

Supplemental Materials for “Accepters, fence sitters, or rejecters: Moral profiles of vaccination attitudes” By Rossen et al. (2018)

Isabel Rossen

University of Western Australia, Australia

Mark J. Hurlstone

University of Western Australia, Australia

Patrick D. Dunlop

University of Western Australia, Australia

Carmen Lawrence

University of Western Australia, Australia

Rossen, Hurlstone, Dunlop and Lawrence (2018) administered a novel inventory designed to measure confidence in childhood vaccination to a self-selected online sample of parents in conjunction with an established measure of moral preferences. Using Latent Profile Analysis—a statistical technique used to identify profiles within a population—they showed that parents could be classified into three different profiles—defined as “vaccine accepters”, “fence sitters”, and “vaccine rejecters”—based on their responses to the vaccine confidence measure. Furthermore, each group of parents was found to be associated with a unique moral profile that may help to understand the psychological roots of their vaccination attitudes. This document reports supplementary literature, methodological details, and statistical analyses to accompany the main paper. It is not meant as a stand-alone paper—please refer to Rossen et al. (2018) for further explanation.

Keywords: Vaccination · Vaccine hesitancy · Moral foundations theory · Moral profile · Liberty

1. Supplementary Literature

In Rossen, Hurlstone, Dunlop, and Lawrence (2018), we explore whether differences in parental attitudes toward vaccination can be understood by recourse to differences in their underlying moral preferences. There were two key motivating factors that led us to explore this possible link. First, recent research in the field of moral psychology suggests that moral decisions are driven by intuitive and rapid judgements rather than rational, reasoned decisions (Haidt and Joseph, 2004; Skitka, 2010). We believe that this may help to explain one of the key features of anti-vaccination attitudes—resistance to change. For example, Nyhan and colleagues tested the efficacy of different messages to shift vaccine attitudes and behaviour. In one study, they debunked the myth that the measles, mumps, and rubella (MMR) vaccine causes autism (Nyhan et al., 2014), whilst in a second study they debunked the myth that the flu vaccine can give you the flu (Nyhan and Reifler, 2015). In both studies, myth-debunking reduced belief in the false claims, but also paradoxically decreased vaccination intent amongst those individuals most opposed to vaccination. The authors concluded that

correcting vaccine myths may be an ineffective approach to promoting vaccination. We suggest that this “backfire effect” on vaccine intent may have occurred because anti-vaccination attitudes stem from deeply held moral preferences. Therefore, merely presenting evidence is unlikely to change attitudes because—consistent with motivated reasoning (Lord et al., 1979)—people readily accept information that is consistent with their moral intuitions, yet question information that runs counter to those intuitions (Haidt, 2001; Haidt and Joseph, 2004).

Second, we believe that Moral Foundations Theory (MFT; Haidt, 2012), in particular, can help to paint a nuanced picture of the specific drivers of anti-vaccination attitudes. Moral Foundations Theory departs from previous conceptions of morality by arguing for the existence of multiple moral domains. Traditional approaches to understanding morality viewed either harm or fairness violations as the only legitimate areas of moral concern (Gilligan, 1977; Kohlberg, 1981). However, using an evolutionary and cross-cultural approach, MFT proposes that there are six core foundations upon which people differentially base their morality. These foundations in-

clude: harm (concerned with violations to the safety and wellbeing of others), fairness (concerned with the pursuit of justice), as well as in-group (a moral preference for loyalty and cooperation), authority (a preference for traditional societal structures and deference to authority), purity (an abhorrence for a hedonistic lifestyle or giving in to impulse), and liberty (a preference for the rights of the individual). The foundations are thought to be differentially embodied by individuals as a function of their personality, and social, political and cultural environments, such that people intuitively come to consider some issues to be morally relevant, and not others (Haidt, 2001; Haidt and Joseph, 2008).

