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Confusing opportunity costs, losses and forgone gains: Assessing the effect of communication bias on support for climate change policy in the United States and Australia

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Abstract

Concerns about the economic impacts of achieving deep cuts in emissions are a pivotal issue in achieving the political support required for emissions reductions. We assess a widespread reference point bias in the communication of economic modelling of climate policy impacts, and find it significantly reduces public support for emissions reductions. At least one in five Americans and Australians incorrectly believe that reducing emissions would result in incomes falling from current levels – triggering loss aversion – rather than incomes rising more slowly. Avoiding this misunderstanding results in support being up to 23 percentage points higher than when impacts are presented as reductions in income from current levels. This suggests that clearly communicating that incomes continue to rise could have a larger effect on support for emissions reductions among US and Australian citizens over the next few years than increased public confidence in climate science. We conclude that improved communication of policy impacts, including that ambitious stabilisation goals are consistent with strong trend economic growth and rising incomes and employment, has a crucial role in facilitating an informed democratic response to climate change, and may be necessary for achieving a political mandate for global action.

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INTRODUCTION

Concerns about the economic impacts of achieving deep cuts in emissions are emerging as a pivotal issue in achieving the political support required for action at both national and global scales (Hopkins 2007, de Boer 2010, Dubash and Rajamani 2010). This paper identifies and assesses a widespread but previously unrecognised reference point bias in the communication of the economic impacts of policy action, where people believe that the 'cost' of action involves a fall in income from current levels rather than a smaller increase in income. This communication issue is not generally recognised by those involved in the communication of climate science and associated economic modelling, despite being implicitly or explicitly raised by Schneider (1993), Stern (2006) and others (Azar and Schneider 2002, Grubb et al 2005), and we are not aware of any previous attempts to assess or quantify the significance of this communication bias.

The study used split sample surveys in the United States and Australia to test the hypothesis that public support for policy to reduce emissions will be higher where (i) people are more confident in the climate science, (ii) the economic impact of achieving a given climate outcome is smaller, and (iii) it is clear that incomes rise notwithstanding policy action – avoiding mistaken loss aversion relative to current income. The results find that each of these variables are significant and positively related to support for policy action. We also found that at least one in five Americans and Australians incorrectly believe that reducing emissions would result in incomes falling from current levels – triggering loss aversion – rather than understanding that incomes will rise, but rise more slowly. Avoiding this misunderstanding by communicating that incomes rise relative to current levels results in predicted support being 5 - 23 percentage points higher than when policy is understood to involve a reduction in income from current levels. The extent of this reference point bias is larger for higher levels of policy impact.

We draw a number of conclusions, including that improved communication of policy impacts, particularly that ambitious stabilisation goals are consistent with strong trend economic growth and rising incomes and employment, could have a larger effect on support for emissions reductions than increased public confidence in climate science – contrary to the thrust of much of the public discussion of climate science ⁽¹⁾ – and may be necessary to achieve the political mandate required for decisive global action.

RESEARCH AND POLICY CONTEXT

Government action to reduce the risk of dangerous climate change is contingent on public support, which depends in turn on perceptions of the scientific case for action and the impacts of policy options (Dietz et al 2003, Hatfield-Dodds et al 2007). Economic modelling and integrated assessments seek to assess the consequences of emissions reductions for national income and other economic variables, allowing

¹ The stated rationale for the creation of the IPCC, for example, is that "... because climate change is such a complex and challenging issue, policymakers need an objective source of information about the causes of climate change, its potential environmental and socio-economic impacts, and possible response options" IPCC Secretariat, 2004, *The Intergovernmental Panel on Climate Change (IPCC)*, IPCC, Geneva

assessments of cost effectiveness, and to compare the costs and benefits of different emissions trajectories (Hatfield-Dodds 2007).

Modelling of scenarios involving stabilizing greenhouse gas concentrations at levels consistent with a reasonable chance of limiting average temperature increases to 2°C universally find that this would be consistent with continuing economic growth and rising average incomes (2). Studies typically find that trend annual economic growth would be around 0.1% lower than it would be otherwise, with cumulative impacts on Gross World Product (GWP) of up to 2% below projected future levels without action in 2020 and 1% to 8% below projections in 2050 (Edenhofer et al 2006). These impacts are small relative to projected growth, with GWP at least tripling and global income per person more than doubling over the next 40-50 years, regardless of whether policy action is taken (EFF 2006, Grubb et al 2005). Analysis of current proposals for reducing emissions through national 'cap and trade' policies suggest net household impacts of less than 0.2% in the US in 2020, equivalent to an annual impact of US\$170 per household – with the most ambitious targets and least flexible policy settings seeing impacts of 0.5% to 2.6% of consumption (3) (US EPA 2010). Allowing for use of international offsets, even the most ambitious target would be unlikely to involve US impacts of more than \$1000 per household in 2020. The impacts of proposed emission reduction policies on Australia are much larger, ranging between A\$700 to A\$1,200 per capita (equivalent to an impact of 1.3 to 2.0%) in 2020 for targets of 5% to 25% below 2000 levels (Australian Government 2008, Hatfield Dodds et al 2007). No known economic modelling indicates emissions reductions would result in real incomes falling relative to current levels.

The difference between the increase in living standards with and without policy action is referred to as the 'cost' of achieving emissions reductions in both expert discussion and general public debate, and is shown as A in Figure 1. While some authors have noted that emissions reductions are consistent with continuing economic growth (Azar and Schneider 2002, Grubb et al 2005, ABRCC 2006, ACG 2006, Stern 2006), including as early as 1993 (Schneider 1993), increases or changes in income relative to current levels (shown as B) are almost never reported when discussing policy impacts (4) (see Gruen 2008). This gives rise to a potential reference point bias, where some people may incorrectly believe that emissions reductions would involve a loss of income relative to current levels (shown as C). This potential bias was confirmed by Roy Morgan polling in the US and Australia (n=1670 and 632 respectively) in June 2008, which found that at least 20 percent of respondents thought that 'achieving significant

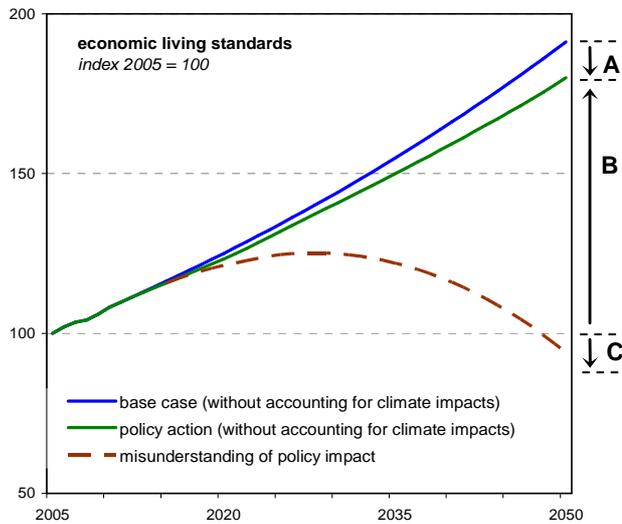
² Some recent studies suggest policy action may increase rates of economic growth relative to the business as usual scenario over the longer term (see note 8).

