

COURT FILE NUMBER KB - RG - 0848 of 2023

COURT OF KING'S BENCH FOR SASKATCHEWAN

JUDICIAL CENTRE REGINA

APPLICANTS SABRINA DYKSTRA, JILL FORRESTER, RYAN HEISE,
KAYLA HOPKINS, LYNN OLIPHANT, HAROLD PEXA,
AMY SNIDER, and CLIMATE JUSTICE SASKATOON
ORGANIZATION INC.

RESPONDENTS SASKATCHEWAN POWER CORPORATION, CROWN
INVESTMENTS CORPORATION OF SASKATCHEWAN,
and THE GOVERNMENT OF SASKATCHEWAN

AFFIDAVIT

AFFIDAVIT OF EXPERT WITNESS DR. KATHERINE ARBUTHNOTT

I, DR. KATHERINE ARBUTHNOTT, of the City of REGINA, SASKATCHEWAN, MAKE OATH AND SAY (or AFFIRM):

1. I hereby provide this opinion to the Court in my capacity as a psychologist, expert in several areas of psychology, including environmental psychology, cognition, emotion, and positive psychology.
2. I provide this opinion evidence contained herein in an objective and non-partisan manner. My opinion evidence provided herein is related only to matters within my areas of expertise. I am aware of my duties as an expert witness to assist the Court as prescribed in *The Queen's Bench Rules* at rule 5-37 and I have made this submission in conformity with those duties.
3. I am a Canadian citizen and lifelong resident of Saskatchewan.
4. I have graduate degrees in Educational Psychology (Bachelors and Masters) and a PhD in Experimental Psychology. Attached to this affidavit as **Exhibit "A"** is my Curriculum Vitae, which further describes my qualifications in greater detail.

5. I was registered with the Saskatchewan College of Psychologists from its inception until my retirement in 2021. My first career was as a psychotherapist, primarily in private practice with Prairie Trainers and Therapists of Saskatoon (1978-1992).
6. I am Professor Emerita with the University of Regina and Campion College. Before I retired in June 2021, I was a Full Professor of Psychology. Throughout my academic career I taught senior undergraduate and graduate courses in Environmental Psychology, Emotion and Motivation, Cognitive Psychology, Developmental Psychology, and Social Psychology (among other junior undergraduate classes) and supervised the research of many graduate students. My tenure with the University of Regina and Campion College extended from 1997-2021.
7. My academic research investigated fundamental processes of attention, memory, and decision-making, and how these processes influence responses to climate change issues. One decision-making error that is very relevant to the current case is 'escalation of commitment', which is the continued investment in a strategy despite evidence of its failure. With my colleague, economist Brett Dolter, I conducted a detailed analysis of the operation of this decision-making error as it applies to fossil fuel production.¹ The use of fossil fuels has been central to human civilization, but evidence of the existential danger posed by carbon emissions means that this use must be curtailed. Thus, the considerable public investment to support fossil fuel industries in SK clearly reflects an escalation of commitment error. Affixed to this affidavit as **Exhibit "B"** is our journal article entitled *Escalation of Commitment to Fossil Fuels*, which appeared in the Journal of Ecological Economics in 2013.
8. The growing evidence of climate change in our lives, such as the frequency of extreme weather events and seasonal uncertainty in environmentally based livelihoods such as farming is increasing mental health difficulties, particularly stress and eco-anxiety. As climate scientist Katharine Hayhoe puts it, "the cascade of events triggered by warming affects everything we care about: where we get the food we eat and how much it costs; how clean or dirty the air that we breathe is; the economy and national security; hunger, disease, and poverty across the planet; the future of civilization as we know it."²
9. Several years ago, the American Psychological Association identified eco-anxiety as a key emerging issue for psychologists,³ and the psychological implications of climate change are clearly

¹ Arbuthnott, K.D., & Dolter, B., "Escalation of commitment to fossil fuels" (2013) *Ecological Economics*, 89, 7-13.

² Hayhoe, K., *Saving us: A climate scientist's case for hope and healing in a divided world* (Toronto: One Signal Publishers, 2021) at 32-33.

³ Doherty, T.J., & Clayton, S., "The psychological impacts of global climate change" (2011) *American Psychologist*, 66, 265-276.

identified as a growing concern for the mental health of Canadians.⁴ Affixed to this affidavit as **Exhibit “C”** is a copy of the Canadian Psychological Association’s *Climate Anxiety Factsheet*.

