

# The cognitive roots of prejudice towards same-sex couples: An analysis of an Australian national sample

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## ABSTRACT

There are well-known correlations between low cognitive ability and support of prejudicial or non-egalitarian attitudes. This paper adds to existing knowledge by providing the first analyses of the associations between cognitive ability and attitudes towards LGBT issues in a non-US sample (Australia), comparing these across three measures of cognitive ability, and examining the separate, joint and interactive effects of education and cognitive ability. Findings from a high-quality, national Australian dataset ( $n = 11,564$ ) indicate that individuals with low cognitive ability are less likely to support equal rights for same-sex couples. This pattern holds in the presence of confounds, is consistent across measures of ability, and is more pronounced for verbal ability. Education and cognitive ability affect attitudes through similar channels, but retain independent effects.

## 1. Introduction

Research conducted chiefly in the US, Canada and Western Europe reports correlations between low cognitive ability and support of prejudicial or non-egalitarian attitudes towards certain social groups (including ethnic minorities, migrants, women and people with AIDS), as well as related constructs, such as conservatism, ethnocentrism, authoritarianism, and dogmatism (Brandt & Crawford, 2016; Dhont & Hodson, 2014; Hodson & Dhont, 2015; Onraet et al., 2015; Stankov, 2009; Van Hiel, Onraet, & De Pauw, 2010). However, despite the significance and contemporaneity of the subject matter, few studies have specifically addressed the links between cognitive ability and attitudes towards LGBT issues.

Identifying the individual and social factors that contribute to the emergence and perpetuation of negative attitudes towards LGBT people and/or same-sex couples is important and topical. Even in highly tolerant societies, non-heterosexual individuals remain disadvantaged across life domains –including income and poverty, physical and mental health, labour market outcomes, and homelessness (see e.g. Institute of Medicine, 2011; Perales, 2016; Uhrig, 2015). The dominant paradigm used to explain the comparatively poor life outcomes of LGBT people, the minority stress framework, attributes these deficits to the day-to-day barriers and stressors non-heterosexual people face due to a hostile social environment, which diminishes their capability to function in society (Meyer, 2003). These stressors emerge from cultural and institutionalized heteronormativity, and are enacted by other people within society via discrimination and stigmatization. Individuals'

behaviors follow from their beliefs (Kraus, 1995), and attitudes towards LGBT people predict how the heterosexual majority interacts with the non-heterosexual minority (Mereish & Poteat, 2015; Morrison & Morrison, 2011). Thus, identifying how individual differences such as cognitive ability influence attitudes towards LGBT issues is a necessary step to devising strategies that promote equality of opportunity by sexual identity.

This paper makes three contributions to the existing knowledge base: it provides the first analysis of the associations between cognitive ability and attitudes towards LGBT issues in a non-US sample (and the first focusing specifically on attitudes towards *equal rights for same-sex couples*), (ii) it compares these associations for three widespread and validated measures of cognitive ability (the National Adult Reading Test, the Symbol Digits Modalities Test and the Backwards Digit Span test), and (iii) it delves into the separate, joint and interactive effects of education and cognitive ability. To accomplish this, it relies on data from a high-quality, national Australian dataset, the Household, Income and Labour Dynamics in Australia (HILDA) Survey ( $n = 11,564$ ).

## 2. Background

### 2.1. Cognitive ability and socio-political attitudes

Cognitive ability refers to a compendium of mental abilities that capture individuals' "psychological resources to process and retain knowledge, solve problems and master challenging tasks" (Dhont & Hodson, 2014, p. 454). Since Adorno's observation that ethnocentric people are

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less intelligent than non-ethnocentric people, (see Adorno, Frenkel-Brunswik, Levinson, and Sanford's 1950) a large and growing body of research in psychology, political science, and sociology has established that low cognitive ability is correlated with intergroup prejudice, ethnocentrism, authoritarianism, dogmatism, conservatism, and other non-egalitarian attitudes (Brandt & Crawford, 2016; Dhont & Hodson, 2014; Hodson & Dhont, 2015; Onraet et al., 2015; Stankov, 2009; Van Hiel et al., 2010).

While the specific mechanisms linking ability to attitudes are not frequently tested empirically, several theoretical explanations have been put forward. Low cognitive ability has been linked to cognitive rigidity, a set of strategies used to deal with unpredictability and ambiguity, and to preferences for simplicity, order and tradition (Dhont & Hodson, 2014; Stankov, 2009). Individuals with low cognitive ability may thus express more prejudicial attitudes because they are less open to new ideas and experiences (Sibley & Duckitt, 2008) and more motivated to maintain strict group boundaries (Brandt & Crawford, 2016; Dhont & Hodson, 2014), which would make them less likely to engage in intergroup contact that can dispel erroneous preconceptions and promote tolerance and acceptance (Dovidio, Love, Schellhaas, & Hewstone, 2017). Similarly, low cognitive ability may enhance the perceived salience of threat from behaviour that is perceived as being non-normative, and induce fear of change, resulting in reactivity against out-groups (Dhont & Hodson, 2014; Jost, Glaser, Kruglanski, & Sullaway, 2003; Stankov, 2009; Wilson, 1973). Other factors argued to connect cognitive ability to non-egalitarian attitudes include right-wing political ideology, perspective-taking abilities, and resorting to stereotypes to make sense of others (Brandt & Crawford, 2016; Devine, Plant, Amadio, Harmon-Jones, & Vance, 2002; Dhont & Hodson, 2014).

Very little research has examined the links between cognitive ability and attitudes towards LGBT issues more specifically. The only study focusing exclusively on this is by Keiller (2010), who examined the associations between abstract reasoning and attitudes towards homosexual men in a convenience sample of 257 US undergraduate college students (see data re-analysis in Hodson & Busseri, 2012). Abstract reasoning was significantly and positively associated with more favourable attitudes towards homosexual men, measured using the Homosexuality Attitudes Scale (Kite & Deaux, 1986). A few other studies have examined LGBT-related attitudes amongst a constellation of other attitudes. Carl's (2014, 2015a) analyses of the US General Social Survey revealed statistically significant, negative associations between vocabulary test scores and beliefs that homosexual relations are wrong, while Brandt and Crawford's (2016) analyses of the American National Election Studies found negative and statistically significant associations between verbal ability and prejudice towards gay and lesbian people.