³ Impacts for Scenario 2, page 28. Other modelling of larger emissions reductions without international trade in permits suggests consumption impacts of up to 2.6% in 2020 (see US EPA 2010 page 62)

⁴ Reporting of Australian Treasury modelling (Commonwealth of Australian 2008) was influenced by the early results of the research reported in this paper, and is an exception (see section 4 of Gruen 2008)

reductions in greenhouse gas emissions' would reduce incomes and living standards from current levels (⁵)

Figure 1. Understanding the economic impacts of emissions reductions



This potential reference bias is important because empirical studies consistently find that people are more concerned by losses than by equivalent-sized gains (Kahneman et al 1991, Horowitz and McConnell 2002), and that the choice of reference point effects real world choices (⁶) (Thaler and Benartzi 2004). This loss aversion implies support for policy action would be expected to be higher where it is perceived to involve a smaller increase in living standards, than if it involves a reduction in living standards (Knetsch 2005). The wellbeing literature also indicates that the lower trend rates of economic growth associated with emissions reductions are likely to have little or no impact on happiness or satisfaction in developed nations (Easterlin 2001, Helliwell 2003, Hatfield-Dodds 2006).

RESEARCH METHOD

We hypothesised that public support for policy to reduce emissions will be higher where (i) people are more confident in the climate science, (ii) the economic impact of achieving a given climate outcome is smaller, and (iii) it is clear that incomes rise notwithstanding policy action – avoiding mistaken loss aversion relative to current income.

⁵ Telephone poll conducted by Roy Morgan polling June 2008. US respondents: 20% 'reduce living standards, so that incomes fall'; 37% 'slow the increase in living standards, incomes rise'; 31% 'no noticeable effect on living standards; 12% 'can't say'. Australian respondents: 25%, 35%, 20% and 5%.

⁶ For example, a study of retirement savings choices by Thaler and Benartzi's (2004) found that 78% of employees who had rejected a conventional savings plan (with salary deductions that reduce current income) chose to join a savings plan that involved forgoing future pay rises, despite it involving larger contributions (and thus a higher opportunity cost) after just two years. This group achieved significantly higher savings rates than employees on the conventional savings plan.

We explored these issues through a split sample phone survey in the US in 2008 (n=2187) and an internet based survey in Australia in 2006 (n=1685) (see also Hatfield-Dodds and Jollands 2006, Morrison and Hatfield-Dodds forthcoming). The focus of the surveys was a referendum question asking respondents whether they would support policy action to ‘reduce the likelihood of serious global warming’ through significant efforts to reduce emissions (⁷). Variants of the referendum question provided information on projected changes in average incomes with and without policy action, framed in three ways. The *forgone gain* framing provided information on both the difference in future average incomes due to policy action (shown as A in Figure 1) and information on the increase in income from current levels (shown as B). *Opportunity cost* provided information on impacts (A), but is silent on the change in income relative today. *Apparent loss* described the opportunity cost impact as if it were a decrease in income relative to current levels (shown as C). The different treatments use similar language and the same range of impacts across framings within each survey, as shown in Figures 2 and 3 below.

The opportunity cost framing represents the dominant way of presenting information on economic impacts in the technical literature (in part because changes relative to current levels are largely determined by the assumptions in the reference case rather than being a modelling result). The apparent loss framing mirrors widespread miscommunication of modelling results, particularly by opponents of policy action.

The script for the three framings of the referendum question in the US phone survey is shown in Figure 2. The internet based survey used in Australia allowed more information to be presented to respondents as a single page with one column for ‘Option A: Continue with current practice’ and a second column for ‘Option B: Reduce the likelihood of serious global warming’. These are illustrated in Figure 3 below.

Figure 2. Illustrative referendum question, US phone survey

Q5. Would you support America participating in global action to substantially reduce greenhouse emissions and the risk of climate change ...

(OC) ... *if the cost of this action was that, on average, personal incomes would be about [\$1500] lower by the year 2020 than they would be without policy action?*

(FG) ... *if this action meant that, on average, personal incomes would grow more slowly – rising by [\$4500] rather \$6000 by the year 2020? This is about [\$1500] lower than without policy action.*

(AL) ... *if the cost of this action was that by the year 2020 personal incomes would be about [\$1500] lower than they are today.*

1 – Yes, would support
2 – No, would not support
3 – Can’t Say

⁷ The phone survey asked respondents whether they would support policy action to ‘substantially reduce the risk of climate change’.

Figure 3. Illustrative referendum question, Australian internet survey

CHOICE SET ELEMENTS		TREATMENT
Please consider the following referendum. If you were asked to choose between the following two alternatives, realistically which one would you vote for?		all
<p>Option A: Continue current practice and accept that serious global warming very likely</p> <p>If no further efforts are made to reduce greenhouse gas emissions, it is estimated that:</p> <ul style="list-style-type: none"> Average temperatures are most likely to rise by around 3.7°C by 2100 There is some chance that average temperatures will rise by around 6°C 	<p>Option B: Reduce the likelihood of serious global warming, and accept lower economic growth and income</p> <p>If significant efforts are made to reduce greenhouse gas emissions, it is estimated that:</p> <ul style="list-style-type: none"> Average temperatures are most likely to rise by around 2.5°C by 2100 There is some chance that average temperatures will rise by around 3°C 	all
SEE INSERTS BELOW		
<i>These estimates are in today's dollars, taking out inflation.</i>	<i>These estimates are in today's dollars, taking out inflation.</i>	all

Insert for Forgone Gain and Opportunity Cost framings

<ul style="list-style-type: none"> Average household income increases from its current level of \$47,600 to \$64,200 in 2020. 	<ul style="list-style-type: none"> Average household income increases from its current level of \$47,600 to \$60,300 in 2020. 	FG only
	<ul style="list-style-type: none"> This increase is \$3,900 less than without action. 	FG only
<ul style="list-style-type: none"> Greenhouse policy has no impact on average household income 	<ul style="list-style-type: none"> Future average household income is 6% lower than it would be without action 	FG & OC
<ul style="list-style-type: none"> 	<ul style="list-style-type: none"> This is equivalent to a cost of \$3,900 a year by 2020. 	OC only

Insert for Apparent Loss framing

<ul style="list-style-type: none"> Greenhouse policy has no impact on average household income 	<ul style="list-style-type: none"> Future average household income falls 6% from its current level of \$47,600 to \$44,700 in 2020 	AL only
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The surveys presented a range of impacts. Varying the impact level presented across respondents makes it possible to determine how support for an environmental protection or improvement is related to impact, and thereby derive an estimate of

community willingness to support the policy option. Importantly, the range of impacts presented ranged from around double to 30 times larger than the typical impacts in the modelling literature, allowing for robust assessment of support even under very pessimistic assessments of policy impacts. In contrast to the typical use of choice modelling and contingent valuation, which use responses to calculate the economic value of the environmental outcome being assessed, the primary focus of this study is on differences in levels of support.

Figure 4 provides an overview of the framings and impact levels, which were constructed so that the range of impacts for the opportunity cost framing (relative to the reference case in 2020) was the same size as the range of impacts for the apparent loss framing (relative to current income), consistent with the miscommunication of results in public debate ⁽⁸⁾ The policy impacts presented were benchmarked against economic modelling of achieving a 60% reduction of Australian greenhouse emissions by 2050 (ACG 2006), which suggested policy would result in average income rising by up to 1.4% less than in the reference lower by 2020, with a increase in real average income of 23-25%, depending on the indicator chosen. These impacts were used to establish the lower end of the range presented, which varied from 2%-24% in the Australian survey and 1%-12% in the US survey (reflecting lower trend income growth).