10. Climate change has significant implications for psychologists practicing in all areas.⁵ Affixed to this affidavit as **Exhibit “D”** is a copy of the journal article I published in 2021 entitled *Psychology and the Natural Environment*. I participated in a working group to develop a position paper on climate change for the Canadian Psychological Association.⁶ Affixed to this affidavit as **Exhibit “E”** is a copy of that position paper entitled *Addressing climate change in Canada: The importance of psychological science. A position paper of the Canadian Psychological Association*.
11. Eco-anxiety is also a significant issue for many Saskatchewan residents, and these issues are exacerbated by the social norms of constraining discussion of climate change in the province. In the winter of 2021, I was approached by two academic colleagues to help establish a support group for people suffering from eco-anxiety and eco-grief. We announced the proposed group through our personal social media networks, and we were surprised by the number of people who responded. For the moment, we have established two Ecostress groups who meet regularly. Through our discussions, it is clear that considerable distress is associated with the Saskatchewan government’s failure to robustly act to reduce our extremely high per capita carbon emissions for a number of residents. Many members of these groups are suffering sufficiently to require stress leaves, so the inaction on climate change is harming both the health of Saskatchewan residents and the productivity of their workplaces.
12. Mental health issues associated with climate change are particularly significant for adolescents and young adults. Research indicates that a large proportion of young people experience significant eco-anxiety,⁷ and I observed this in several of my undergraduate classes over the past decade. Affixed to this affidavit as **Exhibit “F”** is a copy of the journal article entitled “Climate anxiety in children and young people and their beliefs about government responses to climate change: a

⁴ Dr. Lindsay J. McCunn, Mr. Alexander Bjornson, and Dr. Robert Gifford, “*Psychology Works*” *Fact Sheet: Climate Change and Anxiety* (Canadian Psychological Association, 2020) online: <https://cpa.ca/psychology-works-fact-sheet-climate-change-and-anxiety/> (10 March 2023).

⁵ Arbuthnott, K.D., “Psychology and the natural environment” (2021) *Psynopsis*, 43(2), at 22-23, online: <https://cpa.ca/docs/File/Psynopsis/2021-Vol43-2/#p=22> (10 March 2023).

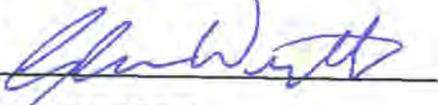
⁶ McCunn, L., Gifford, R., Veitch, J.A., Arbuthnott, K., Zhao, J., Anold-Schutta, P., Young, C., & Jardine, N. “Addressing climate change in Canada: The importance of psychological science. A position paper of the Canadian Psychological Association” (2021) *Psynopsis*, 43(2), at 6-8.

⁷ Hickman, C., Marks, E., Pihkala, P., Clayton, S., Lewandowski, R.E., Mayall, E.E., Wray, B., Mello, C., & van Susteren, L., “Climate anxiety in children and young people and their beliefs about government responses to climate change: A global survey” (2021) *The Lancet Planet Health*, 5(12), e863-e873 online: [https://www.thelancet.com/journals/lanplh/article/PIIS2542-5196\(21\)00278-3/fulltext](https://www.thelancet.com/journals/lanplh/article/PIIS2542-5196(21)00278-3/fulltext) (10 March 2023)

Also: Galway, L. and Field, E., “Climate emotions and anxiety among young people in Canada: A national survey and call to action” (2023) *The Journal of Climate Change and Health*, Vol. 9 online: <https://www.sciencedirect.com/science/article/pii/S2667278223000032?via%3Dihub> (10 March 2023).

global survey." Also affixed to this affidavit as **Exhibit "G"** is a copy of the journal article entitled "Climate emotions and anxiety among young people in Canada: A national survey and call to action." This eco-anxiety is further exacerbated by the failure of governments and business leaders to take urgent action to mitigate the significant existential risks associated with climate change, as was frequently expressed by students in my environmental psychology courses. Young adults are well aware that they will face considerable challenges associated with rising carbon emissions over their lives⁸, increasing uncertainty in their ability to make important life choices, such as having children and choosing career paths.⁹ Thus, urgent societal level action is needed to mitigate the risks of climate change, as well as to make infrastructure changes to reduce the impacts of extreme weather events that threaten citizens' homes and livelihoods.

SWORN (OR AFFIRMED) BEFORE ME
at, Regina, Saskatchewan, *by electronic means*
Saskatoon this 22nd day of March,
2023.



