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Restricted versus unrestricted choice in labelled choice experiments: exploring the tradeoffs of expanding choice dimensions

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Abstract

The main objective of the study outlined in this paper was to examine how the inclusion of an additional labelled alternative, to provide respondents with more choice in a stated preference survey, impacted on choice complexity. The valuation context was to elicit preferences for improvements in the future condition of the Great Barrier Reef, Australia. A split sample experiment was implemented where one survey included four labelled alternatives: a status quo option and three specific policy management options (restricted choice). The other survey provided respondents with an unrestricted choice set by including a fifth alternative choice, labelled as "a combination of management options". While the additional option improved opportunities to find an attractive choice profile, adding an extra alternative increased the complexity of the survey. The tradeoff between choice flexibility and complexity is examined in terms of changes in respondents' choice behaviour and the performance of the different models. The results provide some evidence that adding a combination policy alternative did change the ways that respondents viewed tradeoffs, but that choice behaviour and subsequent value estimates were consistent across the two survey formats.

Keywords: Choice complexity, choice modelling experiments; labelled alternatives; policy management options; multiple alternatives

1. Introduction

Designing choice modelling (CM) experiments can be complex as tradeoffs between increasing choice options and increasing complexity and cognitive burden must be considered (Rolfe and Bennett, 2009). A range of studies have shown that different design elements may impact on CM results (e.g., Boxall et al., 2009; Boyle and Özdemir, 2009; Carlsson and Martinsson, 2008; Caussade et al., 2005; Hensher, 2006; Rolfe and Bennett, 2009), but there has been little focus on the tradeoffs that may be encountered when design dimensions are expanded.

One of the key reasons to expand the design dimensions of a CM survey is to make the choice sets as realistic as possible. In addition, providing more choice in terms of additional alternatives or attributes will increase the likelihood that respondents can find choices that are more closely aligned with their preferences, especially when these preferences are refined through the choice selection process (Rolfe and Bennett, 2009). On the other hand, expanding the choice design may also increase choice complexity and respondents' cognitive burden, which can influence respondents' choice selection behaviour (Boxall et al., 2009; DeShazo and Fermo, 2002; Dhar, 1997; Dhar and Simpson, 2003; Hensher, 2008; Swait and Adamowicz, 2001).

In environmental valuation, there has been very limited use of management labels to help describe choice profiles. This is partly because in many cases the wider policy context is consistent across choice scenarios and partly to avoid increasing the complexity of the CM survey. However, in welfare terms, the utility of environmental protection options may be sensitive to the choice of inputs used to achieve the protection because those inputs may signal the presence of other positive and negative impacts on individual welfare. Johnston and Duke (2007) and Czajkowski and Hanley (2009) have demonstrated that including information about management policy has a significant impact on values for environmental

assets. Blamey et al. (2000) reported that the inclusion of policy labels appeared to shift respondents' attention from the attributes to the labels, but they found no significant differences in the welfare estimates.

The research reported in this paper applied the use of management options in a choice experiment. The case study application involved additional protection measures for the Great Barrier Reef (GBR) in Australia. The area of approximately 35 million hectares is protected by the Australian and Queensland Governments as a marine park, and has had World Heritage site status since 1981. While the GBR remains one of the most healthy coral reef ecosystems in the world, its condition has declined significantly since European settlement and the overall resilience of the reef has been reduced (Furnas, 2003; GBRMPA, 2009). The 2009 GBR outlook report (GBRMPA, 2009) identifies climate change, declining water quality from catchment run-off, and impacts from fishing as three of the key priority issues reducing the resilience of the GBR.

The protection of the GBR is a major policy issue in Australia because of its iconic status and international significance. Three broad policy options to improve protection were identified: increasing conservation zones in marine areas, improving water quality flowing into the lagoon area, and reducing greenhouse gas emissions. As protection measures are hotly debated among different interest groups in Australia, it is likely for some groups that preservation values would be dependent on both the levels of protection involved and the mechanisms used to achieve it. Other groups may focus on the net improvement in environmental health, not caring which combination of management options is applied.

For one split sample in this case study, three management options were included as labelled alternatives, along with a status quo option, in a four alternative choice design. To provide respondents with a less restricted selection of management options, a second split sample survey was conducted that included a fifth alternative labelled as "a combination of management options". The aim of the study outlined in this paper was to explore the impact of providing respondents with an additional combination choice in a labelled CM experiment where the complexity of the additional alternative to consider may be countered by the benefits of having more choice. This tradeoff will be examined in terms of any changes in respondents' choice behaviour and the performance of the different models.

The paper is outlined as follows. In the next section, the potential implications and tradeoffs of broadening the choice dimensions is discussed. The third section provides brief details of the case study context and survey details, while the results are presented in the fourth section. The results are discussed and conclusions drawn in the final section.