Figure 4. Framing and impacts presented relative to projected impacts

Difference in income with policy action in 2020:			
<i>relative to income without policy action in 2020</i>		<i>relative to current income</i>	
('A' in Figure 1)		('B' in Figure 1)	
Framing and impact levels			
		A	B
<i>Forgone gain</i>	FG	\$500-\$5500 lower (US) 2%- 24% and \$1,200-\$15,400 lower (Australia)	\$500-\$8500 higher (US) 3%-32% and \$1200-\$15400 higher (Australia)
<i>Opportunity cost</i>	OC	not stated	not stated
<i>Apparent loss</i>	AL	not stated	\$500-\$5500 lower (US) 2%-24% and \$1200-\$15400 lower (Australia)
Benchmark modelling results			
<i>Actual impacts and implied income or consumption levels</i>		up to 0.2% lower and up to \$170 lower (US) 1-2% and \$4,300-8,300 lower (Australia)	28-32% and \$16,300-20,900 higher (US) 9-23% and \$4,300-\$10,900 higher (Australia)

Sources for modelling results: EPA 2010 (Scenario 2, p.28), Australian Government 2008, ACG 2006

⁸ The US survey also included an additional forgone gain treatment where the increase in income by 2020 was \$9000 rather than \$6000 in the reference case (without policy action), and a corresponding higher amount with policy action.

Since the implementation of the surveys, detailed policy and legislation has been proposed in both Australia and the US, which have been analysed by the Australian Treasury (Australian Government 2008) and US EPA (2010) respectively. The headline results of this analysis are presented in Figure 3. The US EPA (2010) also reports estimated impacts from other studies with an opportunity cost of up to 1.4% in forgone growth in household consumption, for scenarios with a similar national target but no offsets or international trade (which are likely to more than double the permit price and associated economic impacts). Figure 4 also summarises the equivalent information from three modelling reports for the US and Australia.

Each respondent was only presented one set of policy impacts using one framing, and the description of the climate change outcome achieved did not vary within each survey. Other questions asked 'how confident are you in scientific predictions of the effects of climate change' or 'that greenhouse gasses from burning coal, oil or other materials may cause average global temperatures to rise', and gathered information on demographic and attitudinal variables. A variety of techniques were used to avoid survey bias and ensure high quality data collection. More details on the research and survey design are provided in Appendix A, with the full US phone script in Appendix B.

DATA ANALYSIS

The quantitative analysis used logit regression techniques to identify the effect of various factors on predicted support for policy action and respondent voting behaviour within the referendum in the questionnaire, including (a) changes in household cost, (b) alternative cost-framing treatments, and (c) the influence of several attitudinal and socio-demographic variables. This information allows an assessment of the effect of providing information about costs in alternative ways, as well as providing evidence of construct validity given our expectations regarding the effect of these variables on voting behaviour.

In the referendum question, respondents had three possible responses: they could vote in favour of the referendum, against it, or indicate that they were not sure. Their responses are therefore categorical, implying the need to use discrete choice regression techniques to model these data. Several regression techniques could be used to analyse the data. Given our goal of understanding how different framing treatments have influenced support for greenhouse policy, we have chosen to use binary logit regression techniques. In order to use this form of regression it was necessary to transform respondents' votes from three possible responses into two responses. Respondents who answered "not sure" were recoded as voting no. In addition, to further minimise the possibility of yea-saying, those who indicated that they were "not at all certain" or only "slightly certain" in a follow up certainty scale were also recoded as voting no. Studies have demonstrated that excluding those with limited certainty can be an effective method of reducing hypothetical bias in stated preference surveys (Johannesson, Lilkas and Hohansson 1998, Ethier, Poe, Schulze and Clark 2000). The challenge however in using following up certainty scales is knowing which respondents to exclude. This is made more difficult as a variety of follow up certainty scales have been used in the literature (Blumenschein, Blomquist and Johannesson 2006). One study by Johannesson et al (1998) found that excluding respondents who indicated that they were "fairly sure" in a hypothetical treatment

produced a lower proportion of positive responses than occurred when respondents actually faced payment. Therefore, in this analysis, only those who were “not at all certain” or only “slightly certain” were excluded and those who indicated that they were “reasonably certain” or had a greater level certainty were included in the analysis.

The binary logit model is one of the most commonly used models for analysing referendum contingent valuation data (Haab and McConnell 2002). The binary logit has the following form (see Greene 1993):

$$\text{Prob}(\text{yes} | \text{yes, no}) = \frac{e^{\beta'x}}{1 + e^{\beta'x}}$$

The x 's in the above equation include treatment and other variables, hence the model shows how the probability of a choice is influenced by – for the models estimated in this paper – household cost, treatment variables and respondents' attitudes and sociodemographic variables. The binary logit model uses a logistic rather than normal distribution (which is used in the binary probit model). Maximum likelihood is used to derive the model solution. Further details about this model can be found in Greene (1993), Haab and McConnell (2002) and Train (2003).

The variables included in the regression models are described in Table A1. Expectations about the sign of each of the variables are also included in the table. The anticipated sign of a number of the variables is relatively self-explanatory (such as household cost, confidence, pro-environment). For one of the variables, age, the sign is uncertain. A positive sign might be expected as younger people are generally more pro-environmental and more likely to experience the impacts of global warming; conversely it might be expected that older people have stronger bequest motives and may be more willing to support future costs that they are unlikely to pay. The effects of the two dummy variables relating to the communication of impacts (apparent loss and opportunity cost) are expected to be negative, as the incorrect information is likely to reduce support for the hypothetical referendum. In addition, it would be expected that the interaction between household cost and the apparent loss treatment would be negative as this would reduce the perceived ability to pay of households.

Table 1: Variable Definition and Anticipated Signs

Variable	Definition	Expected Sign
Constant	Model constant	?
Household cost	Expected decrease in household income	–
Confidence	Confidence in scientific predictions about global warming (1-not at all confident, 5-fully confident)	+
Apparent loss	Dummy variable representing provision of incorrect information when communicating impacts (Future income with policy action is lower than current income. No information given on increase in future income without policy action.) Missing category is correct information provision.	–
Household Cost * Apparent loss	Interaction between household cost and the apparent loss treatment variable	–
Opportunity cost	Dummy variable representing provision of partial information when communicating impacts (Future income with policy action is lower than future income without action. No information given on increase in future income with policy action relative to current income.) Missing category is correct information provision.	–
Forgone Gain \$9000	Households in a sub-set of the US Sample only are told that the future increase in income expected is \$9000 instead of \$6000	+
Pro-environment	Dummy variable showing that a respondent is pro-environment	+
Age	Age (years)	?
Period 2	Sampling for the Australian sample only occurred over two periods, about three months apart. This dummy variable represents if sampling occurred in the second period.	?

The results for the binary logit models (models 1 and 2) are presented in Table A2. The summary statistics suggest the models are robust. Rho-squared values of 0.2 or greater are considered to indicate extremely good model fits (Louviere, Hensher and Swait 2000).

For the Australian model, all model coefficients are significant and have the expected signs. However, for the US model the dummy variables for the Apparent Loss, Opportunity Cost and Forgone Gain \$9000 treatments are all insignificant. Nonetheless, the interaction between apparent loss and price was insignificant. Note that if this interaction is excluded, the apparent loss coefficient becomes significant, but as the model with the interaction provides a better model fit and is significant, it has been retained. One other point of interest is that the coefficient for age is

negative for the US sample, but positive for the Australian sample. As noted above, this finding is theoretically possible.

