

Head in the (Oil) Sand? Climate Change Scepticism in Canada

Research Article

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Article Information: Submission: 15/08/2015; Accepted: 26/08/2015; Published: 01/09/2015

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Abstract

Determining the extent to which specific psychological barriers limit climate change mitigation behaviour, particularly in individuals from industrialised nations with poor mitigation performance, is a global concern. This pilot study sought to establish for the first time the extent of climate change scepticism in a representative sample of Anglophone Canadians and determine how it may vary with knowledge, values and socio-demographic factors. Participants (n=229) responded to a mail invitation to take part in the online survey. Scepticism and uncertainty toward climate change were assessed using a validated 12-item attitude index that yielded a composite scepticism score. Environmental values were assessed using a modified version of the New Environmental Paradigm scale (NEP), while political association, education attainment, climate change knowledge, and several demographic variables were determined using established measures. A full factor multiple regression analysis showed region, NEP score and Conservative Party of Canada association as the significant predictors of scepticism. When independent factor groupings were modelled separately, *values and politics* explained 31% of the variation in scepticism scores, *socio-demographic* variables 6%, and *education and knowledge* 3%, highlighting the dominant role of environmental values and political orientation. These results are discussed in the context of the theory of socially-organised denial of climate change and the information-deficit model of climate inaction. The findings provide baseline data that will allow changes in climate change scepticism to be tracked over time, and help to inform how public policy and messaging strategies might be optimized to facilitate climate mitigation behaviour.

Keywords: Climate change; Environmental psychology; Perceptions; Uncertainty; Public attitudes; Climate sceptics; Mitigation barriers

Introduction

The evidence for anthropogenic climate change is extremely compelling; indeed, it reaches a level of scientific consensus that is almost unprecedented [1]. While the need for urgent and sustained action to mitigate and adapt to this threat is widely acknowledged, our global response to climate mitigation thus far has been wholly inadequate. For instance, total emissions of green house gases (GHG) - the major anthropogenic contributor to climate change - continue to rise, despite the scientific evidence for and increasing public awareness of their role in climate change [1,2].

While commitment to and the efficacy of mitigation policies vary significantly between nations for various economic, political and ideological reasons, perhaps surprising has been Canada's

poor response over the last decade. Canada traditionally perceives itself as an effective leader on global affairs and threats, including international environmental issues [3], yet now finds itself at the bottom of the Climate Change Performance Index for both G8 and OECD member countries (30th from 30 in 2014). Indeed, "Canada still shows no intention of moving forward with climate policy and therefore remains the worst performer of all industrialised countries" [4]. Domestic federal policy on GHG emissions has remained relatively static across both Liberal and Conservative Party governance [3], while national [5] and global [1] emissions have risen. With current 'business as usual' climate mitigation efforts, global GHG emissions are projected to grow over the next several decades, with increasingly negative impacts on human health and well-being [1]. Given the significant proportion of GHG emissions attributable

to individual and domestic energy use in developed countries (e.g. 6), the severity of climate change impacts is dependent on the extent to which *individuals* choose to engage in mitigation behaviour [6].

Psychological barriers to action

Various psychological barriers preventing such individual action have been identified [7-10]. The latter study, for instance, identifies approximately 20 specific impediments, categorising them within seven psychological constructs: limited cognition, ideologies, other people, investments, discredence, perceived risk and limited behaviour [11]. Common to the various schema in this literature is the concept of climate change scepticism, which while used to capture multiple constructs [12], is understood here as the belief that climate change is not occurring or that human activities are not a significant contributor. These beliefs manifest themselves along a continuum of varying degrees of uncertainty, through to absolute denial. In the context of resource dilemmas, perceived uncertainty reduces pro-environmental behaviour and likely promotes action that is more orientated toward self-interest [13]. As noted by APA [9], uncertainty probably functions as a justification for climate change inaction or postponed action. In addition to directly influencing inaction, uncertainty and scepticism may also impact mitigation intent or behaviour by mediating or interacting with other psychological barriers. For instance, uncertainty increases perceived powerlessness about environmental problems [14], which in turn affects pro-environmental intentions and actions including climate mitigation behaviour [15,16].

Whitmarsh [17] examined climate change attitudes and beliefs in the UK, and noted that the increasing certainty of climate change in both scientific and media messages was at odds with the relative stability of climate change scepticism amongst the public, in approximate agreement with recent data on USA respondents [18]. Her results showed that ideology and environmental values were much stronger predictors of scepticism than climate change knowledge, concurring with Hulme [19]. Such a finding, if generalizable to other populations, may question the emphasis placed on public education by many government and environmental agencies seeking to affect change in climate mitigation and adaptation behaviours amongst their citizens.

Current study

I used a survey approach to establish base-line measures of attitudes and values regarding climate change from a representative sampling of Anglophone Canadians. In particular, I sought to assess scepticism, and determine its variation across several socio-demographic factors, knowledge and values. This is expected to provide actionable data for environmental policy-makers and communicators by, for instance, facilitating more targeted messaging aimed at incentivizing or otherwise influencing climate mitigation behaviour. While primarily an exploratory study, I also tested several discrete hypotheses:

(i) Western Canada's oil sands are the country's greatest and fastest growing GHG-emitting sector [5]. The region enjoys very high economic benefit from that industry, with, for instance, \$172 billion in wages and salaries projected between 2012 and 2035 [20]. These

facts may predict a more acute conflict between pro-environmental values and wealth aspirations for many Western Canadians, and be expressed as greater climate change scepticism as individuals attempt to resolve the cognitive dissonance [21]. Therefore, I hypothesised that scepticism would be higher in respondents from Western Canada (H_1).

(ii) Political conservatism has previously been associated with greater climate change scepticism in other countries [17,18], possibly due to the link between support for free-market ideology and lower pro-environmental values or environmental apathy [22-24]. Therefore, I hypothesized that higher scepticism scores would associate negatively with pro-environmental values (H_2) and positively with Conservative Party association (H_3).

(iii) Public education on climate change has been very limited and controlled in Canada by the incumbent Conservative government over the last eight years through various political and bureaucratic machinations [25,26]. Indeed, the government has been accused of "the construction of ignorance" amongst its citizenry on climate change [27]. Therefore, I anticipated climate change knowledge to be relatively low in Canada, and hypothesized it would inversely associate with scepticism (H_4).