Importantly, research across a range of different socio-political settings indicates that there is meaningful variation in endorsement of the moral domains based on political ideology. Specifically, political liberals tend to ground their morality primarily within the harm and fairness moral foundations. By contrast, political conservatives tend to ground their morality within all five foundations more or less equally (Haidt and Graham, 2007). Furthermore, people's stances on a number of polarising political issues—such as climate change, same sex marriage, and immigration—are informed by their “moral profile”, as defined by their position along the six moral foundations (Koleva et al., 2012). While there is no clear evidence tying vaccination attitudes to the classic liberal-conservative political spectrum, vaccination is clearly a charged socio-political issue. Therefore, we expected that the unique moral profile of those who hold anti-vaccination beliefs may provide greater insight into the complex drivers of these beliefs. Just examining links with political ideology, or demographic variables, as much past work has done, tells us little about what is operating underneath such disputes over vaccination, or why the issue has become so divisive.

An awareness of the moral foundations underlying anti-vaccination and vaccine hesitant attitudes may also be essential to shifting these views. Indeed, there is a line of experimental evidence demonstrating that people's political beliefs can be modified through appropriate moral suasion. That is, several studies have now demonstrated that when people are presented with persuasive appeals congruent with the moral foundations they endorse, it can shift their position on a range of political issues (Day et al., 2014; Feinberg and Willer, 2013, 2015; Kidwell et al., 2013). For example, Feinberg and Willer (2015) demonstrated that those identifying as politically conservative were more likely to support same-sex marriage and universal health care (typically liberal positions) when per-

suasive appeals were framed in terms of the moral foundations typically endorsed by conservatives (in-group, authority, and purity), as opposed to harm and fairness. Furthermore, liberals endorsed typically conservative positions (high military spending, and making English the official language of America) to a greater extent when persuasive appeals were framed in terms of the foundations harm and fairness. Therefore, knowledge of the moral profiles associated with anti-vaccination and vaccine-hesitant attitudes is a necessary inroad to crafting such congruent moral appeals in the vaccination domain.

2. Questionnaires

2.1 Vaccine Confidence Inventory

We developed a novel inventory—the Vaccine Confidence Inventory (VCI)—to gauge parental confidence in vaccines ($\alpha = .98$ for this sample). In constructing the inventory, we consulted work which examines the content that most commonly appears on anti-vaccination webforums (Davies et al., 2002; Kata, 2010, 2012; Wolf et al., 2002). This process resulted in the identification of five major thematic areas that persistently appeared across studies: (1) concerns that vaccines are unsafe, (2) the belief that vaccines are ineffective, (3) conspiracy theories about the nefarious role of government and pharmaceutical companies in the provision of vaccines, (4) the belief that vaccines are unnatural and alternative remedies or a healthy lifestyle is better than being vaccinated, and (5) beliefs pertaining to the liberty of parents to decide whether their child is vaccinated. We constructed three to four items for each of the five themes such that they formed a combination of positively and negatively keyed declarative statements. Participants are asked to rate their agreement with each item on a five point Likert scale, ranging from strongly disagree (1) to strongly agree (5). The items that follow are the original and final items of the VCI; no items were pruned as part of the analysis (note: R = reverse scored item). The items for the VCI—and all other measures reported below—were presented in forward serial order within the survey.

1. Vaccines have not been adequately tested for safety.
2. People should be able to decide whether or not to vaccinate their children.
3. Vaccines overwhelm a child's undeveloped immune system.

4. Getting vaccinated helps protect those who are unable to be vaccinated against disease. (R)
5. Vaccines can cause or worsen allergies.
6. Improved living standards, not vaccination, have reduced infectious diseases.
7. It is important that people are able to make their own decisions about vaccination.
8. Pharmaceutical companies purposefully conceal information about the safety of vaccines.
9. Infectious diseases are virtually eliminated so vaccination is not needed.
10. It should be compulsory for all children to be vaccinated. (R)
11. Vaccines cause the diseases they are supposed to prevent.
12. The government conceals information about the safety of vaccines.
13. Homeopathic medicines are an effective alternative to conventional vaccines.
14. Vaccines introduce unnatural toxins into the body.
15. The more people who get vaccinated the greater the protection against disease. (R)
16. Building immunity by naturally fighting off a disease is better protection than getting a vaccine.
17. It is okay for people to be exempt from vaccination for moral or personal reasons.
18. Pharmaceutical companies create ineffective vaccines in order to make high profit.