Table 2: Binary Logit Regression Results

Variable	Model 1: US Data	Model 2: Australian Data
Constant	-2.008*** (-7.41)	-2.531*** (-6.80)
Household cost	-0.094** (-2.21)	-0.103*** (11.16)
Confidence	0.762*** (14.58)	0.783*** (11.16)
Apparent loss	0.172 (0.58)	-0.870*** (-3.92)
Household Cost * Apparent loss	-0.302** (-2.42)	--
Opportunity cost	-0.015 (-0.09)	-0.475*** (-2.71)
Foregone gain \$9000	0.248 (1.50)	--
Pro-environment	0.788*** (6.15)	0.392*** (2.68)
Age	-0.006** (-1.93)	0.032*** (5.81)
Period 2	--	0.389** (2.03)
Rho-square	0.219	0.175
N	1780	1201

t-statistics are in brackets, *** sig at 1%, ** sig at 5%, * sig at 10%

COMPARISON TO OTHER STUDIES IN RELATION TO LEVELS OF SUPPORT

The survey results suggest public support for policy action of 52-57% in the US in 2008 and around 73% in Australia in 2006, for impact levels of around \$1000 per year in 2020 (described in opportunity cost terms). These levels of support are consistent with other surveys and polling conducted in the US and Australia between 2005 and 2008.

Predicted support in the US aligns very closely with the 53-60% support found by Bannon et al (2007) for a carbon tax or emission cap for electricity involving costs of US\$1044 per year. (The Bannon et al (2007) study also found higher support levels for mandatory electricity standards involving costs up to US\$1164 and lower support for vehicle fuel taxes involving much lower household costs.) Polling by ABC News et al (2008) found that support was sensitive to cost impacts: 57% of respondents

supported a cap and trade policy involving additional electricity costs of \$120 per year, but only 47% of respondents supported this policy if additional electricity costs would be \$300 per year. In a repeat survey the next year, support remained stable for lower cost action (\$120) but fell to 39% if policy action involved costs of \$300 per year (ABC News et al 2009). The same polling indicated US support for greater government action on climate change fell over the period from 68-70% in 2006 and 2007 to 61% in July 2008.

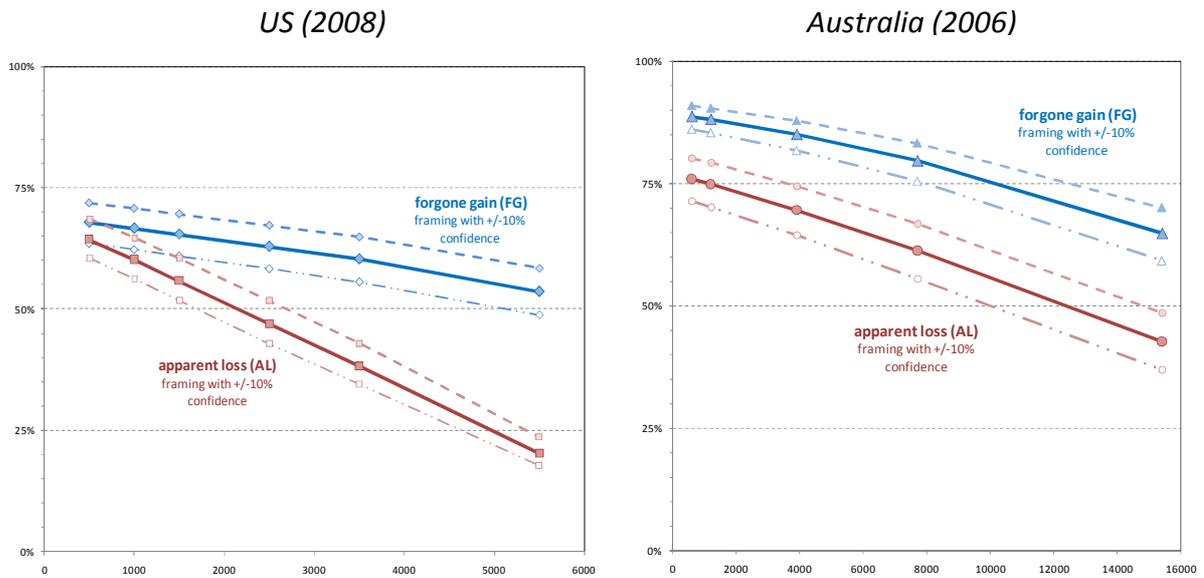
Predicted support in Australia is consistent with other Australian studies and polling for the same period, which indicate a gradual increase in public concern and support for policy action over the years around the survey period, rising from around 38-40% in 2003, to 68-71% in 2005-06, and 76-78% in 2007 (TCI/ARG 2007). These levels of support fall with the range of the Australian results for 2006. Trend changes in concern appear closely related to prolonged drought conditions, which resulted in water restrictions in most Australian cities over this period (Costantoura 2007, Climate Institute 2008, 2010). This is consistent with the emergence of climate change and 'global environmental issues' as security issues or threats to Australia's national interests (Lowy Institute 2005, 2006) – contrasting with frequent perceptions of the environment as an amenity issue or luxury good in the context of 'environment versus development' debates. Since 2008 levels of concern and willingness to pay higher energy prices as a consequence of emissions reductions have both fallen somewhat, consistent with an easing of drought conditions and reduced confidence arising from a breakdown in bipartisan political support for emissions trading domestically and media coverage of controversies around the independence and quality of climate science internationally (Climate Institute 2010, see Morrison and Hatfield-Dodds *in press*).

MAJOR FINDINGS AND DISCUSSION

The data analysis finds that avoiding reference point bias, the level of policy impacts presented, and confidence in the science are all statistically significant and positively related to support for policy action, along with several demographic and attitudinal variables. These findings support the three hypotheses outlined above.

Reference point bias has a dramatic effect on predicted support for policy action, with a larger effect for higher levels of policy impact. Comparing predicted support for policy action for the foregone gain and apparent loss treatments indicates that the reference point effecting up to 23% of US respondents and up to 15% of Australian respondents. This implies that up to one in three US respondents who do not support action when presented as apparent loss would support action when presented as a forgone gain, and almost one in two Australian respondents (shown in Table 3 row 5). The data also allows the magnitude of this reference point effect to be calibrated against other variables. For example, avoiding reference point bias is equivalent to achieving a 9% to 43% increase in reported US confidence in the climate science (equivalent to increasing from the reported actual level of 3.02 to 3.28 to 4.32 on a five point scale, depending on the size of the associated policy impact). Another comparison is that impacts presented as a forgone gain can be three to seven times larger than impacts presented as an apparent loss, and still achieve the same level of support.

Figure 5. Predicted support for emissions reduction policy, forgone gain and apparent loss framings, US and Australia



Support is sensitive to the magnitude of policy impacts (as indicated by the slope of the curves in Figure 5). The results suggest that around one third of US and Australian respondents consider the scale of economic consequences are relevant to their decision to support or not support policy action (in contrast to respondents who may, for example, consider that action should be taken for moral reasons regardless of economic impacts).

Support is also strongly associated with confidence in climate science. The results suggest that only around 20% of US respondents who stated that they are 'not at all confident' would support policy action, rising to around 80% for those 'fully confident'. Confidence appears to be a very slow moving variable in public opinion, however. Australian data across nine months in a period of intense media attention to climate change, prompted by drought and water restrictions in most Australian cities, indicates that confidence varied by around 7% (between 3.33 and 3.57 on a five point scale), suggesting that confidence is unlikely to change significantly over one or two years.

