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PRACTICE INSIGHTS

Talking genetic technologies and conservation: purposeful games as a tool to level the epistemic playing field

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Abstract

In New Zealand, the use of genetic technologies for environmental and conservation purposes is a highly contested issue yet genetic technologies, including RNAi and gene drives may offer technological advances for protecting New Zealand's vulnerable biodiversity. This context makes discussions on the use of gene technology for environmental purposes both challenging and necessary. Such discussions can be difficult, not simply because they are often contested, but also because people find the topic complicated, the language alien and overly scientific.

This research, which sits at the intersection of science and publics, is part of a large national dialogue which aimed to better understand the public's thoughts and feelings around the use of genetic technologies for environmental or conservation purposes. To assist people to feel comfortable at the beginning of the dialogue sessions, we designed purposeful games before engaging in a facilitated conversation. These games are based on heritage games that most people are familiar with but altered to address several issues relevant to genetic technologies in an environmental context.

This article provides an insight into how to design and use purposeful games to foster epistemic confidence in non-scientists. It acts as a helpful guide for others working in contested spaces where there is a need to effectively facilitate engagement of non-scientists in important science-society discussions.

Keywords

Environmental communication; Public engagement with science and technology

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1 ▪ Introduction

How do we have effective public dialogue about technically complicated, potentially environmentally impactful and socially contested science? What is important for people to know to feel confident to speak about their values around contested issues? How do we support people's engagement in contested science? We grappled with these questions as we began designing the first phase of a research project which sought to undertake conversations with a variety of publics about the use of genetic technologies for environmental or conservation purposes.[1]

In Aotearoa New Zealand, the environment is important to national identity and acknowledged to be ever under-threat from introduced species [Biosecurity New Zealand, Ministry for Primary Industries, New Zealand Government, 2024; Milfont et al., 2020]. To protect vulnerable flora and fauna there is stringent biosecurity at the border, and New Zealand has embraced predator eradication at both national and community levels [see, for example, Ministry for Primary Industries, 2024; Department of Conservation, 2024; Predator Free 2050, 2024; Halo Project, n.d.]. Despite consecutive governments adopting the aspirational goal of Predator Free 2050, there is a growing sense that such ambitious initiatives are unlikely to be achieved with current technologies. Genetic technologies are increasingly being proposed as offering technological advances that could offer significant advantages in the biosecurity arsenal.

In New Zealand genetically modified organisms (GMOs) are regulated under the 1996 Hazardous Substances and New Organisms Act (HSNO), and its 2003 amendments [Ministry for the Environment, 2004]. The Act prevents or manages adverse effects of hazardous substances and new organisms. As GMOs are deemed to be new organisms they are regulated by the Act and controlled in contained sites, if approved by the Environmental Protection Agency [Ministry for the Environment, 2021]. As legislation is so stringent it is difficult to use technologies outside containment and there are no commercially available GMOs in New Zealand [Ministry for the Environment, 2018].

Genetic technology use in New Zealand is a contentious issue. While some people view genetic technology as a potentially useful or necessary tool for protecting New Zealand's biodiversity, most people have no experience of it, little understanding about it and some even do not trust it. However, given that most New Zealanders have some connection to and aspiration for their natural environment, there is both a need and a right for them to have input into policy discussions about the future use of genetic technologies in New Zealand. Our project formed part of a large national conversation to provide insights to the public's perceptions on the use of genetic technologies for environmental or conservation purposes [see McEntee, Medvecky, Macknight et al., 2024] and by doing so, to also answer the questions we posed above. Further work will discuss the broader methodology and findings [McEntee, Medvecky, Shadbolt et al., 2024].

Previous research has suggested that discussions on genetic technologies may encounter challenges relating to epistemic, emotional, confidence and trust issues [Allum, 2005]. To address this, we sought a way to empower people to feel comfortable to engage in a discussion about gene technologies and all its complexities, with others, while feeling they

1. This paper came out of a project that included many parties, from collaborators to participants. We especially want to thank Leane Makey, Grant Dumbell and Debbie Larkins for their valuable work on the project.

had a legitimate right to speak on this topic. We also wanted to create the right discursive atmosphere — one that was informal, open and engaging — and where we showed we were genuinely interested in listening to their views and not in changing their minds. To address the many challenges we had to overcome, project-designed purposeful games were assessed to be a useful engagement tool.

