

Determining Tangible and Intangible Dimensions in Genetic Engineering Decisions

Background

To regulate complex technologies, such as genetic engineering, the guiding decision-making framework must reflect both scientific knowledge and community preferences. The non-quantitative nature of socio-cultural values makes them difficult to incorporate into traditional decision-making tools, such as cost-benefit analysis. In decisions about the acceptability of genetically modified organisms (GMOs), appropriately weighting tangible and intangible values is often problematic for policy makers (Finucane & Satterfield, in press). For instance, in determining the acceptability of GMOs, the New Zealand Māori consider risks to whakapapa (the larger genealogical-like relations between organisms) and mauri (an entity's purpose or life force), yet these concepts seem to be given low weight in decisions by government authorities regulating GMO research (Roberts et al., 2004).

Objectives

- To identify the relative importance of the key reasons underpinning decisions by Māori people about the acceptability/nonacceptability of GMO applications.
- To identify the socio-cultural values associated with the decisions.

Method

Based on earlier qualitative work, we developed three versions of a questionnaire. Each questionnaire included:

- A paired comparison (PC) task: Presented 28 pairs of scenarios about GMOs (Figure 1). For each set of four dimensions, we constructed eight scenarios by factorially crossing the levels of the dimensions (using partial replication).
- Attitude ratings scales: Elicited attitudes about key socio-cultural values and their implications for GMO-related decisions.

Figure 1. Example of a pair of GMO application scenarios used in the paired comparison method

Scenario A	Scenario B
<p>Researchers want to insert a copy of an insect gene into pine trees. The insect gene will produce a protein that makes pine tree timber stronger for bulking. If successful, the local Runanga, who own the land, will benefit economically. A panel of Māori experts says this research is unlikely to interfere with the mauri or whakapapa of pine trees.</p>	<p>Researchers want to insert a copy of an insect gene into pine trees. The insect gene will produce a protein that makes pine tree timber stronger for bulking. If successful, the local non-Māori owned company will benefit economically. A panel of Māori experts says this research is likely to interfere with the mauri or whakapapa of pine trees.</p>
<p>A summary of proposal A is as follows: Gene origin: Insect Purpose: Economic benefit (stronger pine tree lumber) Who benefits: Mostly Māori Mauri/Whakapapa interference: Unlikely</p>	<p>A summary of proposal B is as follows: Gene origin: Insect Purpose: Economic benefit (stronger pine tree lumber) Who benefits: Mostly Non-Māori Mauri/Whakapapa interference: Likely</p>
<p>Check only one of these four options:</p> <p><input type="checkbox"/> I am more comfortable with A and accept it <input type="checkbox"/></p> <p><input type="checkbox"/> I am more comfortable with B and accept it <input type="checkbox"/></p> <p><input type="checkbox"/> I am more comfortable with A, but don't accept it <input type="checkbox"/></p> <p><input type="checkbox"/> I am more comfortable with B, but don't accept it <input type="checkbox"/></p>	

We received completed questionnaires from 619 respondents.

Respondent Characteristics

Response rate (# surveys returned / # surveys sent)	27.5
Gender (% female)	9.8
Age (mean years)	41.6
Education (% with at least high school graduation)	66.6
Income (% with income ≥\$40,000)	45.4
Knowledge of Te Reo (% with "a lot" of knowledge or "fluent speaker")	34.1
Percent who identify as Māori (quite or very strongly)	81.4

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Results

Scenario dimensions predicted acceptability values and could be grouped into three main categories of relative importance. Responses to the PC task were used to calculate individuals' relative preference scores for the GMO scenarios. The resulting scale values give the proportion of times that a scenario is chosen as being more acceptable than the alternative in relation to the number of times it could have been chosen. For each respondent, we conducted a regression analysis with the scale values as the dependent variable and the scenario dimensions as the four independent variables (Table 1).

Respondents showed significant agreement in their judgments. Agreement among individuals on scenario acceptability (or non-acceptability) was measured using the Kendall coefficient of agreement (κ). The level of agreement was greater than random comparisons (Table 1).

Respondents' judgments across scenario pairs showed little intransitivity. A maximum of 20 intransitivities are possible. Overall, about 37% of respondents had either zero or only one intransitivity when choosing among GMO scenarios (Table 1).