*Although no previous study has examined attitudes towards equal rights for same-sex couples specifically, it can be expected the mechanisms alluded to before also play a role.* For example, a lack of openness to new experiences with roots in low cognitive ability will likely reduce intergroup contact between heterosexual and non-heterosexual people and, in turn, reduce acceptance of same-sex couples as equals by the former. Similarly, fear of or perceived threat associated with change and a preference for tradition will motivate less cognitively able individuals to oppose equal rights for same-sex couples. In addition, individuals form attitudes about clusters of social issues which they perceive to be interconnected, and there is evidence of high correlations between attitudes towards different dimensions of LGBT issues (Kite & Deaux, 1986). This suggests that the recognised links between cognitive ability and attitudes towards sexual relationships between two men (Carl, 2014; Keiller, 2010) or legal recognition of gay relationships (Carl, 2015b) as well as feeling thermometers towards gay/lesbian people (Brandt & Crawford, 2016), will also manifest in relation to attitudes towards equal rights for same-sex couples.

A first contribution of this study is therefore to ascertain empirically whether or not the associations previously found between cognitive ability and non-egalitarian or conservative socio-political attitudes

(including attitudes towards other aspects of LGBT issues) in countries such as the US, Canada and the UK hold also for prejudice against same-sex couples in the contemporary Australian context.

## 2.2. Effect heterogeneity across cognitive ability measures

Associations between low cognitive ability and conservatism, prejudice or non-egalitarian attitudes have been demonstrated for a range of ability measures, including abstract reasoning (e.g. Keiller, 2010), verbal ability (e.g. Brandt & Crawford, 2016; Stankov, 2009), short- and long-term memory (e.g. Deary, Batty, & Gale, 2008), and general ability (e.g. Oskarsson et al., 2015). These different constructs capture different dimensions of cognitive ability and intelligence, and may be differently associated with holding (non-)egalitarian social views. According to a meta-analysis of 90 international studies conducted between 1984 and 2014 (Onraet et al., 2015), the strongest link between cognitive ability and prejudice was via comprehension-knowledge, whereas the strongest link to right-wing ideological attitudes was via long-term memory and retrieval.

Yet, studies comparing the associations between several ability measures and socio-political attitudes within the same dataset remain scarce and, as posed by Brandt & Crawford (2016, p.890), “*it will [...] be generative to include multiple measures of cognitive ability*” in studies in the field. Thus, a second contribution of this paper is comparing the associations between different markers of cognitive ability and attitudes towards same-sex couples' rights.

## 2.3. Intersections between education, cognitive ability and attitudes

A third contribution of this study is considering the intersections between education and cognitive ability. Longer exposure to education and higher educational attainment should promote the formation and consolidation of egalitarian socio-political attitudes through exposing individuals to humanistic ideals, liberal values and a meritocratic system of achievement (Carvacho et al., 2013; Schoon, Cheng, Gale, Batty, & Deary, 2010; Surridge, 2016). Participation in tertiary education, in particular, has been argued to expose individuals to left-leaning political beliefs, such as egalitarianism, feminism and support for civil liberties, and to promote critical skills that help counteract prejudice, such as cognitive flexibility and perspective taking (see e.g. Ohlander, Batalova, & Treas, 2005). As previously explained, cognitive ability is thought to affect attitudes through channels such as openness, fear of change, perceived outgroup threat and cognitive rigidity (Dhont & Hodson, 2014). Yet it is clear that there are reciprocal relationships between education and cognitive ability: more cognitively able individuals are more likely to move up the educational ladder while, at the same time, participation in education increases cognitive faculties (see e.g. Brinch & Galloway, 2012). In practice, as Dhont & Hodson (2014, p.455) acknowledge, an important shortcoming of studies of the links between cognitive ability and socio-political attitudes is that they fail to account for individuals' educational attainment –see Deary et al. (2008) and Schoon et al. (2010) for exceptions. Other studies use highly homogenous samples in relation to education –including samples of University students and University applicants (see e.g. Stankov (2009) or Keiller (2010)), which precludes examination of the role of educational attainment.

In addition, it remains empirically unclear whether education moderates the association between cognitive ability and socio-political attitudes. It is for instance possible that the cognitive biases emerging from low cognitive ability described before (e.g. perceiving change and the unfamiliar as a threat and focusing on prevention rather than promotion, Dhont & Hodson, 2014) can be suppressed through increased participation in education. If so, then cognitive ability may display a *smaller* association with such attitudes amongst the highly educated compared to the lowly educated. Though this study does not resolve the endogeneity between education and ability (which would require different data), it contributes

to the literature by providing the most encompassing empirical accounts to date of their separate, joint and interactive effects on attitudes towards equal rights for same-sex couples.

### 3. Data and methods

#### 3.1. The Household, Income and Labour Dynamics in Australia Survey

The analyses use data from the HILDA Survey (Watson & Wooden, 2012). This is a household panel study which collects annual information from the same respondents over the 2001–2015 period. It is one of the largest panel surveys in the world and part of the Cross National Equivalent File. The HILDA Survey features a complex, probabilistic sampling design, and its sample is largely representative of the Australian population aged 15 and older. Information is collected through a combination of face-to-face interviews and self-completion questionnaires, and year-on-year retention rates are remarkably high. For more details on the survey methodology, see Summerfield et al. (2016). This study is based on HILDA Survey data from wave 12, 2012 (when measures of cognitive ability were collected) and wave 15, 2015 (the first wave subsequently asking respondents about their attitudes). After listwise deletion of observations with missing data on model variables, the analytical sample comprises 11,654 individuals.

The HILDA Survey offers multiple advantages over other datasets previously used to examine the relationships between cognitive ability and socio-political attitudes. Of note, (i) it is nationally representative (which, unlike for convenience/community samples used in previous studies, allows generalization of the study findings); (ii) it features a very large sample size (which enhances the ability to identify statistically significant relationships and avoid Type II errors in estimation); (iii) it includes three high-quality measures of cognitive ability (which allows comparisons of their associations with individual attitudes); (iv) it extends the available body of evidence to a new country context (Australia); and (v) it includes rich and encompassing socio-demographic information that can be used to adjust the models (e.g. measures such as socio-economic background which were unavailable in many previous studies).