The purposeful games acted as the introduction to the discussion workshops which ran in total for 90 minutes. Participants played the games in groups for 30 minutes at the start of each workshop before being brought together for a facilitated discussion. In this way, games prepared participants for the discussion, supporting epistemic confidence, and emotional and social comfort, while also building trust in each other and the researchers.

We draw on this experience, including feedback received during the design process and the workshops to present some key insights we gained about how to design purposeful games. In this practice insight, we first discuss one way in which we are thinking about this problem — as a case about epistemic anxiety [Allum, 2005; Nagel, 2010]. We recognise that epistemic anxiety was not an issue for all participants. For some people, albeit a minority of the research participants, knowledge was not the issue. For people who are already positioned on the issue of genetic technologies, a bigger concern might have been feeling unheard by authorities and distrusting the decisions of the people in charge. These issues however are beyond the scope of this present paper.

We begin by discussing epistemic anxiety before presenting the purposeful games. We define purposeful games as lying between ludic (playful) and serious games, meaning that the fun *and* the content are both important to their utility. We then describe the games we designed and the process by which we designed them. We close with five key lessons we have learnt throughout this process, lessons we hope might help others using purposeful games to manage open dialogues around technical and contested topics.

1.1 ▪ *Epistemic anxiety and the right to speak*

While the aim of the project was to engage people about possible science futures and science governance rather than to transfer knowledge, knowledge nonetheless remained central. Specifically, we noted that epistemic confidence engendered a person's perception of having a right to speak, and, conversely, the perception that lacking knowledge could restrict their right to voice an opinion. This raised an important question. What impact does knowledge, or the lack of knowledge, have in supporting dialogue? Or more accurately, how does feeling that one has or lacks knowledge, impact one's willingness to engage in dialogue?

One helpful theoretical frame for making sense of this dynamic is the idea of epistemic anxiety. Nagel [2010, p. 408] defines epistemic anxiety as "a force that normally determines how much evidence we are inclined to collect and how thoroughly we will weigh it before making up our minds". To flesh this out further, consider how much knowledge you require before feeling confident that you know enough, or put differently, how certain do you feel you need to be, about the facts you believe in. This will change according to context and situation. If you are having a chat with a friend and make a claim about who acted in the last film you saw, you would likely require less certainty that if you are a member of a jury in a murder trial and have to make a claim about the guilt or innocence of the defendant.

This is because epistemic anxiety has to do with risk assessments and emotions. As Newton [2022, p. 324] explains, anxiety "functions to direct the experiencer's attention towards some risk-possibility and motivate her to take steps to avoid or reduce the relevant risk". Specifically, anxiety comes from imagining realistic possible futures i.e. its representational aspect, along with the unpleasant feelings such as imaginings associated with such futures, what Vazard [2018] calls risk's affective aspects [Vazard, 2018] and the motivation to avoid both these futures and the unpleasant feelings [Newton, 2022].

In our context, the risks were likely multi-dimensional. One aspect was social i.e. the perceived risk of making a fool of oneself by saying something wrong or naïve. Another was pragmatic i.e. the perceived risk of having the workshops sway policy in 'the wrong' way. As Vazard notes [2021, p. 6921], "the mechanisms responsible for our inclinations to doubt must involve an assessment of that proposition not only as epistemically risky but also pragmatically costly".

It is worth noting that some degree of epistemic anxiety is not necessarily bad. Indeed, it is, in the right context, an appropriate response to our knowledge state. As Cabrera [2021] suggests, some level of epistemic concern as opposed to anxiety, might be just the right position to hold in many or most cases. This may be especially the case when engaged with knowledge-rich contexts, such as making claims about complex topics at the intersection between science, society and the environment. Still, one response to epistemic anxiety is to refrain from committing until sufficient knowledge is acquired. In our context this might lead participants to abstain from fully participating in the discussion, thereby significantly limiting our understanding of participants' views, feelings and perspectives.

