



# Public support for Antarctic science: lessons from a national survey of Australians

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**Abstract:** With the Antarctic region featuring more and more in discourse around anthropogenic climate change, understanding public support for research in the region is increasingly important. We examine public support for Antarctic science in Australia, drawing on findings from a nationally representative survey of just over 1000 adults conducted in 2021–2022. Key results reinforce earlier findings in other national contexts - for example, that older people and men are more likely to support Antarctic scientific research than younger people and women. They also reveal new information, including a correlation between particular sources of media coverage and support for Antarctic research. Our data have implications for where and how the public engagement efforts of government agencies and non-governmental organizations could most usefully be applied. While the survey is focused on Australia, it points to complexities around public support for Antarctic research that could be productively investigated in other national and in international contexts.

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## Introduction

Over the last few decades, the Antarctic region has become increasingly connected with both climate change research and climate change impacts. Ice cores taken from the continent provide long-term data on climate variability, and several nations have recently launched ice-drilling projects aimed at producing data ranging back over a million years (Australian Antarctic Division *n.d.* [2022], Beyond EPICA 2023). At the same time, media reports on ice loss and instability in and around the continent appear almost daily. This heightened media presence has been underscored by intergovernmental initiatives, such as the Antarctic Treaty Consultative Parties' recent adoption of resolutions to promote awareness of climate change impacts and research in the Antarctic region to government agencies and the general public (Secretariat of the Antarctic Treaty 2021, 2022).

However, the effectiveness of such exhortations is difficult to measure. Despite increasing scholarly interest in public knowledge, opinions and attitudes in relation to Antarctica and calls for better understanding of 'how the public are engaging with the global commons' (Alexander *et al.* 2022), robust empirical data are limited and piecemeal. Moreover, public support for scientific research in Antarctica has unique complexities. In a

region popularly understood as the planet's last wilderness, any human activity has the potential for negative environmental impact, so that support for science is not necessarily aligned with support for environmental protection. Moreover, as comparatively few people directly experience the continent but rather encounter it largely through the images and stories of others, mediation via various media is proportionately more influential than in places people can more readily visit.

Here, we examine public support for government-funded Antarctic research and research infrastructure in the national context of Australia, a country that is highly invested in the region both politically and scientifically. Our primary research aim was to determine the extent to which various sectors of the Australian public support Antarctic research and related infrastructure, as manifested in recent high-profile government research investment. We addressed this aim by including four questions in a nationally representative survey: the 2021 Australian Survey of Social Attitudes (AuSSA). Each question asked respondents about their level of support for a particular national Antarctic research initiative undertaken by the Australian Antarctic Division (AAD; institutionally located within the federal Department of Climate Change, Energy, Environment and Water). The

questions focused on initiatives that were topical and prominent in the media before and during the period of the survey: a proposal for a concrete runway at a continental station, a new icebreaker, krill research and ice-core research. While these activities in no way reflect the full spectrum of Antarctic research and related infrastructure supported by Australia, together they elicited both an overall indication of public support and a useful picture of the ways in which support varies between particular segments of the public for specific projects.

We begin by outlining previous research on public perceptions and attitudes in relation to the Antarctic region, as well as the recent social and political context of Australia in relation to both public attitudes to science and to Antarctic activities more specifically. We then provide the results of our survey questions for different demographics, as well as an aggregate result indicating support for Antarctic research. Key findings reinforce those of some earlier studies - for example, that older people and men are more likely to support Antarctic scientific research than younger people and women. However, they also reveal new information, such as the correlation between particular sources of media coverage and support for Antarctic research. Our detailed focus on specific kinds of research and research infrastructure reveals a complex picture in which support for certain projects varies with party-political allegiance and other factors in ways that might initially seem counterintuitive. We suggest some cultural and historical influences that might explain these results.

#### *Existing analyses of public attitudes related to the Antarctic region*

The growing centrality of the Antarctic to public debate has been accompanied by increased scholarly interest in the values, perceptions, opinions and attitudes that various groups of people hold with respect to the region. The last 15 years have seen over a dozen scholarly articles exploring this issue, as well as two government-commissioned reports. This body of work indicates a series of trends in public engagement with Antarctica, broadly conceived. However, many of the studies use small, highly specific convenience samples, with educated people, students, young people and city-dwellers receiving more attention than other groups. Thus, while useful evidence is gradually accumulating, this research remains piecemeal.

Previous surveys are usefully collected into three overlapping groups: those focused on cohorts within specific nations, those focused on specific populations and those focused on specific aspects of the Antarctic region. The national cohorts surveyed include Chile (Salazar 2013, Estrada-Goic *et al.* 2023), Argentina (del