2. Tradeoffs of expanding choice dimension

Changing the number of alternatives in a CM experiment is a design issue that has received some attention in the literature. Rolfe and Bennett (2009) used a split sample experiment to compare a two versus three alternative choice design. Their results indicate that respondents in the two alternative version were more likely to select the status quo option. They also found increased incidence of serial nonparticipation (Von Haefen et al., 2005) in the two alternative format where respondents consistently selected the status quo option in all their choices. In contrast, Adamowicz et al. (2005) and Boyle and Özdemir (2009) found that respondents were more likely to choose the status quo option in a three alternative format

compared with a two alternative format. Both Boyle and Özdemir (2009) and Rolfe and Bennett (2009) report improvements in statistical efficiency when moving from a two to a three alternative format.

Other studies have used pooled data with the number of alternatives included as a variable in the choice models. Arentze (2003) found that increasing the number of alternatives from two to three did not lead to an increase in error variance. However, Caussade et al. (2005) found that changing the number of alternatives did have an impact on variance with a U shaped pattern emerging. They calculated the scale parameter associated with different numbers of choice alternatives, reporting that four alternatives provided the best results, followed by five alternatives. The three alternative version was the worst with the largest variance.

The influence of complexity on choice selection has been explored both in laboratory as well as survey experiments. DeShazo and Fermo (2002) described how the influence of complexity induced choice inconsistency while other researchers argue that increasing the complexity of decision environments is more likely to encourage the use of simplifying heuristics (Dhar, 1997; Dhar and Simpson, 2003; Hensher, 2008; Swait and Adamowicz, 2001) and may result in individuals deferring or avoiding choices (Dhar,1997). Boxall et al. (2009) found that respondents were more likely to select the status quo alternative as task complexity increased, which was defined by the single and multiple attribute level changes occurring across all alternatives in a choice set.

The main focus of attention has been on differences between two and three alternative designs. There is little guidance on how respondents might react when moving from a four to a five alternative design, although the work of Caussade et al. (2005) suggests that a five alternative design might perform better than a four alternative design. There are three possible reactions from increasing the number of choice alternatives, as respondents might:

a) find the survey more complex, selecting the status quo option more frequently than respondents in a four alternative survey (Boxall et al., 2009);
b) find the survey more complex, resorting to the use of heuristics in their choice selection process (Dhar, 1997; Hensher, 2008; Swait and Adamowicz, 2001); or
c) find the survey easier because they are more likely to find a choice profile that matches their preferences (Rolfe and Bennett ,2009), in which case the statistical fit of the model should improve.

It is unclear how the choice behaviour of respondents may change when they are provided with an additional alternative that combines management options. In this case study the four alternative model is described as a restricted choice model because, apart from the status quo option, respondents can only select an improvement option associated with a particular management policy. The use of only one alternative for each management label may limit choices for respondents where management policy is important. However, adding a combination management alternative substantially increases options because it allows respondents focused on specific management inputs with a second alternative where they can appear. For others who may have reasons to avoid selecting a specific label, or who may prefer a selection of management options rather than a single one, the unrestricted option may be a preferred choice as it avoids having to make difficult distinctions between labels.

Some respondents might not have strong feelings about the management labels and might focus more on the attribute levels (the range of which vary with each label). In this case,

providing a fifth alternative will provide limited additional benefits as it is likely the four alternatives will provide a least one preferred choice profile. In this case it is likely the benefits of increasing choice availability will be outweighed by the additional complexity involved.

In this paper the effect of providing an additional unrestricted choice option on respondents' choice behaviour will be explored by examining:

a) their opinions about the survey from responses to follow-up questions;
b) the structure of their choices in a nested logit model; and
c) their willingness-to-pay (WTP) values in mixed logit models.

3. The choice modelling case study

The objective of the research reported in this paper was establish whether protection values for the GBR varied according to the type of management option implemented to achieve improvements. Pressures impacting on the condition of the GBR were identified as coming from three main sources (GBRMPA, 2009):

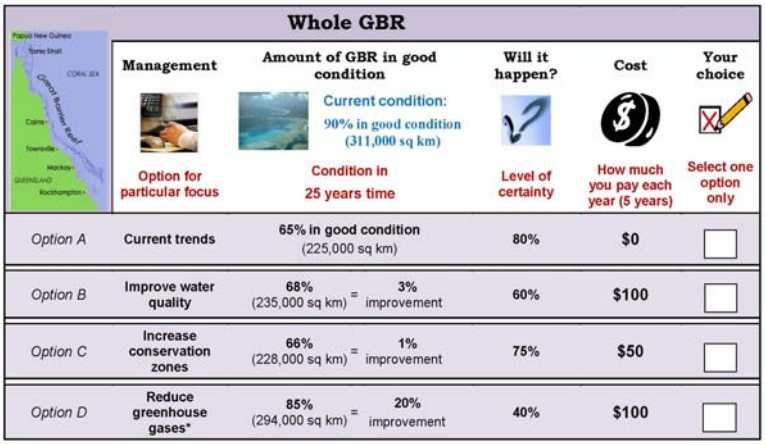
> Land-based activities: Poor water quality comes mainly from agriculture, as well as from urban and industrial activities (Furnas, 2003; GBRMPA, 2008; Haynes et al., 2007).
>
> Ocean-based activities: These include the impacts of tourism, recreational use, fishing, and shipping (GBRMPA, 2009; Hoegh-Guldberg, 2008)
>
> Natural events and climate change: This includes natural events, such as major flooding and cyclones and other events such as coral bleaching and outbreaks of the crown-of-thorns starfish. Climate change may lead to increased frequency of some events (Garnaut, 2008; Lough, 2007).