Method and Materials

Recruitment

Responses were collected using an online survey that employed the Qualtrics® (Provo, Utah, US) platform. In order to obtain as representative sample of the Canadian adult population as possible, invitations to participate were delivered in January 2014 via mail to 13,916 households using the Canada Post Unaddressed Targeted Delivery Service®. This service selects random postal routes within each province/territory, and guarantees deliver to each household within the selected routes. Invitations to participate were sent to each province/territory in approximate proportion to its population, and included houses, apartments, and farm residences. The one-page invitation letter briefly outlined the purpose of the study, and stated that individuals needed to be 18 years or older to participate and that completion of the survey would enter them into a lottery for a \$500 cash prize. Interested individuals were then directed to a secure URL address that housed the survey. To access the survey, respondents had to enter a unique identifier code provided in each letter. An option to complete a hard-copy version of the survey was given for those without Internet access. The study has Brock University Research Ethics Board clearance (File # 12-059).

Demographics

Key demographic characteristics were captured, including age, gender, personal and household income, number of children living at home, country of birth, political orientation (*Which federal political party are you most likely to support?*), ethnicity/culture most closely identified with, and type of community lived in (*city, town, village or hamlet* ('rurality')). Ethnicity response options were those used by Statistics Canada, The Government of Canada (<http://www5.statcan.gc.ca>).

Scepticism

To determine the most appropriate measure(s) of scepticism to employ, I followed the approach of Whitmarsh [17]. Firstly, responses to 23 attitude statements derived from Whitmarsh were collected on a 5-point Likert scale. The order of presentation of statements to participants was fully randomised. Factor Analysis (PCA with varimax rotation) was then applied to the data using XLStat (version 7.5.2, Addinsoft, 40, rue Damremont, 75018 Paris, France). As shown in Table 1, three factors are derived from the analysis. Factor 1 accounts for 26% of the variance in the data set, and cumulatively, the three factors explain 55%. Factor 1 is loaded with items that reflect climate change uncertainty and scepticism, in close agreement with the findings of Whitmarsh [22]. Therefore, the responses to the 12 statements highlight in Factor 1 (Cronbach’s alpha = 0.887) were averaged for each respondent to form this measure of scepticism.

Other measures

Participants were asked their highest education qualification attained and highest qualification in a ‘science-related subject’, with response categories (Table 2) derived from Statistics Canada, The Government of Canada (<http://www5.statcan.gc.ca>).

Self-assessed knowledge about climate change was measured with two questions: *How much, if anything, would you say you know about climate change?* (6-point scale ranging from ‘Nothing, have never heard of it’ to ‘A lot’) and *How well informed do you consider yourself on the issue of climate change?* (6-point scale ranging from

‘Not informed’ to ‘Very well informed’). Finally, *environmental values* were assessed using the New Environmental Paradigm scale (NEP; 29), as shortened and adapted by Whitmarsh [22]. The six statements used were: ‘Humans have the right to modify the natural environment to suit their needs’, ‘Humans are severely abusing the planet’, ‘Plants and animals have the same rights as humans to exist’, ‘Nature is strong enough to cope with the impact of modern industrial nations’, ‘Humans were meant to rule over the rest of nature’, and ‘The balance of nature is very delicate and easily upset’, with reverse coding applied to statements 1, 4 and 5.

Data treatment and analysis general approach

All procedures were carried out using XLStat. Scepticism scores (mean, 2.26; SD, 0.88) were standardised (mean = 0), and investigated using one-way ANOVA, with the various socio-demographic, knowledge and values factors used as the independent variables. Tukey’s HSD_{0.05} was used as the means separation test. Possible associations were also examined for quantitative variables using Pearson’s correlation. Linear regression was used to determine the relative effect of socio-demographic, education/ knowledge and values measures on standardised scepticism scores.

Results

Sample description

229 respondents completed all or most of the survey, representing an overall response rate of 1.6%. The sample, described in Table 2, is

Table 1: Factor analysis of attitude statements concerning climate change (CC).

	Factor		
	1	2	3
Claims that human activities are changing the climate are exaggerated.	0.708		
CC is just a natural fluctuation in earth’s temperatures.	0.622		
I do not believe CC is a real problem.	0.499		-0.607
I am uncertain about whether CC is really happening.	0.681		
It is too early to say whether CC is really a problem.	0.718		
The evidence for CC is unreliable.	0.688		
There is too much conflicting evidence about CC to know whether it is actually happening.	0.738		
CC is too complex and uncertain for scientists to make useful forecasts.	0.563		
Too much fuss is made about CC.	0.731		
Floods & heat-waves are not increasing, there is just more reporting of it in the media these days.	0.481		-0.454
Many leading experts still question if human activity is contributing to CC.	0.652		
The media is often too alarmist about issues like CC.	0.547		-0.446
Talking about CC is boring.		0.638	
The thought of CC fills me with dread.			0.745
CC is something that frightens me.			0.760
I feel a moral duty to do something about CC.			0.696
Recent floods and heat-waves in this country are due to CC.	-0.435		0.643
The effects of CC are likely to be catastrophic.	-0.479		0.590
I consider CC to be an unacceptable risk.			0.505
CC is too complicated for me to understand.		0.663	
I often talk about CC to family or friends.		-0.690	0.474
It is difficult to know which products are better for the environment.		0.472	
I need more information to form a clear opinion about CC.	0.439	0.442	

‘Climate change’ rather than the abbreviated ‘CC’ shown here was used for all statements in the survey. The PCA and varimax rotation options within XLStat were used. Only items loading with coefficients over 0.4 are shown. Values in bold correspond for each variable to the factor for which the squared cosine is the largest.

Table 2: Sample demographics and description (n=229).

