Australia's National
Science Agency

Public perceptions of using synthetic biology to prevent the culling of male chicks

Synthetic biology technologies, such as gene marking, could eliminate the need for culling male chicks in the egg-laying industry

Synthetic biology at CSIRO

Synthetic biology is an emerging field of research that combines genetics, chemistry and engineering. Scientists working in synthetic biology design, build and test DNA to enable plants, animals and other organisms (e.g. bacteria, fungi, algae) to function in different ways. These organisms could then be used to help manage environmental and societal problems such as pollution, waste, land degradation and biodiversity loss.

The CSIRO Synthetic Biology Future Science Platform has developed a range of synthetic biology techniques, such as genetic engineering, gene editing and gene marking. But what do Australians think about these techniques? Involving the public is a critical step in the development of any new technology. By understanding Australians' needs, researchers can develop technology that is both fit-for-purpose and helpful to the community.

This brochure is part of a series that explores people's views towards several synthetic biology tools to help solve environmental, industrial and health challenges facing Australia. The full brochure series is available at: **www.csiro.au/synbiosurvey**

We surveyed the Australian public, asking for their initial impressions on using synthetic biology to mark the genes of chickens:

- What do people **think and feel** about this new technology?
- What **risks** do they perceive?
- How would people want to be **engaged** in decision-making in the future?

Assessing a technology's suitability

CSIRO has adopted a three-pronged process to explore the development and application of new technology. These three aspects include (1) problem assessment, (2) technical feasibility and (3) social feasibility.

1. Problem assessment

Identification and conceptualisation of a problem and how it fits within the broader human-environment system.

Example: Why are male chicks being culled and why is this a problem?

2. Technical feasibility

Assessment of current solutions to the problem and proposed new solutions (strengths, weaknesses, opportunities and threats).

Example: What is being done to manage the problem and how effective are these strategies?

3. Social feasibility

Assessment of user and stakeholder perceptions, and acceptability of a range of solutions.

Example: What do communities think of the proposed solutions and what are their views on how the problem is best managed?

Synthetic biology to eliminate the culling of male chicks

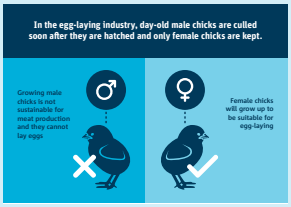
In the egg-laying industry, male chicks are not sustainable to grow for meat production. After hatching, male chicks are identified and then humanely culled when they are around one day old. But this is a long-standing issue for which the egg-laying industry would like a solution.

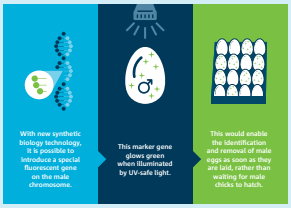
Synthetic biology techniques enable scientists to place a marker gene specifically on the male chromosome (meaning only male eggs will have it). The marker gene produces a special protein that is visible when illuminated by a light. This means male chicks can be identified before the eggs hatch. These male eggs can then be removed from the food production system (along with the gene marker) without the need for culling.

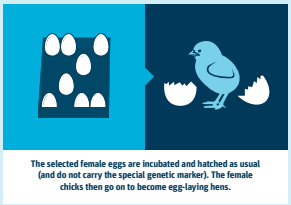
The early removal of male eggs from the production system would not only eliminate the need for culling male chicks but would also halve the number of eggs needing incubation. The female eggs (with no marker gene) would be incubated, hatched, and grown as usual, just like hens today. These hens would then go on to lay eggs – the same as what we currently eat – with no evidence of the marker gene.

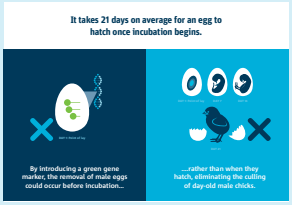
Using this synthetic biology technique of gene marking may therefore remove the need for culling male chicks, potentially reducing industry input costs and improving overall industry sustainability.

Storyboard sequence shown to survey participants, before they were asked their thoughts about eliminating the culling of male chicks in the egg-laying industry using synthetic biology technology.