#### 3.2. Cognitive ability

Within its 12<sup>th</sup> wave (2012) the HILDA Survey implemented three hands-on tests of cognitive ability. After careful consideration about test selection and implementation in the context of a large-scale national survey (see Wooden, Mackinnon, Rodgers, & Windsor, 2012), the survey data collectors settled for three separate tests: a 25-item version of the *National Adult Reading Test* (NART), the *Symbol Digits Modalities Test* (SDMT) and the *Backwards Digit Span* (BDS) test. These tests were administered to the full sample as part of the face-to-face interviews, implemented by trained, professional interviewers, and resulted in high-quality survey measures (see Wooden, 2013). To date, they have been used for example in studies of university participation (Schurer, Kassenboehmer, & Leung, 2015), labour market outcomes (Sabia, Wooden, & Nguyen, 2017), health reports (Black, Johnston, Shields, & Suziedelyte, 2017), saving behaviour (Broadway & Haisken-DeNew, 2017), volunteering (Hosking & Anstey, 2016) and financial decision making (Johnston, Kassenboehmer, & Shields, 2016).

The NART-25 is a reading test that approximates pre-morbid intelligence (Nelson, 1982). In the HILDA Survey, its implementation involved the interviewer asking the respondent to pronounce 25 irregularly spelled words printed on show cards, and recording the number of correct answers. On the possible 0–25 range, the NART-25 average in the sample was 13.87 ( $SD = 5.35$ ). The SDMT is a measure of divided attention, visual scanning and motor speed (Smith, 2007; Strauss, Spreen, & Sherman, 2006). Its implementation involves participants matching symbols to numbers using a printed key within a 90-s time interval. In the sample, the average SDMT score (the number of items

matched) was 49.20 ( $SD = 12.51$ ). The BDS test is a measure of working memory span, and is features in many traditional intelligence tests, including the Wechsler Adult Intelligence Scales (Wooden, 2013). Its implementation involves interviewers reading progressively longer numbers (from 2 to 8 digits), and asking participants to repeat them backwards. In the HILDA Survey sample, the means BDS test was 4.96 ( $SD = 1.41$ ).

Given their highly diverging metrics, for the purpose of these analyses the three tests were rescaled to range from 0 (lowest ability) to 1 (highest ability)—which was accomplished through the following linear transformation: (individual score – sample minimum)/sample maximum – sample minimum). The new sample means were 0.55 for the NART-25 ( $SD = 0.21$ ), 0.45 for the SDMT ( $SD = 0.11$ ), and 0.62 for the BDS test ( $SD = 0.18$ ). As argued in Wilkins (2015, p.61), the three tests are complementary and tap different dimensions of intelligence: “*the BDS and SDM tests can be characterised as providing measures of ‘fluid’ general intelligence—the ability to think logically and solve problems in novel situations, independent of acquired knowledge—while the NART provides a measure of ‘crystallised’ general intelligence—the ability to use skills, knowledge, and experience*”. Following Schurer et al. (2015), a composite measure of cognitive ability was derived by averaging the rescaled scores for individuals with non-missing scores across the three tests (i.e. NART + SDMT + BDS/3). This had a mean of 0.54 and a standard deviation of 0.12.

While Cronbach Alpha was small ( $\alpha = 0.54$ ), it is well known that this test is downward-biased when it is based on few items (Yuan & Bentler, 2002), which applies to the present study (3 items). In this scenario, a better way to assess whether items should be combined into a single index is to examine the inter-item correlations (Briggs & Cheek, 1986). These ranged from 0.20 to 0.36 (Table 2), with the mean inter-item correlation being 0.30, which is optimal to justify combining the items. While it is possible that the low Alpha score may lead to attenuation of the results presented, principal-component factor analysis confirmed that the composite measure is unidimensional, with only a single factor having an Eigenvalue greater than 1 (1.59) and all items loading positively on that factor. Key results are also presented for the three tests separately, and alternative results using the first factor extracted from the aforementioned factor analysis are also presented.

#### 3.3. Attitudes towards equal rights for same-sex couples

The HILDA Survey captures attitudes towards equal rights for same-sex couples through a question asking respondents to rate their agreement with the statement “*Homosexual couples should have the same rights as heterosexual couples do*”. This item was placed within the HILDA Survey self-completion questionnaire instead of the face-to-face interview to reduce the likelihood of respondents answering in a socially desirable way. Possible responses are on a 7-point Likert scale from ‘strongly disagree’ [1] to ‘strongly agree’ [7]. The variable’s mean was 5.17 ( $SD = 2.16$ ). Hence, the HILDA Survey data reveals relatively high levels of support for equal rights for same-sex couples.

#### 3.4. Control variables

The richness of the HILDA Survey data allows controlling for a range of socio-demographic and economic factors which may be correlated with both attitudes towards same-sex couples and cognitive ability, and which could otherwise confound the associations of interest. The control variables resemble those used in previous, cognate studies (see e.g. Armenia & Troia, 2017; Brandt & Crawford, 2016; Hodson & Busseri, 2012; Perales & Campbell, 2018), but include potential confounds which are typically unavailable, such as education and socio-economic background (Dhont & Hodson, 2014). All variables are measured in wave 15 (2015), contemporaneously to the outcome variable, except for religiosity (wave 14) and sexual identity (wave 12). Variable categories and descriptive statistics are presented in Table 1.

**Table 1**  
Descriptive statistics on model variables.

	Mean	%	SD
Attitudes towards equal rights for same-sex couples			
Ordered measure (1–7)	5.17		2.16
Cognitive ability			
Composite measure	0.54		0.12
National Adult Reading Test, rescaled	0.55		0.21
Symbol Digits Modalities test, rescaled	0.45		0.11
Backwards Digit Span test, rescaled	0.62		0.18
Controls			
Gender			
Male		46.23%	
Female		53.77%	
Sexual orientation (in 2012)			
Straight/heterosexual		89.29%	
Gay/lesbian		1.31%	
Bisexual		1.22%	
Other response/no information		8.18%	
Age (in years)	47.91		18.10
Highest educational qualification			
Degree or higher		28.02%	
Certificate or diploma		33.69%	
Year 12		15.72%	
Below Year 12, or indeterminate		22.57%	
Religiosity (in 2014)			
Not religious		64.09%	
Religious		33.50%	
No information		2.41%	
Ethno-migrant group			
Australian, not Indigenous		76.73%	
Indigenous Australian		2.15%	
Migrant, English-speaking background		10.18%	
Migrant, non-English-speaking background		10.94%	
Socio-economic background			
No parent had a degree		30.32%	
One parent had a degree		32.56%	
Both parents had degrees		25.84%	
Incomplete information		11.28%	
Area remoteness			
Major city		64.31%	
Inner regional area		24.67%	
Outer regional, remote or very remote area		11.02%	
State/territory of residence			
New South Wales		29.41%	
Victoria		24.97%	
Queensland		21.25%	
South Australia		9.13%	
Western Australia		9.35%	
Tasmania		2.99%	
Northern Territory		0.75%	
Australian Capital Territory		2.15%	

Notes: HILDA Survey data ( $n = 11,564$ ). The religiosity measure is derived from the question: “On a scale from 0 to 10, how important is religion in your life?” with ‘non-religious’ defined as scores 0–4 and ‘religious’ as scores 5–10. The sexual orientation (religiosity) residual category identifies respondents who did not answer the relevant question or did not participate in study wave 12 (14).