2.2 Vaccine Safety Concerns Scale

The Vaccine Safety Concerns Scale (VSCS) contains fourteen items assessing a person's degree of belief in various vaccine myths ($\alpha = .98$ for this sample). The items correspond to common myths reported by Australian parents (cf. Myths and Realities: Responding to arguments against vaccination a guide for providers. Australian Government: Department of Health and Ageing). Half of the items correspond to 'general' myths about vaccination, whereas the other half relate to myths about 'specific' vaccines. Participants are asked to rate their agreement with each item on a five point Likert scale, ranging from strongly disagree (1) to strongly agree (5). The items that follow are the

original and final items of the VSCS; no items were pruned as part of the analysis. Note that for brevity the results associated with this scale are not reported in Rossen et al. (2018) since it contains a lot of content overlap with the VCI.

1. Mercury in vaccines can cause autism.
2. Vaccines can cause diabetes.
3. Vaccines can cause cancer.
4. Vaccines can cause mad cow disease.
5. Vaccines can cause sudden infant death syndrome.
6. Vaccines can cause infertility.
7. Vaccination of young children can cause seizures.
8. MMR vaccine can cause autism.
9. Pertussis vaccine (used to treat whooping cough) causes brain damage.
10. Polio vaccines cause HIV/AIDS.
11. Hepatitis B vaccine causes multiple sclerosis.
12. Flu vaccine causes the flu.
13. The flu vaccine causes febrile convulsions in young children.
14. HPV vaccines can cause infertility or problems with pregnancy.

2.3 Vaccine Behavioural Intentions Scale

The Vaccine Behavioural Intentions Scale (VBIS) contains a list of twelve different vaccine-preventable diseases relevant to childhood immunisation ($\alpha = .99$ for this sample). Participants are asked to indicate the likelihood that they would vaccinate a future child against each disease on a six point Likert scale, ranging from very unlikely (1) to very likely (6). Participants also have the option to select don't know if they are unsure. The items that follow are the original and final items of the VBIS; no items were pruned as part of the analysis.

1. Hepatitis A
2. Hepatitis B
3. Human papillomavirus (HPV)
4. Measles

5. Meningococcal disease
6. Pertussis ('whooping cough')
7. Mumps
8. Poliomyelitis ('polio')
9. Rotavirus
10. Rubella
11. Tetanus
12. Varicella ('chickenpox')

2.4 Political Ideology

Political ideology along the left-wing vs. right-wing continuum was examined with the single item "Please indicate the extent to which you identify yourself as politically left-wing (progressive) or right-wing (conservative)." Participants responded on a seven point Likert scale, ranging from very left-wing (1) to very right-wing (7). We also examined the extent to which participants self-identified as politically libertarian with the single item "Please indicate the extent to which you identify as politically libertarian". Participants indicated their response on a four point Likert scale ranging from do not identify at all (1) to strongly identify (4).

2.5 Moral Foundations Questionnaire

The Moral Foundations Questionnaire (MFQ) is used to determine a person's position along the five moral foundations (harm, fairness, in-group, authority, and purity) in MFT (Graham et al., 2009) (harm $\alpha = .71$; fairness $\alpha = .65$; in-group $\alpha = .65$; authority $\alpha = .74$; purity $\alpha = .78$ for this sample). The questionnaire consists of two sections. The first asks questions of 'moral relevance' and the second asks questions of 'moral agreement'. The moral foundation items are assessed on a six point scale, ranging from not at all relevant (1) to extremely relevant (6) in section one, and strongly disagree (1) to strongly agree (6) in section two.

Section 1.

1. Whether or not someone suffered emotionally.
2. Whether or not some people were treated differently than others.
3. Whether or not someone's action showed love for his or her country.

4. Whether or not someone showed a lack of respect for authority.
5. Whether or not someone violated standards of purity and decency.
6. Whether or not private property was respected.
7. Whether or not someone was good at math.
8. Whether or not someone cared for someone weak or vulnerable.
9. Whether or not someone acted unfairly.
10. Whether or not someone did something to betray his or her group.
11. Whether or not everyone was free to do as they wanted.
12. Whether or not someone conformed to the traditions of society.
13. Whether or not someone did something disgusting.
14. Whether or not someone was cruel.
15. Whether or not someone was denied his or her rights.
16. Whether or not someone showed a lack of loyalty.
17. Whether or not an action caused chaos or disorder.
18. Whether or not someone acted in a way that God would approve of.