Public attitudes towards using synthetic biology to eliminate the culling of male chicks

Awareness of the culling of male chicks in the egg-laying industry

Our research found that about half of Australians (55%) were initially unaware that day-old male chicks are culled in the egg-laying industry. Once made aware, the majority of people (72%) considered culling to be a moderate to very big problem.

Initial impressions of gene marking in chicken eggs

After viewing a storyboard presentation on the use of gene marking to eliminate the culling of male chicks, Australian participants reported being moderately-to-strongly supportive of the development of this technology.

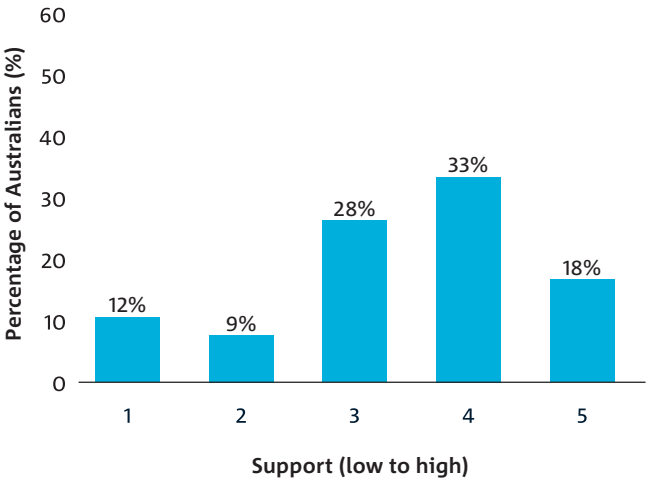


Figure 1 Australians' support of gene marking to eliminate the culling of male chicks.

When asked whether they would be willing to purchase eggs laid by hens involved in this process (the eggs purchased would not be genetically marked themselves), 59% of Australians surveyed indicated they would be willing or very willing to do so. Approximately 23% of participants indicated a moderate willingness to purchase eggs laid by hens involved in the gene marking process, and 18% indicated less or no willingness. This public concern is important to know and understand, as it helps scientists shape how the technology will be developed.