To reflect these pressures, three management options were included as labelled alternatives in the choice sets:

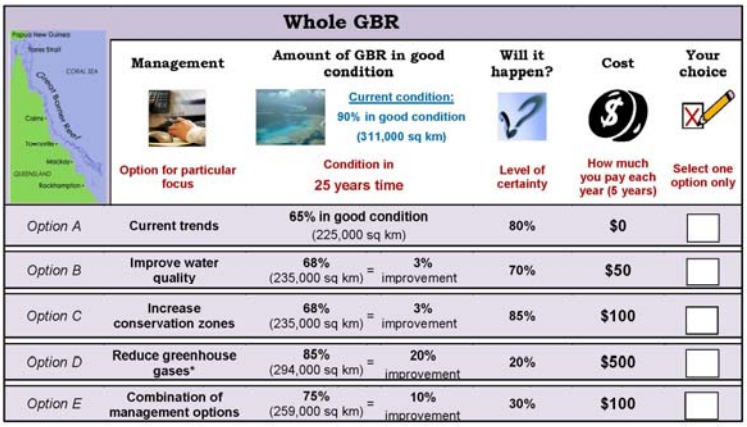
> improve water quality;
> increase conservation zones (within the GBR); and
> reduce greenhouse gas emissions.

Two split samples of the survey were developed. In one version (referred to as restricted choice), respondents were presented with four labelled alternatives in each choice set; the three management policy options and a status quo alternative. In the other version (referred to as unrestricted choice), each choice set included an additional fifth labelled alternative (combination of management options). An example of each choice set is provided in Figure 1. In each survey version the first alternative was a constant base depicting the amount of the GBR expected to be in good condition in 25 years time under current policy settings and with no additional investment. Based on the predictions of Wolanski and De'ath (2005), Lough (2007) and Garnaut (2008) this was set at 65% of the GBR, down from approximately 90% in current times (GBRMPA ,2009; Wolanski and De'ath, 2005). The other labelled alternatives provided scenarios where protection of the GBR could be improved through additional investment.

Figure 1. Example choice sets



Whole GBR					
	Management	Amount of GBR in good condition	Will it happen?	Cost	Your choice
	Option for particular focus	Current condition: 90% in good condition (311,000 sq km) — Condition in 25 years time	Level of certainty	How much you pay each year (5 years)	Select one option only
Option A	Current trends	65% in good condition (225,000 sq km)	80%	$0	☐
Option B	Improve water quality	68% (235,000 sq km) = 3% improvement	60%	$100	☐
Option C	Increase conservation zones	66% (228,000 sq km) = 1% improvement	75%	$50	☐
Option D	Reduce greenhouse gases*	85% (294,000 sq km) = 20% improvement	40%	$100	☐



Whole GBR					
	Management	Amount of GBR in good condition	Will it happen?	Cost	Your choice
	Option for particular focus	Current condition: 90% in good condition (311,000 sq km) — Condition in 25 years time	Level of certainty	How much you pay each year (5 years)	Select one option only
Option A	Current trends	65% in good condition (225,000 sq km)	80%	$0	☐
Option B	Improve water quality	68% (235,000 sq km) = 3% improvement	70%	$50	☐
Option C	Increase conservation zones	68% (235,000 sq km) = 3% improvement	85%	$100	☐
Option D	Reduce greenhouse gases*	85% (294,000 sq km) = 20% improvement	20%	$500	☐
Option E	Combination of management options	75% (259,000 sq km) = 10% improvement	30%	$100	☐

Three key attributes were used in the choice sets to show the differences between the policy alternatives. The first described the amount of the GBR in good condition, using both percentage and absolute area values to convey the information. The second attribute was used to represent the certainty of outcomes occurring from the different management options because the extent, timing and certainty of outcomes can be expected to vary across options. A general payment vehicle (where a number of potential methods were described) was used for the third attribute, cost. The attribute levels were tailored to the management alternatives (Table 1).