So our challenge, was to empower our participants to feel permitted to speak freely and openly, while feeling they hold sufficient knowledge so as not to be overwhelmed by epistemic anxiety. To address this challenge, we started our workshops with engaging our participants in playing purposeful games.

1.2 ▪ *Game-based interventions: purposeful games and genetic technology*

We define purposeful games as lying between ludic and serious games, or to put it another way, between fun and 'the real world'. Both these aspects were important since our aim was to encourage enjoyable, open and engaged dialogue about important real-world issues. Unlike others who have used games in their work, our aim was not to change behaviours. Some knowledge transfer was hoped for, but mostly in the form of increased comfort with some of the technical and scientific terminology of the topic under discussion. However, we primarily sought to alert people to the broader context of the issues, going beyond the technical details of genetic technologies to support their thinking about ecosystems, science governance and scientific research.

We are all familiar with the idea that games can be fun. Fun, however, isn't necessarily frivolous. Instead, by having fun playing games, people can develop shared bonds with others, gain increased comfort and confidence in the social setting, and enhance their engagement with, and memory of, content [Grams & Jurowetzki, 2015; Pekrun, 2011]. However, as emphasising the 'fun' aspect of a research workshop might put off some participants, we suggest taking care with how fun is framed for different publics. Often the term 'serious games' has been used, in part, to dispel the impression of games as 'just fun'.

Another way to describe 'fun' in the literature has been 'levity', or the extent to which even serious games can draw players into the game and into collaborative relationships with each other [Aubert et al., 2019, p. 2; see also Zhou, 2014]. We prefer the term 'purposeful games' to bypass the dualism of serious therefore important, vs fun therefore pointless. People's experience of games can change the affective mood for individuals and groups, and this can impact the tone of conversations [Lucero & Vaajakallio, 2008]. For these reasons, games are used in team building to enhance workplace relationships [Kloep et al., 2023; Leeder, 2014].

Serious games, by contrast, are developed for goals other than fun [Vecchio & Del Greco, 2023]. Serious games are increasingly explored as participatory and collaborative tools to enhance learning, inform, assist decision-making and facilitate discussion about environmental issues, for example, sustainable management of land and resources [Den Haan & Van der Voort, 2018; Stanitsas et al., 2019], climate change [Flood et al., 2018], single-use plastic behaviours [Vecchio & Del Greco, 2023], and catchment/watershed management [Furber et al., 2018; Mittal et al., 2022]. These games broadly have two objectives, either to provide information or to promote behaviour change [Vecchio & Del Greco, 2023]. Furber et al. [2018] stated that serious games are a useful tool for decision-making of complex systems or where there is significant uncertainty, or multiple stakeholders with divergent perspectives. Games can act as safe innovation spaces, for experimentation and learning to interactively engage with, for example, alternate climate futures, testing a range of water management strategies, and socialising climate adaptation with different publics [Edwards, 2023; Edwards et al., 2019; Furber et al., 2018; Geels et al., 2011].

Adding the goal of enjoyment to the challenges of serious games increases the difficulty for research design. What makes a game fun? How much variety is there in what people enjoy? How much does competition enhance fun for different people? What are likely barriers to enjoyment? We had to be strategic when we designed games to help participants to share perspectives, values and ideas, knowledge, and visions of the future, while also forming social bonds of shared enjoyment. So, what did these games look like in practice?

1.3 ▪ *Our purposeful games*

We describe in brief below the four main purposeful games we designed to engage people in conversations about New Zealand conservation and genetic technologies. Table 1 is provided to compare key features of each game. We developed these games with the help of a pilot session where we trialled the games to gather feedback from participants about the games — what was working and what was not. Some games changed immensely following the feedback, as we better understood how important the purpose of the games was for our participants.

The four main games we designed were:

'Ecological Collapse': a context of ecosystem vulnerability
This was a collaborative game played in groups of 3–6 players and based on the game Jenga where players try not to collapse a wooden block tower. This is shown in Figure 1 below. The purpose of this game was to highlight the various human actions, climatic conditions, and flora and fauna changes that can have impacts on the quality of the natural environment and more specifically the New Zealand forest environment. The game sought to emphasise a range of ecosystem vulnerabilities and to implicitly ask players whether genetic technologies

Table 1. A summary of the key purposes of each game.