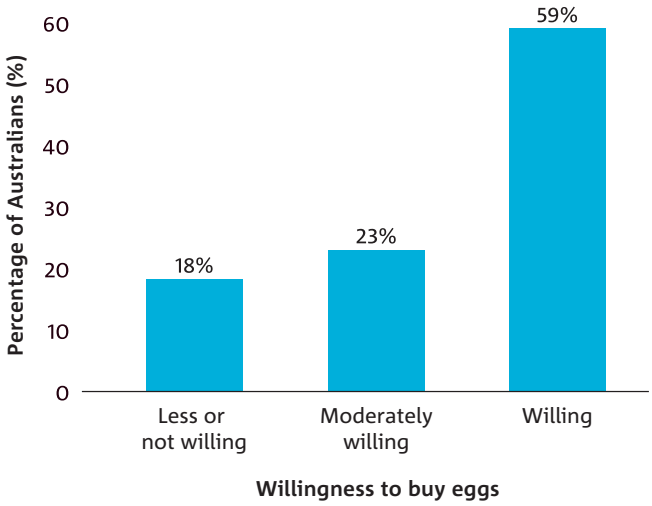


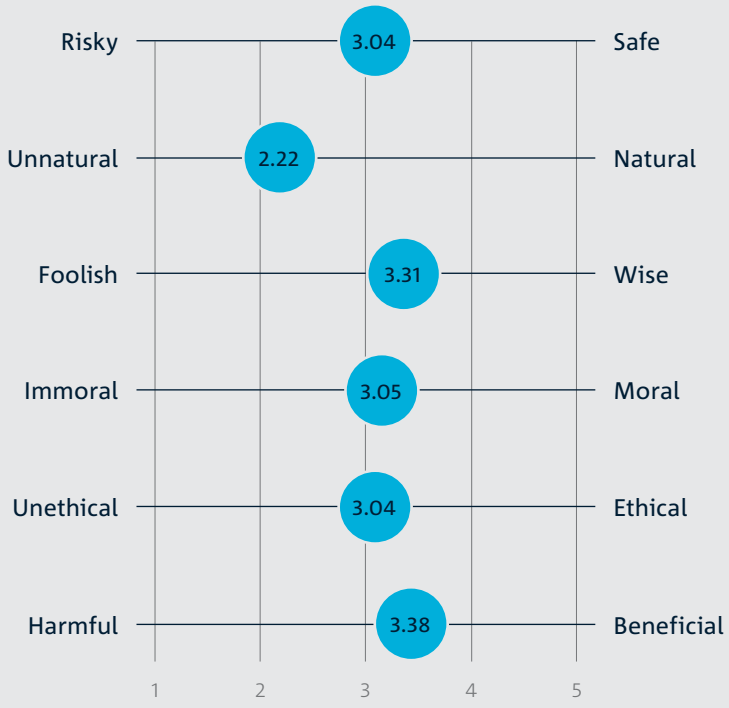
Figure 2 Australians' willingness to buy eggs laid by hens involved in the gene marking process.

How do Australians feel about synthetic biology?

Gene marking in chickens

Emotions indicated by Australians*

Attitudinal pairs*



*Data range: 1 – 5

Perceptions of benefits and risks associated with the technology

A majority of Australians sampled (around 88%) rated synthetic biology technologies as moderately to very helpful in eliminating the culling of male chicks. Most Australians (64%) also agreed, or strongly agreed, that this technology would be better than current methods of culling male chicks once hatched.

Despite their support, Australians did have some reservations about the technology. Most were concerned that gene marking could have negative long-term consequences:

- 76% were at least moderately concerned about consequences for humans and animals
- 75% were at least moderately concerned about risks to the natural environment
- 82% were at least moderately concerned about whether consequences arising from this technology could be controlled or managed.

Trust and regulation

The majority of Australians (80%) moderately-to-strongly trusted scientists to develop this technology responsibly. However, 77% of people were at least moderately concerned about the possibility of the technology being used for 'bad' purposes. Additionally, 82% were at least moderately concerned that technology misuse could lead to unintended negative consequences.

Approximately 67% of Australians held at least moderate trust towards the government agency responsible for approving and regulating the technology. On average, people moderately agreed that legislation and regulation would ensure the technology would be developed in a safe way – 37% agreed strongly that the technology would be well regulated, and 38% also agreed strongly that legislation and regulation would ensure its safe development.

Public engagement in future

Most Australians (about 79%) indicated they were keen to know more about this synthetic biology technology. They said they wanted to know more about:

- the possible risks
- what is being done to regulate and control the technology
- what is being done to deal with the social and ethical issues involved.

Most Australians (81%) indicated that the public should have access to an easy-to-read summary of scientific results, and 72% agreed that risk documentation should be made available.

About 41% of Australians thought it was important to consult the public, so their opinions could be considered when making decisions about this technology. Fewer people (35%) thought it was necessary for the public to be kept informed of decisions made about synthetic biology.

Around 21% of Australians indicated that they did not need, or want, to know anything more about this technology than was already provided within the storyboard presented. Our survey also suggests that people may be more interested in understanding the risks, and the process of managing these risks, than understanding the benefits of the technology.