Designing the experiment in this way allowed the potential outcomes of the different alternatives to be summarised in a realistic way. For example, increasing conservation zones was an option that could generate improvements with high certainty at relatively low cost, but only limited gains were possible. In contrast, reducing greenhouse gas emissions has more potential to make larger improvements to the protection of the GBR, but is associated with higher cost and lower levels of certainty. The constant base option was assigned a certainty level of 80% to reflect the reality that this was only a prediction of the future outcome.

The inclusion and interpretation of the uncertainty attribute is discussed elsewhere and is not included in the analysis reported in this paper.

Table 1. Attribute levels for choice alternatives

	Amount of GBR in good condition	Will it happen? Level of certainty	Cost
Option A Current trends (SQ)	65% (225,000 sq km)	80%	$0
Option B Improve water quality (WQ)	68%, 72%, 76% (235,000, 249,000, 263,000 sq km)	50%, 60%, 70%	$50, $100, $200, $300
Option C Increase conservation zones (CZ)	66%, 68%, 70%, (228,000, 235,000, 242,000 sq km)	75%, 80%, 85%	$20, $50, $100, $200
Option D Reduce greenhouse gases (GG)	75%, 80%, 85% (259,000, 276,000, 294,000 sq km)	10%, 20%, 40%	$100, $200, $300, $500
Option E Combination of management options (ALL)	70%, 75%, 80% (242,000, 259,000, 276,000 sq km)	30%, 60% 80%	$50, $100, $200, $500

Two D-efficient experimental designs were created which required 12 choices sets to be collected. To avoid respondent fatigue, the designs were blocked into two versions so that each respondent was assigned a random block of six choice sets.

Both drop-off and collect, and online (internet panel) collection methods were used in the restricted choice survey, with the latter method used exclusively in the unrestricted choice survey and in the last round of survey collection. The paper-based surveys were collected to provide a check on the accuracy of the online responses. The effects of collection mode were tested for, but little significant difference could be identified (Windle and Rolfe, 2010), supporting the results of Olsen (2009). The surveys were collected in Brisbane, the state capital, between August and December 2009.

3.1 Respondent characteristics

A total of 421 surveys were collected from households in Brisbane, the state capital. This included 160 online surveys and 97 drop-off and collect for the restricted choice split sample, and 164 online surveys for the unrestricted choice split sample. The paper-based survey yielded a high response rate of 91%. It is not realistic to estimate accurate response rates for the online surveys because emails were sent to over 20,000 panellists in each round and there is no way of knowing what proportion of panellists responded before the target sample size was attained and the survey closed. The use of age and gender quotas further confounded the issue. In the second round, 2145 people responded to the survey before the target sample size of 1012 responses was reached. A total of 663 respondents were excluded under quota restrictions and of the remaining 1482 responses, there were 470 drop-outs (32%), yielding an approximate response rate of 68%.

The socio-demographic characteristics of survey respondents were well aligned with those of the population (Table 2), apart from education levels which were higher for the sample than the population. There were also fewer people represented in the highest income category.