	Knowledge-building ecological	*Knowledge building: gene technology*	*Knowledge building: social/ethical*	*Competitive*	*Team-work*	*Relaxing*
Ecological Collapse	X		X		X	
Snakes and helixes Science research Game		X	X	X (with element of chance)		
Gene Editing Game		X				
Stakeholder Target Game			X	X		
Word / Concept Pictionary	X	X	X	X	X	
Puzzles						X

Figure 1. Ecological collapse tower with a playing card.

could have a role in mitigating those vulnerabilities. It was played collaboratively, to underscore as part of the playing experience a sense of shared responsibility for ecosystem protection.

Snakes and Helixes: a journey of scientific research

As the name implies, this game was based on the familiar competitive game of Snakes and Ladders (see below on the usefulness of using familiar games). The purpose of our re-designed version was to tell a story of a scientist's research journey and to highlight the various points when a scientist's work might interact with social, ethical, funding and policy imperatives that are beyond their technical expertise. The game also introduced players to technical genetic language and ideas such as RNAi, gene drive, and trojan females. This game is shown in Figure 2 below.

Figure 2. Snakes and Helixes board with game play figures and dice.

Figure 3. Gene target game. Sections spin to reverse side when hit with nerf gun pellet.

Target Game — 'gene editing'
This game introduced players to some of the broad technical ideas of gene editing, while also encouraging discussion about untended consequences. By shooting a 'CRISPR' toy nerf gun at a model of a chromosome, shown in Figure 3, players could mimic the 'editing' of a gene. If they missed the intended target on the model, they had an 'unintended consequence'. This competitive game of skill was particularly effective for engaging rural communities.

Target Game: 'stakeholders decision-making table'
This competitive skill-based game engaged people in decision-making over who should be involved in genetic technology governance. People were asked to circle four stakeholder groups from a range of pre-selected stakeholders (for example, scientists, Māori (indigenous

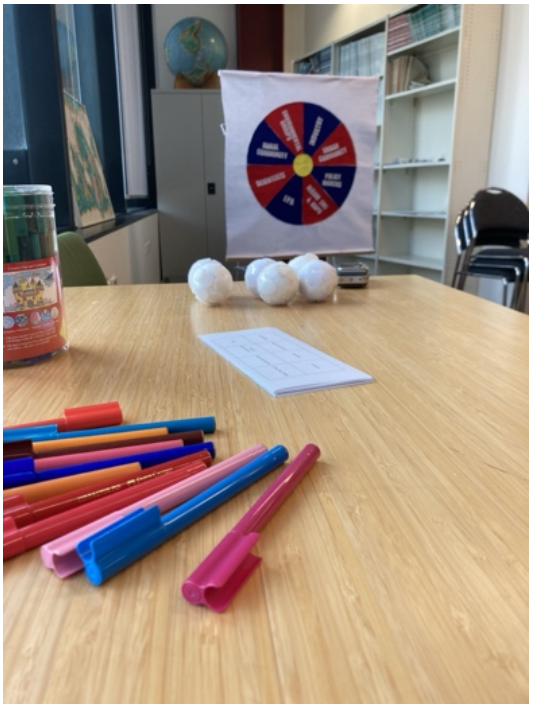

Figure 4. Stakeholder target with velcro balls and bingo cards.

communities), policymakers, rural communities). They were invited then to throw a velcro ball on a target board containing the various groups and get the ball to stick to their pre-selected stakeholders (see Figure 4). This game enabled understanding of who people trusted to govern genetic technologies and opened-up conversations about key decision-makers.

We also developed two further 'games'. One of these 'additional' games was Pictionary, with words chosen to support people to become more familiar with concepts around genes, science and conservation. In addition, two puzzles (one an image of a landscape and the other of a gene) were also offered if participants wanted some time-out activities or to step away from disagreements around these potentially contentious topics [see McEntee, Medvecky, Macknight et al., 2024, appendix 10.1 for full description of games].