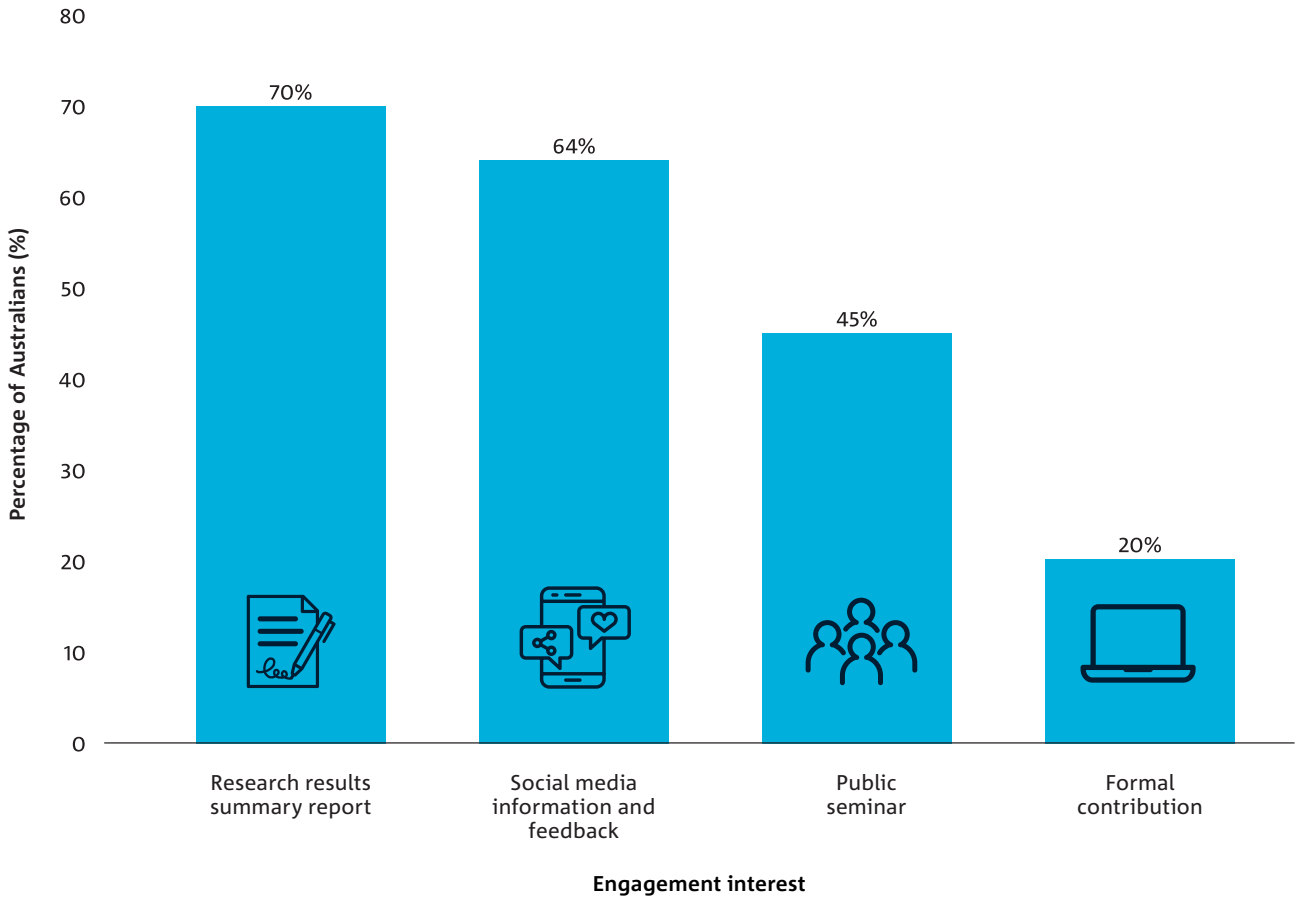


Figure 3 Personal preferences for receiving information and being involved in decision-making about the technology.

Impact

Understanding Australians' attitudes to synthetic biology can help scientists and research organisations to decide how to approach the development and implementation of new technologies.