### 3.5. Estimation

The relationships between cognitive ability and supportive attitudes towards equal rights for same-sex couples were estimated using a series of ordinary least squares (OLS) regression models of the following general form:

$$ATT = \beta_0 + \beta_1 COG + \beta_2 CON + e \quad (1)$$

where  $ATT$  is a variable representing attitudes towards equal rights for same-sex couples;  $COG$  is a given measure (or measures) of cognitive ability;  $CON$  is a vector of control variables;  $\beta_0$  is the model's grand intercept;  $\beta_1$  and  $\beta_2$  are model coefficients (or vectors of coefficients); and  $e$  is a random error term.

## 4. Results

### 4.1. Bivariate correlations

**Table 2** shows the bivariate correlations between the different cognitive ability measures and the 7-point measure of attitudes towards equal rights for same-sex couples. All correlations are highly statistically significant ( $p < 0.001$ ). The three individual measures of cognitive ability are highly and positively correlated with each other (Pearson's  $r = 0.20$  for NART-25 & SDMT; 0.36 for NART-25 & BDS; 0.32 SDMT & BDS) and with the composite measure (Pearson's  $r = 0.80$  for NART-25; 0.57 for SDMT; 0.78 for BDS). All four measures of cognitive ability exhibit moderate, positive correlations with attitudes towards equal rights for same-sex couples: Pearson's  $r$  equals 0.20 for the composite measure, 0.14 for the NART-25, 0.23 for the SDMT, and 0.09 for the BDS.

### 4.2. Regression models: main associations

#### 4.2.1. Regression models

This section reports on the results of regression models of attitudes towards equal rights for same-sex couples. In the main text, we present results of models that use the outcome variable in its original 7-point Likert-scale metric. For the interested reader, analogous results from regression models in which the dependent variable is standardized (i.e., [attitude scale score – mean]/standard deviation) are presented in **Tables A1 to A5** in the Appendix. These coefficients are referred to in the text as ' $\beta_{std}$ '.

Columns 1–4 in **Table 3** (& **Table A1**) present the results of unadjusted OLS models of the associations between the cognitive ability measures and attitudes towards equal rights for same-sex couples. Given the scaling of the ability variables, the magnitude of the estimates refers to a difference between the minimum and maximum sample test scores.

There is strong evidence that all four measures of ability are associated with the outcome variable. The coefficients on the cognitive ability variables are large and highly statistically significant:  $\beta = 3.39/\beta_{std} = 1.51$  ( $p < 0.001$ ) for the composite measure,  $\beta = 1.46/\beta_{std} = 0.65$  ( $p < 0.001$ ) for the NART-25,  $\beta = 4.45/\beta_{std} = 1.99$

**Table 2**  
Pairwise correlations between key variables.

	Attitudes (1–7)	Ability: composite	Ability: NART-25	Ability: SDMT	Ability: BDS
Attitudes (1–7)	–				
Cognitive ability: Composite	0.20 (<0.001)	–			
Cognitive ability: NART-25	0.14 (<0.001)	0.80 (<0.001)	–		
Cognitive ability: SDMT	0.23 (<0.001)	0.57 (<0.001)	0.20 (<0.001)	–	
Cognitive ability: BDS	0.09 (<0.001)	0.78 (<0.001)	0.36 (<0.001)	0.32 (<0.001)	–

Notes: HILDA Survey data ( $n = 11,564$ ).  $p$  values in parentheses. NART-25: 25-item National Adult Reading Test; SDMT: Symbol Digits Modalities Test; BDS: Backwards Digit Span test.

**Table 3**

Coefficients from regression models of attitudes towards equal rights for same-sex couples.

	Unadjusted				Adjusted			
	Composite	NART-25	SDMT	BDS	Composite	NART-25	SDMT	BDS
	1	2	3	4	5	6	7	8
Cognitive ability	3.39*** (<0.001) [3.08,3.70]	1.46*** (<0.001) [1.28,1.64]	4.45*** (<0.001) [4.11,4.79]	1.11*** (<0.001) [0.89,1.33]	1.73*** (<0.001) [1.41,2.05]	1.34*** (<0.001) [1.15,1.54]	0.99*** (<0.001) [0.59,1.38]	0.37*** (<0.001) [0.17,0.58]
Gender (ref. Male)								
Female					0.64*** (<0.001) [0.57,0.71]	0.65*** (<0.001) [0.58,0.72]	0.63*** (<0.001) [0.56,0.71]	0.66*** (<0.001) [0.59,0.73]
Sexual identity (ref. Straight)								
Gay/lesbian					1.29*** (<0.001) [0.98,1.60]	1.26*** (<0.001) [0.95,1.57]	1.33*** (<0.001) [1.02,1.64]	1.32*** (<0.001) [1.01,1.63]
Bisexual					0.76*** (<0.001) [0.44,1.08]	0.72*** (<0.001) [0.40,1.04]	0.79*** (<0.001) [0.47,1.11]	0.77*** (<0.001) [0.45,1.09]
Age (in years)					-0.02*** (<0.001) [-0.02,-0.02]	-0.03*** (<0.001) [-0.03,-0.02]	-0.02*** (<0.001) [-0.02,-0.02]	-0.02*** (<0.001) [-0.02,-0.02]
Education (ref. Degree or higher)								
Certificate/diploma					-0.27*** (<0.001) [-0.37,-0.18]	-0.23*** (<0.001) [-0.32,-0.13]	-0.38*** (<0.001) [-0.48,-0.29]	-0.40*** (<0.001) [-0.49,-0.30]
Year 12					-0.12* (0.045) [-0.23,-0.00]	-0.09 (0.128) [-0.20,0.03]	-0.19** (0.001) [-0.30,-0.07]	-0.21*** (<0.001) [-0.32,-0.09]
Below Year 12					-0.35*** (<0.001) [-0.23,-0.00]	-0.27*** (<0.001) [-0.39,-0.16]	-0.50*** (<0.001) [-0.61,-0.39]	-0.53*** (<0.001) [-0.64,-0.42]
Religiosity (ref. not religious)								
Religious					-1.24*** (<0.001) [-0.46,-0.23]	-1.24*** (<0.001) [-0.39,-0.16]	-1.26*** (<0.001) [-0.61,-0.39]	-1.26*** (<0.001) [-0.64,-0.42]
Ethno-migrant group (ref. Aust., not Ind.)								
Indigenous Australian					-1.32*** (0.455) [-1.32,-1.17]	-1.31*** (0.414) [-1.31,-1.16]	-1.34*** (0.712) [-1.34,-1.18]	-1.34*** (0.795) [-1.34,-1.19]
Migrant, English-speaking background					0.09 [-0.15,0.34]	0.10 [-0.14,0.35]	0.05 [-0.20,0.29]	0.03 [-0.21,0.28]
Migrant, non-English-speaking background					0.21*** (<0.001) [0.09,0.32]	0.19** (0.002) [0.07,0.31]	0.21*** (<0.001) [0.09,0.33]	0.22*** (<0.001) [0.10,0.34]
Parental education (ref. No parent had degree)								
One parent had degree					0.07 (0.133) [-0.02,0.16]	0.05 (0.276) [-0.04,0.14]	0.10* (0.035) [0.01,0.19]	0.10* (0.036) [0.01,0.19]
Both parents had degrees					0.19*** (<0.001) [0.09,0.29]	0.16** (0.003) [0.05,0.26]	0.24*** (<0.001) [0.14,0.34]	0.24*** (<0.001) [0.14,0.34]
Area remoteness (ref. Major city)								
Inner regional					-0.17*** (<0.001) [-0.25,-0.08]	-0.16*** (<0.001) [-0.25,-0.07]	-0.18*** (<0.001) [-0.27,-0.09]	-0.18*** (<0.001) [-0.27,-0.09]
Outer regional/remote/very remote					-0.38*** (<0.001) [-0.50,-0.26]	-0.36*** (<0.001) [-0.48,-0.24]	-0.41*** (<0.001) [-0.53,-0.28]	-0.41*** (<0.001) [-0.54,-0.29]
R <sup>2</sup>	0.04	0.02	0.05	0.01	0.21	0.21	0.20	0.20

