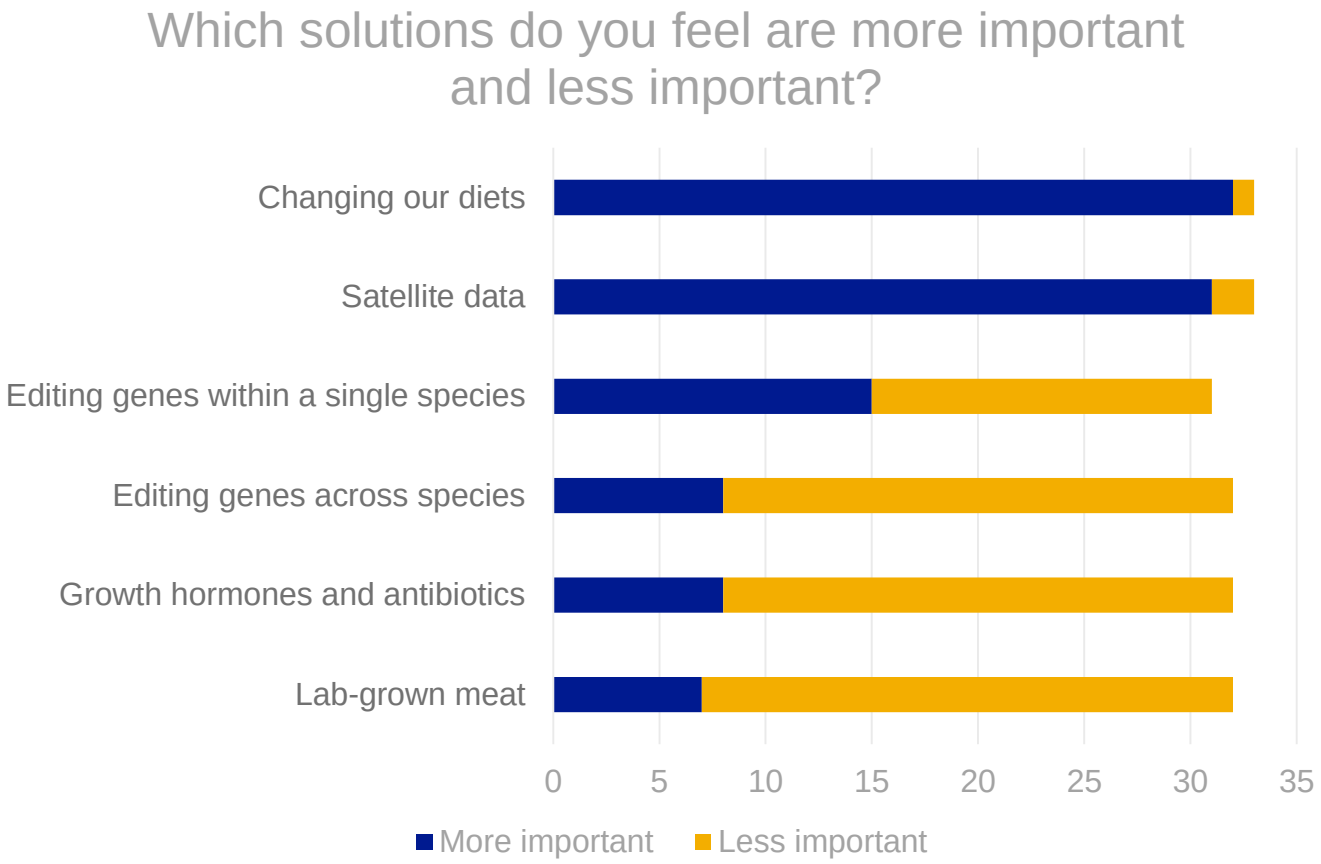
Concerns

- Negative responses tended to be **instinctive and emotional** rather than rationalised
- Uncertainty about whether this was **'real' meat**
- Uncertainty about how it would **taste** – concern it would be similar to meat substitutes
- Uncertainty over potential **long term health** implications
- Some worried that lab-grown meat is already in supermarkets **without them knowing**

While this solution was polarising, many participants were concerned around long term health implications, and felt that scientists were trying to 'play God'

"I dislike the idea of lab-grown meat altogether as I'd like to think that I'm only putting natural ingredients in my body." Digital Dialogue. Female

After seeing the information about the solutions, participants considered changing diets and using satellite data to be the most important solutions to the issue of food security



There was preference for solutions that were considered to facilitate more efficient use of existing resources

Importance was also determined by how 'natural' participants determined a solution to be

Participants tended to place more importance on the solutions that they were more comfortable with

5.
Understanding and acceptability of genome editing within and across species in food production

Participants did differentiate between editing within and across species– but some were more able than others to distinguish differences in benefits and risks

Were not able to see different benefits and risks

Were able to see different benefits and risks

Understood there are differences between editing *within* and *across* species but less interested in the different benefits and risks of each.
More instinctive responses.

"It does sound very Jurassic park! Could risks arise from potential negative changes to animals characteristics, could some animal start developing dangerous characteristics?" Digital Dialogue, Male

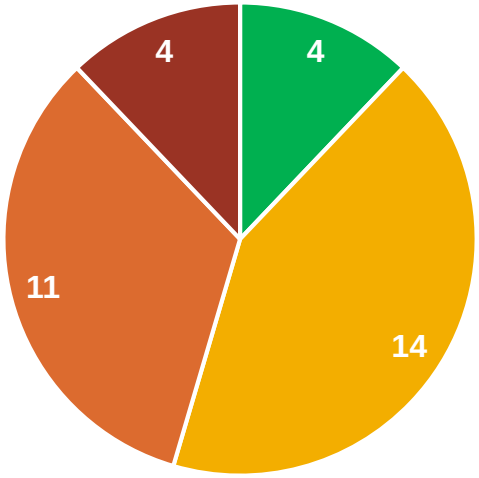
"Editing a gene within a species now seems less risky to me…I can see the benefits of gene editing in a single species as it's like natural selection - just faster." Digital Dialogue, Female