Gender	
Female	53%
Male	47%
Age	
18-29	21%
30-39	15%
40-44	13%
45-54	16%
55-64	20%
65-84	14%
Annual Personal Income ¹	
Under \$5,000	14%
\$5,000-\$19,999	14%
\$20,000-\$34,999	17%
\$35,000-\$49,999	15%
\$50,000-\$74,999	21%
\$75,000-\$99,999	10%
\$100,000 and over	9%
Annual Household Income ¹	
Under \$15,000	10%
\$15,000-\$29,999	13%
\$30,000-\$44,999	14%
\$45,000-\$59,999	14%
\$60,000-\$89,999	18%
\$90,000-\$149,999	20%
\$150,000 and over	13%
Political Affiliation	
Conservative Party	19%
Green Party	9%
Le Bloc Québécois	1%
Liberal Party	36%
New Democratic Party	20%
None/ Would not vote	9%
Other	6%
Highest Qualification	
University Graduate Degree	23%
University Certificate, Diploma or Degree at the Bachelor Level	29%
University Certificate, Diploma or Degree below the Bachelor Level	5%
College, CEGEP or other non-University Certificate or Diploma	16%
Apprenticeship or Trades Certificate or Diploma	4%
High School Certificate or Equivalent	21%
No Formal Qualifications	1%
Highest Qualification in a Science-related Subject	
University Graduate Degree	9%
University Certificate, Diploma or Degree at the Bachelor Level	24%
University Certificate, Diploma or Degree below the Bachelor Level	6%
College, CEGEP or other non-University Certificate or Diploma	8%
Apprenticeship or Trades Certificate or Diploma	3%
High School Certificate or Equivalent	38%
No Formal Qualifications	14%
Number of Children (under 16) in Household	

0	64%
1	15%
2	13%
3 and over	7%
Community Type	
City	52%
Town	27%
Village or Hamlet	21%
Ethnicity ^{1,2}	
North American (non-Aboriginal)	57%
Aboriginal	4%
North American Indian (1%)	
Métis (1%)	
Inuit (1%)	
Other aboriginal (2%)	
British Isles	14%
French	8%
Western European	10%
Eastern and Southern European	9%
South, East and Southeast Asian	12%
Other	11%
Location of Respondents	
Alberta	7%
British Columbia	8%
Manitoba	3%
New Brunswick	5%
Newfoundland and Labrador	4%
Northwest Territories	1%
Nova Scotia	7%
Nunavut	2%
Ontario	39%
Prince Edward Island	6%
Québec	7%
Saskatchewan	3%
Yukon	8%

¹ Some responses categories collapsed for summary purposes. ² Respondents could select multiple options

broadly representative of the Canadian adult population with respect to gender, age, immigration status, ethnicity, mean employee income, mean household/family income and rurality [28,29]. With respect to declared political party orientation for the major political parties, the sample aligns closely with a recent poll on federal vote intentions [30]. There are two noteworthy differences between this sample and the wider Canadian population. Respondents appear to have a significantly higher level of education attainment; 52% of this sample report possessing a Bachelor’s degree or higher, compared with 22% of the general adult population [31]. However, in the latter survey, adults were defined as 15 years of age or older, which would artificially lower the proportion of Bachelor degree holders in comparison to this sample. Secondly, the proportion of respondents from the province of Quebec is significantly lower than the wider population. This may be because the survey was only offered in English; a majority of Quebec residents report French as the mother tongue [28].

Scepticism

Table 3 shows total agreement for the 12 individual scepticism

Table 3: Total agreement for scepticism statements.

Scepticism statements	Total Agreement ¹ (%)	Mean ²	SD
Claims that human activities are changing the climate are exaggerated.	19.2	2.1	1.3
Climate change is just a natural fluctuation in earth's temperatures.	30.5	2.7	1.3
I do not believe climate change is a real problem.	7.5	1.7	1.0
I am uncertain about whether climate change is really happening.	15.5	2.0	1.2
It is too early to say whether climate change is really a problem.	11.8	1.9	1.2
The evidence for climate change is unreliable.	14.6	2.1	1.1
There is too much conflicting evidence about climate change to know whether it is actually happening.	20.7	2.4	1.3
Climate change is too complex and uncertain for scientists to make useful forecasts.	25.4	2.5	1.2
Too much fuss is made about climate change.	18.8	2.1	1.3
Floods and heat-waves are not increasing, there is just more reporting of it in the media these days.	13.6	2.1	1.1
Many leading experts still question if human activity is contributing to climate change.	36.6	2.8	1.4
The media is often too alarmist about issues like climate change.	38.0	2.8	1.4

¹ Total agreement is the sum of the "agree a little" and "agree strongly" response options. ² Average score on 5-point likert-scale (1 = strongly disagree; 5 = strongly agree).

statements. Highest agreement was for *The media is often too alarmist about issues like climate change* (38% of respondents) and *Many leading experts still question if human activity is contributing to climate change* (37%), while the lowest agreement was for *I do not believe climate change is a real problem* (8%). Average agreement across all scepticism statements is 2.3, which falls approximately halfway on the scale between *disagree a little* and *neither agree nor disagree*.

Socio-demographic factors

The age of respondents was not linearly associated with scepticism scores ($r=-0.00$, $p=0.99$), however one-way ANOVA showed a significant effect of age categories ($F=2.23$, $p=0.05$). Interestingly, scores of participants aged between 40 and 44 yrs were significantly higher than for all other age classes (Figure 1 (I)). Scores were not linearly associated with personal income ($r=-0.03$, $p=0.71$), and one-way ANOVA of the major personal income classes (<\$5 000, \$5 000-\$24 999, \$25 000-\$49 999, \$50 000-\$74 999, \$75 000 and over) showed no effect ($F=0.31$, $p=0.87$). Scepticism scores did not vary with household income when the major income groupings (\$0-\$19 999, \$20 000-\$39 999, \$40 000-\$59 999, \$60 000-\$99 999, \$100 000-\$149 999, \$150 000 and over) were analysed ($F=0.72$, $p=0.61$), although significant differences were observed between the two extreme household income groupings (<\$30 000 vs. \$150 000 and over; $t=4.45$, $p=0.04$; Figure 1 (II)). Scores from respondents with three or more children in their households were significantly higher than for those with two, one or no children ($F=3.28$, $p=0.02$; Figure 1 (III)). Respondents whose highest qualification was below a Bachelor degree were significantly more sceptical of climate change than those with a Bachelor or graduate degree ($t=5.13$, $p=0.03$; Figure 1 (IV)).