Notes: HILDA Survey data ( $n = 11,564$ ).  $p$  values in parentheses; 95% CIs in brackets. Controls in the adjusted models include also dummy variables for Australian states/territories, ‘Other response/no information’ on sexual identity, ‘No information’ on religiosity, and ‘Incomplete information’ on parental education. NART-25: 25-item National Adult Reading Test; SDMT: Symbol Digits Modalities Test; BDS: Backwards Digit Span test. Statistical significance: \* $0.05$ , \*\* $0.01$ , \*\*\* $0.001$ .

( $p < 0.001$ ) for the SDMT, and  $\beta = 1.11/\beta_{\text{std}} = 0.49$  ( $p < 0.001$ ) for the BDS.

Columns 5–8 in Table 3 (and Table A1) present the results of analogous models adjusted for gender, sexual identity, age, education, religiosity, ethno-migrant background, area remoteness, and state/territory of residence. In these models, the coefficients on the composite measure of ability ( $\beta = 1.73/\beta_{\text{std}} = 0.77$ ,  $p < 0.001$ ), the SDMT ( $\beta = 0.99/\beta_{\text{std}} = 0.44$ ,  $p < 0.001$ ), and the BDS ( $\beta = 0.37/\beta_{\text{std}} = 0.17$ ,  $p < 0.001$ ) become noticeably smaller, but remain large and

statistically significant. The coefficient on the NART-25 measure remains virtually unchanged ( $\beta = 1.34/\beta_{\text{std}} = 0.60$ ,  $p < 0.001$ ). The estimates on the control variables are consistent with expectations.

A range of sensitivity analyses were performed to assess the robustness of the adjusted associations (Tables 5 & A3). The results remained consistent when:

- using the first factor from a factor analysis as the measure of cognitive ability (Column 1),

**Table 4**

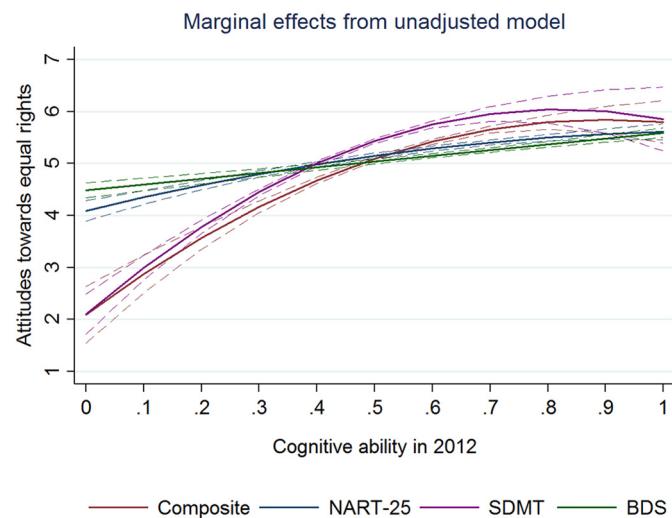
Coefficients from regression models of attitudes towards equal rights for same-sex couples, non-linear effects.

	Unadjusted				Adjusted			
	Composite	NART-25	SDMT	BDS	Composite	NART-25	SDMT	BDS
	1	2	3	4	5	6	7	8
Cognitive ability	8.30*** (<0.001) [6.23,10.38]	2.72*** (<0.001) [1.96,3.48]	9.58*** (<0.001) [7.84,11.33]	2.42*** (0.001) [1.02,3.82]	4.09*** (<0.001) [2.16,6.02]	1.38*** (<0.001) [0.67,2.08]	3.13*** (<0.001) [1.46,4.80]	1.05 (0.102) [−0.21,2.31]
Cognitive ability, squared	−4.59*** (<0.001) [−6.51,−2.67]	−1.20*** (0.001) [−1.90,−0.49]	−5.83*** (<0.001) [−7.77,−3.89]	−1.00 (0.062) [−2.06,0.05]	−2.20* (0.015) [−3.97,−0.42]	−0.03 (0.925) [−0.68,0.62]	−2.40** (0.009) [−4.21,−0.59]	−0.52 (0.284) [−1.47,0.43]
Controls	No	No	No	No	Yes	Yes	Yes	Yes
R <sup>2</sup>	0.04	0.02	0.06	0.01	0.21	0.21	0.20	0.20

Notes: HILDA Survey data ( $n = 11,564$ ).  $p$  values in parentheses; 95% CIs in brackets. Controls as in [Table 3](#). NART-25: 25-item National Adult Reading Test; SDMT: Symbol Digits Modalities Test; BDS: Backwards Digit Span test. Statistical significance: \*0.05, \*\*0.01, \*\*\*0.001.