2 ▪ Participants' experiences of playing games

Evaluation surveys collected participants' perceptions about playing games before engaging in a facilitated conversation about gene technologies. These revealed that participants felt the games enabled them to feel more comfortable to participate in the subsequent conversation. In addition, while 75% of people reported coming with pre-held positions on gene technologies, through the combination of the games and the facilitated conversation, 40–45% of these participants re-evaluated their positions. While the workshops were not designed to direct people to a specific view, the games nonetheless contributed to people reconsidering their prior beliefs when provided with information that they could access in an clear and enjoyable way. Furthermore, more than three quarters of participants left feeling more confident to engage in future discussions about genetic technologies. Participants' comments also revealed that the games enabled them to explore connections between ideas,

to listen in an enjoyable way to other participants' perspectives and this was particularly useful for people who held strong prior views, and to increase their understanding of challenging concepts, as the following quotes illustrate:

> *Jenga game was a very effective method to show the impact one thing has on others.*
>
> *It was cool to see different perspectives. Games were also very fun.*
>
> *Discussions and learning and follow up Q and A during games led to significant growth in understanding.*
>
> *I feel it shows us all that we are capable of expressing our beliefs in this space.*

The games also supported wider 'non-technical' discussion particularly around the consequences and risks of gene technologies. For example, the gene editing target game, where participants used a 'CRISPR tool' (a nerf gun) to target and edit a 'gene' stimulated discussion in the facilitated discussion about unintended consequences of the technology. People used this to talk about the uncertainty of science knowledge and of natural genetic change. For example, in the discussion one participant said,

> *"Because like playing that game, if we hit the wrong thing on that chromosome game, you've got outcomes that you don't know what they're going to be, and you may not know those outcomes for 20, 30, 40 years. So it's understanding that we don't know with genes. Our genes change without us actually using a CRISPR tool to change them. They change naturally. So it's a messy one."*
> (Participant North Island environmental group workshop).

Furthermore, the stakeholder decision-making target game, where people circled which four stakeholder groups (on the board) they would want around a decision-making table, triggered participants' subsequent comments in the facilitated discussion on issues of governance and who they would trust to oversee the management of genetic technologies. One participant recalling the low inclusion of industry stakeholders being chosen by members in the stakeholder game, used this in the facilitated discussion to politely caution others about the risks of not including private sector firms engaged in genetic technology research around the decision-making table. This engagement with wider issues of gene technology was particularly noted by a participant in their post session comments, when they wrote "*Awesome introduction to social aspects*".

3 ▪ How to design purposeful games. What we learnt

A range of epistemic, emotional and trust issues can be mitigated using purposeful games. Well-designed games can support people to feel they have the knowledge and legitimacy to

talk about their visions for the natural environment and the role genetic technologies may play — if at all. Moreover, as Lucardie [2014] also found, having fun allows people to feel engaged and connected with each other and with the issues at hand.

We have learnt five key lessons from designing games and engaging people in playing purposeful games. We share these in the hope they support others to consider games for complex and contentious science conversations with the public.

1. Make it easy: use what people already know... but go further
Games that participants felt were familiar to them were useful to reduce the initial cognitive load. Using culturally common 'heritage' games like Snakes and Ladders and Jenga as a base on which to design the games, meant participants found the games more approachable, and they needed little explanation on how to play them. Instructions were available for people who had grown up in cultures where these games were not played, as we recognised not all participants might be familiar with them (see 'context matters' section below). This is especially important to note when considering the previously mentioned epistemic concerns we faced and which others have also noted [Nagel, 2010].

However, for most of our participants the initial moments of meeting the games were straightforward and this left cognitive room for the further learnings built into the games. For example, Jenga, a tower collapsing game was reframed as ecological collapse. As participants recognised the basic rules of Jenga they could easily accommodate the new way of playing. This also meant the ideas conveyed on the wood blocks about human and non-human impacts on ecosystems could speak more loudly to them.

In other words, being easy to use, made the games more fun and less stressful for participants. The games themselves therefore did not trigger epistemic anxiety, and instead eased people into thinking and talking about the ideas contained within the games.