Understood the difference and were able to distinguish benefits and risks
Understood the reduced risk of editing *within* a species and considered it to be more 'natural'
Wanted clearly defined boundaries of regulation
More considered responses

Clear, comparisons between editing within and across species may enable participants to differentiate between them

Overall, participants were more comfortable with editing within a single species than across species, understanding it to replicate a natural process

Editing genomes within a single species



- Very comfortable
- Quite comfortable
- Quite uncomfortable
- Very uncomfortable

"I am quite comfortable as the editing is only mimicking natural reactions." Digital Dialogue, Male

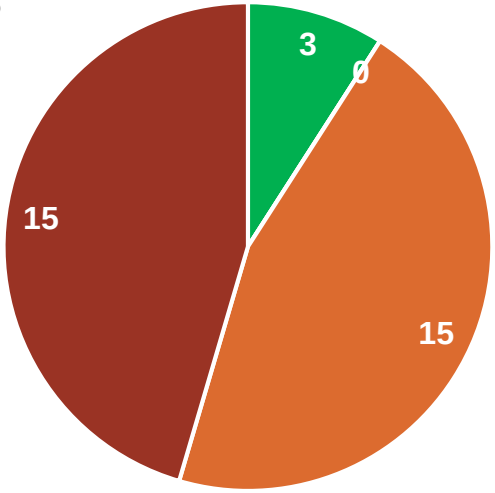
Those who were more comfortable recognised that this would result in greater food production efficiency and were reassured that it replicated a natural process that genomes go through over generations

Those who were less comfortable tended to refer to their lack of knowledge about regulation and long term side effects as their main concerns.

Editing genomes across species

"It's meddling with nature and how species have evolved, I don't think it's up to humans to interfere with how nature was meant to be." Digital Dialogue, Female

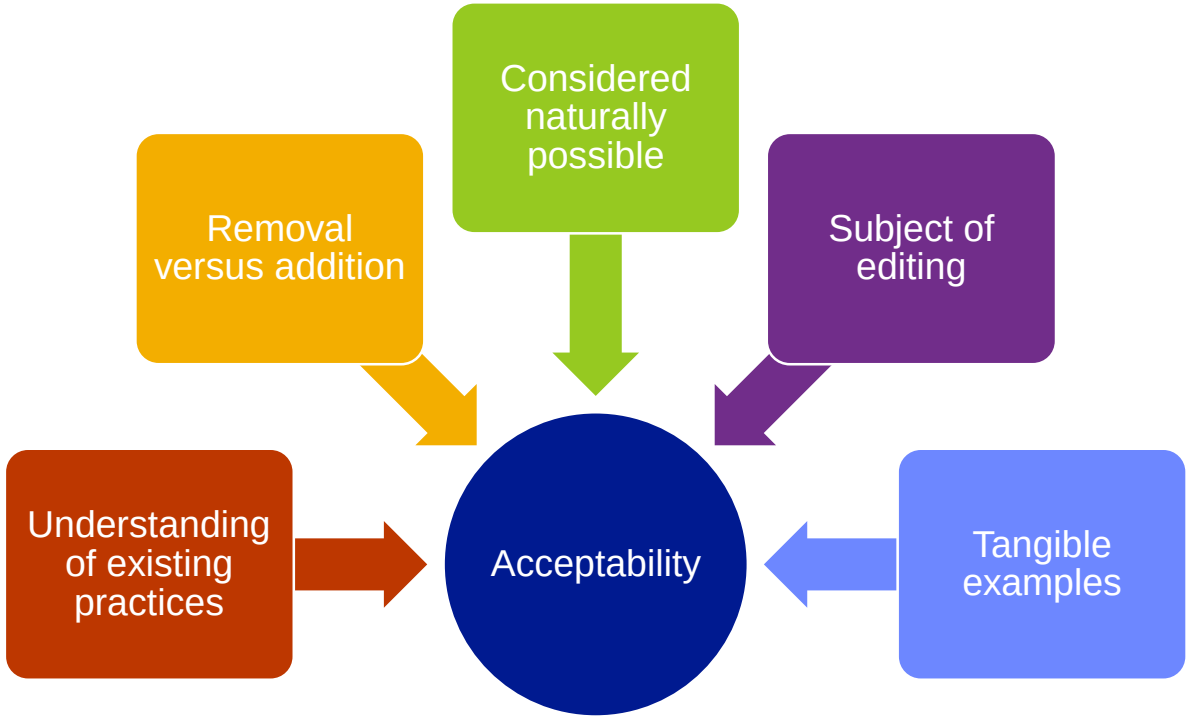
- Very comfortable
- Quite comfortable
- Quite uncomfortable
- Very uncomfortable



The few that were comfortable recognised the scale of the issue of food security and saw this as an efficient and necessary response

Overwhelmingly, participants were concerned that not enough research had been done to ensure this solution was safe. They were also concerned that humans were 'playing God' by mixing species, and that this was a 'slippery slope' to use on humans

Overall, five key factors drove how acceptable participants found the editing of genomes to help address the issue of food security



Genome editing was considered most acceptable when participants:

- **Had knowledge of and understood existing practices -** where participants were aware of previous practices including selective breeding, and how these linked with genome editing
- **Genes were removed rather than added -** participants were more comfortable with undesirable characteristics being removed, rather than something new being added to a species
- **Considered naturally possible -** when the changes were seen to have been possible over time without human intervention
- **Felt less connected to the subject of editing-** Where the subject was an animal, participants felt more emotional about genomes being edited. Where the subject was a plant, there was less emotion involved
- **Tangible examples available** – where participants could see the reality of genome editing in action, reducing their uncertainty and associations with sci-fi examples

Understanding of how genome editing relates to existing practices, such as selective breeding, reassured participants of the outcomes of genome editing

Understanding of existing practices

"Selective breeding has been happening since the beginning of time…Cross breeding has been used to change colour for instance beetroot, with white rings or tomatoes, carrots in a range of colours." Digital Dialogue, Female

Why do participants' knowledge and understanding of existing practices drive acceptability?