- using attitudes measured in 2011 (instead of 2015) as the outcome (Column 2),
- excluding respondents from non-English-speaking backgrounds (for many of whom ability test scores may be hindered by a lack of English-language proficiency; Column 3), and
- controlling for quartiles of household, financial-year, disposable, regular income (which is not done in the main models as ability is, theoretically, causally prior to income, Column 4).

In addition, tests of non-linear relationships between cognitive ability and attitudes towards equal rights for same-sex couples were implemented through the inclusion of squared terms for the ability measures ([Tables 4 & A2](#)). The results provide evidence of non-linear associations for the composite measure, the NART-25 and the SDMT in unadjusted models, and the composite measure and the SDMT in adjusted models. Marginal effects for the preferred, unadjusted specifications (linear model for the BDS, quadratic models for all other measures) are visually represented in [Fig. 1](#). This evidences that the effects of the composite measure and the SDMT taper off when their scores approximate 0.7.



**Fig. 1.** Unadjusted associations between cognitive ability measures and attitudes towards equal rights for same-sex couples.

Notes: HILDA Survey data ( $n = 11,564$ ). Marginal effects; based on Model 4 in [Table 3](#), and Models 1 to 3 in [Table 4](#). 95% confidence intervals around estimates.

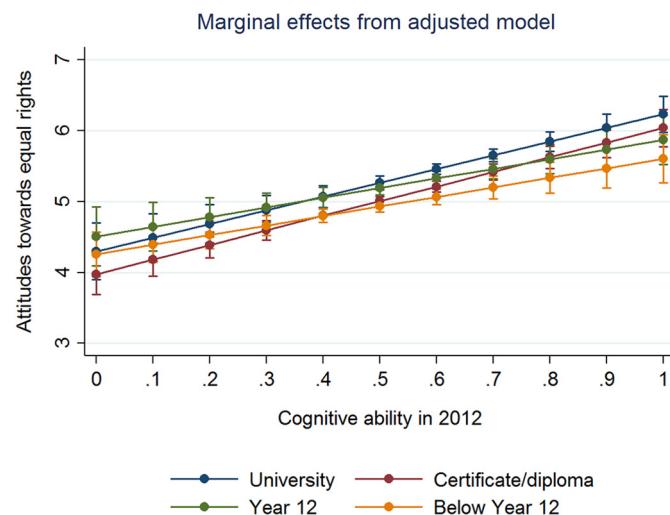
#### 4.3. Combinations of cognitive ability measures

[Table 6](#) (& [Table A4](#)) presents the results of models using different permutations of the three cognitive ability tests. When the NART-25 is combined with either the SDMT (Column 1) or the BDS (Column 3), only the NART-25 remains a statistically significant predictor of the outcome variable, while the magnitude and statistical significance of the coefficients on the other measures fade. When the SDMT and the BDS are included together in the same model (Column 2), both of their coefficients remain statistically significant. Finally, when all three tests are introduced in the model at the same time (Column 4), only the NART-25 remains positively and statistically significantly associated with the outcome. Altogether, these results indicate that individual scores in the NART-25 are most predictive of attitudes towards equal rights for same-sex couples.

#### 4.4. Interactions between education and cognitive ability

A final set of analyses, presented in [Table 7](#) (& [Table A5](#)), examines the separate, joint and interactive associations between education, cognitive ability and attitudes towards equal rights for same-sex couples. When education is not controlled for (Column 1), the  $\beta$  coefficient on the cognitive ability variable is 2.12 ( $\beta_{std} = 0.95$ ;  $p < 0.001$ ). When cognitive ability is not controlled for (Column 2), the  $\beta$  coefficients on the dummy variables capturing highest educational qualification (with ‘degree or higher’ as the reference category) are −0.42 for ‘certificate/diploma’ ( $\beta_{std} = -0.19$ ;  $p < 0.01$ ), −0.22 for ‘school year 12’ ( $\beta_{std} = -0.10$ ;  $p < 0.01$ ), and −0.57 for ‘below school year 12’ ( $\beta_{std} = -0.25$ ;  $p < 0.01$ ). Therefore, consistent with expectations, support for equal rights is greatest amongst those with tertiary-education qualifications. When both cognitive ability and education are introduced in the model (Column 3), the magnitude of the  $\beta$  coefficient on the cognitive ability variable decreases by 18.4%, and the magnitude of the coefficients for the dummy variables capturing highest educational qualification decreases by 35.7% (certificate/diploma), 45.5% (year 12), and 38.6% (below year 12), respectively. This indicates that some of the associations between attitudes towards equal rights for same-sex couples and cognitive ability on the one hand and education on the other run through the same channel. However, all coefficients on the education and cognitive ability variables remain statistically significant in the hypothesised direction, which confirms that these variables have independent effects on attitudes.

The possibility of interactive effects (i.e. moderation) between education and cognitive ability is tested in Column 4. This model sheds light over whether or not the association between cognitive ability and attitudes is weaker/stronger amongst people with different educational credentials (and vice versa). There is however no evidence of this: the  $\beta$  coefficients on all of the variables capturing the interaction effects are



**Fig. 2.** Interactive effects of education and cognitive ability (composite) on attitudes towards equal rights for same-sex couples.

Notes: HILDA Survey data ( $n = 11,564$ ). Marginal effects at the means; based on Model 4 in Table 7. 95% confidence intervals around estimates.

**Table 5**  
Coefficients from regression models of attitudes towards equal rights for same-sex couples, sensitivity analyses.

	Ability factor	Attitudes, in 2011	Attitudes, in	Income controls			
			No NESB in sample				
		1	2	3	4		
Cognitive ability (composite)	1.35*** (<0.001) [1.07,1.62]	1.67*** (<0.001) [1.34,1.99]	1.54*** (<0.001) [1.20,1.89]	1.71*** (<0.001) [1.39,2.04]			
Controls	Yes	Yes	Yes	Yes			
n	11,564	12,443	10,379	11,654			
R <sup>2</sup>	0.20	0.20	0.20	0.21			

Notes: HILDA Survey data.  $p$  values in parentheses; 95% CIs in brackets. Controls as in Table 3. Column 1: Ability measured as the first factor of a factor analysis (principal components) of the three test scores (Eigenvalue = 1.59) rescaled to range from 0 to 1. Column 2: Model using attitudes measured in 2011 (instead of 2015). Column 3: Model excluding respondents from a non-English-speaking background (NESB). Column 4: Model with additional controls for quartiles of household, financial-year, disposable, regular income. Statistical significance: \*\*\*0.001.