Section 2.

1. Compassion for those who are suffering is the most crucial virtue.
2. When the government makes laws, the number one principle should be ensuring that everyone is treated fairly.
3. Society works best when it lets individuals take responsibility for their own lives without telling them what to do.
4. I am proud of my country's history.
5. Respect for authority is something all children need to learn.
6. People should not do things that are disgusting, even if no one is harmed.

Table S1

Summary of the parenting and vaccination forums and Facebook pages on which the survey link was posted.

Name	URL	Description
Bub Hub	https://www.bubhub.com.au	Forum
Essential Baby	https://www.facebook.com/EssentialBabyAU	Facebook page
Kids Matter	https://www.facebook.com/KidsMatterForFamilies	Facebook page
Practical Parenting	https://www.facebook.com/practical.parenting.australia	Facebook page
Raising Children Network	http://raisingchildren.net.au	Forum
Nurture Parenting Magazine	https://www.facebook.com/NurtureParentingMagazine	Facebook page

7. It is better to do good than to do bad.
8. The government interferes far too much in our everyday lives.
9. One of the worst things a person could do is hurt a defenceless animal.
10. Justice is the most important requirement for a society.
11. People should be loyal to their family members, even when they have done something wrong.
12. People who are successful in business have a right to enjoy their wealth as they see fit.
13. Men and women each have different roles to play in society.
14. I would call some acts wrong on the grounds that they are unnatural.
15. The government should do more to advance the common good, even if that means limiting the freedom and choices of individuals.
16. It can never be right to kill a human being.
17. I think it's morally wrong that rich children inherit a lot of money while poor children inherit nothing.
18. Property owners should be allowed to develop their land or build their homes in any way they choose, as long as they don't endanger their neighbours.
19. It is more important to be a team player than to express oneself.
20. People should be free to decide what group norms or traditions they themselves want to follow.
21. If I were a soldier and disagreed with my commanding officer's orders, I would obey anyway because that is my duty.

22. Chastity is an important and valuable virtue.
23. I think everyone should be free to do as they choose, so long as they don't infringe upon the equal freedom of others.

We also included six economic/government items and three lifestyle liberty items developed subsequently to the original MFQ (Iyer et al., 2012) (economic/government liberty $\alpha = .72$; lifestyle liberty $\alpha = .61$ for this sample). The items are assessed on a six point Likert scale, ranging from not at all relevant (1) to extremely relevant (6).

Economic/Government Liberty.

1. Whether or not private property was respected. (relevance rating)
2. People who are successful in business have a right to enjoy their wealth as they see fit.
3. Society works best when it lets individuals take responsibility for their own lives without telling them what to do.
4. The government interferes far too much in our everyday lives.
5. The government should do more to advance the common good, even if that means limiting the freedom and choices of individuals. (R)
6. Property owners should be allowed to develop their land or build their homes in any way they choose, as long as they don't endanger their neighbors.

Lifestyle Liberty.

1. Whether or not everyone was free to do as they wanted. (relevance rating)
2. I think everyone should be free to do as they choose, so long as they don't infringe upon the equal freedom of others.

3. People should be free to decide what group norms or traditions they themselves want to follow.

3. Participant Recruitment

To facilitate our moral profile analysis, our objective was to obtain a sample of parents with a diverse range of views on vaccination that encompassed pro-vaccination, anti-vaccination, and vaccine-hesitant attitudes. However, anti-vaccination and vaccine-hesitant parents are relatively few in number—the former group constitute approximately 1–3% of the Australian general population, whereas the latter group constitute less than 10% of the Australian general population. This means that representative probability sampling will not yield a statistically adequate number of cases to make any meaningful inferences about these groups, unless a prohibitively large number of parents are recruited. For example, assuming that anti-vaccination parents (*viz.* those that outright reject vaccines for their children) account for 3% of the population, to obtain 74 parents who fall into this category—the number of parents in our Profile 3 “vaccine rejecters”—we would need to sample at least 2,500 parents. This would result in massive oversampling of vaccine accepters who are the least interesting and informative group of parents of those under consideration.