Acebo Ibáñez & Costa 2010), the USA (Hamilton 2008, Hamilton *et al.* 2012, Tin *et al.* 2018), the Netherlands (Tin *et al.* 2011, Bastmeijer & Tin 2015), New Zealand (Colmar Brunton 2011, 2015), Malaysia (Shabudin *et al.* 2016, Goh *et al.* 2019) and Australia (Leane *et al.* 2021). All of these nations are Antarctic Treaty signatories, with four of them (Chile, Argentina, New Zealand and Australia) being territorial claimants and one (the USA) being a 'reserved claimant'.<sup>1</sup> Several comparative studies between two or more national groups were conducted, with results in each case suggesting comparatively few differences across national cohorts (Bastmeijer & Tin 2015, Peden *et al.* 2016, Tin *et al.* 2019). Two further studies synthesize the results of several surveys (including those already mentioned) across different locations (Neufeld *et al.* 2013, McLean & Rock 2016). In many cases, cohorts are convenience samples of particular targeted groups, such as university students or residents of certain cities. Five of the surveys with a national cohort were randomized (Hamilton 2008, Hamilton *et al.* 2012, Tranter 2020, 2021, Tranter *et al.* 2022), while two (Colmar Brunton 2011, 2015) were drawn from a panel study weighted by age, gender and region. An overlapping subset included a focus on the corresponding nation's policies and/or activities in Antarctica (Colmar Brunton 2011, 2015, Salazar 2013, Shabudin *et al.* 2016, Goh *et al.* 2019), which aligns them with the focus of the present study.

Many previous surveys target specific populations based on demographics or role identity, or they are heavily weighted towards one of these categories due to the recruitment methods used. These categories include Antarctic researchers or support workers (Stewart *et al.* 2006, McLean & Rock 2016), secondary or tertiary students (Peden *et al.* 2016, Shabudin *et al.* 2016, Tin *et al.* 2018, 2019), young people (del Acebo Ibáñez & Costa 2010, Tin *et al.* 2011, Bastmeijer & Tin 2015; Estrada-Goic *et al.* 2023), people living in cities (del Acebo Ibáñez & Costa 2010, Salazar 2013, Goh *et al.* 2019, Leane *et al.* 2021, Estrada-Goic *et al.* 2023) and cruise tourists (Tin *et al.* 2016). Lastly, the studies varied in the object of their enquiries. While most were interested in questions of values, awareness, perceptions and attitudes in relation to Antarctica, several were more specific, focusing on Antarctica in relation to wilderness (Tin *et al.* 2011, 2016, 2018, Peden *et al.* 2016), 'gateway' connections (Salazar 2013, Leane *et al.* 2021) and tourism (Stewart *et al.* 2006). Three surveys (Hamilton 2008, Hamilton *et al.* 2012, Tranter 2020) included questions about both polar regions; the remainder focused specifically on the Antarctic region.

<sup>1</sup>Along with Russia, the USA is a reserved claimant in the sense that it 'does not hold any formal territorial claims to the continent at present but has reserved the right to do so in the future' (Hingley 2022, p. 9).

Given the heterogeneous nature of these surveys, drawing general conclusions from the group is not straightforward. Some broad themes relevant to our study certainly emerge - for example, the valuing of Antarctica as a form of natural scientific laboratory, particularly in relation to climate, and as a wilderness region, and approval for scientific activities but not for infrastructure. Particularly pertinent in the context of our study are the larger national surveys. Two such surveys, entitled 'Public Opinion of Antarctica', were commissioned by Antarctica New Zealand in 2011 and 2015. These surveys were based on online interviews of pre-existing panels of > 1000 adults, weighted to ensure national representation (Colmar Brunton 2011, 2015).<sup>2</sup> Results across the two reports indicated that younger New Zealanders (under 24 years of age), women and respondents from Asian ethnic groups were less likely to consider Antarctica as important to them and/or had lower levels of awareness of the continent. New Zealanders considered the most important role for their government in Antarctica to be protecting the environment, although marine research, climate change research and land-based research were also highly valued, in that order. These studies also focused on the media as a source of information, reporting that approximately half of New Zealanders surveyed had noticed 'something about Antarctica in the media' over the previous 6 months, with just under half in 2011 and just over half in 2015 agreeing that this information had improved their knowledge of Antarctica (Colmar Brunton 2015, pp. 15, 17).

Closer methodologically to our survey were two surveys undertaken in the USA in 2006 and 2010. With support from the US Office of Polar Programs, a series of interview questions related to both polar regions were included in these years in the General Social Survey and were answered by a representative sample of > 1800 adults. Several questions tested knowledge about each region, both general and climate change-related, and one question asked whether Antarctica 'should be reserved primarily for scientific purposes', as opposed to being open for commercial and mineral activities. Examining both surveys, Hamilton *et al.* (2012) report that conservative ideology predicts lack of support for reserving the Antarctic for science, and knowledge of the polar regions has a positive effect on support for this idea. Hamilton (2018) found that only 52% of Americans knew that the South Pole is characterized by thick ice over land (rather than, for instance, thin ice over a deep ocean), and only 34% realized that melting of Greenland and Antarctic land ice would have greater impact on sea levels than melting of Arctic sea ice.

While again not focused on Antarctica specifically, Tranter's 2018 nationally representative survey of Australians, which replicates Hamilton's approach, is also relevant. Tranter found that Australians scored similarly to Americans on their knowledge of the North and South Poles, with < 50% of Australians and just over 50% of US respondents indicating the most correct physical description of the South Pole in a multiple-choice question (Hamilton 2018, Tranter 2020). However, Australians were more likely than Americans to correctly identify the implications for sea-level rise of melting land ice in Greenland and the Antarctic. Australian men scored higher than women on the polar knowledge questions (when other factors were controlled for), older people scored higher than younger people and people born in Australia scored higher than those not born there (Tranter 2020, p. 544).