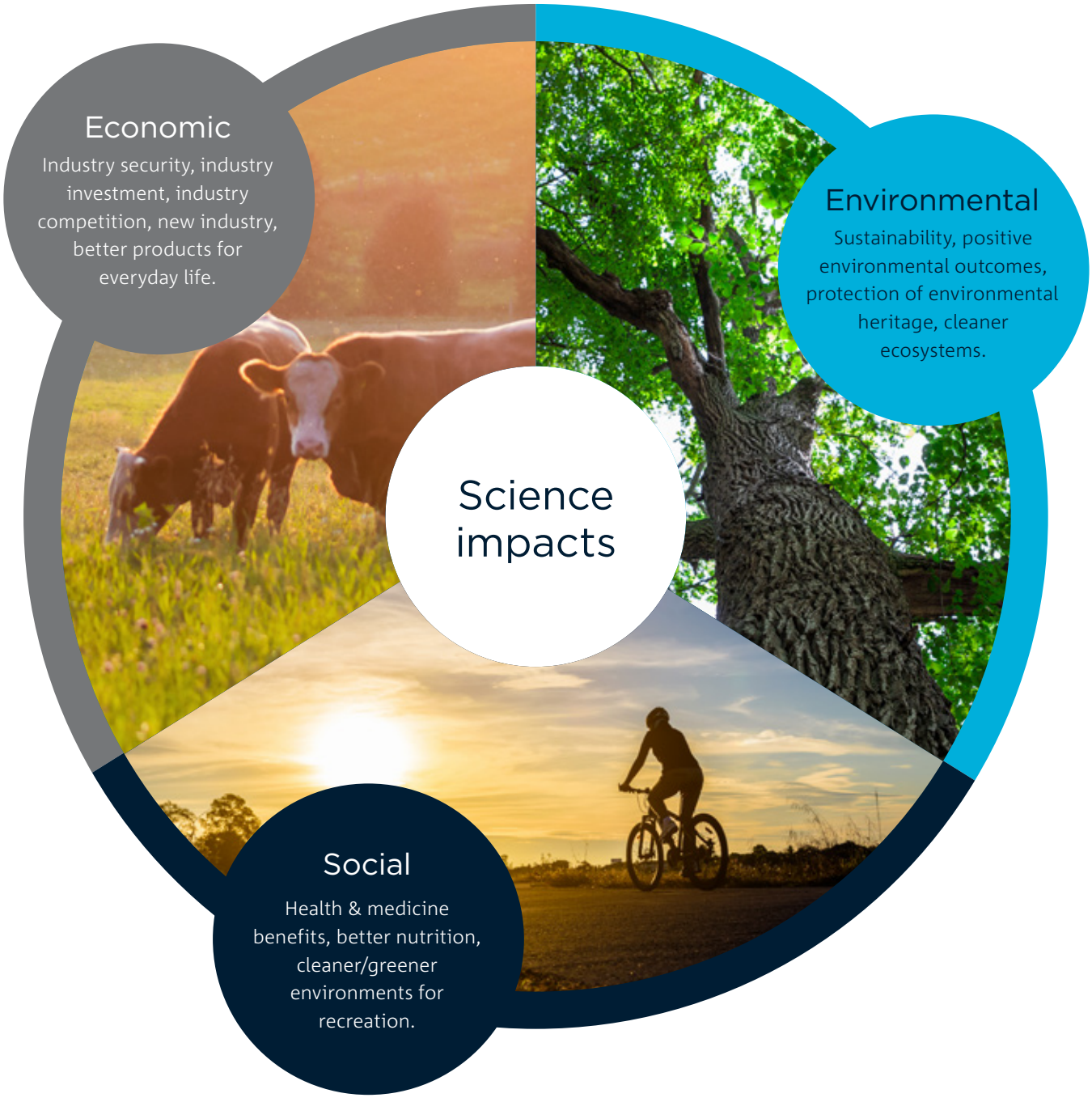
Our survey findings have many applications and can be used in a variety of ways.

1. By government: to inform policy and regulatory decision-makers on how new technologies will be perceived by the public and how best to engage people.

2. By the science community: to inform scientists on how they can develop and plan future science activities in ways that address users' needs. This approach supports a responsible science agenda and acts as a quality-control measure to ensure that technology is being developed in a worthwhile and meaningful way. The survey findings also build the capacity of scientists to reflect on the social and ethical considerations of their work. Understanding the science and technology needed by Australians to solve current issues can lead to greater and more effective scientific innovation.

3. To benefit society: surveys provide insights into the public's understanding and perceptions of Australian science. Survey data can highlight the extent of society's trust in science and identify knowledge gaps. Increased understanding can shape future science directions and inform better ways for communities and scientists to work together.

This is one of the world's first comprehensive national surveys examining public perceptions across a range of synthetic biology technologies.



Research methods

The study involved presenting an online public attitude survey to 8,037 Australians. It examined how novel synthetic biology technologies could help address a range of important issues facing Australia.