Table 3. Summary results from regression analysis

row / notes <i>Impact on average income in 2020</i>	United States		Australia			
	US\$1,000	US\$3,500	A\$1,000	A\$3,500		
Predicted support						
Forgone gain	1	57%	52%	84%	79%	
Opportunity cost	2	na	na	73%	67%	
Apparent loss	3	52%	29%	71%	65%	
Reference point effect						
share of respondents	4	a	4.8%	22.6%	12.7%	14.8%
share of 'not support' in AL framing	5	b	10.1%	32.0%	44.2%	41.9%
<i>Equivalent increase in confidence</i>						
from AL to FG	6	c	9%	43%	27%	27%
<i>Equivalent economic impact in 2020</i>						
FG impact level to match support for AL at impact level of \$1000, \$3500	7	d	\$2,306	> \$5,500	\$6,293	\$6,293
Sensitivity of support to 100% increase in economic impact						
Forgone gain	8		-2.1%	-7.3%	-0.8%	-4.1%
Apparent loss	9		-9.7%	-19.7%	-1.2%	-5.6%

Notes: (a) \$1000 is less than the lowest cost presented in the Australian survey; (b) Opportunity cost framing not found to be significant in US sample; (c) Increase from 3.02 to 3.28 and 4.32 on five point scale in US, and from 3.12 to 3.96 in Australia; (d) The implied FG impact is more than \$7,000, which is above the highest impact level of \$5,500 presented in the US survey.

These major findings are supported by cross-tab analysis of the US survey data, which finds that prior views of the impact of emissions reductions policy are strongly and systematically related to other key variables. Respondents who considered that significant reductions in emissions would 'reduce incomes and living standards' from current levels have lower confidence in climate science, lower support for emissions reductions, higher general support for development, and lower general support for environmental protection. More details are provided in Appendix C.

Overall, the analysis and results suggest very significant 'willingness to pay' for policy action when this is presented in terms of the share of future income that might be sacrificed in order to reduce climate risks. On face value, the studies suggest that more than 50% of respondents in the US and Australia would be prepared to support collective action that involves sacrificing up to half the increase in average national incomes from today until to 2020, if this would significantly reduce the likelihood of global warming. This willingness to pay is comfortably above the projected impact on future income growth suggested by economic modelling of recent proposals (US EPA 1010, Australian Government 2008). Although results of this kind should be treated as indicative rather than definitive, they imply strong and widespread support for action that is clearly presented as being consistent with rising incomes and continuing trend economic growth.

CONCLUSIONS

We draw five main conclusions.

First, we find that reference point bias is highly salient to US and Australian citizens, and that the widespread misunderstanding that policy 'costs' involve reductions in living standards from current levels appears to be suppressing political support for policy action in these nations. In addition, the finding that this reference point bias is more significant for larger economic impacts (particularly in US respondents) suggests that public opinion will be particularly vulnerable to voices that both misrepresent impacts as losses relative to today and exaggerate the size of expected economic impacts. (Elsewhere we show that the same strategies also trigger the tendency of people to disengage when they perceive policy issues to be complex or highly contested, see Morrison and Hatfield-Dodds in press). Overall, we consider it likely that misplaced loss aversion and associated issues are central to understanding why many people do not currently support emissions reductions.

Second, the available data suggests that prior beliefs about the impact of emissions reductions on incomes and living standards may be systematically related to different world views and cultural values (see Appendix C), suggesting that support will be influenced by *how* emissions reductions are to be achieved – and their congruence with different values orientations – as well by the nature and magnitude of impacts on incomes and living standards (Kahan 2010, Bannon et al 2007). This warrants further investigation.

Third, we consider the effect of this reference bias is likely to be more stable and significant than more general communication issues, such as the choice of key words (Villar and Krosnick 2010) and the political framing of climate policy (see Nisbet 2009). This is because reference point bias connects to a fundamental misunderstanding of the nature of policy impacts (with at least one in five respondents incorrectly believing that reducing emissions would result in incomes falling from current levels), that is likely to influence attitudes towards policy action regardless of world view or political orientation.

Fourth, to help ensure a clear public understanding of policy impacts we consider all those involved in economic modelling and impact assessment should routinely provide information on changes in income and other key economic variables relative to current levels as well as relative to future levels in the reference case of 'business as usual' projection. (Where data is available this could include reporting impacts on energy affordability as well as on energy prices, see Hatfield-Dodds and Denniss 2008). This would remedy the weakness of existing communication, which tends to focus on future 'costs' and impacts without providing information on changes in income relative to today (risking misinterpretation of the results).

Fifth, our results suggest that avoiding communication bias would have a larger effect on support for emissions reductions than increased public confidence in climate science – at least in the US and Australia – contrary to the conventional wisdom among the climate science community. More generally, we consider that improved communication of policy impacts, including that ambitious stabilisation goals are consistent with strong trend economic growth and rising incomes and employment, has a crucial role in facilitating an informed democratic response to climate change, and may be necessary to achieve the political mandate required for decisive global action.

ACKNOWLEDGEMENTS

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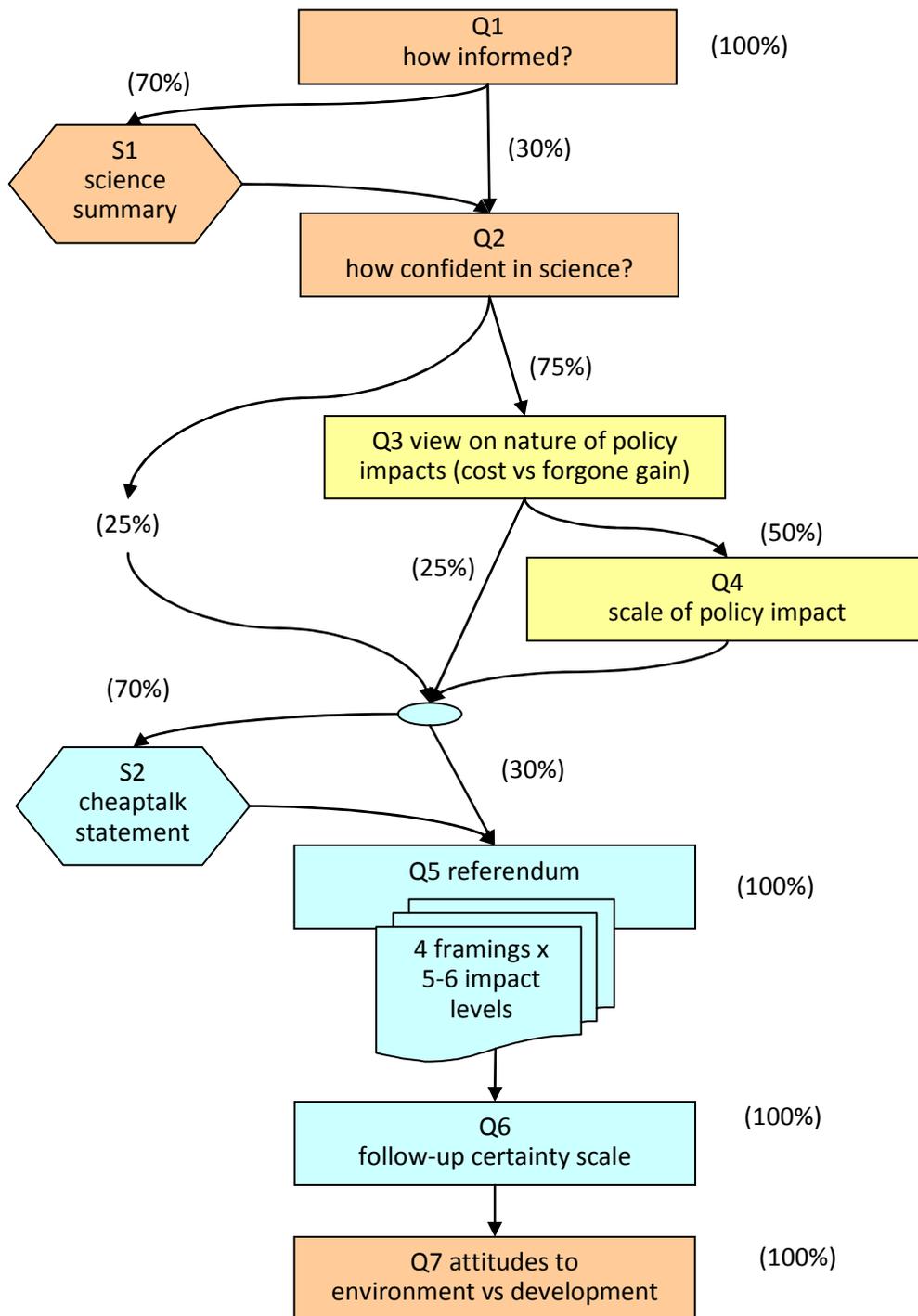
APPENDIX A: ADDITIONAL DETAIL ON RESEARCH AND SURVEY DESIGN