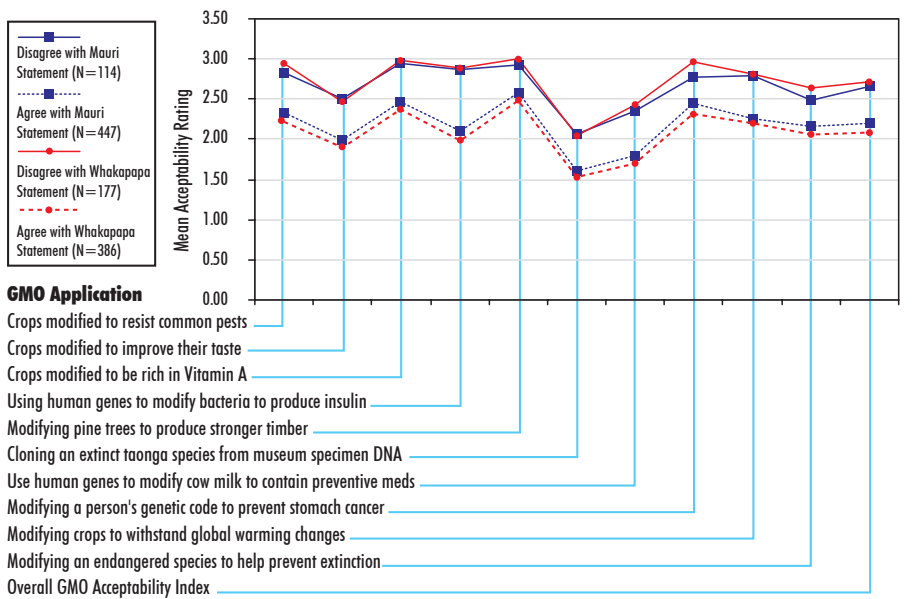
Table 1. Mean standardized regression coefficients (from within subject regressions) and summary statistics for each version of the survey

Survey Version A			
Gene Origin	0 = Insect 1 = Human	-0.27	
Purpose	0 = Economic 1 = Medical	0.33	
Who Benefits	0 = non-Māori 1 = Māori	0.34	
Mauri Interference	0 = Unlikely 1 = Likely	-0.28	
	Mean R-squared	0.86	
	N	139	
	Kendall κ	0.255	
	Mean # Intransitivities	3.2	
	% intransitivities = 0 or 1	37.4	
Survey Version B			
Gene Origin	0 = Insect 1 = Human	-0.43	
Purpose	0 = Conservation 1 = Medical	0.29	
Product Type	0 = Non-food 1 = Food	-0.18	
Modified Species	0 = Non-Native 1 = Native	0.07	
	Mean R-squared	0.85	
	N	196	
	Kendall κ	0.199	
	Mean # Intransitivities	4.5	
	% intransitivities = 0 or 1	37.8	
Survey Version C			
Gene Origin	0 = Insect 1 = Human	-0.50	
Location of Research	0 = Field 1 = Lab	0.23	
Who Controls Patent	0 = Crown 1 = Local Runanga	0.22	
Purpose	0 = Control of pest 1 = Conservation of endangered species	0.00	
	Mean R-squared	0.89	
	N	175	
	Kendall κ	0.224	
	Mean # Intransitivities	4.2	
	% intransitivities equal 0 or 1	37.7	
			<input type="checkbox"/> = RELATIVELY MOST IMPORTANT <input type="checkbox"/> = RELATIVELY MODERATELY IMPORTANT <input type="checkbox"/> = RELATIVELY LEAST IMPORTANT

Paired comparisons and ratings converge. The attitude rating responses support the idea of key cultural value dimensions.

Figure 2. Mean Acceptability Rating of Each GMO Application by Agreement With Statements About Mauri and Whakapapa

Mauri statement: "The ill-effects of GMOs, if any, are likely caused by tampering with mauri or the wairua of the modified organism."
Whakapapa statement: "I am uncomfortable with GMOs because they don't belong in our whakapapa."



Discussion

Summary

These results demonstrate the relative importance of tangible and intangible dimensions in decisions about genetic engineering and can be used to develop a decision framework that adequately incorporates community concerns. The PC data showed that judgments of GMOs were made on the basis of the information provided in the scenarios and not other unexplained variables. Most important were dimensions related to gene origin, application purpose, who benefits, and interference with cultural values. Responses to attitude rating scales supported these findings. Good agreement among respondents was evident and intransitivity rates were comparable to other studies (e.g., Chuenpagdee et al., 2001).

Innovation

We used the PC method to examine an indigenous community's subjective judgments of alternative GMO scenarios described on both tangible and intangible dimensions. The PC method obtains repeated measures of each scenario, thereby resulting in more reliable responses than single-point estimates. It also avoids the limitations of self-reported opinions and tests transitivity assumptions (Peterson & Brown, 1998; Rutherford, Knetsch, & Brown, 1998).

Limitations

Several "incomplete" questionnaires were returned. Some participants may have "protested" a debate that assumes some acceptable GMO applications.

Future Directions

- To explore ways of capturing protest responses.
- To test the framework applied to real-life decisions about GMO proposals as an alternative to existing decision tools that favor more scientific, economic, or quantitative dimensions.

References

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- Roberts, M., Haami, B., Benton, R., Satterfield, T., Finucane, M.L., Henare, M., Henare M. (2004). Whakapapa as a Māori mental construct: Some implications for the debate over genetic modification of organisms. *The Contemporary Pacific*, 16(1), 1-28.
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Figure 3. Cultural Values Influencing GMO Acceptability Judgments