By contrast, neither gender ($t=1.97$, $p=0.16$), rurality ($F=1.59$, $p=0.21$), immigrant status (born in Canada vs. immigrated; $t=0.00$, $p=0.96$) nor highest science qualification attained ($F=0.76$, $p=0.52$) associated with scepticism. With consideration to respondent location, variation between individual provinces and territories could

not be examined due to the low number of responses for many cells. However, when the wider geographical regions of Western Canada (British Columbia and Alberta) and Central Canada (Ontario and Quebec) were compared - which captures the four most populated provinces and 86% of the Canadian population [28]- respondents from Western Canada showed significantly higher scepticism scores ($t=5.83$, $p=0.02$; Figure 1 (V)).

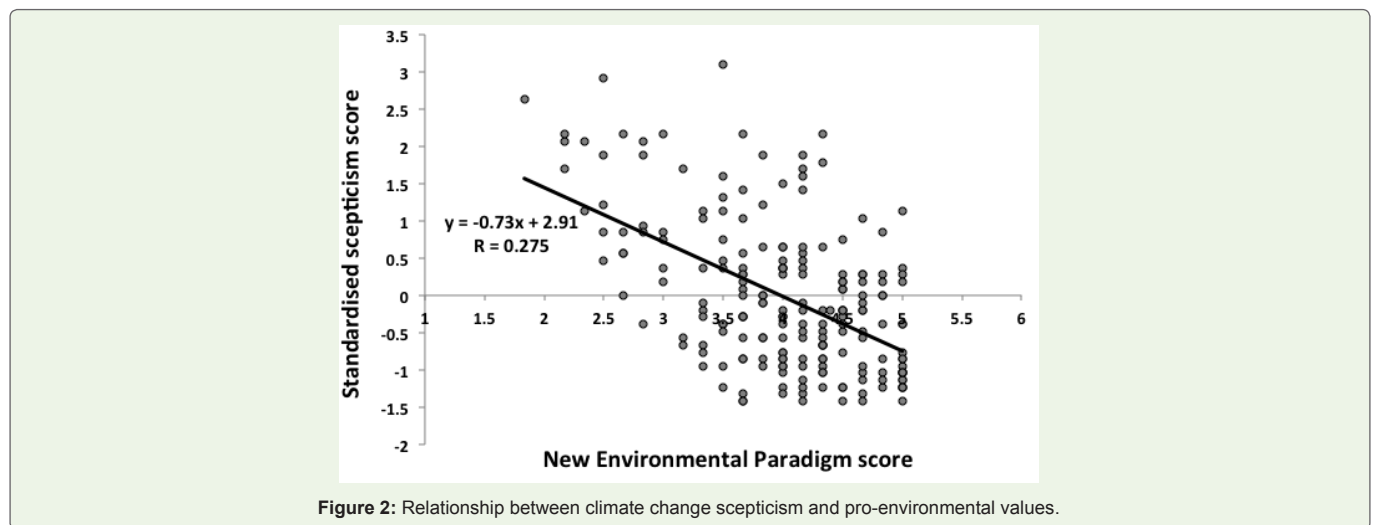
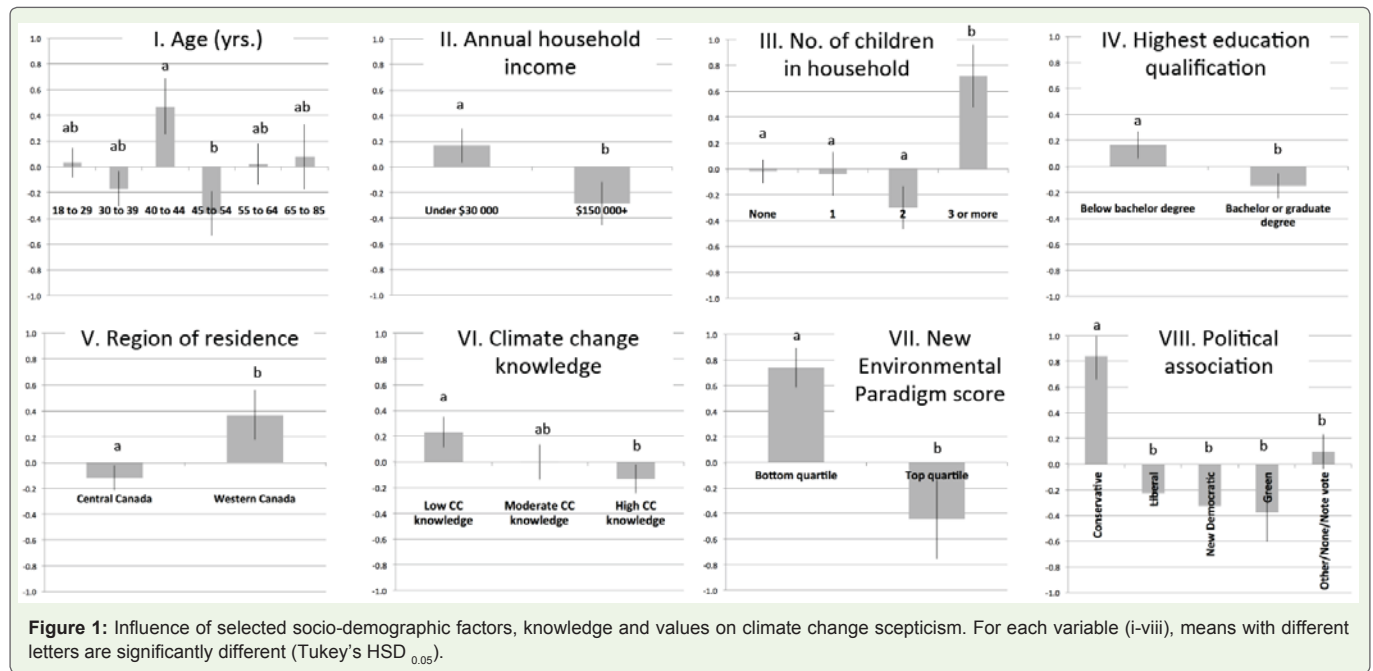
Climate change knowledge, environmental values, and political orientation

Climate change knowledge was assessed by averaging responses to the questions *How much, if anything, would you say you know about climate change?* and *How well informed do you consider yourself on the issue of climate change?* Answers to these two questions were significantly correlated ($r=0.72$, $p<0.0001$). To perform ANOVA, responses were coded as low (1-3.5), moderate (4) or high (4.5-6) climate change knowledge; no significant effect was found ($F=2.43$, $p=0.09$), although a comparison of the high vs. low knowledge groups showed significantly higher scepticism scores in the latter ($t=4.83$, $p=0.03$; Figure 1 (VI)).