Given these considerations, we opted against using a probability sampling approach in favour of a non-probability sampling approach. Specifically, we sought to recruit denizens of parenting and vaccination online forums, since these forums are likely to attract a higher proportion of anti-vaccination and vaccine-hesitant parents than are typically observed in the population. To this end, between June and July 2014 we issued requests to several Australian vaccination and parenting forums to post an advertisement and link to a study on “Attitudes to Vaccinations” on their online platforms. The standardised study advertisement was as follows:

Attitudes to Vaccinations

You are invited to participate in a study evaluating people’s attitudes towards vaccinations. The study is being conducted by Jessica Sipes as part of a research project in the School of Psychology at the University of Western Australia, supervised by Dr Mark Hurlstone and Isabel Rossen. The study should take approximately 15 minutes of your time.

If you decide to participate, you will be required to answer some questions regarding how you would think or act in various situations and your beliefs about vaccinations. There are no risks associated with taking part in this study.

If you are above 18 years of age and would like to participate in the research, please click the web link below after which you will receive further information about the study.

Table S1 provides a summary of the six online platforms that accepted our request to issue a community post containing the above advertisement and a weblink to our study (the participation of the online platforms extended no further than this; that is, they were not collaborators in the collection of the actual data). The online platforms consisted of a mixture of discussion forums and Facebook pages associated with parenting issues including—but not confined to—childhood vaccination. An inspection of the comments of users of these forums and Facebook pages revealed predominantly pro-vaccination views, but with a large minority of anti-vaccination and vaccine-hesitant views.

4. Profile Enumeration Strategy

The first goal was to investigate the emergence of profiles, or constellations of attitudes towards vaccination and, accordingly, we employed person-centred analytical methods. To this end, we undertook Latent Profile Analysis (LPA) with Mplus 7.3 (Muthén & Muthén, 2014). LPA bears some similarity to both cluster analysis and factor analysis. It is similar to cluster analysis in the sense that it attempts to identify a set of profiles within a population. Unlike cluster analysis, however, LPA does not definitively allocate cases to the emergent profiles and instead takes into account the potential for classification inaccuracy. LPA is also similar to factor analysis in that it attempts to model a single latent variable that accounts for the observed covariance amongst the indicators, with the key difference being that the latent variable in LPA is categorical rather than continuous as is the case for factor analysis.

The initial step in undertaking LPA is to identify an appropriate number of profiles in a process called profile enumeration. To this end, our strategy involved specifying a single profile model, and then models with increasing numbers of profiles. In making the final decision, we considered: (a) the relative

Table S2
Goodness-of-fit quantities for 1-profile through to 3-profile solutions.

<i>k</i> Profiles	AIC	SSA-BIC	Δ SSA-BIC (relative to <i>k</i> -1 profiles)	LMRLRT (<i>p</i> value)	BLRT (<i>p</i> value)	Entropy
1	19074.695	19093.380	–	–	–	–
2	14085.942	14114.489	-4918.637	.003	< .001	.989
3	12296.426	13034.835	-1019.399	.031	< .001	.987

Note—AIC = Akaike Information Criterion; SSA-BIC = Sample sized adjusted Bayesian Information Criterion (lower AIC and SSA-BIC indices indicate better fit); Δ SSA-BIC = change in SSA-BIC as number of profiles increases; LMRLRT = Lo-Mendell-Rubin Likelihood Ratio Test; BLRT = Bootstrap Likelihood Ratio Test. For the LMRLRT and BLRT tests, a significant *p* value suggests that the model with *K* profiles is a significantly better fit than the model with *K*-1 profiles.

improvement in model fit with the addition of profiles (see below) (Asparouhov & Muthén, 2014), (b) the sizes of the profiles (small profiles can be a sign of profile over-extraction or the absence of distinctive profiles in the population), and (c) the form of the profiles (profiles of similar shape but slightly different levels can be a sign of profile over-extraction) (Muthén & Muthén, 2000). Profiles were estimated in Mplus 7.3 via the maximum-likelihood robust estimator using the TYPE=MIXTURE command (Muthén, 2014).