**Table 6**  
Coefficients from regression models of attitudes towards equal rights for same-sex couples, combinations of cognitive ability measures.

	1	2	3	4
NART-25	1.31*** (<0.001) [1.11,1.51]		1.38*** (<0.001) [1.17,1.59]	1.35*** (<0.001) [1.14,1.56]
SDMT	0.25 (0.237) [-0.16,0.66]	0.85*** (<0.001) [0.44,1.26]		0.31 (0.153) [-0.11,0.73]
BDS		0.25* (0.025) [0.03,0.46]	-0.11 (0.320) [-0.33,0.11]	-0.14 (0.202) [-0.37,0.08]
Controls	Yes	Yes	Yes	Yes
R <sup>2</sup>	0.21	0.20	0.21	0.21

Notes: HILDA Survey data ( $n = 11,564$ ).  $p$  values in parentheses; 95% CIs in brackets. Controls as in Table 3. NART-25: 25-item National Adult Reading Test; SDMT: Symbol Digits Modalities Test; BDS: Backwards Digit Span test. Statistical significance: \*0.05, \*\*\*0.001.

statistically insignificant ( $p > 0.05$ ), and so are contrasts of the interaction effects included in the model ( $p > 0.05$ , not shown in tables). The pattern of results is represented graphically in Fig. 2.

## 5. Discussion and conclusion

This paper has examined the associations between different measures of cognitive ability and prejudice against same-couples. A first contribution to the literature was expanding current knowledge on the links between cognitive ability and prejudice by considering a new outcome measure (attitudes towards equal rights for same-sex couples) in a new country context (Australia) using high-quality, nationally-representative data (HILDA Survey,  $n = 11,654$ ). The findings are consistent with previous scholarship in the area (see e.g. Brandt & Crawford, 2016; Carl, 2014, 2015a; Keiller, 2010), indicating that individuals with low cognitive ability report less supportive attitudes towards equal rights for same-sex couples. This pattern of association holds in the presence of an encompassing set of potential confounds.

A second contribution involved comparing the magnitude of the associations across three distinct, high-quality measures of cognitive ability: the NART-25, the SDMT and the BDS test. While high scores in all tests were positively associated with increasing support for equal rights, the magnitude of association in the adjusted models was larger for the NART-25. In addition, when the different measures were simultaneously included as model predictors, the NART-25 was the most influential. This suggests that the link between cognitive ability and attitudes towards same-sex couples is stronger for verbal ability than divided attention, visual scanning and motor speed (SDMT) or working memory span (BDS). This is important, as verbal ability has been shown to share the most variance with general intelligence (Brandt & Crawford, 2016; Wolfe, 1980), and is consistent with previous findings documenting a dominant role for verbal compared to non-verbal ability in driving the intelligence-ideology link (Ludeke, Rasmussen, & DeYoung, 2017).

A third contribution was examining the intersections between attitudes to equal rights for same-sex couples, cognitive ability, and education level. While there is theoretical recognition that education and cognitive ability may have independent and overlapping effects on prejudicial attitudes, few research studies have grappled empirically with this issue – none in the context of attitudes towards LGBT issues. The results showed that about 18% of the effect of ability on attitudes towards equal rights for same-sex couples is shared with highest educational qualification, and 36% to 46% of the effect of education on such attitudes is shared with ability. There was however no evidence of moderation: the association between cognitive ability and attitudes towards equal rights for same-sex couples was statistically the same across levels of education.

Despite these contributions, several shortcomings must be acknowledged. These point to avenues for methodological refinement and further inquiry. First, the measurement of cognitive ability (2012) is not contemporaneous to the measurement of attitudes towards equal rights for same-sex couples (2015). This may have resulted in some measurement error in estimation. However, having a lagged predictor is sometimes seen as having convenient statistical properties, e.g. by offering protection against simultaneity. In addition, the results were virtually identical when using a measure of attitudes collected in 2011 in sensitivity analyses (Table 5). Relatedly, the lack of repeated observations on the cognitive ability measures precluded longitudinal examination of possible causal pathways using the HILDA Survey. This course of action may become possible if this panel study collects new information on cognitive ability in one of its subsequent waves. Second, our attitude measure is a single-item measure, and just one of many markers for the concept of homophobic prejudice (i.e. negative attitudes and feelings towards LGBT people). Hence, subject to data availability, future research should undertake similar analyses using a broader measure of homophobia, such as the Index of Homophobia

**Table 7**

Coefficients from regression models of attitudes towards equal rights for same-sex couples, education and cognitive ability.

	1	2	3	4
Main effects				
Cognitive ability (composite)	2.12*** (<0.001) [1.82,2.42]		1.73*** (<0.001) [1.41,2.05]	1.93*** (<0.001) [1.30,2.57]
Education (ref. Degree or higher)				
Certificate or diploma		−0.42*** (<0.001) [−0.51,−0.33]	−0.27*** (<0.001) [−0.37,−0.18]	−0.32 (0.194) [−0.81,0.16]
Year 12		−0.22*** (<0.001) [−0.34,−0.11]	−0.12* (0.045) [−0.23,−0.00]	0.21 (0.471) [−0.36,0.78]
Below Year 12		−0.57*** (<0.001) [−0.68,−0.46]	−0.35*** (<0.001) [−0.46,−0.23]	−0.04 (0.875) [−0.54,0.46]
Interaction effects				
Cognitive ability * certificate/diploma				0.13 (0.761) [−0.70,0.95]
Cognitive ability * year 12				−0.57 (0.246) [−1.54,0.39]
Cognitive ability * below Year 12				−0.59 (0.197) [−1.48,0.30]
Controls	Yes	Yes	Yes	Yes
R <sup>2</sup>	0.20	0.20	0.21	0.21

Notes: HILDA Survey data (n = 11,564). p values in parentheses; 95% CIs in brackets. Controls as in Table 3. NART-25: 25-item National Adult Reading Test; SDMT: Symbol Digits Modalities Test; BDS: Backwards Digit Span test. Statistical significance: \*0.05, \*\*0.01, \*\*\*0.001.