Where participants were aware of existing farming practices (selective breeding), they commonly saw the outcomes of genome editing as less controversial and scary, instead seeing genome editing as speeding up existing outcomes. Familiarity reduced the uncertainty that concerned other participants.

What knowledge facilitated acceptability?

Selective breeding: where participants were aware that this practice has been used for a long time, they were more accepting of genome editing

Natural mutations: knowledge provided reassurance that the outcomes of editing within a species could happen naturally

Who more commonly held the relevant knowledge?

Those with a higher level of interest in science tended to already have some knowledge of selective breeding and natural mutations

Genome editing was more acceptable where the purpose was to remove undesirable or harmful characteristics rather than adding a genome and new ability/characteristic

Removal versus addition

"If it was just a case of bad genes being removed […] then that can't be a bad thing and if it is protecting the supply of crops so that the food supply is enough for everyone then *I'm comfortable with it." Digital Dialogue, Female*

Why is the purpose of genome editing important to participants?

Participants were more concerned about genome editing that adds something 'new' to an organism. They expressed concerns about a 'slippery slope' to unregulated genome editing and the production of 'alien' species and wanted reassurance that genome editing was about controlled and ethical approaches to improving efficiency.

What purposes were considered 'acceptable'?

Subtracting genomes that would be harmful to a plant or animal
Removing undesirable characteristics that would be harmful for humans to consume

What purposes were considered 'unacceptable'?

Participants tended to be more concerned about adding genomes as this was associated with creating 'alien' species and harming animals (e.g. through increasing muscle mass to an extent that would impact animal health)

Where edits to genomes were seen to have been able to occur naturally, ethical and health concerns were more easily offset

Considered naturally possible

"I am quite comfortable as the editing is only mimicking natural reactions. If I knew for a fact that there was no more effective way of selective breeding then that would increase my comfort even more." *Digital Dialogue, Male*

Why was it important for the outcomes of genome editing to be 'naturally possible'?

Reduces concerns about creating 'alien' species with unknown characteristics, risks, and implications
Reduces concerns about health implications of consuming 'manufactured' species

What was considered 'naturally possible'?

Genome editing within a single species where changes in characteristics could have been brought about by breeding or natural mutations

What was not considered 'naturally possible'?

Genome editing across species where natural breeding would not be possible

Participants were more comfortable when the editing subject was biologically further away from humans – being more comfortable with plant than animal editing

Subject of editing

"I'm not sure why I feel more comfortable with crops being modified rather than animals, but somehow I do, I suppose that animals are so similar with similar internal organs, brains, hearts, lungs etc, yet crops don't hold that same emotional pull." Digital Dialogue. Female

Why was the 'subject' of genome editing important?

Participants' instinctive, emotional responses were strongly determined by the subject of editing. Where the subject felt biologically further from humans, they considered it to be safer and felt more reassured that there would not be a 'slippery slope' towards use on humans

What was considered an appropriate 'subject'?

Participants were more comfortable with the genes of plants being edited. There was a less emotional response to this, fewer concerns about welfare and this practice felt further removed from gene editing on humans

What was not considered an appropriate 'subject'?

Participants tended to be less comfortable with the editing of animals' genes. While some were unable to articulate why, others discussed animals' biological make up as being more similar to humans, meaning they empathised with them more

Tangible examples grounded genome editing in reality, and made participants less uncertain and concerned

Tangible examples

"The more I am reading about it and seeing all the major benefits it possesses and issues its resolving the more comfortable I am with genes being edited. We can see the food security benefits easily with these examples above." Digital Dialogue, Male

Why were tangible examples important?

When tangible examples were provided to participants, this helped them to see the reality of genome editing, which tended to be less shocking and scary than they imagined, reducing their uncertainty and instinctive associations with sci-fi examples (e.g. adding extra limbs to animals)

Tangible benefits

Where participants could see personal benefits they became more open to the prospect of genome editing within a species
These benefits could include continued access to food, or food that could be produced in a changing climate

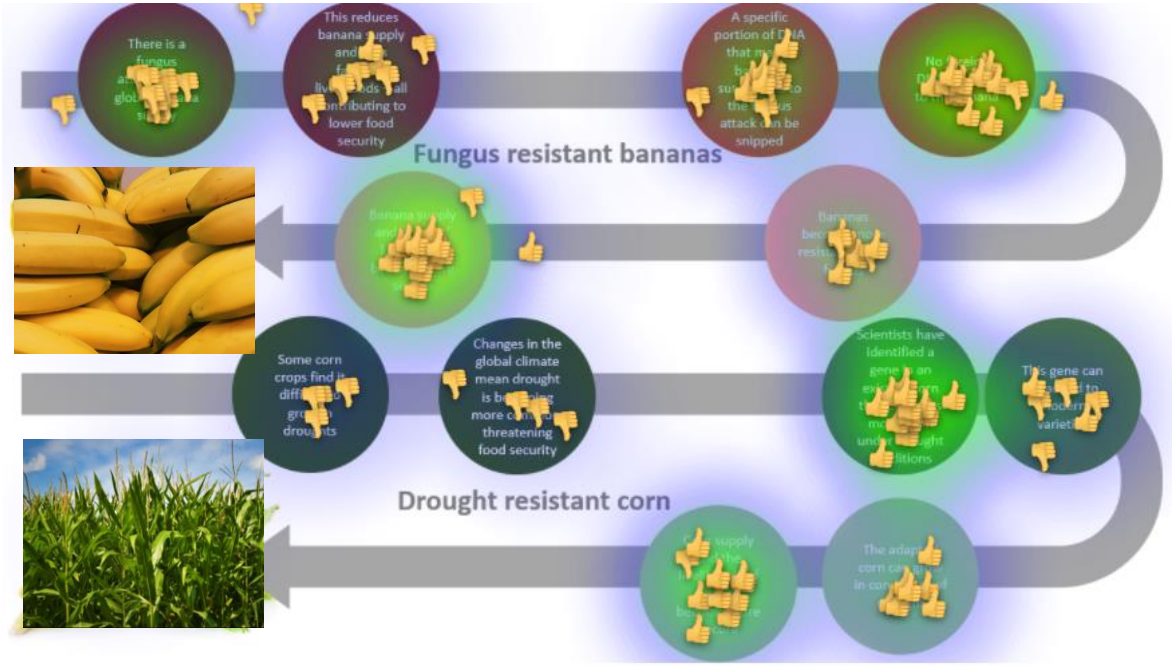
Reality of what the results of genome editing might look like