The survey reported here is methodologically most similar to Tranter's and Hamilton's surveys, but in content it most resembles the surveys conducted for Antarctica New Zealand, in that our questions focused on particular government infrastructure and activities related to Antarctic science. Ours is the first peer-reviewed report of a national-level probability survey focused specifically on the Antarctic, and it is usefully combined with the outcomes of these and the other surveys referenced above to suggest where future public engagement efforts might be best directed.

#### *The Australian national context*

With a relatively small population and a comparatively strong economy, Australia is traditionally understood as a 'middle power' in global terms. In relation to Antarctic science and governance, however, Australia has played something of an outsized role. Australia asserts sovereignty over a larger fraction of the continent (42%) than any of the six other territorial claimants. In 1959, Australia was one of 12 original signatories to the Antarctic Treaty, which effectively reserved the continent as a place of science and peace. The Treaty does not extinguish the territorial claims, but it states that these cannot be diminished or reinforced while it is in force. Many more states have since become signatories to the Treaty: there are now 56 signatories, 29 of which are Consultative Parties with substantive scientific programmes and decision-making status. However, the original signatories, particularly the seven claimants and the two reserved claimants (the USA and Russia), have remained most influential in both political and scientific terms, and Australia, the UK and New Zealand have been identified as 'an obvious leadership group ahead of all the others' (Dudeney & Walton 2012, p. 3). The Australian government, then, has a particularly strong investment in Antarctic science and policy, and public support for these

<sup>2</sup>Available as slide summaries, both reports reference an earlier (2009) survey by Colmar Brunton that we have not been able to locate.

things might be expected to be more important in Australia than in many other national contexts.

During the survey period, the centre-right Liberal-National Coalition was in power federally in Australia, although the centre-left Labor Party won a federal election on 23 May 2022 - that is, just after the survey concluded. Alongside these two major parties, the third most significant political party operating federally is the Australian Greens, who are left of both Labor and the Coalition, with a strong environmental and social justice mandate. Three of the survey questions relate to projects - the runway, the icebreaker and the million-year ice core - that were announced under the Coalition government, and the fourth - krill research - also received investment during this time. As some funding announcements occurred during the survey period, it is worth giving a brief outline of significant events here.

In the 5 years prior to the survey, the Coalition government commenced a number of Antarctic science- and policy-related initiatives. In April 2016, the government announced a 'New Era in Antarctic Engagement', launching the Australian Antarctic Strategy and 20 Year Action Plan (Commonwealth of Australia 2016). Among other things, the Plan recommended restoring the capability to traverse the continent's interior, infrastructure for krill research, 'expanded aviation capabilities' and a new icebreaker (Turnbull *et al.* 2016, p. 3). In the same year, the government committed AUD 45 million to fund a 'million-year ice core' project that would require the kind of inland traverse capability mentioned in the Plan, 'increas[ing] Australia's reach and presence in Antarctica, and support[ing] critical scientific research in the Australian Antarctic Territory' (Frydenberg 2016). The icebreaker, costed at AUD ~500 million, had already been announced by the Prime Minister in late 2015, and a competition to name the as-yet unbuilt vessel was subsequently held (Ikin *et al.* 2015). With its construction slowed by the COVID-19 pandemic, the icebreaker (now called the *Nuyina*, the local Indigenous term for the aurora australis) arrived in Australia in late 2021. By this time, the government had also announced plans for the continent's first paved runway at Davis Station. A statement released in mid-May 2018 noted that the runway would improve the nation's ability 'to conduct world-class scientific research and respond to emergencies' (Bishop & Frydenberg 2018).

However, the anticipated environmental impact of the concrete runway produced criticism and protest. Critical articles appeared in newspapers (e.g. Watts 2020), and one environmental non-governmental organization (NGO) ran a full-page newspaper advertisement in Hobart, the home port of the *Nuyina*, on the day that the ship arrived, stating 'Nice ship ... shame about the airport' (Bob Brown Foundation 2021). The runway debate had geopolitical as well as environmental dimensions, with some media

reports (e.g. Packham 2021) arguing that year-round air access was a necessary strategic advantage over China, at a time when relations between the two countries were tenser than usual.<sup>3</sup> The project was eventually abandoned in late 2021 (while our survey was still running), with the government citing 'higher projected costs, potential environmental impacts, and the complexity of a 20-year construction process in an extreme and sensitive environment', and promising 'future investment' (Ley 2021). The latter arrived in February 2022, in the form of an AUD 800 million package to 'strengthen our strategic and scientific capabilities in the region', including 'inland traverse capability', marine science and a krill aquarium, and ice-sheet research (Morrison *et al.* 2022). This coincided with an update to the Australian Antarctic Strategy and 20 Year Action Plan, with more emphasis on public engagement, awareness and understanding (Commonwealth of Australia 2022, pp. 8, 11, 19). As this summary makes clear, large scientific projects and related infrastructure in Antarctica are often entangled with geopolitical strategies and environmental concerns, and the importance of public support in these projects is increasingly being recognized.