In the survey, we presented information on one of seven environmental, industrial or health challenges in Australia:

- **Eliminating the culling of male chicks in the egg-laying industry**
- **Changing the properties of natural fibres**
- **Protecting endangered species**
- **Managing invasive pest species**
- **Reducing pollution in waterways**
- **Reducing mosquito-borne diseases**
- **Restoring the Great Barrier Reef**

The survey sample was representative of the Australian population in key demographics including age, gender, and location, including representation of Aboriginal and Torres Strait Islander peoples.

The research methodology for this CSIRO study was externally reviewed by a panel of three Australian social and behavioural science experts:

- Professor Kelly Fielding (The University of Queensland)
- Professor Catherine Waldby (Australian National University)
- Professor Iain Walker (Australian National University)

Information was presented to participants in the form of a PowerPoint-style slideshow, known as a 'storyboard'. The storyboards had a standard format with similar sequencing of information, language, use of visuals and length.

Social scientists teamed up with biotechnology scientists and professional science communicators to develop the storyboard content and visuals. The storyboards were validated and tested in fourteen public focus groups to ensure they were easy to understand and included the necessary information.

The Online Research Unit (ORU) hosted the online surveys throughout October and November 2018 and recruited a representative sample of Australians. Participants received a small standard payment from the ORU for participation. Research participants were randomly assigned to view just one of the seven storyboards.

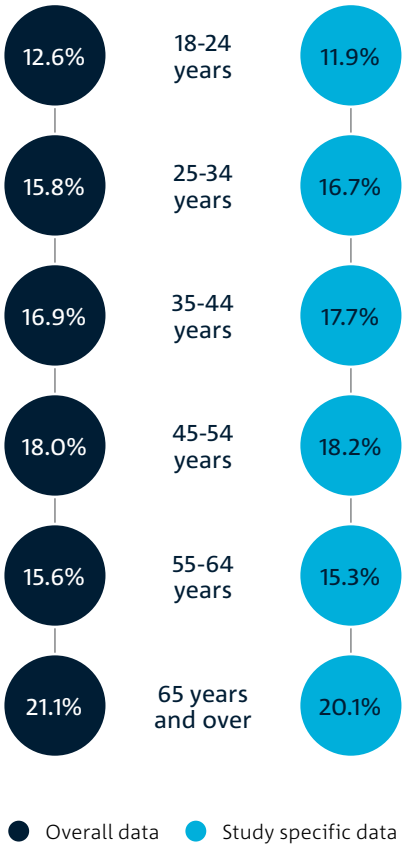
The survey asked participants how they felt about the development of the synthetic biology technology, what concerns they had about the technology, and if they would like to receive more information and be involved in further surveys.

The survey has provided CSIRO with important insights into Australian attitudes. It is a powerful new contribution to decision making in Australia about issues facing the country.

This research was approved by the CSIRO Social and Interdisciplinary Research Human Research Ethics Committee (Ethics Clearance 013/18).

Australian demographic data

All surveys and this specific survey



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Australians

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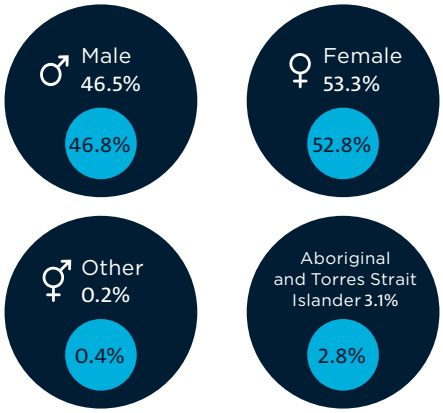

Next steps in understanding public perceptions of synthetic biology

Our study incorporated a representative sample of the Australian public. However, some topics may be more relevant to particular communities. Future community- or place-based research will therefore be more targeted. It will involve identifying places where a particular synthetic biology technology could help in addressing a problem.

Researchers would engage with local people to understand their views about using new technologies to tackle problems directly affecting them.

This direct engagement will help communities, government and researchers decide whether, and how best, to deliver evidence-based programs to improve the treatment of animals.

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