Seeing the small changes that could be made reassured participants' concerns that this technology could be used to create 'mutant' plants or animals

Participants were broadly comfortable with editing genomes within a plant species…

Understanding of existing practices
Uncertainty over the process commonly drove any remaining concerns

Considered naturally possible
Reassured that no 'foreign' DNA would be added. Recognition of the need to speed up 'natural' changes to account for growing population



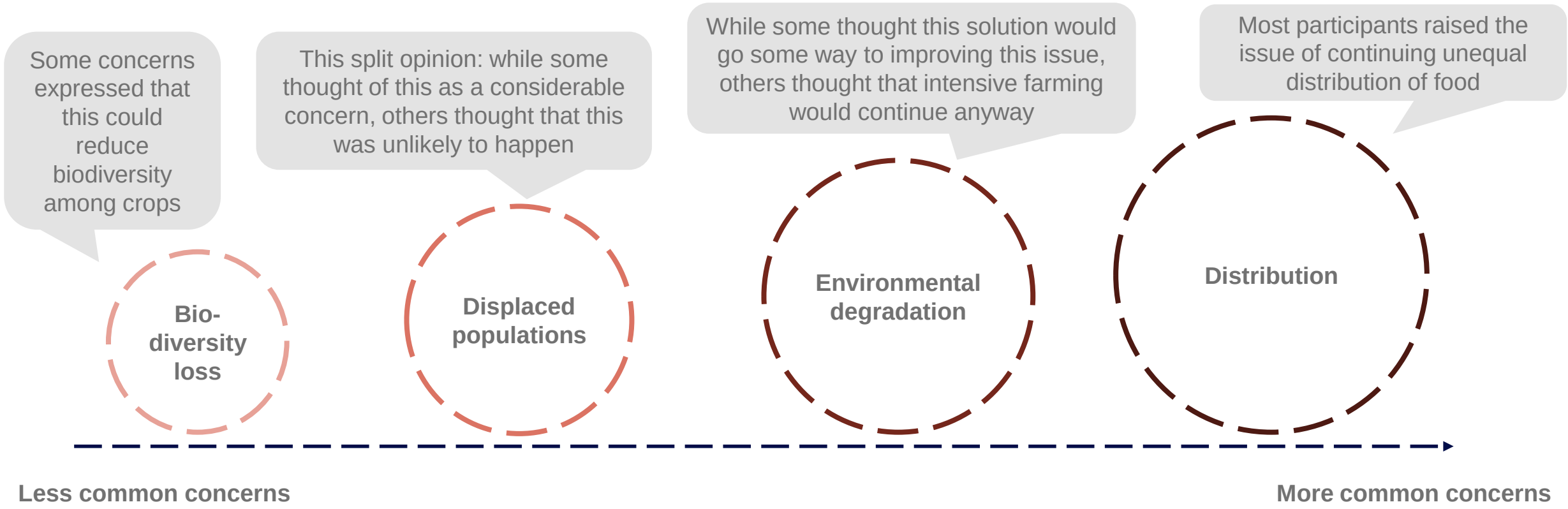
Tangible examples
Demonstrated tangible benefits for crops that they regularly consume
Reassured participants that no radical changes would occur to the products

Removal versus addition
Participants were more concerned about the corn, where a gene was added, than the bananas, where the DNA was snipped

Subject
Biological make-up further away from human meaning there was less of an 'emotional pull' and therefore changes were more comfortable within plants

"The idea of foreign DNA not being used is reassuring and I certainly feel more comfortable now with this approach." Digital Dialogue, Male

…but remained critical that this solution did not address what they saw as the fundamental issue of unequal food distribution

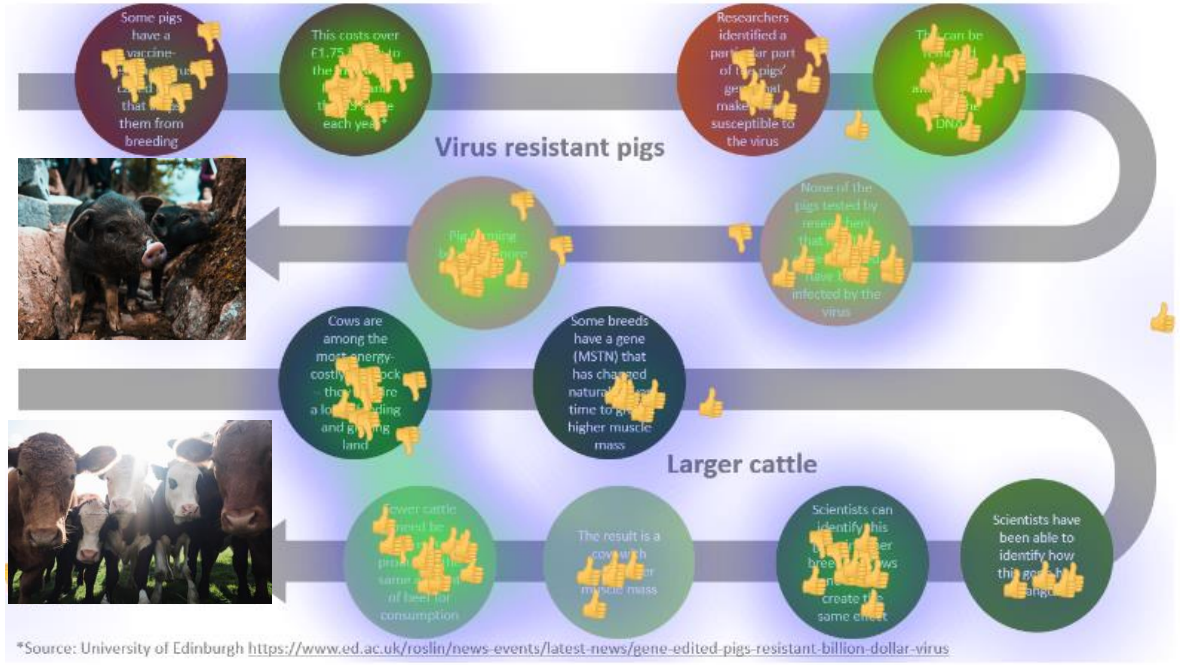


Participants' main concern was that editing genes within a single species of plant would not address the issue of unequal food distribution. This was what was considered to be a key issue in tackling the issue of food security.