Because our survey focused on scientific research and research infrastructure in Antarctica, Australian attitudes towards science more broadly form an important context for the findings. The Australian Beliefs and Attitudes Towards Science report indicates that two-thirds of Australians feel 'at least "fairly well informed" about science', with males slightly more likely than females to answer this way, and with only 3% of respondents considering themselves 'not at all informed' (Lamberts 2018, pp. 3, 5, 16). In the 3M State of Science Index surveying global attitudes to science, the most recent wave of which ran in the second half of 2021, 89% of Australians indicated that science was important to their everyday lives, which was mid-range for the 17 countries surveyed (3M 2023). Australia is not, then, a global outlier in terms of public attitudes towards science, suggesting that the nation's particular relationship with Antarctica is more likely to be a determining factor in our results.

### Research question

To what extent do Australians support government-funded research projects in Antarctica?

### Data and methods

The AuSSA conducts a nationally representative mail survey of Australian adults each year, which includes a

<sup>3</sup>The million-year ice-core project could also be understood in terms of geopolitical as well as scientific motivation (see Hemmings 2019), but this angle has not been covered prominently in the press.

**Table I.** 'How supportive are you of the Australian government funding ...' (percentages).

	Runway	<i>Nuyina</i>	Krill	Ice core
Very supportive	21	37	58	39
Somewhat supportive	39	41	33	40
Not very supportive	27	16	7	17
Not supportive at all	13	6	3	5
<i>N</i>	978	975	985	985

Note: Percentages may not total to 100% due to rounding. Estimates are based on weighted data.

Source: Australian Survey of Social Attitudes, 2021.

standard series of questions. Our data were generated from additional questions bespoke to our research included in four survey waves between May 2021 and February 2022.<sup>4</sup> A sample of 5000 people were randomly selected by the Australian Electoral Commission from the Australian Electoral Roll, of whom 343 were ineligible for inclusion. The 2021 AuSSA had a response rate of 23%, equating to 1060 respondents (i.e. 1060/(5000 - 343)). These data are weighted to match the 2016 census on age, sex and highest education level using the weighing variable provided by the AuSSA researchers (McNeill *et al.* 2022).

We developed survey questions based upon existing and intended AAD research projects, which we broadly understood to include the creation of large infrastructure to facilitate research (see Table I). Given that we could not expect all respondents to be familiar with AAD research, we provided preambles to each of our survey questions describing each project (see Supplemental Material). The preambles were designed to inform respondents and, where the projects in question were potentially contentious, to list the potential benefits and consequences associated with each project. The four questions (with the following response categories: very supportive; somewhat supportive; not very supportive; not supportive at all) in summary were:

- 1) How supportive are you of the Australian government funding the proposed concrete runway at Australia's Davis Station on the Antarctic continent?
- 2) How supportive are you of the Australian government funding the new Antarctic icebreaker ship, the RSV *Nuyina*?
- 3) How supportive are you of the Australian government funding scientific research that both informs the management of the krill fishing industry and protects the Antarctic environment?
- 4) How supportive are you of the Australian government funding the million-year ice-core drilling research project in Antarctica?

<sup>4</sup>Specifically, surveys were distributed on 24 May 2021, 2 August 2021, 8 November 2021 and 1 February 2022.

### Dependent variables

We constructed an additive scale from responses to questions 2–4 above. We initially used Cronbach's alpha to test scale reliability for all four question items (alpha = 0.77). However, a three-item scale with the 'runway' question omitted produced a more reliable scale (alpha = 0.80). In addition, the proposed concrete runway project was abandoned by the Australian government after some of our data were collected, so we decided to analyse a scale-dependent variable constructed from the remaining three items using ordinary least squares (OLS) regression. We rescored the scale so that it ranges from 0 (low support) to 100 (high support) for ease of interpretation for OLS regression (scale mean = 71.1; SD = 27.8).

### Independent variables

We consider the associations between the research scale and several independent variables measuring aspects of social background (respondent sex, age, education, (non) religion, occupation and location in 'big cities' and states). With the exception of respondent age - measured as a continuous variable in years - all social background variables are dummy variable (1/0) coded (see Supplemental Materials for descriptive statistics).

We examine respondents' self-identified left/right political orientations on a scale in response to the following question: 'In politics people sometimes talk of left and right. Where would you place yourself on a scale from 0 to 10 where 0 means the left and 10 means the right?' Political party identification variables were constructed from the following question: 'Do you usually think of yourself as close to any particular political party and, if yes, which party is that?' (i.e. dummy 1/0 variables for the Australian Labor Party = 1, Liberal Party and National Party Coalition = 1; Greens = 1; no party affiliation and other party/missing, reference category = 0). Country of birth is coded as Australia = 1; other countries = 0. We also construct a dummy variable from the question 'What is your main source of daily news and information?', combining the public broadcaster and broadsheet newspapers (Australian Broadcasting Commission (ABC; television, radio or website) + 'Newspapers (including online) like the *Sydney Morning Herald*, *The Age* or *The Guardian*' = 1; other sources = 0).