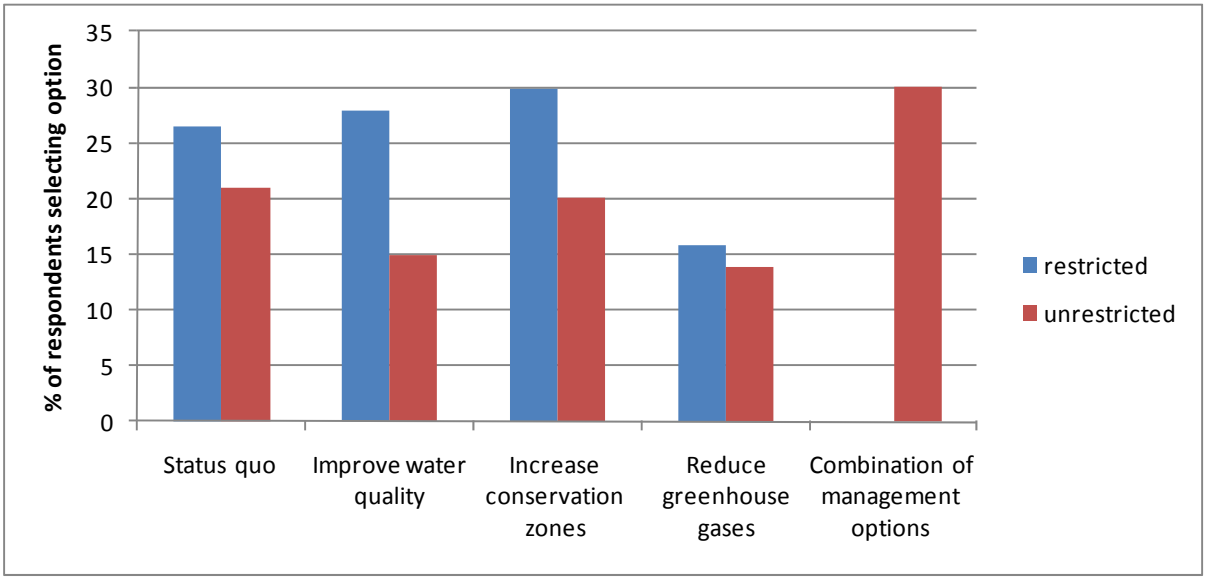
Table 2. Respondent characteristics

		Survey sample	Population (ABS 2006 census)
Gender	Female	52%	50%
Children	Have children	69%	n/a
Average age	Details for online respondents	44 years	43 years
Education	Post school qualification	63%	56%
	Tertiary degree	35%	24%
Income	less than $499 per week	13%	17%
	$500 – $799 per week	21%	18%
	$800 – $1199 per week	25%	21%
	$1200 – $1999 per week	28%	24%
	$2000 or more per week	14%	21%

4. Results

The key objective of this study was to determine whether the benefits of increased choice selection outweighs the increases in cognitive ability and complexity of moving from a four to a five alternative design. The proportion of respondents selecting the different management options and how this changed when an additional combination option was introduced is presented in Figure 2.

Figure 2. Management option selection in the restricted and unrestricted surveys



The additional alternative was an attractive choice with 30% of respondents selecting the option when available. Preferences were primarily drawn away from the water quality and conservation zone options whereas preferences for the greenhouse gas option appear to have been more stable. Providing more choice also meant that a lower proportion of respondents selected the status quo option, with a 5% decline in responses. Further analysis indicates there was a statistically significant reduction (chi-squared crosstab at 1%) in serial

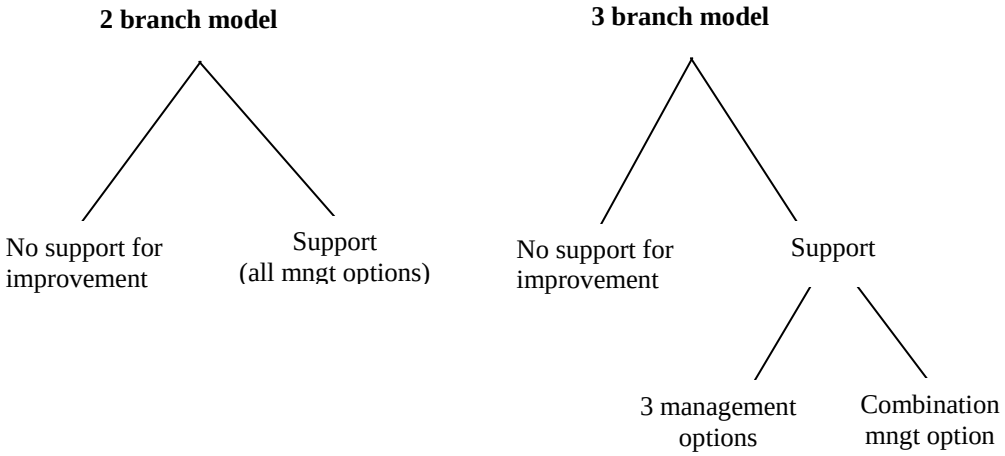
nonparticipation (Von Haefen et al., 2005) from 15% of respondents always selecting the status quo option in the restricted version to 10% in the unrestricted version.

There was very low incidence of serial label selection (always selecting the same label) in the restricted survey with 3%, 5% and 2% of respondents in the restricted survey always selecting the water quality, conservation zone and greenhouse gas options respectively. In the unrestricted survey, serial selection of specific labels dropped (reduced to 1%, 1% and less than 1% respectively) but 6% always selected the combination option. This would further suggest that given the choice, some respondents preferred to avoid selecting a specific label.

The lack of an increase in the selection of the status quo option in the unrestricted survey provides some indication that the survey had not become more complicated. Furthermore, the responses to evaluation questions after the choice sets imply that the increased choice did not negatively impact on cognitive burden. One question asked respondents how confident they were about the choices they had made. There was a significant difference (Pearson's chi-squared crosstab) in the responses between the two survey versions (but only at 10%), with the unrestricted choice respondents having a slightly higher level of confidence in their choices. Respondents were also asked about how credible they thought the choice questions were and how confusing they found them. There was no significant difference in responses between the two survey versions.

To examine how the choice structure varied between the two surveys, nested logit models were developed. The significance of a two branch structure would provide some information about whether respondents were making a clear decision to support or not to support an improvement option, even if they didn't like the specific management labels. In addition, a three branch structure (Figure 3) was applied in the unrestricted model to highlight any potential structural separation in the choice between the three specified management options and the additional combination option.

Figure 3. Nested choice structure in two and three branch models



The key environmental attribute, GBR in good condition, was presented in the survey in both percentage and absolute terms to help define it to respondents. In the interests of brevity, all models presented in this paper report only results based on percentage values. Details of the model variables are presented in Table 3 and the model results are presented

in Table 4. The attribute levels were modelled generically across all alternatives, included the status quo, while the socio-demographic variable were modelled against the status quo option.