Commissioner for Oaths
for Saskatchewan
Being a Solicitor

(signature)

⁸ Hans-O. Pörtner, et al, *Climate Change 2022: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change: Summary for Policymakers*, IPCC, 2022 (Cambridge, UK: Cambridge University Press, 2022) at D5.3.

⁹ Wray, B. *Generation dread: Finding purpose in an age of climate change* (Toronto: Alfred A. Knopf, 2022) at 24-25 and 75-102.

Curriculum Vitae

Katherine D. Arbuthnott
Professor Emerita
Department of Psychology
Campion College, University of Regina
Telephone: Home (306) 347-7806
E-mail: Katherine.Arbuthnott@uregina.ca

Education

University of Saskatchewan:

Sept, 1969 - May, 1974: Bachelor of Education (with distinction)

Sept, 1976 - May, 1978: Masters of Education (Educational Psychology)
(supervisor: Dr. W. Pawlovich)

Sept, 1991 - May, 1995: Doctor of Philosophy (Experimental Psychology)
(supervisor: Dr. Jamie I.D. Campbell)

Thesis title: Error minimization in sequential retrieval: Repetition,
intention, and inhibition

Research Experience

- 2006 – 2021 Professor, Campion College, University of Regina
- Research program investigating goal pursuit with application to pro-environmental behaviour; NSERC funded until 2012
 - Research Ethics Board Chair for University of Regina (2005 – 2007)
- 2004 – 2006 Associate professor, Campion College, University of Regina
- NSERC funded research program investigating processes of executive control and attention
 - SSHRC funded applied research program investigating memory processes in psychotherapy (memory misattributions)
- 2001 - 2004 Associate professor, University of Regina
- NSERC funded research program investigating processes of executive control and attention
 - SSHRC funded applied research program investigating memory processes in psychotherapy (memory misattributions)
- 1997 - 2001 Assistant professor, University of Regina
- NSERC funded research program investigating processes of executive control and memory
 - applied research program investigating memory processes in psychotherapy (prospective memory and memory misattributions)
- 1996 - 1997 Consumer Science Unit, Unilever Research, Colworth House, Sharnbrook, Bedford, MK44 1LQ, UK
- investigating the effects of tea on cognition and mood
- 1995 - 1996 Post-doctoral fellow, Centre for Agricultural Medicine, University of Saskatchewan, Saskatoon, SK
- Tri-council green plan funded position investigating the

neurobehavioural effects of pesticide exposure

- supervisors: Dr. Margaret Crossley (neuropsychology), Dr. Karen Semchuk (neuroepidemiology)

Teaching Experience

Campion College, University of Regina Professor:

2006 – 2021 Courses: introductory psychology, human information processing, research methods, memory, emotion & motivation, developmental psychology, infant cognition, aging cognition, environmental psychology, leadership
Levels: first year undergraduate to graduate classes

Campion College, University of Regina Associate Professor:

2004 – 2006 Courses: human information processing, research methods, memory, emotion & motivation, infant cognition, aging cognition
Levels: second year undergraduate to graduate classes

University of Regina Associate Professor:

2001 – 2004 Courses: human information processing, research methods, memory, perception, learning, traumatic memory, infant cognition, honours seminar
Levels: second year undergraduate to graduate classes

University of Regina Assistant Professor:

1997 - 2001 Courses: human information processing, research methods, memory, perception, learning, traumatic memory, honours seminar, social psychology
Levels: second year undergraduate to graduate classes

University of Saskatchewan Sessional Lecturer:

1981-1996 Courses: dyadic communication, learning, statistics, perception, development (all psychology)

University of Regina Sessional Lecturer:

1981 - 1989 Courses: dyadic communication, development, counselling theories & applications (all social work)

Administrative Experience

1996-1997 Research manager at Consumer Science Unit, Unilever Research, Colworth House, Sharnbrook, Bedford, MK44 1LQ, UK

2003-2004 Research Ethics Board Education Coordinator, University of Regina

- co-supervised consumer science laboratory of 5

2005-2007 Research Ethics Board Chair, University of Regina

- board of 25, serving university of 425 researchers

2007-2016 Assistant Dean, Campion College

- supervised registrars' office and student services
- managed academic student affairs and curricular matters

2007; 2009-2012 Psychology Department Head, Campion College

- department of 3 regular faculty and 6-8 sessional lecturers

Books

Arbuthnott, K.D., Arbuthnott, D.W., & Thompson, V.A. (2006). *The Mind in Therapy: Cognitive Science for Practice*. Mahwah, NJ: Erlbaum.