There was a more mixed response to gene editing within an animal species, although tangible examples prompted more positive attitudes…

Understanding of existing practices
Participants were aware of other practices to prevent diseases in animals, and so if used for this reason genome editing in animals was more acceptable

Considered naturally possible
More comfortable editing within the same species, but raised some concerns with cross-breed editing. Discussed some adverse effects that cross-breeding has had for dogs



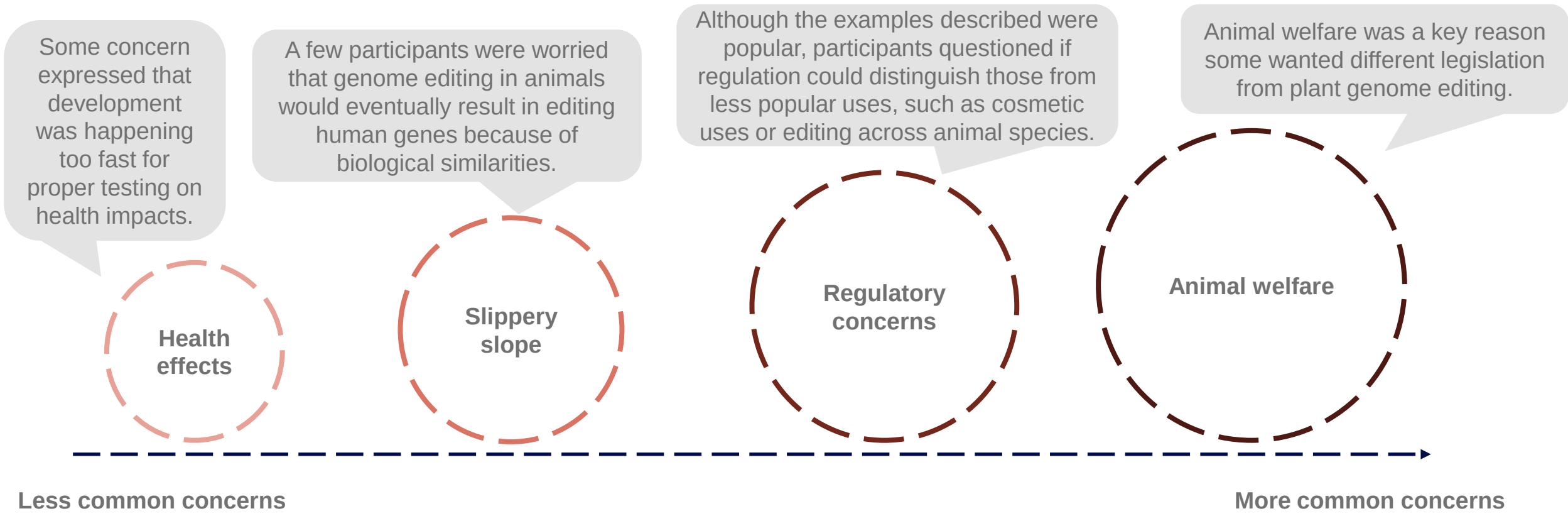
Examples shown
Demonstrated benefits for animals themselves, through virus resistance and the environment. Reassured participants over concerns that this would result in 'mutant' animals.

Removal versus addition
Participants were positive where a gene that could cause harm to the animal was removed. This was seen as a positive for animal welfare

Subject
Participants were more averse to animal gene editing because many saw animals as biologically similar to humans, which drew a more emotional response