Table S2 shows two fit statistics (Akaike Information Criterion [AIC] and sample size adjusted Bayesian Information Criterion [SSA-BIC]) of models with 1 through 3 profiles, along with statistical tests of the comparison of a model with *K* versus a model with *K*-1 profiles (as indicated by the *p* values for the Lo-Mendall-Rubin Likelihood Ratio test [LMRLRT] (Lo et al., 2001), and the Bootstrapped Likelihood Ratio Test [BLRT] (Nylund et al., 2007); statistically significant values imply that the model with *K* profiles offers statistically significantly better fit than the model with *K*-1 profiles). In choosing the appropriate number of profiles, one must consider the relative size of the decline in AIC and SSA-BIC on the addition of profiles to the solution. Table 1 shows that fit appeared to improve substantially with the two and three-profile models. The LMRLRT and BLRT tests suggest that there may be value in considering a fourth profile, however, attempts to extract such a model led to estimation problems.¹ We therefore settled on a 3-profile solution.

Table S3 shows the pattern of moral foundation endorsement, political ideology, and intention to vaccinate across the three extracted profiles: “vaccine accepters” (Profile 1), “fence sitters” (Profile 2), and “vaccine rejecters” (Profile 3). For a discussion and visualisation of these data, please consult Rossen et al. (2018).

5. Supplementary Analyses

To determine the internal structure of the three novel measures developed for the purpose of our work, we conducted a series of exploratory and confirmatory factor analyses of the VCI, VSCS, and VBIS.

5.1 VCI

Although we identified five major themes when reviewing the content used to develop these items, we were not necessarily expecting these themes to form different factors. That is, it seemed very likely that there would be a general ‘vaccine acceptance’ factor that would drive the responses to all the items. Indeed, an exploratory factor analysis (maximum likelihood) of the items yielded the following eigenvalues (only the first five are listed): 13.6, 0.93, 0.40, 0.38, and 0.37. The first factor explained 75.5% of the variance in the 18 items and the factor loadings ranged from 0.767 to 0.954 providing convincing evidence that responses to these items were driven strongly by a common factor.

A confirmatory factor analysis (CFA) with robust maximum likelihood estimation (MLR) in Mplus 7.3 suggested, however, that a single-factor model fit the data very poorly. The resultant fit indices were: $\chi^2_{df=35} = 771.9$, RMSEA = .126 (90% CI = .118, .135), and CFI = .873. Inspection of modification indices revealed that the four items pertaining to the freedom to choose whether to vaccinate were covarying among themselves, independently of the common factor. Such a pattern is consistent with LPA results that showed that the three profiles diverged substantially in shape only with respect to this item sub-set.

¹Inspection of the results from the 4-profile analyses suggested that the fourth profile had a mean response to three of the items at the maximum possible score (i.e., indicative of extremely negative attitudes towards vaccinations), thus within that profile, variance on those items must be zero. We suspect that the presence of this profile may have caused model estimation to fail.

Table S3

Significance of differences between the three profiles of parents on the moral foundations, political ideology, and intention to vaccinate measures.