Table 3. Model variables

Main variables	Description
Main attributes	
COST	Annual payment for a 5-year period
GBR CONDITION	Amount of GBR in good condition (%)
CERTAINTY	Level of certainty that stated outcome will occur (%)
Management Options	Labelled alternatives
SQ…	Prefix to denote management option: Current situation
WQ…	Prefix to denote management option: Improve water quality
CZ…	Prefix to denote management option: Increase conservation zones
GG…	Prefix to denote management option: Reduce greenhouse gases
ALL…	Prefix to denote management option: Combination of management options
ASC	Alternative specific constant
Other variables	
AGE	Age in years. Only categorical details were collected in the paper survey. The mid point of each category was applied.
GENDER	Male = 0; Female = 1
CHILDREN	Children = 1; no children = 2
EDUCATION	Coded from 1= primary to 5 = tertiary degree or higher
INCOME	Categories 1-5 (see Table 2 for details). The mid point of each category was used for analysis with an additional 25% added to the last category.

Table 4 Nested logit models

	Restricted 2 branch			Unrestricted 2 branch			Unrestricted 3 branch		
	Coefficient		*SE*	*Coefficient*		*SE*	*Coefficient*		*SE*
COST	-0.0037	***	0.0004	-0.0046	***	0.0004	-0.0048	***	0.0005
GBR CONDITION	0.0856	***	0.0121	0.1295	***	0.0119	0.1397	***	0.0160
CERTAINTY	0.0118	***	0.0042	0.0193	***	0.0031	0.0213	***	0.0039
AGE	-0.0068		0.0043	0.0176	***	0.0067	0.0176	**	0.0073
GENDER	-0.3169	**	0.1238	0.3639	**	0.1645	0.3660	**	0.1713
CHILDREN	-0.1556		0.1146	0.2931		0.2000	0.2901		0.2063
EDUCATION	-0.1978	***	0.0568	0.0121		0.0738	0.0120		0.0735
INCOME	-0.1E-05	***	0.2E-06	0.3E-06		0.2E-06	0.3E-06		0.2E-06
WQ_ASC	5.4330		11.7864	10.6489		9.2861	20.4929		23.0110
CZ_ASC	5.4181		11.7618	10.7889		9.2884	20.6218		23.0270
GG_ASC	4.7825		11.8384	10.6475		9.3151	20.5158		23.0065
ALL_ASC				11.1189		9.2995	16.0946		12.8617
IV Parameters									
2 branch: No Support	1						1		
Support	0.4047		0.3689	0.5931	**	0.2446	0.5407	**	0.2483
3 branch: No Support							1		
3 mngt options							0.7843	**	0.3463
combination							0.9215	***	0.1497
Model statistics									
No of Observations	1500			978			987		
Log L	-1901			-1353			-1352		
Finite sample: AIC	2.5505			2.7938			2.7970		
Info. Criterion: BIC	2.5930			2.8584			2.8714		
McFaddon R-sqrd	0.1541			0.2254			0.2206		
Chi Sqrd	693			787			765		

*** significant at the 1% level; *** significant at 5%; *significant at 10%

All models are significant (high chi-squared values) and the three main attributes are all significant and signed as expected. Higher levels of GBR CONDITION and CERTAINTY and lower levels of COST are all consistently preferred across models. The main result of note is that the branch structure in the model for the restricted split sample is not significant. In contrast, the same two branch structure in the model for the unrestricted split sample is significant, indicating that the addition of the combination alternative changed the way that respondents viewed the first four choice alternatives. Addition of the combination alternative meant that respondents considered the group of improvement options in a different way to the status quo option.

The choice behaviour is differentiated further in the three branch structure for the unrestricted split sample. The significance of the three branch structure indicates that respondents viewed the combination option not just as an additional management option, but more as a separate alternative to the group of specific management labels.

Across the nested models the ASCs for the management options are not significant, indicating there are no unobserved effects unaccounted for in the models. The socio-demographic variables (modelled to explain the choice of the status quo option) vary in significance between the restricted and unrestricted choice models. Of particular note, the income variable is not significant in the models for the unrestricted split sample. This may indicate greater heterogeneity in choice patterns occurring when the additional combination option was added.

A comparison of model fit using McFaddon R-squared values indicates that the models were stronger for the unrestricted split sample compared to the restricted split sample. However the AIC and BIC statistics, which better correct for differences in sample size, indicate that the restricted split sample generated the better model fit. This suggests that adding the combination alternative increased the heterogeneity of choice behaviour among respondents.

To explore the heterogeneity in choice behaviour across labelled alternatives, mixed logit models were developed with the attributes modelled against each alternative (Table 5). These models had the additional benefit of being able to handle panel data and account for the grouping of individual choices. The ASCs associated with each labelled alternative were randomised in the models while the socio-demographic variables were modelled to explain the choice of the status quo option.