The study used split sample survey and choice modelling techniques to quantify the effect of the framing and size of policy impacts on expressed support for policy action to reduce greenhouse emissions and the risks of climate change. These were implemented in an internet survey in three waves from late September to early December 2006 in Australia (n=1685) and a phone survey in June 2008 in the United States (n=2187). A pilot phone survey was also conducted in Australia and New Zealand in March 2006 (n=1852) (see Hatfield-Dodds and Jollands 2006).

A.1 Survey structure

The two main surveys involved up to eight questions, beginning with information on climate change, followed by the referendum question, and then a range of standard demographic and attitudinal questions. The structure of the US survey is shown in Figure A, and the full script is provided at Appendix B. The Australian internet survey provided information on the nature and causes of global warming, acknowledging scientific and media debate on global warming processes (Boykoff and Boykoff 2004). This involved 315 words of text, a simple diagram, and chart of projected temperature increases over the next 100 years, with three questions related to the information provided. The US phone survey included a 58 word summary statement on climate science, and questions on how informed and how confident respondents were about climate science. In both surveys, the introduction was followed by a referendum question as a choice between two options, with a follow up question that asked respondents to rate how certain they were in their answer. The US survey included a question exploring respondents existing views of the impact of emissions reductions on average income, which was not asked in the 2006 Australian survey, but was run a separate Australian Roy Morgan poll in 2008.

Figure A. Flow chart of US phone survey questions



Several strategies were employed to discourage insincere support or ‘yea-saying’ by respondents, including a ‘cheaptalk statement’ based on Olar at al (2007). The pilot phone survey consisted of two questions embedded in a commercial omnibus survey, asking first how knowledgeable the respondent considered themselves on climate change, and secondly whether they would support policy action to ‘substantially reduce the risk of climate change’. All the surveys were pre-tested, and the internet survey was piloted in early September 2007 before the questionnaire was finalised. While the main Australian and US surveys were not identical, this does not impact on

the integrity of the findings on reference point bias, which relates to the extent of the framing effect found within each survey.

A.2 Payment vehicle and reference point treatments

The surveys stated that policy action to reduce emissions ‘would have costs’ (US survey), ‘lead to higher energy prices’, and ‘reduce the rate of economic growth’ (Australia). The underlying logic is that emissions reductions will require increased investment in energy efficiency and more costly low emissions energy sources, decreasing the resources available for private consumption. In the information that accompanied the referendum question this impact was expressed as lower average incomes. The contingent valuation literature in economics refers to this as the ‘payment vehicle’, representing one aspect of the trade-off to be considered by respondents when choosing whether to support policy action to reduce emissions. This payment vehicle has been used in other contingent valuation studies (Boyle et al 1994, Boyle 2003), including studies valuing reducing the impacts of global warming (Berrens et al 2004), and recent Australian surveys suggest this is a credible payment vehicle.

A.3 Choice set and response format

The use of the referendum question format is well established in the contingent valuation literature. This format is considered to have strong theoretical properties compared to other formats (Hoehn and Randall 1987, Caron and Groves 2007) and its use was recommended by the NOAA panel on contingent valuation following the Exxon Valdez oil spill (Arrow et al 1993). In this format respondents are presented with two alternatives one of which usually represents the status quo, while the other represents the alternative scenario to be valued or evaluated. Respondents are asked which alternative they would vote for in a referendum, and may be given a not sure option (recommended to reduce yea-saying behaviour (Blamey et al 1999)). The size of policy impacts were varied randomly across respondents to provide data on how support varies with the scale of the policy impacts presented.

A.4 Methods used to reduce hypothetical bias

Contingent valuation practitioners are concerned to guard against the potential for hypothetical bias, particularly yea-saying where respondents vote in favour of a referendum, when if actually faced with this choice they would vote no (Blamey et al 1999). Although this issue is of less concern in assessing differences in support or valuation between treatments within the survey, rather than absolute levels of support, the survey incorporated a number of elements intended to reduce yea-saying and improve the realism and reliability of the results.

The first strategy employed was to express the impacts tangibly in dollars (and percentages in the internet survey), and to focus on impacts in 2020 on the basis that these are more likely to be salient to respondents than impacts in 2050. These measures also help ensure the payment vehicle is credible and fits comfortably with respondents’ pre-existing expectations and outlooks.

The second strategy was to include follow-up certainty scales immediately after the referendum question. This asks respondents to indicate how certain they are in their

response to the referendum question, with different scales used for respondents who chose 'support', 'don't know' and 'oppose'. The certainty scale response may then be used to re-code less-certain positive responses as negative for analytical purposes. Studies testing alternative numerical (Champ and Bishop 2001, Ethier et al 2000) and labelled rating scales (Johannesson and Johansson 1998) have demonstrated that the use of follow-up certainty scales is effective at eliminating the difference between actual and hypothetical mean willingness to pay. It is difficult, however, to know how much calibration will be required for a given context. In this study a five point labelled rating scale has been used, where 1 indicates not at all certain, 2 indicates slightly certain, 3 indicates reasonably certain, 4 indicates largely certain and 5 indicates completely certain. A labelled scale was used as the use of labels reduces interpersonal differences in the use of ratings scales. The data analysis re-coded support to exclude those indicating that they were not at all certain or slightly certain.