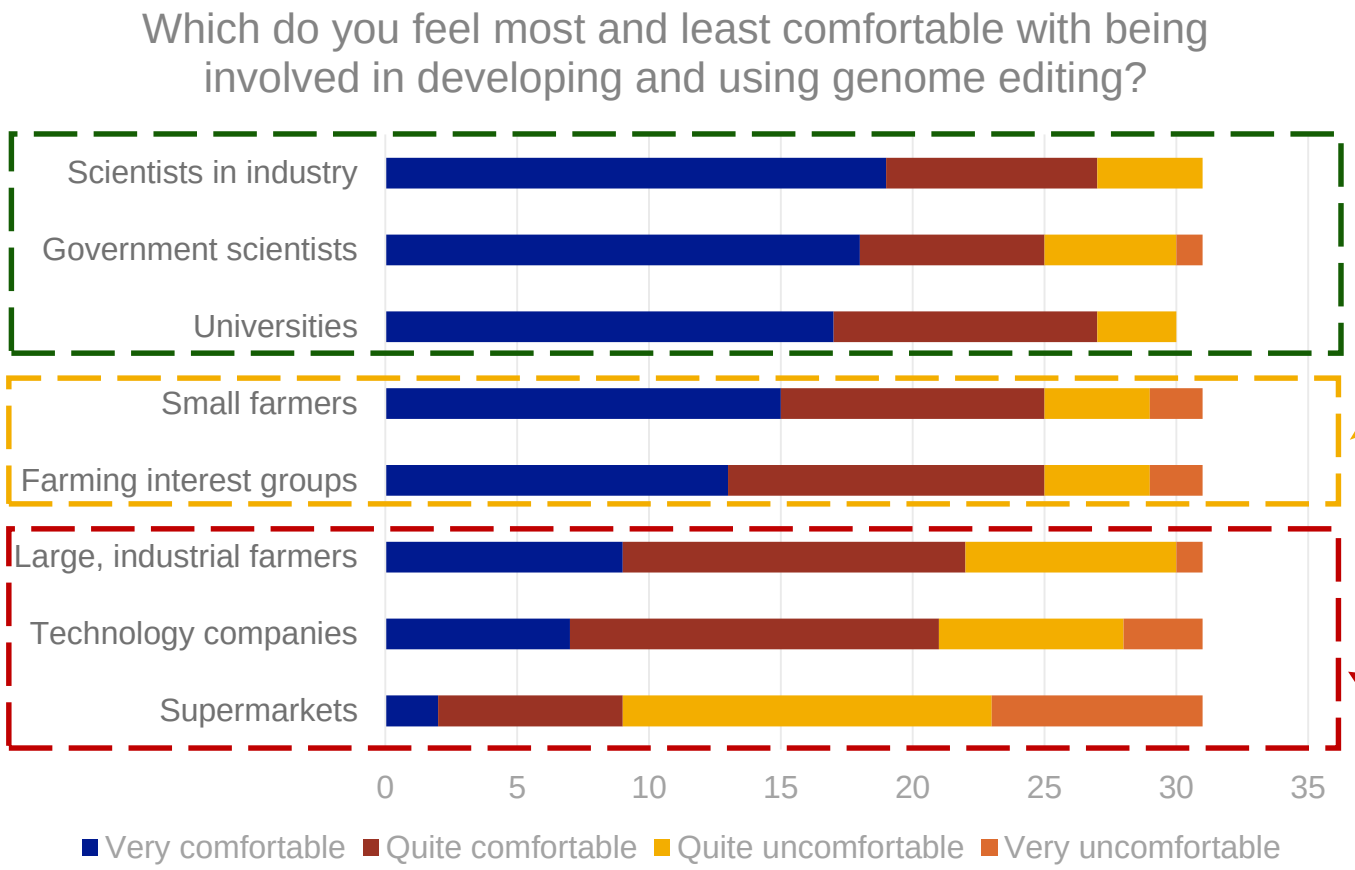
"If something is edited within it's own species in a safe and secure way, and it decreases disease then I could possibly get on board with that. I do think we need further education on this type of treatment though." – Female, Digital Dialogue

…but concerns persisted about adverse impacts on animals welfare



Some participants were concerned with using animals as a means to our ends in this way, unlike with plants. They either talked about the capacity animals have to feel physical and mental pain or simply felt an emotional aversion to the practice because animals are more 'like us'

Participants were more comfortable with organisations being involved in genome editing that they saw as more stringently regulated and having more specialised knowledge



More comfortable where organisations were…

- Considered to have stricter ethical rules and be more highly regulated
- Seen to be more 'specialist' and knowledgeable – scientists were seen as objective

Conflicted views about organisations …

- Considered to have the best interests of animals at heart, and know a lot about their own products, but where there were concerns about technological expertise and how regulation would be governed and implemented

Less comfortable where organisations were…

- Considered to be driven by profit
- Considered to be less concerned about consumer safety
- Mirrors findings in 'Wave 1: Trust in Science and Scientists' where 'industry' is not yet trusted, but scientists in industry are

Q9.1: Which do you feel most and least comfortable with being involved in developing and using genome editing?
Base: all responses 31

Participants were more comfortable with organisations being involved in genome editing that they saw as more stringently regulated and having more specialised knowledge

"I feel most comfortable with **government scientists** being involved in genome editing within a single species in farming because I believe they will adhere to stricter rules and laws and will need to be convinced of their merit before giving the go ahead."

Digital Dialogue, Female

"I feel least comfortable about **Small Farmers** being involved in genome editing within a single species in farming because there are not qualified and not governed enough."

Digital Dialogue, Male

"I feel least comfortable about **Supermarkets** being involved in genome editing within a single species in farming because They will always go with the cheapest alternative and it wont be until years after that we hear of what they have being selling. The horsemeat scandal is a example of this."

Digital Dialogue, Male

"For me the most reliable would be **universities** and **government scientists**."

Focus groups, Female

"Would they not have bias because they're **farming interest groups**? [The scientific groups] are all independent but here the interest is coming from the farmers."

Focus groups, Female

"**Supermarkets** – stick them at the bottom! [They're] profit-driven."

Focus groups, Female

Organisations who would profit financially or reputationally were perceived to be the biggest beneficiaries of genome editing – this was negatively perceived by participants

Who benefits the most from genome editing?	
Profit	**Farmers**: through more efficient production. It was expected that larger farmers would be more likely to afford the technology and benefit in this way **Supermarkets**: by passing on costs to consumers **Technology companies**: selling the technology to farmers **Government**: through taxation **Universities**: through research
Reputation	**Universities**: flagship research into new technologies **Government**: recognition of investing in new, efficient technologies

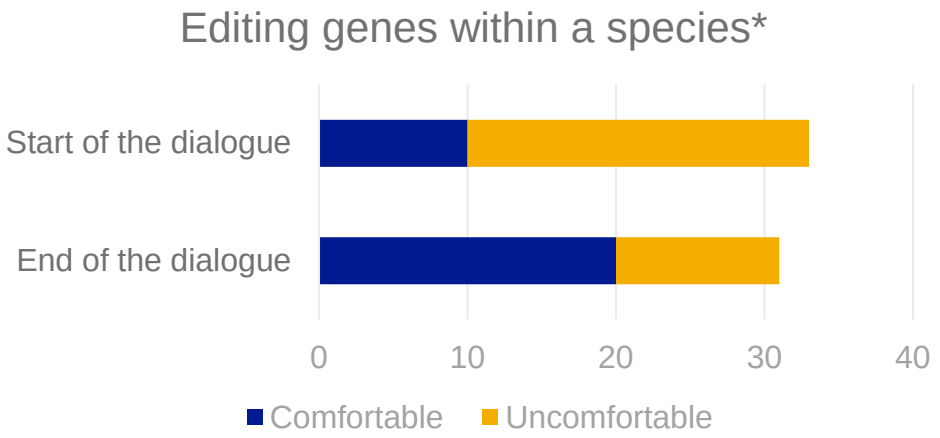
Who benefits the least from genome editing?	
Cost	**Small farmers**: unable to afford to invest in new technology
Income	**Low income customers**: expected that initial costs of produce would be higher, cutting them out of the market **Highest income customers:** already have spending power to make decisions about what to buy, so this technology may not make a significant difference to them