(Bouton et al., 1987) or the Homosexuality Attitudes Scale (Kite & Deaux, 1986). Third, we are unable to test the mechanisms producing the reported associations between cognitive ability and attitudes towards equal rights for same-sex couples. Recent studies have begun to consider and empirically test the pathways linking cognitive ability to intergroup prejudice, which include right-wing ideology, openness, and intergroup contact (see e.g. Hodson & Busseri, 2012). For example, it is likely that political conservatism or right-wing authoritarianism are important mechanisms mediating the observed associations between cognitive ability and unsupportive attitudes towards equal rights for same-sex couples – as it has been argued for other socially conservative attitudes (see e.g. Dhont & Hodson, 2014). Future research should examine whether this and other factors also mediate the associations between cognitive ability and attitudes towards LGBT issues.

Altogether, the findings provide clear evidence that cognitive ability is an important precursor of prejudice against same-sex couples. These findings are highly relevant in the contemporary Australian context, where a national postal plebiscite on the legalisation of same-sex marriage took place in late 2017 and was accompanied by substantial political and public debate on marriage equality. Debates to influence public opinion between the “Yes” and “No” campaigns were heated, often resorting to highly emotional arguments not based on evidence and facts. While the “Yes” case prevailed with 61.6% of the vote, 38.4% of voters (or roughly 4.87 million people) returned a “No” answer. Under these circumstances, understanding the individual differences that influence discrimination against same-sex couples is important in devising political and public policy strategies to bridge public opinion, foster social cohesion, and ultimately improve the life outcomes of a

vulnerable social group, such as the LGBT collective. The findings in this report suggest that strategies aimed at increasing participation in (higher) education and improving levels of cognitive ability within the population could act as important levers in counteracting prejudice towards same-sex couples and LGBT people. A better understanding of the mediators of the relationships between cognitive ability and prejudicial attitudes is required to inform the development of more targeted programs and policies that can combat intergroup prejudice and inequality (Hodson & Dhont, 2015).

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## Appendix A. Appendix

Table A1

Coefficients from regression models of attitudes towards equal rights for same-sex couples (standardized).

	Unadjusted				Adjusted			
	Composite	NART-25	SDMT	BDS	Composite	NART-25	SDMT	BDS
	1	2	3	4	5	6	7	8
Cognitive ability	1.51***	0.65***	1.99***	0.49***	0.77***	0.60***	0.44***	0.17***
R <sup>2</sup>	0.04	0.02	0.05	0.01	0.21	0.21	0.20	0.20

Notes: HILDA Survey data (n = 11,564). Controls in the adjusted models as in Table 3. NART-25: 25-item National Adult Reading Test; SDMT: Symbol Digits Modalities Test; BDS: Backwards Digit Span test. Statistical significance: \*\*\*0.001.

Table A2

Coefficients from regression models of attitudes towards equal rights for same-sex couples (standardized), non-linear effects.

	Unadjusted				Adjusted			
	Composite	NART-25	SDMT	BDS	Composite	NART-25	SDMT	BDS
	1	2	3	4	5	6	7	8
Cognitive ability	3.71***	1.21***	4.28***	1.08***	1.83***	0.62***	1.40***	0.47
Cognitive ability, squared	-2.05***	-0.53***	-2.60***	-0.45	-0.98*	-0.01	-1.07**	-0.23
Controls	No	No	No	No	Yes	Yes	Yes	Yes
R <sup>2</sup>	0.04	0.02	0.06	0.01	0.21	0.21	0.20	0.20

Notes: HILDA Survey data (n = 11,564). Controls as in Table 3. NART-25: 25-item National Adult Reading Test; SDMT: Symbol Digits Modalities Test; BDS: Backwards Digit Span test. Statistical significance: \*0.05, \*\*0.01, \*\*\*0.001.

Table A3

Coefficients from regression models of attitudes towards equal rights for same-sex couples (standardized), sensitivity analyses.

	Ability factor	Attitudes, in 2011		No NESB in sample	Income controls
		1	2		
Cognitive ability (composite)	0.60***	0.75***	0.69***	0.77***	
Controls	Yes	Yes	Yes	Yes	Yes
n	11,654	12,443	10,379	11,654	
R <sup>2</sup>	0.20	0.20	0.20	0.21	

Notes: HILDA Survey data. Controls as in Table 3. Column 1: Ability measured as the first factor of a factor analysis (principal components) of the three test scores (Eigenvalue = 1.59) rescaled to range from 0 to 1. Column 2: Model using attitudes measured in 2011 (instead of 2015). Column 3: Model excluding respondents from a non-English-speaking background (NESB). Column 4: Model with additional controls for quartiles of household, financial-year, disposable, regular income. Statistical significance: \*\*\*0.001.

Table A4

Coefficients from regression models of attitudes towards equal rights for same-sex couples (standardized), combinations of cognitive ability measures.

	1	2	3	4
NART-25	0.59***		0.62***	0.60***
SDMT	0.11**	0.38***		0.14
BDS		0.11*	-0.05	-0.06

(continued on next page)

Table A4 (continued)

	1	2	3	4
Controls	Yes	Yes	Yes	Yes
R <sup>2</sup>	0.21	0.20	0.21	0.21

Notes: HILDA Survey data (n = 11,564). Controls as in [Table 3](#). NART-25: 25-item National Adult Reading Test; SDMT: Symbol Digits Modalities Test; BDS: Backwards Digit Span test. Statistical significance: \*0.05, \*\*0.01, \*\*\*0.001.

Table A5

Coefficients from regression models of attitudes towards equal rights for same-sex couples (standardized), education and cognitive ability.

	1	2	3	4
Main effects				
Cognitive ability (composite)	0.95***		0.77***	0.86***
Education (ref. Degree or higher)				
Certificate or diploma		-0.19***	-0.12***	-0.14
Year 12		-0.10***	-0.05*	0.09
Below year 12		-0.25***	-0.16***	-0.02
Interaction effects				
Cognitive ability * certificate/diploma				0.06
Cognitive ability * year 12				-0.25
Cognitive ability * below year 12				-0.26
Controls	Yes	Yes	Yes	Yes
R <sup>2</sup>	0.20	0.20	0.21	0.21

Notes: HILDA Survey data (n = 11,564). Controls as in [Table 3](#). NART-25: 25-item National Adult Reading Test; SDMT: Symbol Digits Modalities Test; BDS: Backwards Digit Span test. Statistical significance: \*0.05, \*\*\*0.001.

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