The average NEP score in this sample was 3.98 ± 0.72 . As expected, these scores were inversely associated with climate change scepticism ($r=-0.52$, $p<0.0001$; Figure 2), and an analysis of the top vs. bottom quartiles showed scepticism was substantially greater for respondents with low NEP scores ($t=51.01$, $p<0.0001$; Figure 1 (VII)). An ANOVA examining political party affiliation (Liberal Party, Conservative Party, New Democratic Party, Green Party, and Other/None/Would not vote) showed significantly higher scepticism scores for respondents identifying with the Conservative Party of Canada ($F=11.00$, $p<0.0001$; Figure 1 (VIII)).

Multivariate analysis

In order to assess the relative contribution to scepticism from these diverse variables, I followed the approach of Whitmarsh [22]



and used linear regression to separately model the socio-demographic, education/knowledge, and value/politics factors (Table 4). In Model 1, which just considered the socio-demographic measures, number of children in the household - dichotomised as three or more vs. less than three - was the only significant variable. When education and knowledge elements were added (Model 2), both gender and number of children in the household were significant, with - in the case of gender - males tending to be more sceptical. Highest educational qualification attained and climate change knowledge were both significantly and inversely predictive of scepticism scores. All four significant variables in Model 2 had comparable effect sizes, as evidenced by their similar standardised coefficients (β). However, all four became non-significant when environmental values and political orientation were added to the model, both of which are highly predictive. Interestingly, region becomes significant in Model 3,

reflective of the lower scepticism of respondents from Central Canada. The full model accounts for 35% of the variation in scepticism scores (Table 4). When the three independent variable groups are modelled separately, *socio-demographic* variables explain 6% of the variation, *education and knowledge* 3%, and *values and politics* account for 31%, highlighting the dominant role of environmental values and political orientation in predicting climate change scepticism in this sample.

In order to test for mediation, the significant predictors were regressed onto the socio-demographic and education/knowledge variables (Table 5). Region is associated with highest educational qualification, with 66% of Central Canada respondents holding a Bachelors degree or higher compared with 41% in other regions. Pro-environmental values are positively associated with (female) gender, and inversely associated with number of children (3 or more).

Table 4: Linear regression analysis of climate change (CC) scepticism scores.

Model #	Adjusted R ²	Predictor variables	B	SE	β	t	Sig	B	SE	β	t	Sig	B	SE	β	t	Sig	
1	0.06	Socio-demographic	Constant	1.32	0.37		3.55	***	1.99	0.53		3.77	***	3.27	0.58		5.62	***
			Gender	-0.27	0.15	-0.13	-1.79	NS	-0.42	0.16	-0.21	-2.68	**	-0.10	0.14	-0.05	-0.67	NS
			Age	0.00	0.01	0.00	0.02	NS	0.00	0.00	-0.01	-0.09	NS	-0.00	0.00	-0.01	-0.21	NS
			Household income	0.00	0.00	-0.09	-1.34	NS	0.00	0.00	-0.07	-0.99	NS	0.00	0.00	-0.09	-1.46	NS
			Rurality	-0.15	0.09	-0.12	-1.70	NS	-0.16	0.09	-0.12	-1.80	NS	-0.13	0.08	-0.10	-1.72	NS
			No. of children	-0.73	0.26	-0.19	-2.77	**	-0.74	0.26	-0.19	-2.82	**	-0.26	0.24	-0.07	-1.09	NS
			Region	-0.27	0.14	-0.13	-1.90	NS	-0.21	0.14	-0.11	-1.48	NS	-0.26	0.13	-0.13	-2.03	*
2	0.11	Education & Knowledge	Highest educational qual					-0.40	0.17	-0.20	-2.33	*	-0.24	0.15	-0.12	-1.58	NS	
			Science education					0.11	0.08	0.12	1.46	NS	0.09	0.07	0.09	1.31	NS	
			CC knowledge					-0.17	0.07	-0.17	-2.23	*	-0.10	0.07	-0.10	-1.5	NS	
3	0.35	Values & Politics	Environmental values										-0.57	0.09	-0.41	-6.10	***	
			Political orientation											0.52	0.17	0.20	2.99	**

Model 1 consists of Socio-demographic variables only; Model 2 includes Socio-demographic and Education/Knowledge variables; Model 3 includes Socio-demographic, Education/Knowledge and Values/Politics variables. Number of children coded as 3 or more vs. less than 3. Region coded as Central Canada vs other provinces/territories. Highest educational qualification coded as Bachelor or graduate degree vs. below Bachelor degree. Environmental values represented by New Environmental Paradigm scores. Political orientation coded as vote Conservative Party of Canada vs. all other responses. * p<0.05; ** p<0.01; *** p<0.001.

Table 5: Linear regression analysis examining mediation of region, environmental values and political orientation.