While AuSSA does not include a question on trust in government, a measure of general (interpersonal) trust was derived as a proxy from the following question: 'Generally speaking, would you say that most people can be trusted, or that you can't be too careful in dealing with people?' (responses: you can't be too careful = 1 to most people can be trusted = 5). Responses 4 and 5 were

**TABLE II.** 'How supportive are you of the Australian government funding ...' (% 'Very supportive').

	Runway	Nuyina	Krill	Ice core
<i>Gender</i>				
Men	26a	46a	60a	51a
Women	17b	29b	57a	29b
<i>Age (years)</i>				
18–29	12a	21a	57a,b	28a
30–49	17a,b	35b	53b	39b
50–64	22b,c	42b,c	60a,b	41b
65+	29b,c	48c	65a	46b
<i>Education</i>				
Degree	12a	38a	59a	45a
Non-tertiary	23b	36a	57a	37b
<i>ANZSCO occupational category</i>				
Professionals	18a	38a	69a	45a
Managers	24a	42a	60a,b	47a
Other ANZCO occupations	21a	36a	55b	36b
<i>Residential category</i>				
Live in big city	22a	41a	65a	47a
Live elsewhere	21a	36a	57a	38a
<i>Region of Australia</i>				
New South Wales	22a	40a,b	62a,b	43a
Victoria	17a	35a,b	54b,c	34b
Queensland	24a	37a,b	51c	40a,b
South Australia	17a	29b	58a,b,c	43a,b
Western Australia	22a	35a,b	66a	38a,b
Tasmania	23a	52a	69a,b,c	27a,b
Australian Capital Territory	25a	52a	75a,b	50a,b
<i>Political alignment</i>				
Left (0–3)	21a	50a	74a	57a
Centre (4–6)	26b	37b	59b	40b
Right (7–10)	20a	40a,b	52b	41b
<i>Party affiliation</i>				
Labor	24a,b	53a	71a	60a
Coalition	29b	46a,b	55b	42b
Green	11c	39b,c	85c	49a,b
No party	18a,c	28c	52b	30c
<i>News source</i>				
News from ABC/broadsheets	19a	48a	69a	49a
Elsewhere	22a	31b	51b	33b
<i>View on CC</i>				
CC is anthropogenic	17a	38a	64a	43a
CC is 'natural'	36b	43a	52b	37a,b
CC is not happening	40b,c	30a,b	30b,c	20b,c
Don't know	21a,c	27b	30c	21c
<i>Place of birth</i>				
Born in Australia	21a	39a	59a	41a
Born elsewhere	20a	30b	57a	33b
<i>All</i>	21	37	58	39

Notes: Reading down each column, when the letters next to percentages in cells are different (e.g. for 'Runway': men 26a and women 17b), then percentage differences are statistically significant at the 95% level. Estimates are based on weighted data.

ABC = Australian Broadcasting Commission; ANZCO = Australian and New Zealand Standard Classification of Occupations; CC = climate change.

Source: Australian Survey of Social Attitudes, 2021.

coded 1; responses 1–3 were coded 0. A satisfaction with democracy dummy variable was created from the following question: 'On the whole, are you very satisfied,

**Table III.** Respondent characteristics as predictors of support for Antarctic research funding (ordinary least squares regression).

	<i>b</i>	95% CI	Beta
Intercept	29.06	-	-
<i>Gender</i>			
Men	8.1***	4.94–11.35	0.15
Women (referent)	0		
<i>Age</i>			
Aged (years)	0.27***	0.16–0.38	0.16
<i>Education</i>			
Degree	1.4	-2.46 to 5.20	0.02
Non-tertiary	0		
<i>Religion</i>			
No religion	4.1*	0.74–7.46	0.07
Religious denomination	0		
<i>ANZSCO occupational category</i>			
Professionals	3.5	-0.67 to 7.66	0.05
Managers	5.3*	0.95–9.65	0.07
Others ANZCO occupations	0		
<i>Residential category</i>			
Live in big city	3.9^	-0.02 to 7.82	0.05
Live elsewhere	0		
<i>Region of Australia</i>			
New South Wales	5.0*	0.75–9.29	0.08
Victoria (referent)	0		
Queensland	6.4*	1.55–11.32	0.09
South Australia	4.9^	-0.78 to 10.49	0.05
Western Australia	5.4^	-0.48 to 11.20	0.06
Tasmania	8.6^	-0.33 to 17.59	0.05
Australian Capital Territory/Northern Territory	3.8	-6.08 to 13.68	0.02
<i>Political alignment</i>			
Left-right scale (0–10)	-1.03^	-2.09 to 0.03	-0.07
<i>Party affiliation</i>			
Labor	9.7***	5.45–14.01	0.14
Coalition	6.4**	1.71–11.13	0.10
Green	6.8*	0.90–12.76	0.06
No party (referent)	0		
Other/missing	-5.3	-14.35 to 3.78	-0.04
<i>News source</i>			
News ABC/broadsheets	3.8*	0.24–7.28	0.07
Elsewhere	0		
<i>Place of birth</i>			
Born in Australia	4.9**	1.21–8.60	0.08
Born elsewhere	0		
<i>Trust</i>			
Trust others	5.6**	2.29–8.89	0.10
Neutral or can't be too careful	0		
<i>Satisfaction with democracy</i>			
Satisfied with how democracy works	3.6*	0.12–7.04	0.06
Not satisfied with democracy			
<i>View on CC</i>			
CC is anthropogenic	10.4***	6.26–14.53	0.17
CC is 'natural', no CC, don't know	0		
<i>R<sup>2</sup></i>	0.20		
<i>N</i>	980		

Notes: ^*P* < 0.1; \**P* < 0.05; \*\**P* < 0.01; \*\*\**P* < 0.001. Dependent variable 0–100 scale.

ABC = Australian Broadcasting Commission; ANZCO = Australian and New Zealand Standard Classification of Occupations; CC = climate change; CI = confidence interval.