2. Make it varied, make it fun: allow games to trigger physical, social and emotional responses
Aiming a nerf gun, gently throwing a ball underarm, groaning in frustration while moving your piece down yet another snake, delicately pushing a block from a stack while someone else helps to steady the tower and the tension mounts — these were some of the varied experiences built into these games. Providing opportunities for a variety of social, emotional and physical responses was important to make the experience accessible and enjoyable for all.

In addition, we offered games that were competitive (a typical characteristic of games) and collaborative. During the gene target game, participants were competing based on their skill with a nerf gun (giving an advantage to people with rural and/or hunting backgrounds). In Snakes and Helixes, participants were competing but this time their success was based on the luck of the dice. In Ecological Collapse, participants were collaborating and supporting each other — and the tower. This variety meant that a range of relationships were developed between participants, sometimes based on friendly competition, sometimes based on collaboration. Alongside these social relationships were the varied emotions that come from playing with others — such as excitement, gratitude, and anxiety. As noted above, games can help people develop connections with others and feel more comfortable and confident, thereby enhancing their engagement with and recall of content [Grams & Jurowetzki, 2015; Pekrun, 2011].

Of note is the need to consider different abilities and disabilities. To some extent the variety of games supported diverse abilities — to try to provide something for everyone. But we also suggest care in selecting games and making resources for different communities. For example, a nerf gun would not be appropriate in all settings but was useful in others. Further, we recommend making sure all game instructions and other text are available in large fonts, as well as considering other ways games could be experienced as inaccessible. The need to consider disabilities was particularly an issue with older demographics. On our feedback form, for example, one participant suggested we, 'Remind older communities to use their hearing devices ☺' (Participant, South Island seniors' workshop)

3. Focus on wider dynamics beyond the technology to develop both specific and broad understanding and knowledge

As the games were being used as a tool to spark broad discussions there was a need for a range of specific and more general content to be presented. The genetic technologies themselves were only a part of what we wanted people to be ready to talk about. Indeed, the less technical aspects were of high importance, for example aspirations and values for the natural environment, the complexity of ecosystems, and the trust given to various stakeholders. It was these wider socio-cultural dynamics we wanted to bring out in discussion and not simply focus on the technical aspects of gene technology. Games are very useful for triggering topics and conversations in subsequent discussions. This was most noticeable for challenging topics such as uncertainty and risk around genetic and ecological futures. In this way, the games aimed to engage participants on more than the either the technology or its potential applications in something closer to what Priest [2013, p. 138] calls critical science literacy. She describes this critical move understanding "the kind of everyday, tacit knowledge of "how things work" that members of a culture take for granted but outsiders can find mystifying", such as the inherent uncertainty of scientific research, as was described in the participants' experiences section above.

The games also provided opportunities for the facilitator to guide conversations into addressing wider issues such as governance. For example, one facilitator asked, "Going back to [the stakeholder — who sits around the table] game, who would you have sitting around the [decision-making] table?" Because participants had already thought about who they would include at that table, it was easier for facilitators to start a conversation about who are trusted decision makers, who are not, and why — these conversations were based around themes of trusted knowledge, environmental responsibility and key stakeholders.

However, initial participant feedback indicated they also wanted more information about the genetic technologies themselves. To address this, we modified our sessions in two ways. First, we added a glossary to the Snakes and Helixes game, so that people could read in more detail about the squares they landed on. For example, 'square 62' read, "Reduced pests' ability to survive to reproductive age". As the square size dictated only a brief explanation, if the participant was curious and wanted to know more, they could consult the glossary and read, "Gene silencing, or RNAi (RNA interference) has been used in studies to 'turn off' genes in flies, in ways that shorten their lifespan. This does not change or modify the genes, only alters the cell's ability to make specific proteins. Could this be used for mammalian predator control?" Often participants read these explanations aloud to their group. This gave participants more information as part of the context of the game, as well as suggesting key focussing questions for deeper contemplation. Second, we also developed a 'further information sheet' to hand out to participants as they left the workshop. This

addressed feedback that indicated participants were eager to also learn at the session more about the science of gene technology.