Measure	Profile means (SD)			Accepters vs. Fence Sitters		Accepters vs. Rejecters		Fence Sitters vs. Rejecters		Omnibus
	Accepters	Fence Sitters	Rejecters	Hedges' <i>g</i>	χ^2	Hedges' <i>g</i>	χ^2	Hedges' <i>g</i>	χ^2	
Harm	4.59 (0.78)	4.80 (0.68)	4.92 (0.64)	-0.28	4.21*	-0.45	11.52**	-0.18	1.18	11.76***
Fairness	4.45 (0.60)	4.57 (0.58)	4.75 (0.44)	-0.21	4.56*	-0.55	18.38***	-0.36	1.94	18.38***
In-group	2.94 (0.74)	3.10 (0.71)	2.90 (0.81)	-0.22	2.87	0.05	0.08	0.26	2.70	3.47
Authority	3.37 (0.84)	3.46 (0.88)	3.03 (0.76)	-0.11	0.61	0.42	9.17**	0.53	10.03**	12.79**
Purity	2.70 (0.95)	2.97 (1.03)	3.06 (0.95)	-0.27	3.33	-0.38	7.13**	-0.09	0.33	8.02*
Economic Liberty	3.38 (0.78)	3.93 (0.77)	4.69 (0.70)	-0.70	24.20***	-1.73	161.22***	-1.04	38.46***	157.44***
Lifestyle Liberty	4.14 (0.83)	4.58 (0.75)	5.14 (0.68)	-0.55	15.55***	-1.28	93.96***	-0.79	22.35***	93.06***
Political Ideology	2.47 (1.04)	2.58 (1.13)	2.63 (1.15)	-0.10	0.68	-0.15	1.09	-0.04	0.03	1.273
Libertarianism	2.03 (0.87)	2.26 (0.85)	2.52 (0.93)	-0.27	3.45	-0.56	14.75***	-0.29	3.08	14.643**
Intention to Vaccinate	6.92 (0.19)	6.09 (1.15)	2.43 (0.70)	1.26	35.28***	10.53	2935.71***	3.87*	532.25***	2879.07***

Note—Hedges' *g* estimates are mean differences divided by the profile size-weighted pooled standard

deviation.

We next specified a five-factor model with one factor capturing each of the five themes we had identified in constructing the measure. This model offered a dramatically improved fit with the data $\chi^2_{df=125} = 236.8$, RMSEA = .055 (90% CI = .044, .066), and CFI = .978; scale-corrected $\Delta\chi^2_{df=10} = 257.23$, $p < .0001$. Except for those involving the factor that was indicated by the freedom to choose items, the inter-factor correlations were all $> .90$. Those involving the freedom to choose factor were all $> .80$.

Ultimately, our latent profile analyses hinged on the presence of a single categorical factor model rather than a continuous factor model. That is, we found that the sample was heterogeneous (i.e., there existed three distinct profiles) and that this heterogeneity affects the inter-relations among the items, especially with respect to how the freedom to choose to vaccinate items inter-relate with the remaining ones.

5.2 VSCS

Our VSCS comprised a set of items that we anticipated could form two sub-scales ('general' vaccine myths and myths about 'specific' vaccines). However, we found that these items also converged into a very strong single factor. The first five maximum-likelihood factor analysis eigenvalues were: 10.90, 0.86, 0.40, 0.32, and 0.28. The first factor explained 77.9% of the variance in the 14 items and the factor loadings ranged from 0.645 to 0.945. In other words, and perhaps unsurprisingly, beliefs in myths about vaccination in general were very strongly associated with beliefs in myths about specific vaccinations.

5.3 VBI

Because this scale comprised items that were identical, aside from the specific disease in question, we thought it likely that they would form a very strong

single factor and indeed, this is what we found. The first factor explained 93% of the variance in the 12 items, and all factor loadings were $> .93$. A single factor MLR-estimated CFA exhibited a reasonable fit with the data $\chi^2_{df=54} = 169.1$, RMSEA = .085 (90% CI = .071, .099), CFI = .938. Though fit was not strong, we had no clear reason to specify any additional factors in this model, nor allow residuals among the items to covary.

References

- Asparouhov, T., Muthén, B., 2014. Auxiliary Variables in Mixture Modeling: Three-Step Approaches Using Mplus. *Struct. Equ. Modeling*. 21(3), 329–341.
- Davies, P., Chapman, S., Leask, J., 2002. Antivaccination activists on the world wide web. *Arch. Dis. Child*. 87, 22–25.
- Day, M. V., Fiske, S. T., Downing, E. L., Trail, T. E., 2014. Shifting liberal and conservative attitudes using moral foundations theory. *Pers. Soc. Psychol. B*. 40, 1559–1573.
- Feinberg, M., Willer, R., 2013. The moral roots of environmental attitudes. *Psychol. Sci*. 24(1), 56–62.
- Feinberg, M., Willer, R., 2015. From gulf to bridge: when do moral arguments facilitate political influence? *Pers. Soc. Psychol. B*. 41(12), 1665–1681.
- Gilligan, C., 1977. In a different voice: Women's conceptions of self and of morality. *Harvard. Educ. Rev*. 47(4), 481–517.
- Graham, J., Haidt, J., Nosek, B. A., 2009. Liberals and conservatives rely on different sets of moral foundations. *J. Pers. Soc. Psychol.* 96(5), 1029–1046.
- Haidt, J., 2001. The emotional dog and its rational tail: a social intuitionist approach to moral judgment. *Psychol. Rev*. 108(4), 814.