	Region					Environmental values					Political orientation				
	B	SE	β	χ ²	Sig	B	SE	β	t	Sig	B	SE	β	χ ²	Sig
Constant	-1.12	1.16		0.93	NS	2.96	0.39		7.62	***	-2.60	1.48		3.08	NS
Gender	0.64	0.35	0.18	3.34	NS	0.43	0.12	0.29	3.64	***	1.23	0.47	0.34	6.84	**
Age	0.00	0.01	0.02	0.03	NS	0.00	0.00	0.02	0.32	NS	-0.01	0.01	-0.05	0.22	NS
Household income	0.00	0.00	-0.09	1.04	NS	0.00	0.00	-0.01	-0.17	NS	0.00	0.00	-0.15	1.71	NS
Rurality	0.34	0.19	0.15	2.98	NS	0.08	0.06	0.09	1.25	NS	-0.16	0.24	-0.07	0.45	NS
Number of children	0.20	0.58	0.03	0.12	NS	0.40	0.20	0.14	1.99	*	1.97	0.64	0.29	9.61	**
Highest educational qualification	-1.06	0.37	-0.29	8.25	**	0.10	0.13	0.07	0.78	NS	0.92	0.49	0.25	3.57	NS
Science education	0.14	0.17	0.08	0.61	NS	-0.04	0.06	-0.06	-0.72	NS	0.07	0.23	0.04	0.10	NS
Climate change knowledge	0.12	0.16	0.07	0.57	NS	0.07	0.06	0.11	1.34	NS	0.48	0.22	0.27	4.69	*

Region coded as Central Canada vs other provinces/territories. Environmental values represented by New Environmental Paradigm scores. Political orientation coded as vote Conservative Party of Canada vs. all other responses. Number of children coded as 3 or more vs. less than 3. Highest educational qualification coded as Bachelor or graduate degree vs. below Bachelor degree. * p<0.05; ** p<0.01; *** p<0.001.

Conservative Party association is positively linked with (male) gender and number of children (3 or more), while inversely associated with climate change knowledge. Amongst the mediator variables themselves, environmental values are predicted by Conservative Party association (B=-0.79, β=-0.43, t=-6.67, p<0.0001), but not by region (t=-0.56, p=0.56). NEP scores were 19% lower for respondents who identified with the Conservative Party compared with all other responses (t=44.46, p<0.0001).

The most sceptical

As greater opportunities to affect attitudinal and behavioural change may exist amongst the more sceptical Canadians, I also examined their socio-demographic, education/knowledge and values/politics responses compared to the entire sample in order to best identify and characterise these individuals. ‘Most sceptical’ was defined as a standardised scepticism score of 1 or greater. This corresponded to a mean raw score of 3.8 ± 0.5 for this group,

compared with 1.9 ± 0.6 for other respondents; they were twice as sceptical about climate change. Their profile is shown in Figure 3. The most sceptical were 2.3 times more likely to vote Conservative, and over 70% more likely to reside in Western Canada. They also had more children in their household and were most likely to be male. As expected, the NEP scores of the most sceptical were (modestly) lower than for the entire sample.

Discussion

Regional and international comparisons (H₁)

Overall, there appears to be a general acknowledgement that climate change is a problem, with only 8% agreeing with *I do not believe climate change is a real problem*. However, responses to some of the more nuanced statements are less compelling, with, for instance, only 44% of respondents disagreeing with the statement *Climate change is just a natural fluctuation in earth’s temperatures*. This apparent discrepancy may be illustrative of multiple constructs underlying understanding and expression of scepticism by the public [12]. Some confidence in the robustness of the composite scale used here, at least with respect to capturing ‘epistemic scepticism’ [12], is its strong agreement with that derived by Whitmarsh [22] with UK respondents; the same 12 statements associated with scepticism and uncertainty also loaded on the first factor of her PCA, and also showed good internal validity. Also noteworthy in this study are the attitudes loading on Factors 2 and 3, with statements in Factor 2 reflective of disinterest and need for information, and Factor 3 broadly capturing emotional and moral dimensions of climate change risk perception.

Heath and Gifford previously surveyed a small sample of Canadians from British Columbia, and measured belief that global climate change is occurring [24]. Ecocentrism, environmental

apathy, and perceived knowledge were identified as the significant predictors, with the latter finding in general agreement with the results reported here (Figure 1 (VI)). The higher scepticism scores of individuals from Western Canada in the current study may reflect an attempt to resolve the cognitive dissonance created between pro-environmental values and wealth aspirations or goals, facilitated by the economic dominance of the high GHG-emitting oil sands industry in the region (Section 1.3), similar to the “socially-organised denial of global warming” in oil-rich Norway reported by Norgaard [32]. This interpretation is supported by the observation that there were no differences between the *average* NEP scores of Western Canadians and respondents from other regions ($F=1.84, p=0.18$), although it requires further testing.

The composite scepticism scale used here has not been widely applied in other countries, which makes direct comparisons with other populations more challenging. However, Whitmarsh [22], using the same index, reported average climate change scepticism scores in the UK public of 2.7 and 2.9 in 2003 and 2008, respectively, suggesting modestly higher overall scepticism than observed in this study, although time frames are obviously different. More recently, the data of Leiserowitz et al. [18] suggest Americans - Canada’s closest neighbours - are significantly more sceptical, with, for example, 23% of USA respondents reporting they do not believe global warming is happening. Interestingly, the authors also report that this scepticism increased in the USA during 2013.

Politics and values (H₂ & H₃)

Conservative political association was a strong predictor of climate change scepticism in the current study, in agreement with USA and UK findings [17,33]. This result is likely driven, at least

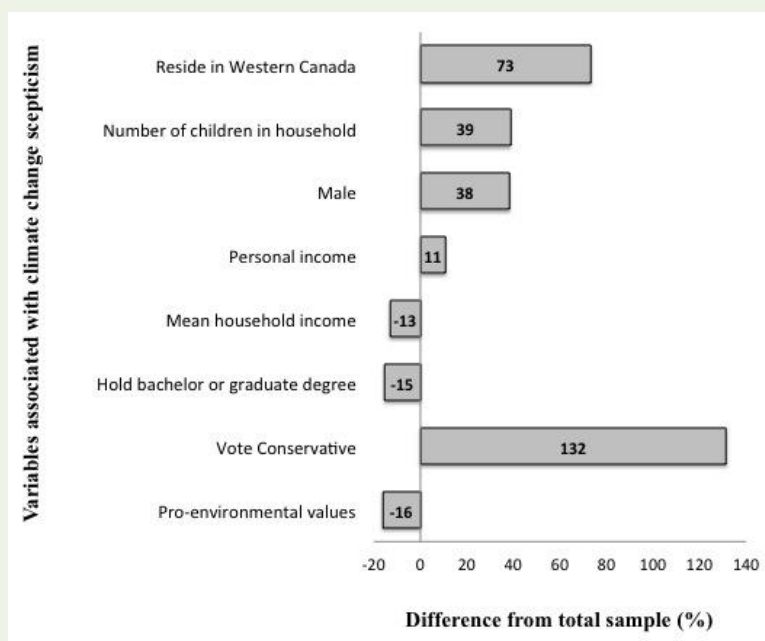


Figure 3: Profile of the most sceptical. Data represent the proportional difference in key measures between respondents with standardised scepticism scores of 1 or greater and the total sample.