Peer-Reviewed Papers

(students in bold)

- Arbuthnott, K.D., Sutter, G.C., Belcher, J., & **Stewart, S.** (2022). There's nothing like the real thing: nature connection and emotion in outdoor and online Songs for Nature workshops. *Environmental Education Research*. DOI: 10.1080/13504622.2022.2074377
- Arbuthnott, K.D. (2021). Psychology and the natural environment. *Psynopsis*, 43(2), 22-23.
- Arbuthnott, K.D., & Sutter, G.C. (2019). Songwriting for nature: Increasing nature connection and well-being through musical creativity. *Environmental Education Research*, DOI: 10.1080/13504622.2019.1608425
- Neill, C., Gerard, J., & Arbuthnott, K.D.** (2018). Nature contact and mood benefits: Contact duration and mood type. *Journal of Positive Psychology*. Doi: 10.1080/17439760.2018.1557242
- Hembroff, C.C., Arbuthnott, K.D., & Kratzig, G.P.** (2018). Emergency response driver training: Dual-task decrements of dispatch communication. *Transportation Research Part F*, 59, 222-235.
- Brooks, A.M., Ottley, K.M., Arbuthnott, K.D., & Sevigny, P.** (2017). Nature-related mood effects: Season and type of nature contact. *Journal of Environmental Psychology*, 54, 91-102. Doi: 10.1016/j.jenvp.2017.10.004
- McMartin, D.W., Sammel, A.J., & Arbuthnott, K.D. (2018). Community response and engagement during extreme water events in Saskatchewan, Canada and Queensland, Australia. *Environmental Management*, 61, 34-45. Doi: 10.1007/200267-017-0944-y
- Arbuthnott, K.D., & **Scerbe, A.** (2016). Goal framing in public issue and action decisions. *Analyses of Social Issues and Public Policy*, doi: 10.1111/asap.12119
- Arbuthnott, K.D., & **Scerbe, A.** (2016). How do money and time restrictions influence self-constraining behavior in polluting the commons? *Organization & Environment*, 1-15., doi: 10.1177/1086026616652667
- Heidt, C.T., Arbuthnott, K.D., & Price, H.L.** (2016). The effects of distributed learning on enhanced cognitive interview training. *Psychiatry, Psychology, and Law*. 23, 47-61. doi: 10.1080/13218719.2015.1032950
- Arbuthnott, K.D., & **Kratzig, G.P.** (2015). Effective teaching: Sensory learning styles versus general memory processes. *Innovative Teaching*, 4, 1-10. Doi: 10.1466/06.IT.4.2
- Arbuthnott, K.D., & **Devoe, D.** (2014). Understanding of biodiversity among western Canadian university students. *Human Ecology*, 42, 147-158.
- Arbuthnott, K.D., Sutter, G.C., & **Heidt, C.T.** (2014). Natural history museums, parks, and connection with nature. *Museum Management and Curatorship*, DOI: 10.1080/09647775.2014.888818
- Arbuthnott, K.D., & Dolter, B. (2013). Escalation of commitment to fossil fuels. *Ecological Economics*, 89, 7-13.
- Arbuthnott, K.D., **Devoe, D., & Lawrie, T.** (2012). Economic development and environmental interactions: A comment on Liu and Sibley (2011). *Analyses of Social Issues and Public Policy*, 12, 209-215.
- Arbuthnott, K.D. (2012). Sustainable consumption: Attitudes, actions, and well-being. *Analyses of Social Issues and Public Policy*, 12, 204-208.
- Arbuthnott, K.D. (2010). Taking the long view: Environmental sustainability and delay of gratification. *Analyses of Social Issues and Public Policy*, 10, 4-22.