The third strategy was to include a 'cheap talk' script as an entreaty or commentary just prior to asking the referendum question. This approach has been found effective at reducing yea-saying (Cummings and Taylor 1999), and alternative versions of this approach have been tested in a number of studies (List 2001, Brown et al 2003, Aadland and Caplan 2003, Lusk 2003, Murphy et al 2005). Overall, the evidence indicates that cheap talk differs in its effectiveness, but it is most effective for public goods where respondents are relatively inexperienced with the good being valued, and for moderate to high bid levels, as is the case in this study. The study used a short version of a cheap talk script developed by Olar et al 2007, which uses simpler language than other scripts (List et al 2006). The script is as follows:

Before answering the next question, we would like to let you know about a problem we have with asking people how they would vote in a referendum. How people say that they will vote in a survey such as this one is often not a reliable indication of how people would vote if the referendum were actually held. In surveys, some people ignore the monetary and other sacrifices that they would really have to make if their vote won a majority and became law. We call this hypothetical bias. In surveys that ask people if they would pay more for certain services, research has found that people may say that they would pay 50% more than they actually would pay in real referenda.

It is very important that you "vote" as if this were a real vote. You need to imagine that you were voting about what would happen to your actual future income.

**APPENDIX B: SCRIPT FOR US CLIMATE SURVEY CONDUCTED BY ROY MORGAN
POLLING, JUNE 2008**

[begin with standard US Roy Morgan Research introduction, then ...]

I'd first like to ask you a couple of questions about climate change and government policy.

Q1. On a scale of 1 to 5, #where 1 means not at all informed and 5 means completely informed/# where 5 means completely informed and 1 means not at all informed#, how well informed do you consider yourself to be about the issue of global warming? Are you...?

- 1 –not at all informed
- 2 - a little informed
- 3 - moderately informed
- 4 - reasonably well informed
- 5 –fully informed
- 6 – CAN'T SAY

S1 *Science statement*

Scientists generally agree that human activity, particularly burning fossil fuels, is contributing to a gradual change in the earth's climate. This is likely to result in increasing average temperatures, changes in rainfall, and more intense floods, storms, droughts and heat waves. Governments could take action to reduce the risks of climate change, but these actions would have costs.

Q2 Thinking about what you might have seen or read, how confident are you in scientific predictions about the effects of global warming? Are you...?

- 1 – not at all confident
- 2 – a little confident
- 3 – moderately confident
- 4 – reasonably well confident
- 5 – fully confident
- 6 – can't say

Reverse order of codes 1-5 in 50% of sample.

Q3 What do you think would be the economic impact of America making significant reductions in greenhouse gas emissions, as part of global action involving all major emitters?

- 1 – Reducing greenhouse gas emissions would *reduce* American living standards, so that incomes fall from today's level
- 2 – Reducing greenhouse gas emissions would *slow the increase* in American living standards, so incomes rise more slowly from today's level
- 3 – Reducing greenhouse gas emissions would *have no noticeable effect* on American living standards and incomes
- 4 – Can't Say

[reverse order of codes 1-3 in 50% of sample]

[codes 3 and 4 in Q3 skip to S2]

Q4a *[for respondents choosing code 1 in Q3]*

How large do you think this reduction in living standards would be by 2020?

- 1 – more than 10% [= price point #6]
- 2 – 6-10% [= #4, #5]
- 3 – 2-5% [= #2, #3]
- 4 – less than 2% [= #1]
- 5 – Can't Say

[reverse order of codes 1-4 in 50% of sample]

Q4b *[for respondents choosing code 2 in Q3]*

How large do you think this slowing of the increase in living standards would be?

- 1 – more than 50% of the increase that would occur otherwise
- 2 – between 21% and 50% of the increase that would occur otherwise
- 3 – between 5% and 20% of the increase that would occur otherwise
- 4 – less than 5% of the increase that would occur otherwise
- 5 – Can't Say

[reverse order of codes 1-4 in 50% of sample]

S2 *Cheaptalk Statement*

Before answering the next question, we would like to let you know about a problem we have with asking people how they would vote in a referendum. How people say that they will vote in a survey such as this one is often different to how people would vote if the referendum were actually held. In surveys such as this one, people may say that they would pay 50% more than they actually would pay in real life, because they don't take into account the monetary and other sacrifices they would have to make.

It is very important that you "vote" as if this were a real vote. You need to imagine that you were voting about what would happen to your actual future income, as if this was a real referendum.

Q5 *Referendum Question*

[four treatments with five or six price points for each treatment]

Would you support America participating in global action to substantially reduce greenhouse emissions and the risk of climate change ...

(OC) ... if the cost of this action was that, on average, personal incomes would be about [\$1500] lower by the year 2020 than they would be without policy action?

(FG6) ... if this action meant that, on average, personal incomes would grow more slowly – rising by [\$4500] rather \$6000 by the year 2020?
This is about [\$1500] lower than without policy action.

(FG9) ... if this action meant that, on average, personal incomes would grow more slowly – rising by [\$7500] rather \$9000 by the year 2020?
This is about [\$1500] lower than without policy action.

(RL) ... if the cost of this action was that by the year 2020 personal incomes would be about [\$1500] lower than they are today.

1 – Yes, would support

2 – No, would not support

3 – Can't Say

Q6a *[for respondents choosing code 1 or 2 'yes' or 'no' in Q5]*

How certain are you that you would actually choose this option in a referendum on responding to global warming?

1 – Not at all certain

2 – Only a little certain

3 – Reasonably certain

4 – Largely certain

5 – Completely certain

Q6b *[for respondents choosing code 3 'don't know' in Q5]*

If you had to choose, which option do you think it is most likely that you would choose?

1 – I would almost certainly support emissions reductions

2 – It is likely that I would support emissions reductions

3 – I would be equally likely to vote for either option

4 – It is likely that I would *not* support emissions reductions

5 – I would almost certainly *not* support emissions reductions

7 *[Attitude towards environment and development]*

Over the years, when you have heard about proposed projects where there is a conflict between development and the environment have you tended to:

- 1 – favour preservation of the environment more frequently
- 2 – favour development more frequently
- 3 – favour preservation of the environment and development equally

Reverse order of codes 1-2 in 50% of sample

Figure B. Framing and impact levels for Q5
(expressed as difference in income by 2020)

Treatment	Price point					
	#1	#2	#3	#4	#5	#6
OC	500	1000	1500	2500	3500	5500
FG*6	5500 v	5000 v	4500 v	3500 v	2500 v	500 v
	6000	6000	6000	6000	6000	6000
FG*9	8500 v	-	7500 v	6500 v	5500 v	3500 v
	9000		9000	9000	9000	9000
AL	-500	-1000	-1500	-2500	-3500	-

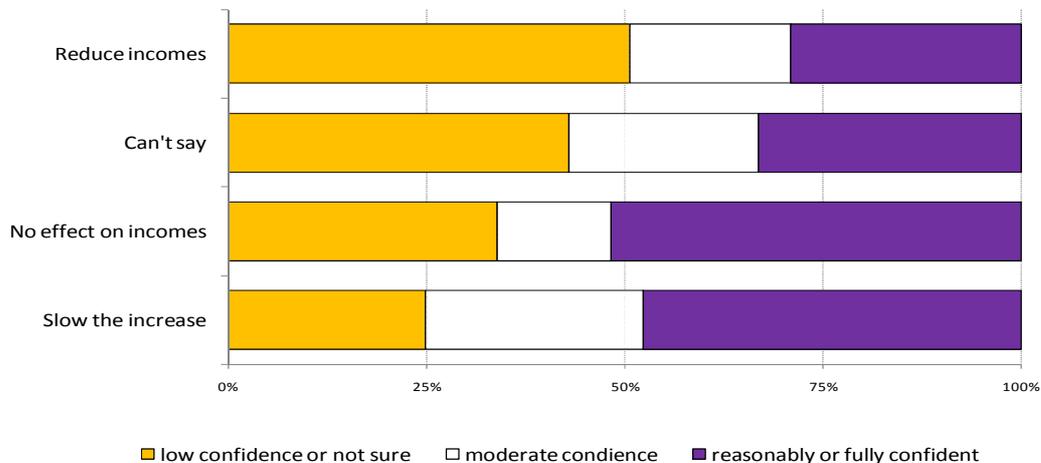
APPENDIX C. ANALYSIS OF PRIOR VIEWS OF POLICY IMPACTS

These major findings from the regression analysis are supported and complemented by cross-tab analysis of the US survey data,⁽⁹⁾ presented in Figure C and Table C.