Source: Australian Survey of Social Attitudes, 2021.

fairly satisfied, not very satisfied or not at all satisfied with the way democracy works in Australia?' (very satisfied and satisfied = 1; not very or not at all satisfied = 0).

Finally, given that ice-core research is directly related to the measurement of climate change, we include a variable measuring acceptance of anthropogenic climate change from the following question: 'Which of the following statements do you personally believe?' (Climate change is happening now, and is caused mainly by human activities = 1; Climate change is happening now, but is caused mainly by natural forces + Climate change is not happening now + I don't know whether climate change is happening or not = 0).

We present cross-tabulations in [Table II](#) using *SPSS* (version 29) 'crosstabs', as this procedure 'computes pairwise comparisons of column proportions and indicates which pairs of columns (for a given row) are significantly different ... using subscript letters ... calculated at the 0.05 significance level' (IBM *SPSS* Statistics n.d.) In [Table II](#), comparing down each column, cells with different letters after the numbers indicate statistically significant differences between percentages at the 95% level. For example, men (26a) are more likely than women (17b) to support government funding for the runway, a difference of 9 percentage points. For the regression analyses in [Table III](#), we analyse AuSSA data using *STATA* version 16.0. We report *P* values based upon robust standard errors (Hamilton 2013, p. 190), 95% confidence intervals and standardized regression coefficients (beta) for the OLS regression estimates.

## Results

Of the four questions we included in the AuSSA, public support for a concrete runway at Australia's Davis Station was the least popular ([Table I](#)). The AuSSA data indicate that only 21% of respondents were 'very supportive' of government funding to construct a concrete runway, compared to 37% who strongly supported funding the research ship *Nuyina* and 39% for ice-core research. However, a far larger percentage of Australians (58%) were 'very supportive' of Australian government funding for krill research.

We explore some of the social background differences in responses in [Table II](#) using the crosstabs procedure in *SPSS* (version 29). With the exception of krill research, for which minimal and non-significant gender differences in responses were apparent, men were more likely than women to strongly support government funding of Antarctic research. Some 46% of men were very supportive of the research ship *Nuyina*, compared to 29% of women, while 51% of men strongly supported ice-core research, compared to only 29% of women.

Once again with the exception of krill research, older Australians were more likely support AAD projects than were younger Australians. University graduates were more likely than non-graduates to support government funding of ice-core research but less likely than non-graduates to support the construction of the now-abandoned concrete runway project. We also compared the Australian and New Zealand Standard Classification of Occupations (ANZSCO) occupational categories 'professionals' and 'managers' with other occupations. Both professionals and managers were more supportive of government funding for ice-core research than other occupational groups, with professionals significantly more supportive of krill research than other occupations.

To understand political factors, we considered the extent to which support for Antarctic research funding is associated with left-right political orientations and political party identification. We found the left to be considerably more likely than the right or centrists to support three of the four research projects: the research icebreaker, krill research and ice-core research. Left-right political orientations are strongly correlated with political party identifications, and both variables exhibit relatively strong associations with our dependent variables. Coalition identifiers are most likely to support government funding of a concrete runway (although the Coalition response is not significantly higher than the Labor response at the 95% level), while Greens are least supportive. For krill research, the opposite is true: Coalition identifiers are less supportive than Labor or Greens partisans. Non-identifiers and Green identifiers are less supportive of funding the RSV *Nuyina* than Labor identifiers are, with the latter being most likely to support this investment, while Greens are not significantly more supportive of ice-core drilling than Coalition supporters.

One's source of information and news about Antarctica is potentially important here. We group together respondents who source their news/information primarily from the publicly funded ABC either by television, radio or online and from broadsheet newspapers such as the *Sydney Morning Herald*, *The Age* or *The Guardian* (including online). We contrast the ABC/broadsheet respondents with those who mainly consume news from other sources. With the exception of the concrete runway at Davis Station, we found that ABC/broadsheet news consumers are more likely to support government funding for all of the Antarctic research projects we examined.

Finally, attitudes regarding the veracity of human-caused climate change may also be relevant, as some of the listed research projects have implications for climate science. Those who accept the consensus position held by the vast majority of climate scientists

(i.e. that climate change is occurring and is mainly caused by humans) are more likely to support krill and ice-core research. Conversely, respondents who accept anthropogenic climate change are least likely to support funding for a concrete runway at Davis Station.

### Regression results

As mentioned above, we use a scale that ranges from 0 to 100 to measure general support for Antarctic research funding, analysed with OLS regression. The regression results presented in Table III indicate that when all independent variables are entered into the regression model simultaneously, some of the differences detected in Table II are no longer statistically significant at the 95% level. Nevertheless, several independent variables show consistent associations with the research scale-dependent variable.

Men are more likely than women to support Antarctic research funded by the Australian government, with men scoring 8 points higher on the 0–100 scale. Older Australians are more supportive of Antarctic research than their younger counterparts. Tertiary education ( $b = 1.4$ ;  $P = 0.48$ ) is not significantly associated with support for Antarctic research funding at the 95% level in the regression model. However, the non-religious score around 4 points higher than those with a religious affiliation on the research scale. Managers score 5.3 points higher than other occupational groups, and although living in a big city is associated with scoring ~4 points higher on the scale, this estimate is at borderline significance at the 95% level ( $b = 3.9$ ;  $P = 0.051$ ).