We recognise that knowledge and information is not a tool for changing people's minds or leading them to support the science and technology in question. Indeed, we recognise that this approach is not only ineffective, but also unethical in the research context [Jasanoff et al., 2015]. However, carefully worded, non-biased information was sought by people to support their understanding and deliberations on topics that are technical and unfamiliar.

4. Think about context

In settings where people didn't know each other and trust in science was high, games were a fun way for people to feel comfortable with each other [Kloep et al., 2023; Leeder, 2014]. In other settings, for example where trust in science was low, games were used only as a pause, less played than explored, as people made decisions about how to trust us as researchers. In still other settings, the role of the games was more epistemic, helping people feel comfortable with scientific language and the broad ecosystem focus of the workshop. Games therefore were not always received in the way we had expected. This meant that we had to be flexible and responsive to how people wanted to use the games.

Games are a tool to support conversations and the support needed in different settings will vary. This is to say, *context matters* and it is important to use games in ways that work for a variety of groups without being concerned that they are being used 'incorrectly' or not in the way designers imagined. An open attitude to games and their multiple potential uses, will help researchers and participants find the most appropriate ways to approach games for each context.

5. Embrace complexity

The science around genetic technologies is complicated, technical and nuanced. Its application in the real world carries uncertainties and complexities. While the details of various genetic techniques, feasible applications and their potential flow on effects are important, it is also critical for people to engage in conversations about genetic technologies even if they feel they don't know "enough". Indeed, as discussed previously, some degree of epistemic anxiety is not unhealthy as it suggests some level of epistemic humility [Cabrera, 2021], though such anxiety needs to be balanced with the sense of permission to participate that the context creates. In other words, the complication of the science shouldn't be a barrier to talking about the complexities and values which underpin both the application of the science and people's responses to it. Games were a tool to move beyond information and beyond epistemic anxiety, and invite broad, complex and value-laden conversations about possible environmental futures.

This is illustrated by the ecological collapse game. On the surface this was a game about the various impacts on ecosystems. However, it revealed both complicated and complex ecological relationships. Conversations around the game showed people responding to it in deep ways by re-thinking how decisions are made in the face of multiple values and a changing world. As one player reflected:

> *"We've got such enormous complex [issues], even bigger than Jenga. We're going to have to move to a new framework of understanding and consideration and contemplation of what has served us well in the past. That whole decision-making process has deteriorated with the more information we've had. We're gonna have to come up with something better. We don't know what that looks like. But we've got to make moves towards a more inclusive, funded, educated view of making good decisions."*
> (Participant, South Island Workshop)

It is exactly this process of making inclusive, educated, considered decisions where we believe purposeful games can assist both participants and researchers.

4 ▪ Conclusion

In this paper we have sought to show how purposeful games can support workshop participants to feel comfortable and confident conversing about complicated, complex and contested science and technology. We have argued that recognising epistemic anxiety as a barrier is important to allow people to feel they have a legitimate voice in those conversations. Purposeful games, we have suggested, are a way to dispel feelings of illegitimacy, or at least reduce them, through two means. One is that purposeful games can be fun. This means distinct from so-called 'serious' games, where behaviour change or knowledge increase are key goals, purposeful games aim to build positive social relationships and increased comfort for discussing challenging topics and to enable participants to work with others in groups — often who they have never met before. Secondly purposeful games communicate the complexity, as opposed to technical complication of contested issues. This complexity emphasises values and feelings alongside knowledge, and it recognises the limits of scientific decision-making for issues that are complex and contentious.

This paper has described and reflected on games designed to support conversations about genetic technologies for environmental purposes in Aotearoa New Zealand. We hope that the five lessons learnt about how to design games effectively: to make them easy to use and varied and fun; to focus on wider dynamics beyond the technology; to understand the context; and to embrace complexity provide useful insights to guide others seeking to design purposeful games to support inclusive dialogue and deliberation. Most importantly the games presented here acted as valuable tools to support people to feel more comfortable, more valued, more cheerful and to see themselves as important and legitimate voices in a conversation about contested and complex science.

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