- Haidt, J., Joseph, C., 2004. Intuitive ethics: How innately prepared intuitions generate culturally variable virtues. *Daedalus* 133(4), 55–66.
- Haidt, J., Joseph, C., 2008. The moral mind: How five sets of innate intuitions guide the development of many culture-specific virtues, and perhaps even modules. In P. Carruthers, S. Laurence, S. Stich (Eds.), *The innate mind* (Vol. 3, pp. 367–391). New York: Oxford University Press.
- Iyer, R., Koleva, S., Graham, J., Ditto, P., Haidt, J., 2012. Understanding libertarian morality: The psychological dispositions of self-identified libertarians. *PLoS One* 7(8): e42366.
- Kata, A., 2010. A postmodern Pandora's box: Anti-vaccination misinformation on the Internet. *Vaccine* 28(7), 1709–1716.
- Kata, A., 2012. Anti-vaccine activists, Web 2.0, and the postmodern paradigm—An overview of tactics and tropes used online by the anti-vaccination movement. *Vaccine* 30(25), 3778–3789.
- Kidwell, B., Farmer, A., Hardesty, D. M., 2013. Getting liberals and conservatives to go green: Political ideology and congruent appeals. *J. Consum. Res.* 40(2), 350–367.
- Koleva, S. P., Graham, J., Iyer, R., Ditto, P. H., Haidt, J., 2012. Tracing the threads: How five moral concerns (especially Purity) help explain culture war attitudes. *J. Res. Pers.* 46(2), 184–194.
- Kohlberg, L., Levine, C., Hewer, A., 1983. Moral stages: A current formulation and a response to critics.
- Lo, Y., Mendell, N. R., Rubin, D. B., 2001. Testing the number of components in a normal mixture. *Biometrika*, 88(3), 767–778.
- Lord, C. G., Ross, L., Lepper, M. R., 1979. Biased assimilation and attitude polarization: the effects of prior theories on subsequently considered evidence. *J. Pers. Soc. Psychol.* 37(11), 2098.
- Muthén L. K., Muthén B. O., 2000. Integrating person-centered and variable-centered analyses: Growth mixture modeling with latent trajectory classes. *Alcoholism: Clinical and Experimental Research*, 24(6), 882–891.
- Muthén, L. K., Muthén, B. O., 2014. *Mplus: Statistical analysis with latent variables: User's Guide* (7th ed.). Los Angeles, CA: Muthén & Muthén.
- Myths and Realities: Responding to arguments against vaccination a guide for providers. Australian Government: Department of Health and Ageing. Retrieved from: <https://beta.health.gov.au/resources/publications/myths-realities-about-immunisation>
- Nyhan, B., Reifler, J., Richey, S., Freed, G. L., 2014. Effective messages in vaccine promotion: A Randomized Trial. *Pediatrics*, 133(4), e835-e842.
- Nylund, K. L., Asparouhov, T., Muthén, B. O., 2007. Deciding on the number of classes in latent class analysis and growth mixture modeling: A Monte Carlo simulation study. *Struct. Equ. Modeling*. 14(4), 535–569.
- Nyhan, B., Reifler, J., 2015. Does correcting myths about the flu vaccine work? An experimental evaluation of the effects of corrective information. *Vaccine*, 33(3), 459–464.
- Rossen, I., Hurlstone, M. J., Dunlop, P. D., Lawrence, C., 2019. Accepters, fence sitters, or rejecters: Moral profiles of vaccination attitudes. *Soc. Sci. Med.*
- Skitka, L. J., 2010. The psychology of moral conviction. *Social and Personality Psychology Compass*, 4(4), 267–281.