The bivariate results in Table II indicate that those on the left of the political spectrum tended to be more supportive of funding the *Nuyina* and krill and ice-core research. Yet, after controlling for other independent variables in the regression model, estimates for the left-right scale are not quite significant at the 95% level ( $P = 0.056$ ; without the 'accepting anthropogenic climate change' variable in the model, the left-right scale is highly significant,  $P = 0.005$ ). Those who do not identify with any political party comprise our reference category for party identification. The estimates suggest that Labor identifiers score ~10 points higher than non-identifiers ( $b = 9.7$ ), and Coalition identifiers score 6 points higher ( $b = 6.4$ ), with Greens also scoring higher than the politically non-aligned ( $b = 6.8$ ;  $P = 0.02$ ).

One's source of news also shows a significant positive association in the regression model ( $b = 3.8$ ), with consumers of ABC/broadsheet news more likely than others to support research funding. Being born in Australia tends to increase the odds of supporting Antarctic research by ~5 points ( $b = 4.9$ ), as does interpersonal trust ( $b = 5.6$ ) and satisfaction with

democracy ( $b = 3.6$ ). However, accepting anthropogenic climate change produces the largest regression estimate, with support for Antarctic research projects increasing by 10 points among those who accept human-caused climate change compared to those who do not. The beta statistics show that accepting anthropogenic climate change ( $\beta = 0.17$ ), age ( $\beta = 0.16$ ) and respondent sex ( $\beta = 0.15$ ) generate the largest standardized regression coefficients.

### Discussion

Responses to our nationally representative survey show that support for Antarctic research in Australia is strong, with a mean score of 71 on our 0–100 Antarctic research scale. However, support varies markedly between projects and among particular segments of the public. Unsurprisingly, the controversial concrete runway received the weakest support, although 60% of Australians surveyed were nonetheless somewhat or strongly supportive of the runway. While the announcement that this project would not go ahead occurred partway through our survey, analysis of the different waves (not shown here) indicates that there was no significant change in the bivariate results (supportive vs. unsupportive) between waves, suggesting that the government decision reflected rather than produced this comparatively low support. The new icebreaker *Nuyina* and the ice-core project received far stronger and approximately similar levels of support (just under 80%). The most support, however, was for krill research, at > 90%, with nearly 60% being strongly supportive -19 percentage points higher than the next highest result. While low support for the runway is relatively easily explained in terms of the negative media that the project received due to its anticipated environmental impact, the greater support for krill research over ice-core research or the icebreaker is more intriguing.

One possible reason for this result is that the runway, the icebreaker and the million-year ice-core project all involve significant infrastructure. Previous research has shown that both wilderness and aesthetic values in Antarctica are negatively associated with permanent infrastructure and major transient activity (defined as 'ships, aircraft and heavy vehicles'; Summerson & Bishop 2012, pp. 10, 18). While the runway, icebreaker and ice-core traverse obviously require large infrastructure, 'krill research' may not automatically evoke this idea. Gender may also be a factor here: women did not support the three obviously infrastructure-heavy initiatives as much as men, but krill research received approximately equal support across genders. Furthermore, the infrastructure factor explains an apparent contradiction with Hamilton *et al.*'s findings in the US context, where women are more likely



to support reserving the Antarctic for science. The wording of the question in the US survey, which opposed 'reserv[ing] the region for science with opening it up for 'tourism, fishing, exploration for oil and other commercial purposes', associated preservation with science and infrastructure with its opposite. In contrast, the initiatives we examined, with the apparent exception of krill research, were all infrastructure-intense science projects. Resistance to research infrastructure in Antarctica might also explain why Green identifiers are not only least supportive of funding the runway, but also less supportive than Labor identifiers of funding the *Nuyina* and less supportive of ice-core drilling than both major party supporters, despite ice cores being central to climate change research.

Speculatively, another factor behind the broader support for krill research might be the masculine and 'heroic' imagery that attaches to the other three projects - in addition to large equipment and vehicles, all involve travel into extreme areas, evoking ideas of early twentieth-century exploration, an all-male endeavour. The ice-core project, for example, has been dubbed a 'race' in some media articles, referencing the famous 'race to the pole' of the British exploration team led by Robert F. Scott and its Norwegian counterpart led by Roald Amundsen (e.g. Denholm 2016), and a 'quest' in others (e.g. Chandler 2022), echoing a long tradition of male-centred narrative (Leane 2009). Although the current million-year ice-core field leader is a woman (Australian Antarctic Division 2023), coverage in both left- and right-leaning broadsheets is at times accompanied by visuals that emphasize this 'heroic' masculine ideal (see images in Denholm 2016, Chandler 2022). Researchers have shown that 'the pervasiveness of heroic white masculine leadership and exploration' is a problematic part of Antarctic work in terms of gender equity (Nash *et al.* 2019). Given that images of remote projects, in the absence of usual media representatives, are presumably created, supplied or at least approved by the national Antarctic programme itself, one way of fostering broader appeal could be to ensure that images that run counter to this masculine heroic tradition (in composition and camera angle as much as personnel featured) are featured instead of or alongside these more stereotypical ones.