in part, by the lower environmental concern of Canadians holding conservative political values, which concurs with previous studies (see 23 for a review). Environmental protection - and via extension, climate change mitigation - involves government intervention into free markets, which conflicts with conservative values [34]. Similarly, individuals with free-market ideology are more likely to believe that 'the market' will solve all problems, including environmental, and thus are more sceptical about climate change [24]. A closer examination of responses shows a significant interaction between political association and highest educational qualification attained ($F=15.85$, $p=0.045$). While higher educational attainment (dichotomised as below Bachelor or above Bachelor degree) associated with lower scepticism for non-Conservatives, Conservative voters with a Bachelor degree or higher were more sceptical of climate change than those with lower attainment (data not shown). This result agrees with the findings of McCright and Dunlap [34], although it is not due to lower pro-environmental values in the more highly educated Conservatives, as suggested by Zhou [23]; the interaction between political orientation and education was not significant for NEP scores ($F=0.71$, $p=0.40$).

Pro-environmental values were the strongest independent predictor of climate change scepticism, in concurrence with Whitmarsh [22]. Notably, the predictive power (β) and direction of both political and environmental values and their relative effect size compared with other variables examined are very similar to her findings for UK respondents, perhaps suggestive that this result might generalize to other predominantly Anglophone countries as well.

Climate change knowledge (H_4)

It is often assumed that a low level of climate change education or understanding is a major contributor to scepticism and inaction - the so-called 'knowledge-deficit model' [35] - and therefore policy and other activities are best to focus on public education. However, self-reported climate change knowledge did not differ ($t=0.30$, $P=0.58$) between the most sceptical (mean=4.35) and other (mean=4.25) respondents in this study, and only 1.2% of the overall variance in scepticism scores was attributable to knowledge of climate change in this regression model. To the extent that climate change knowledge is linked to scientific literacy, these findings are consistent with those of Kahan et al. [36], who did not find support for the hypothesis that limited scientific literacy and understanding of climate change underlies public apathy and scepticism. Some caution should be applied in interpreting our results, however, as objective measures of climate change knowledge, such as those used by Tobler et al. [37], were not obtained here.

These results suggest there may be a relatively low return on interventions focused solely or even primarily on climate change education in Canada. A possible exception may be for Conservative voters, who report lower overall knowledge of climate change, perhaps reflective of the current Conservative government's substantial efforts to centralize and restrict messaging about climate change and its impacts and/or simple apathy [24,27].

Limitations and Other considerations

A limitation of the study is the lower than expected response rate, and thus relatively small sample size. This reduces confidence in the

representativeness of the sample, and may have underpowered some analyses. While the sample demographics are generally representative of the Canadian adult population, inclusion of a French version of the survey to capture more responses from Quebec would have been appropriate. A larger sampling in the future may enable a robust segmentation of the Canadian public, similar to the Six Americas initiative on attitudes and beliefs about global warming in the USA [33], which may ultimately assist in more targeted and effective communications around climate mitigation and adaptation.

Non-response bias is also an inherent problem in research that seeks a representative sampling of a population's attitudes or behaviour. In this instance, it is possible that Canadians who are the most sceptical about climate change are those least likely to complete a survey on climate change perception. A significant financial incentive for participation in the study was included to try and mitigate this risk.

As noted by Whitmarsh [22], climate sceptics base their beliefs on ideology, rather than evidence; a view supported by the primacy of political association and pro-environmental values in the current study. Communications strategies based on climate change 'education' are therefore less likely to be effective in the most sceptical, as the information will be interpreted within the context of their existing values and worldviews, which are difficult to change. Instead, climate messaging for this group may be more effective if framed around other issues, such as energy independence and security [17]. For the less sceptical, communication campaigns may be best advised to avoid sensationalism or alarmist approaches, as many Canadians already attribute the media with such hyperbole on climate change, and alarmist communication may lead to less public engagement and lower motivation for mitigation behavior [38]. Finally, structural interventions that foster pro-environmental values may be an effective long-term strategy in Canada, although further research is needed to elucidate how climate change communication and policy can be tailored and optimised, given the diversity of public scepticism and values.

Conclusion

Scepticism and uncertainty represent potentially powerful psychological barriers to individuals taking meaningful action on climate mitigation and adaptation. This exploratory study surveyed a representative sample of the Canadian adult population to determine their level of climate change scepticism and how it varies with select socio-demographic, knowledge/education and value dimensions. H_1 was confirmed: respondents from Western Canada were more sceptical about climate change than those from the other regions examined, which may be interpreted as a strategy for resolving cognitive dissonance between pro-environmental values and wealth aspirations. H_2 and H_3 were confirmed: scepticism scores were negatively associated with pro-environmental values, and were higher for respondents with a Conservative Party orientation. Indeed, these two factors were the strongest predictors of climate change scepticism of all measures assessed. H_4 was partially confirmed. While a full factor regression model failed to identify climate change knowledge as a significant predictor, scepticism was modestly higher in low-knowledge respondents compared to high-knowledge respondents.

The most highly sceptical of all Canadians are male, Conservative Party voters living in Western Canada with a greater number of children in their household.

The baseline data reported here will allow changes in climate scepticism in Canada to be tracked over time, including evaluation of the efficacy of various interventions aimed at encouraging climate change mitigation behaviours. Taken together, these findings highlight the importance of ideology and values in shaping beliefs on climate change, and illustrate the heterogeneity of empirical scepticism in a population, which in turn may underlie variation in levels of mitigation engagement. This suggests that messaging and policy strategies on climate mitigation might need to be differentiated and optimised for different segments of the public.

Acknowledgements

The Environmental Sustainability Research Centre and the Council for Research in the Social Sciences, Brock University, are sincerely thanked for funding that supported this project. Samantha Morris, Dr Ryan Plummer, Hannah Pickering (Brock University), and Kerrie Pickering (Green Health Global) are thanked for valuable technical and editorial assistance

Declaration of conflicting interests

The author declares no potential conflicts of interests with respect to the authorship and/or publication of this article.