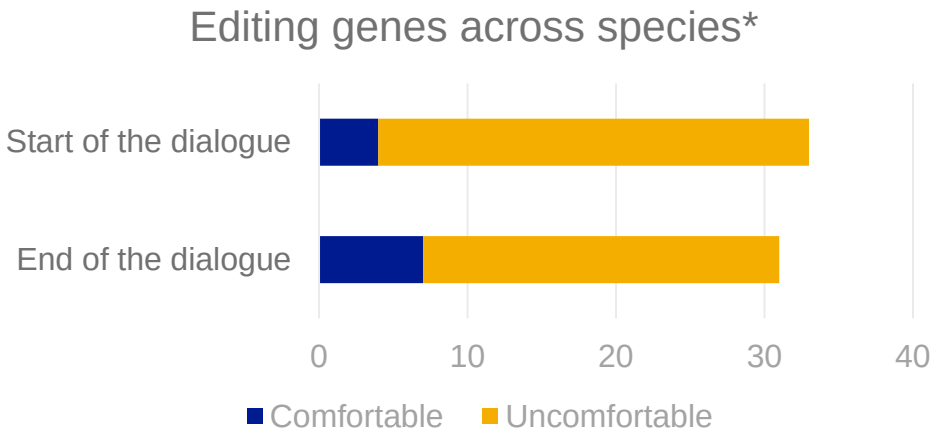
"Technology companies surely stand to make the most given that the will own the rights and sell it globally." Digital Dialogue, Female

"Low income consumers would benefit the least. Genetic editing costs money so the initial costs would be high. Those on a low income wouldn't be able to afford this." Digital Dialogue, Female

6.
Reflections

After reflecting on the dialogue, some participants had become more comfortable with genome editing within a species…





Some participants had become more comfortable with **editing genes within a species** because…

- They recognised the **positive impact** that could be had on food security
- They recognised it to be the **speeding up of a natural process**
- It was **less invasive** than previously assumed

A small number participants had become more comfortable with editing genes **across species** because…

- They recognised the **positive impact** that could be had on food security

Others had no change in attitude towards these solutions because…

- They felt that potential **long term health impacts** had not been addressed
- They remained concerned that this was a **slippery slope** to use on humans
- They preferred the use of the **other technological solutions** discussed

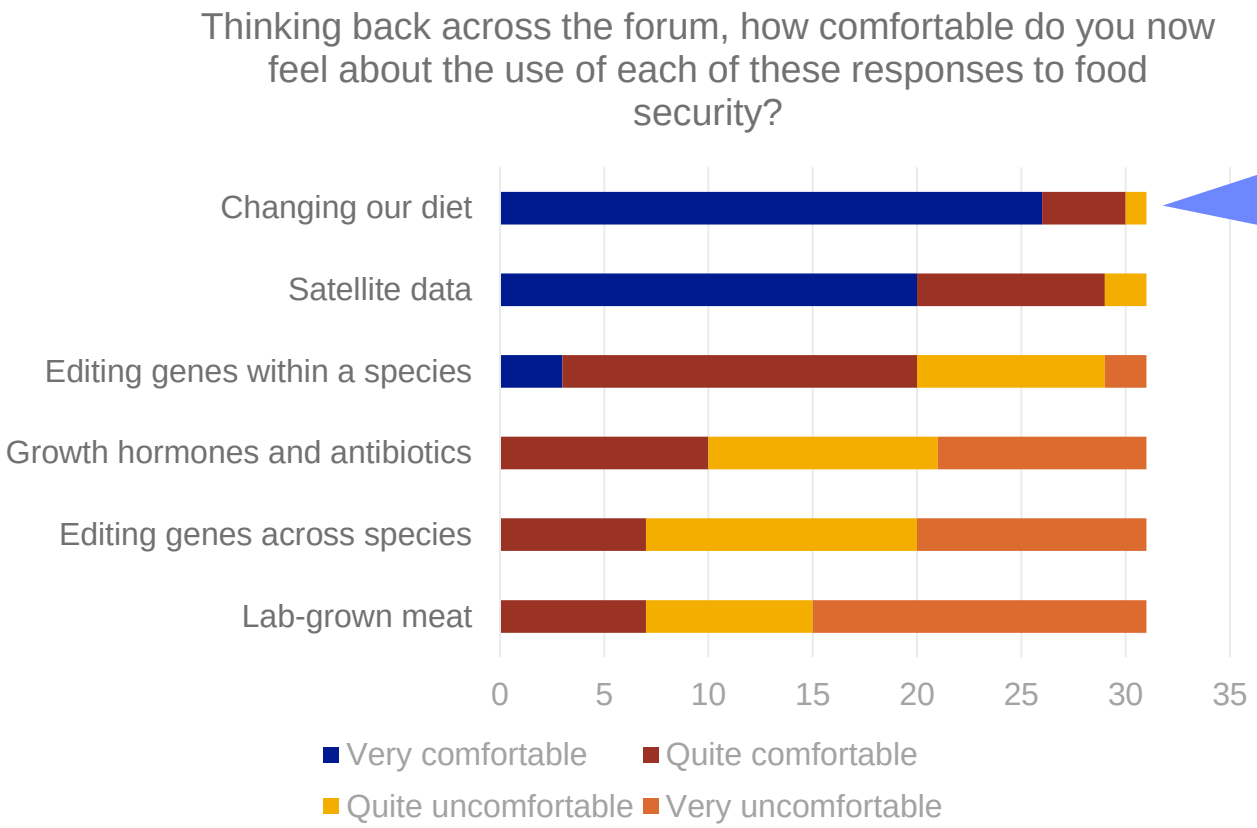
Q6.2: How comfortable are you with the editing of genes within a single species as a potential solution to the issue of food security? Base: all responses 33

Q6.3: How comfortable are you with the editing of genes within a single species as a potential solution to the issue of food security? Base: all responses 33