A paradox emerges, however, in this lack of support for large research infrastructure and support for research itself. While krill research can be undertaken in an aquarium, marine science voyages are also necessary, particularly because sea-ice distribution has an impact on krill populations (Nicol 2006). Thus, krill research requires a vessel such as the *Nuyina*, just as ice-core research requires large drills, tractors and other heavy equipment. Bastmeijer & Tin (2015, p. 559) address this paradox as part of their survey analysis, asking whether

the "Public's Dream" of Antarctica being both "a scientific laboratory" and "one of the world's last wildernesses" is a "Mission Impossible". They call on the Antarctic Treaty Consultative Parties to adopt principles that 'reverse the on-going trend of erosion of the Antarctic wilderness by limiting the human footprint arising from scientific research and associated logistical activities' (Bastmeijer & Tin 2015, p. 589). A similar dynamic seems to be at play in our results, with research itself being supported but the infrastructure enabling it less so, suggesting that public communication needs both to explain the distinctively scientific (as opposed to geopolitical) necessities behind particular infrastructure investments and to indicate what is being done to minimize the environmental footprint of this infrastructure.

Another possible reason for the favouring of krill research is that, while a project such as the million-year ice core is collecting data about past climate change, the krill research is understood to be protecting the environment in a more immediate sense. Krill are a keystone species on which charismatic and visually appealing Antarctic megafauna, such as whales and penguins, rely. The preamble to the relevant survey question mentions both the management of the krill fishery and the protection of the Antarctic environment, whereas the ice-core project preamble explained that this research would show 'how the climate and atmosphere has changed over time' - one step removed from protecting the environment, at least perhaps in the perception of the respondents. This might explain the lack of significant gender differences in support for krill research in the bivariate findings, as women consistently score higher than men on environmental concern in Australia (Fielding *et al.* 2012, Tranter 2014, Tranter & Lester 2017) and elsewhere (Tranter & Booth 2015). If so, this points to the greater challenges of - and greater investment required for - communicating the benefits of projects that are less easy to visualize and understand in terms of practical purpose.

The general support for Antarctic research, based on regression analysis of the combined data of three questions (with the outlying runway question removed), revealed some relationships that are similar to those found in New Zealand (Colmar Brunton 2011, 2015), specifically greater overall support for Antarctic research by men and older people. This similarity is unsurprising given that both nations are territorial claimants and original signatories to the Antarctic Treaty and that they share geographical and cultural similarities. Where the New Zealand survey asked respondents about how media mentions of Antarctica impacted on their views in general, our survey allowed us to distinguish between consumers of the public broadcaster ABC and broadsheet newspapers and other sources, producing a

significant difference between the two, with the former consumers more likely to support Antarctic research. At the same time, this finding reinforces the New Zealand finding that media influence public opinions about activities in Antarctica. Surveying Australian media coverage of Antarctica from October 2019 to December 2020 (the period leading up to our survey), Alexander *et al.* (2022, pp. 5–6) note that science was the second most discussed feature, which also aligns with the importance of media evident from our research.

The largest factor positively influencing support for Antarctic research was acceptance of anthropogenic climate change. This is not surprising given the strong links between Antarctica and climate change impacts and data. It also aligns with Hamilton *et al.*'s (2012, p. 160) results indicating that conservative ideology has a negative effect on support for reserving the Antarctic region for science.

## Conclusion

Public support for Antarctic research takes on a particular shape across population segments because Antarctic science itself has characteristics influenced by the continent's location and history. While much high-profile Antarctic research is directed towards environmental knowledge and protection - of the region itself or the whole planet - the continent's lack of a human population and extreme conditions mean that most scientific activity undertaken there necessarily involves large infrastructure that is incongruous with the continent's popular wilderness image. At the same time, Antarctica's history, which in the public mind (at least in Anglo-European cultures) is strongly associated with early land-based exploration, associates research and discovery strongly with a heroic masculine tradition - which contemporary research activities can still inadvertently or deliberately evoke, potentially creating a differential response between women and men.

Thus, while our study suggests that public support for Antarctic science in this particular national context is generally strong - as might be expected in a nation that claims more of Antarctica than any other and invests heavily in the region both in terms of science and governance - there are lessons to be drawn from our findings. In particular, governments and other entities should undertake communication and engagement activities with particular population segments in mind - specifically women and younger people - and should be particularly aware of the impacts of contemporary media representations of Antarctic activities. The latter have been the subject of very few empirical analyses, so research in this area should be encouraged and supported. Similarly, survey work of the kind

undertaken here could be expanded in scope and repeated at intervals to produce longitudinal understanding of the impacts of particular projects and engagement efforts. We are currently working with the AAD on such an expanded project, which we hope to report on in future publications.

The findings reported here are useful to institutions, NGOs and government agencies involved in fostering public engagement with Antarctic research, as our data suggest where their efforts might most effectively be applied. And while the survey is focused on Australia, it points to complexities of public support for Antarctic research that could be productively investigated in other national and in international contexts. With the Antarctic region likely to feature more and more in discourse around anthropogenic climate change, understanding public support for research in the region is increasingly important.

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## Author contributions

Bruce Tranter designed the survey, conducted the statistical analysis, wrote the majority of the methods and results sections and contributed to other sections. Elizabeth Leane wrote the other sections and contributed to the interpretation of data and writing of the methods and results sections.

## Supplemental material

To view supplementary material for this article, please visit <https://doi.org/10.1017/S0954102023000263>.

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