In both models the ASCs are significant with very high but negative values. This indicates that when the influence of the attributes specific to each option is separated out then there were quite large unobserved effects that caused respondents to avoid selecting the option. This would suggest that respondents were selecting options based on the attribute levels (ASCs were positive and not significant when generalised across alternatives) and other influences were causing them to avoid the options. The significant standard deviations of parameter distributions indicate substantial heterogeneity in the choice of the different management labels. A number of significance tests relating choice to the answers from several attitudinal questions in the survey did not identify any obvious patterns that would explain avoidance of management options.

Table 5. Mixed logit models with attributes specified for each management option

	Restricted choice			Unrestricted choice		
	Coefficient		SE	Coefficient		SE
Random parameters in utility functions						
WQ_ASC	-19.6863	***	2.3538	-19.3171	***	3.3288
CZ_ASC	-28.6828	***	4.0396	-22.6562	***	6.8047
GG_ASC	-10.3062	***	2.6469	-7.1503	**	2.8135
ALL_ASC				-11.1107	***	2.5759
Derived standard deviations of parameter distributions						
WQ_ASC	2.4036	***	0.1955	2.3899	***	0.3296
CZ_ASC	2.4011	***	0.2198	1.7247	***	0.2060
GG_ASC	3.1888	***	0.3619	2.5408	***	0.2987
ALL_ASC				2.6686	***	0.3239
Non Random parameters in utility functions						
AGE	-0.0122		0.0092	0.0309	**	0.0125
GENDER	-0.6514	**	0.2662	0.6039	**	0.2980
CHILDREN	-0.2910		0.2250	0.3963		0.3719
EDUCATION	-0.3427	***	0.1218	-0.0069		0.1292
INCOME	-0.1E-05	***	0.4E-06	0.1E-06		0.4E-06
Management option: Improve water quality						
WQ_COST	-0.0077	***	0.0008	-0.0082	***	0.0014
WQ_GBR CONDITION	0.2201	***	0.0327	0.2688	***	0.0421
WQ_CERTAINTY	0.0089		0.0115	0.0488	***	0.0156
Management option: Increase conservation zones						
CZ_COST	-0.0088	***	0.0020	-0.0044		0.0028
CZ_GBR CONDITION	0.3106	***	0.0583	0.3203	***	0.1047
CZ_CERTAINTY	0.0515	**	0.0227	0.0456		0.0290
Management option: Reduce greenhouse gases						
GG_COST	-0.0045	***	0.0007	-0.0054	***	0.0010
GG_GBR CONDITION	0.0701	**	0.0286	0.1219	***	0.0306
GG_CERTAINTY	-0.0010		0.0077	0.0086		0.0117
Management option: Combination of options						
ALL_COST				-0.0065	***	0.0009
ALL_GBR CONDITION				0.1849	***	0.0304
ALL_CERTAINTY				0.0216	***	0.0059
Model statistics						
No of Observations	1500			978		
Halton draws	100			100		
Log L	-1562			-1154		
Finite sample: AIC	2.1104			2.4134		
Info. Criterion: BIC	2.1809			2.5369		
McFaddon R-sqrd	0.2486			0.2665		
Chi Sqrd	1034			839		

There is some difference between models for the two split samples in the size of coefficients and significance of the different attributes for each management option. The largest change occurs for the conservation zone option, where the COST and CERTAINTY attributes failing to reach the 10% significance level in the model for the unrestricted split sample. This suggest more variation in choice and perhaps greater use of heuristics when the combined alternative was added to the choice sets.

Tests were also conducted for equivalence of marginal values (part-worths) from the models for the two split samples (Table 6). One test compared the willingness to pay (WTP) estimates for GBR CONDITION calculated from the two split samples using the two branch

nested models. The results showed overlapping confidence intervals, and the Poe et al. (2005) procedure which calculates the proportion of differences greater than zero, indicates there is no significant difference between them. The second set of tests compared the willingness to pay (WTP) estimates for GBR CONDITION by each management policy label in the mixed logit models. Overlapping confidence intervals and the results of the Poe et al. (2005) tests indicate no significant difference between the split sample models.

In addition, there is also no significant difference (Poe statistic of 0.71) between the WTP from the restricted nested model ($28.06) where attribute levels were not label specific and the WTP for the combination option ($28.33). However, there is significant difference between the WTP value in the restricted model ($23.23) and that for the combination management option ($28.33) with a Poe statistic of 0.97. This provides some additional evidence that inclusion of the combination alternative has had some impact on the way that respondents viewed tradeoffs.