Q10.1: Thinking back across the forum, how comfortable do you now feel about the use of each of these responses to food security? Base: all responses 31

*See Page 25 for explanation of the differences between editing within and across a species

… but overall changing diets and use of satellite data remained the solutions that participants were most comfortable with



Some participants, who tended to have higher levels of education, suggested that they might start to have more ethical consumption behaviours by…

- Reducing their food waste
- Eating less meat
- Looking into how meat they consume is produced
- Placing less focus on food aesthetics

Others would not change their behaviour because…

- They could not see the role an individual could play
- They enjoyed their current consumption habits and did not want to feel judged for these

"No, there is nothing that I can do personally that will effect worldwide food security." Digital Dialogue, Male

Q10.1: Thinking back across the forum, how comfortable do you now feel about the use of each of these responses to food security?
Base: all responses 31

7.
Implications

Implications

Area	Implications
Awareness of food security	Awareness of food security was low, but there was appetite for learning more about this issue once it was introduced. Some participants, particularly those digitally excluded and with lower education, struggled to see its relevance to themselves and the UK where they saw food as plentiful. Showing tangible example of how food security may impact people directly in the UK could help to make it more pertinent.
Responses to technological solutions	Participants were most comfortable with changing diets and using satellite technology – because these technologies were more familiar and seen to be more 'natural'. They struggled to overcome these barriers regarding lab-grown meat, hormones and antibiotics, and cross species gene editing. Increasing familiarity may help to offset some concerns.
Responses to genome editing	Comfort with genome editing within a species grew over the dialogue, as participants came to understand that this method speeds up 'natural' processes and were exposed to tangible applications. De-mystifying the process helped people to feel more comfortable. However, low levels of comfort with cross species editing did not change, and it remained seen as 'playing God' and to have health and animal welfare implications, along with raising concerns that this method could be used on humans. Although they were more comfortable with plant than animal editing, participants remained concerned that genome editing does not address the fundamental problem of unequal food distribution and they remained un-reassured about animal welfare implications. There needs to be further dialogue with the public about how genome editing will address unequal distribution of food and about the animal welfare implications.
Organisations	There was greater comfort with organisations being involved in genome editing that were seen to be more stringently regulated and to have greater expertise, and lower levels of trust in the organisations seen to be most likely to financially profit and personally benefit – and this reflects findings from wave 1 about what drives trust in scientists and experts.
Changing our diet	There was widespread enthusiasm for changing our diets to help address the issue of food security, with some participants reporting that they were already trying to reduce their meat consumption. However, further research should explore the feasibility of behaviour change in this space for the public. Demonstrating the impact of an individual changing their behaviour may help to increase sense of personal responsibility.

8.
Appendix

Appendix A: Stakeholder list

The Kantar Public team would like to extend our thanks to the stakeholders who participated in this wave of the dialogues. They helped with the development and review of the materials for the digital dialogue and focus groups and took part in the online forum to provide accurate and up-to-date information and ensure that the dialogue was a two-way process.

- Dr Emma Martinez-Sanchez - Babraham Institute
- Professor Nigel Halford - Rothamsted Research
- Helen Sang - Roslin Institute, University of Edinburgh

Appendix B: Sample – digital dialogue

	Target	Achieved	Scotland	Northern Ireland	Wales	Yorkshire and the Humber	West Midlands	South East
Total	33	33	5	5	5	6	6	6
GENDER								
Male	MIN 12	16	3	3	3	2	2	3
Female	MIN 12	17	2	2	2	4	4	3
AGE								
18-34	MIN 8	12	3	1	2	2	2	2
35-54	MIN 8	10	0	3	1	2	2	2
55+	MIN 8	11	2	1	2	2	2	2
SEG								
ABC1	MIN 12	20	3	2	3	4	4	4
C2DE	MIN 12	13	2	3	2	2	2	2
INTEREST IN SCIENCE								
Low interest (2-5 on scale)	MIN 12	15	3	3	2	2	2	3
High interest (6-9 on scale)	MIN 12	18	2	2	3	4	4	3
ACTIVITIES								
Visited a science and/or technology museum Visited a science and/ or technology exhibition Attended a science or technology conference	MAX 5	1	0	0	0	0	1	0
EDUCATION LEVEL								
Higher than GCSE	MIN 12	21	4	4	2	5	2	4
GCSE or lower	MIN 12	12	1	1	3	1	4	2

Appendix C: Sample – digitally excluded focus groups

	Target	Bristol 1	Bristol 2	Scotland 1	Scotland 2
Total	8	8	8	6	7
GENDER					
Male	MIN 3	4	4	3	4
Female	MIN 3	4	4	3	3
AGE					
18-34	MIN 2	2	3	0	2
35-54	MIN 2	3	3	4	3
55+	MIN 2	3	2	2	2
SEG					
ABC1	MIN 3	3	4	4	3
C2DE	MIN 3	5	4	2	4
INTEREST IN SCIENCE					
Low interest (2-5 on scale)	MIN 3	5	3	2	3
High interest (6-9 on scale)	MIN 3	3	5	4	4
ACTIVITIES (PER GROUP)					
Visited a science and/or technology museum Visited a science and/ or technology exhibition Attended a science or technology conference	MAX 2	0	0	0	0
EDUCATION LEVEL					
Higher than GCSE	MIN 2	2	6	3	5
GCSE or Lower	MIN 2	6	2	3	2

Appendix D: Definition of food security

A community enjoys food security when all people are able to access enough safe and nutritious food to meet their requirements for a healthy life, in ways the planet can sustain into the future

Four elements contribute to this

Food availability

Quality food can be grown, produced domestically or imported to the country

Food access

People can access quality food when they can afford to buy it, or when they are able to produce it themselves

Utilisation

People's bodies can use food most efficiently where they also have access to clean water, sanitation and healthcare

Stability

Food is available throughout the year regardless of conflict, natural disasters or season

Source: http://www.fao.org/fileadmin/templates/faoitaly/documents/pdf/pdf_Food_Security_Cocept_Note.pdf