References

- IPCC (2014) The Fifth Assessment Report of the Intergovernmental Panel on Climate Change, IPCC, Geneva.
- IPCC (2007) The Fourth Assessment Report of the Intergovernmental Panel on Climate Change, IPCC, Geneva.
- Cass LR (2013) A climate of obstinacy: symbolic politics in Australian and Canadian Policy. In PG: Harris (Ed.) The Politics of Climate Change. Routledge, London, UK.
- Burck J, Marten F, Bals C (2014) The Climate Change Performance Index 2014. A comparison of the 58 top CO₂ emitting nations.
- Government of Canada (2014) Canada's Sixth National Report on Climate Change. Minister of the Environment, Ottawa, Canada.
- Baiocchi G, Minx J, Hubacek K (2010) The impact of social factors and consumer behavior on carbon dioxide emissions in the United Kingdom. *J Industrial Ecology* 14: 50-72.
- Kollmuss A, Agyeman J (2002) Mind the gap: why do people act environmentally and what are the barriers to pro environmental behavior? *Environmental Education Research* 8: 239-260.
- Lorenzoni, Nicholson-Cole S, Whitmarsh L (2007) Barriers perceived to engaging with climate change among the UK public and their policy implications. *Global Environmental Change* 17: 445-459.
- American Psychological Association (2009) Psychology and Global Climate Change: Addressing a Multi-faceted Phenomenon and Set of Challenges. Report of the American Psychological Association Task Force on the Interface between Psychology and Global Climate Change.
- Gifford R (2011) The dragons of inaction: psychological barriers that limit climate change mitigation. *Am Psychol* 66: 290-302.
- Gifford R, Kormos C, McIntyre A (2011) Behavioral dimensions of climate change: drivers, responses, barriers, and interventions. *WIREs Climate Change* 2: 801-827.
- Capstick SB, Pidgeon NF (2014) What is climate change scepticism? Examination of the concept using a mixed methods study of the UK public. *Global Environmental Change* 24: 389-401.
- Hine DW, Gifford R (1996) Individual restraint and group efficiency in commons dilemmas: The effects of two types of environmental uncertainty. *Journal of Applied Social Psychology* 26: 993-1009.
- Kaplan S (2000) Human nature and environmentally responsible behavior. *Journal of Social Issues* 56: 491-508.
- Haller M, Hadler M (2008) Dispositions to act in favor of the environment: fatalism and readiness to make sacrifices in a cross-national perspective. *Sociological Forum* 23: 281-311.
- Aitken C, Chapman R, McClure J (2011) Climate change, powerlessness and the commons dilemma: Assessing New Zealanders' preparedness to act. *Global Environmental Change* 21: 752-760.
- Whitmarsh L, Seyfang G, O'Neill S (2011) Public engagement with carbon and climate change: To what extent is the public 'carbon capable'? *Global Environmental Change* 21: 56-65.
- Leiserowitz A, Maibach E, Roser-Renouf C, Feinberg G, Rosenthal S, et al. (2014) Climate change in the American mind: Americans' global warming beliefs and attitudes in November, 2013. Yale University and George Mason University. New Haven, CT: Yale Project on Climate Change Communication.
- Hulme M (2009) *Why We Disagree About Climate Change*. Cambridge University Press, Cambridge.
- Burt M, Crawford T, Arcand A, (2012) Fuel for Thought: The Economic Benefits of Oil Sands Investment for Canada's Regions. The Conference Board of Canada.
- Festinger L (1957) *A Theory of Cognitive Dissonance*. California: Stanford University Press.
- Whitmarsh L (2011) Scepticism and uncertainty about climate change: Dimensions, determinants and change over time. *Global Environmental Change* 21: 690-700.
- Zhou M (2013) A multidimensional analysis of public environmental concern in Canada. *Canadian Review of Sociology* 50: 453-481.
- Heath Y, Gifford R (2006) Free-market ideology and environmental degradation The case of belief in climate change. *Environment and Behaviour* 38: 48-71.
- Cuddy A (2010) *Troubling Evidence: The Harper Government's Approach to Climate Science Research in Canada*. Ottawa: Climate Action Network.
- O'Hara K (2010) Canada must free scientists to talk to journalists. *Nature* 467: 501.
- Young N, Coutinho A (2013) Government, anti-reflexivity, and the construction of public ignorance about climate change: Australia and Canada compared. *Global Environmental Politics* 13: 89-108.
- Statistics Canada (2006-2013) August 18th, 2014.
- Dunlap R, Van Liere K, Mertig A, Jones R (2000) Measuring endorsement of the New Ecological Paradigm: A revised NEP scale. *Journal of Social Issues* 56: 425-442.
- EKOS Research Associates (2014) August 18th, 2014.
- Employment and Social Development Canada (2012) August 18th, 2014.
- Norgaard KM (2006) "We don't really want to know": environmental justice and socially organized denial of global warming in Norway. *Organization and Environment* 19: 347-370.
- Maibach E, Roser-Renouf C, Leiserowitz A (2009) *Global Warming's Six Americas 2009: an audience segmentation analysis*. Yale University and George Mason University. New Haven, CT: Yale Project on Climate Change Communication.
- McCright AM, Dunlap RE (2011) The Politicization of Climate Change and

- Polarization in the American Public's Views of Global Warming, 2001-2010. *The Sociological Quarterly* 52: 155-194.
35. Bulkeley H (2000) Common knowledge? Public understanding of climate change in Newcastle, Australia. *Public Understanding of Science* 9: 313-333.
36. Kahan DM, Peters E, Wittlin M, Slovic P, Ouellette LL, et al. (2012) The polarizing impact of science literacy and numeracy on perceived climate change risks. *Nature Climate Change* 2: 732-735.
37. Tobler C, Visschers VHM, Siegrist M (2012) Consumers' knowledge about climate change. *Climatic Change* 114: 189-209.
38. O'Neill S, Nicholson-Cole S (2009) 'Fear won't do it': promoting positive engagement with climate change through visual and iconic representations. *Science Communication* 30: 355-379.