Respondents were WTP more for improvements achieved through an increase in conservation zones than for an improvement in water quality, while values were lowest for improvements gained from a reduction in greenhouse gas emissions. However, there was considerable preference heterogeneity in both split-samples. A Poe et al. (2005) procedure indicates that, in the restricted split-sample, there was no significant difference in WTP for improvements from the improving water quality and increasing conservation zone options. Values for generating improvements from both these options were significantly higher than those from the reducing greenhouse gas emissions option, but only at the 10% level.

Table 6. WTP estimates for improvement in GBR CONDITION

		Improve water quality	Increase conservation zones	Reduce greenhouse gases	Combination of mngt options
Restricted choice					
2 branch nested model	$23.23*** $16 - $33				
Labelled mixed logit		$28.57*** $19 - $39	$35.36*** $18 - $82	$15.57** $4 - $35	
Unrestricted choice					
2 branch nested model	$28.06*** $21 - $37				
Labelled mixed logit		$32.73*** $23 - $48	$72.85 -$416 - $635	$22.66*** $12 - $39	$28.33*** $18 - $42
Poe test: proportion of difference >0	0.79	0.73	0.73	0.74	

5. Discussion and conclusion

The main objective of this study was to examine the tradeoffs encountered in expanding the dimensions of a CM survey. The principal issue was whether the benefits of increasing the choice options available were offset by a respective increase in cognitive burden and complexity. In the absence of any definite tests, a number of factors were considered that related to the choice behaviour of respondents and the performance of the choice models.

The use of management options to label choice alternatives has been significant in explaining choice behaviour. Adding the combination option attracted a large proportion (30%) of preferences. There are a number of possible explanations. Adding an extra alternative increased the likelihood that an attractive choice profile will be offered. Some respondents may not have had clear preferences for a management policy, and hence preferred to support the combination of management alternatives. Other respondents may have had clear preferences for a management alternative, but selected the combination alternative when it had a better package of attribute levels.

The low incidence of serial selection of any of the three specific management options suggests that the management labels were not overpowering reasons for selecting alternatives. The majority (77%) of combination option responses appear to have been diverted away from the water quality and conservation zone options, suggesting the preferences for these management options were not as strong as those for the greenhouse gas option where preferences remained more stable. If respondents were more focused on the attribute levels rather than the labels, the extra option (which only provided a selection of attribute levels already present in the other options) may have been of limited additional benefit.

The structural significance of the three branch nested model (Table 4) indicates that respondents made a clear distinction between the three management specific labels and the combination option. As well, the nested models identified that addition of the combination alternative changed the way that respondents viewed the improvement options. It is possible that respondents viewed single management policies as unrealistic in addressing all threats to the GBR, so the presentation of a combination option together with the specific management policy options was both more realistic and distinctive.

The high response rate for the additional combination option may indicate that respondents did find it easier to make a selection in the unrestricted survey. The decrease in the proportion of status quo preferences (Boxall et al., 2009) and fall in the incidence of serial nonparticipation (Von Haefen et al., 2009) suggest that the five alternative design was not more complex than the four alternative design. Respondents in the five alternative design did not find the choice questions more confusing or less credible than their four alternative counterparts. There was even a statistically significant difference between survey respondents' confidence in their choice selection with the five alternative respondents having a slightly higher level of confidence.

However, there is also some indication that a corresponding increase in the cognitive burden may have affected respondents' choice decision process and possibly encouraged the use of heuristics. First, the income variable was signed incorrectly and not significant in either of the unrestricted models (Tables 4 and 5) indicating that perhaps respondents were not giving full consideration to their budgetary considerations or some were registering a kind of protest vote. In comparison, the income variable in the restricted model was always highly significant and signed as expected (people with higher income levels were more likely to select an improvement option). Second, in the mixed logit models, the cost attribute was not significant for the conservation zone option in the unrestricted model, indicating that some respondents were not giving due consideration to the attribute levels in this option. While these two factors are not conclusive evidence of the use of heuristics, they are suggestive that respondents in the unrestricted survey were not as focused on the cost elements compared with the restricted respondents.

The results presented above do not provide conclusive evidence that the benefits of increasing choice options outweigh the difficulties of increased choice complexity. The results indicate that while addition of a combination option may be attractive to many respondents, there are offsetting complexity costs that lead to greater use of heuristics and randomness in choice selection.

However, there are many encouraging outcomes of this experiment. First, the evidence from both the nested and mixed logit models is that choices are complex, and adding a combination option had some effect on the way respondents made choices. This suggests that care has to be taken in using labelled choice formats. Second, the part-worth values estimated for protecting the Great Barrier Reef were consistent according to whether they were averaged across different management policies ($26.50 for each 1% improvement) or estimated as a combination of the management policies ($28.33 for each 1% improvement). This indicates that choice behaviour was relatively consistent across different formats. Third, the level of support for different policy options varied across management labels, with the greenhouse gas policy alternative retaining very similar support across different design dimensions. The results provide policy makers with a better understanding of how community support may vary with different management options used to achieve protection.

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