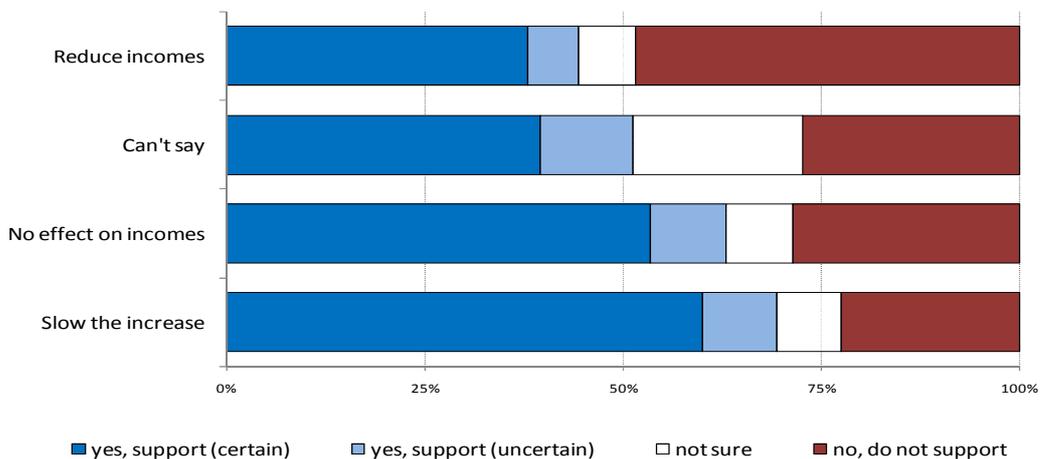
This analysis finds that prior views of the impact of emissions reductions policy are strongly and systematically related to other key variables. Respondents who considered that significant reductions in emissions would ‘reduce incomes and living standards’ from current levels have lower confidence in climate science, lower support for emissions reductions, higher general support for development, and lower general support for environmental protection.

Figure C. Prior view of policy impacts and other variables, US respondents

(i) *confidence in climate science*



(ii) *support for policy action*



Source: Data in Table 4

Comparing the ‘reduce incomes’ with ‘slow the increase’ groups indicates stark differences in views: low confidence in the science is twice as common in the ‘reduce incomes’ group (51% to 25%), support for emissions reductions is a third lower (38% to

⁹ This question was not asked as part of the 2006 Australian survey, and so it is not possible to provide the same analysis for Australian respondents.

60%), support for development is higher (16% to 10%), and net support for the environment is around half (19% to 39%, see Table C).

Table C. Attitudes and support by prior view of policy impacts, US respondents

Column	1	2	3	4	5	6	7
Views on nature of policy impacts on living standards and incomes (Q3)	Slow the increase	No effect	Can't say	Reduce	Not asked	Whole sample	Column #1 minus #4 (a)
number of respondents	618	513	205	334	517	2187	na
share of respondents asked	37%	31%	12%	20%	na	100%	na
Confidence in climate science (Q2)							
Average confidence (5 point scale)	3.35	3.23	2.83	2.59	3.08	3.10	0.77
Share low confidence or not sure (b)	25%	34%	43%	51%	37%	35%	-26%
Share moderate confidence	28%	14%	24%	20%	24%	22%	7%
Share reasonably or fully confident	48%	52%	33%	29%	39%	42%	19%
Support (Q5) – all treatments and impact levels							
Average impact presented (c)	\$2,229	\$2,378	\$2,344	\$2,132	\$2,037	\$2,214	na
<i>All respondents</i>							
support (certain) (d)	60%	53%	40%	38%	*	51%	22%
support (uncertain) (e)	9%	10%	12%	6%	*	8%	3%
not sure	8%	8%	21%	7%	*	10%	1%
no, do not support	22%	29%	27%	49%	*	30%	-26%
<i>Support (certain) by confidence in the science</i>							
low confidence respondents (c)	30%	17%	22%	6%	*	21%	24%
reasonably or fully confident	78%	78%	56%	67%	*	76%	11%
Attitude on environment versus development (Q7)							
favour environment	49%	50%	44%	35%	45%	46%	14%
neutral	38%	37%	37%	44%	41%	39%	-6%
favour development	10%	9%	9%	16%	7%	10%	-2%
not sure	3%	4%	9%	5%	6%	5%	-6%
net 'favour environment' (f)	39%	41%	35%	19%	38%	36%	20%

Notes: (a) difference in values across respondents who consider emissions reductions will 'slow the increase' in living standards versus 'reduce' living standards (column 1 minus column 4), rows may not sum due to rounding; (b) sum of Q2 'little or no confidence', 'low confidence' and 'not sure'; (c) differences in value of impact presented to each group reflect random assignment of impact levels, treatments presented were also random but are distributed proportionally across columns 1-4; (d) Q5 yes and Q6a reasonably, largely or completely certain; (e) Q5 yes and Q6a 'not at all' or 'only a little' certain; (f) share 'favour the preservation of the environment more frequently' minus 'favour development more frequently'; * not reported due to differences in average impact and relative shares of different treatments presented.

The size and systematic nature of these differences in confidence and attitudes suggests that prior views on the impact of policy action are not reflecting a random cognitive process, where some people (randomly) correctly interpret policy impacts while others (randomly) incorrectly interpret these impacts. Instead, it seems likely that the data reflects the tendency for individuals to accept information if it fits with

their existing values orientation and world view (Kahan 2010), particularly if they are strongly engaged or informed politically (Michaud et al 2009) – so that beliefs about facts such as the causes of climate change and the impacts of emission reductions are systematically shaped by cultural values and ideology (Nature 2010, Kahan et al 2007 pp.5-6, Heath and Gifford 2006).

This suggests that some prior views on the impacts of policy on incomes and living standards are correlated with unobserved world views or cultural values. The data presented in Table 4 suggests that the ‘reduce’ values cluster is resistant – but not totally opposed – to policy action on climate change, while the ‘slow the increase’ cluster is favourably disposed to emissions reductions. These dispositions appear to have a stronger effect on support for policy action when confidence in the science is low (see Hatfield-Dodds and Jollands 2006), consistent with people falling back on their cultural narrative ideology and status quo bias when issues are perceived as complicated (Morrison and Hatfield-Dodds in press). The ‘no effect on incomes’ and ‘can’t say’ responses do not seem strongly correlated with particular value clusters, with close to average support expressed by the ‘no effect’ group.

This suggests that it would be fruitful for future studies to explore the relationship between world views and support for policy action (noting that support is likely to be sensitive to specific policy strategies (see Kahan et al 2007, Bannon et al 2007) as well as to policy goals and impacts).

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