- Dolter, B. & Arbuthnott, K. (2010). Any risk is unacceptable: Cultural identity, ethics and support for the nuclear industry in Saskatchewan. *Prairie Forum*, 35, 79-112.
- Hepting, D.H., Spring, R., **Maciag, T.**, Arbuthnott, K., & Slezak, D. (2010). Classification of facial photograph sorting performance based on verbal descriptions. *RSCTC 2010 Proceedings*.
- Hepting, D.H., **Maciag, T.**, Spring, R., Arbuthnott, K., & Slezak, D. (2010). A rough sets analysis of facial similarity judgments. Special issue of *TRS (RSFDGrC09)*.
- Campbell, J.I.D., & Arbuthnott, K.D. (2010). Effects of mixing and cuing simple addition and multiplication. *European Journal of Cognitive Psychology*, 22, 422-442.
- Arbuthnott, K.D., & **Brown, A.A.** (2009). The use of autobiographical knowledge in age estimation. *Memory*, 17, 279-287.
- Arbuthnott, K.D. (2009). The representational locus of spatial influence on backward inhibition. *Memory and Cognition*, 37, 522-528.
- Krätzig, G.P.**, & Arbuthnott, K.D. (2009). Metacognitive learning: The effect of item-specific practice and age on metamemory calibration and planning. *Metacognition and Learning*, 4, 125-144.
- Arbuthnott, K.D. (2009). Education for sustainable development: Beyond attitude change. *International Journal of Sustainability in Higher Education*, 10, 152-163.
- Arbuthnott, K.D. (2008). The effect of task location and task type on backward inhibition. *Memory & Cognition*, 36, 534-543.
- Arbuthnott, K.D. (2008). Asymmetric switch cost and backward inhibition: Carryover activation and inhibition in switching between tasks of unequal difficulty. *Canadian Journal of Experimental Psychology*, 62, 91-100.
- Arbuthnott, K.D., **Kealy, K.L.K.**, & **Ylioja, S.** (2008). Judgment of childhood memories. *Applied Cognitive Psychology*.
- Jackiw, L.B.**, Arbuthnott, K.D., Pfeifer, J.E., Marcon, J.L., & Meissner, C.A. (2008). Examining the cross-race effect in lineup identification using Canadian and First Nations samples. *Canadian Journal of Behavioural Science*, 40, 52-57.
- Kratzig, G.P.**, & Arbuthnott, K.D. (2006). Perceptual learning style and learning proficiency: A test of the hypothesis. *Journal of Educational Psychology*, 98, 238-246.
- Robinson, K.M.R., Arbuthnott, K.D., Rose, D., **McCarron, M.C.**, Globa, C.A., & Phonexay, S.D. (2006). Stability and change in children's division strategies. *Journal of Experimental Child Psychology*, 93, 224-238.
- Arbuthnott, K.D. (2005). The influence of cue type on backward inhibition. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 31, 1030-1042.
- Arbuthnott, K.D. (2005). The effect of repeated imagery on memory. *Applied Cognitive Psychology*, 19, 843-866.
- Arbuthnott, K.D. (2005). Stereotypes and profiles: Forensic categorization. *The Canadian Journal of Police & Security Services*, 3, 131-140.
- Woodward, T.S., Whitman, J.C., Arbuthnott, K., Kragelj, T., Lyons, J., & Stip, E. (2005). Visual search irregularities in schizophrenia depend on display size switching. *Cognitive Neuropsychiatry*, 10, 137-152.
- Arbuthnott, K.D., Arbuthnott, D.W., & **Ylioja, S.** (2003). Memory errors for everyday events: Forensic implications. *The Canadian Journal of Police and Security Services*.
- Arbuthnott, K.D., & Campbell, J.I.D. (2003). The locus of self-inhibition in sequential retrieval. *European Journal of Cognitive Psychology*, 15, 177-194.
- Kealy, K.L.K.**, & Arbuthnott, K.D. (2003). Phenomenal characteristics of guided imagery and autobiographical memories: Effects of conversational encoding and delay. *Applied Cognitive Psychology*, 17, 801-818.
- Hepting, D. & Arbuthnott, K.D. (2003). The implications of verbal overshadowing for computer interface design. Computer Science Technical Report TR-CS-2003-10. University of

Regina, Dept. of Computer Science (ISBN 0-7731-0461-5).

- Arbuthnott, K.D., & Woodward, T.S. (2002). The influence of cue-task association and location on switch cost and alternating-switch cost. *Canadian Journal of Experimental Psychology*, 56, 18-29.
- Arbuthnott, K.D., **Geelen, C.B.**, & **Kealy, K.L.K.** (2002). Phenomenal characteristics of guided imagery, natural imagery and autobiographical memories. *Memory & Cognition*, 30, 519-528.
- Robinson, K.M., Arbuthnott, K.D., & Gibbons, K.A. (2002). Adults' representations of division facts: A consequence of learning history? *Canadian Journal of Experimental Psychology*, 56, 302-309.
- Arbuthnott, K.D., Arbuthnott, D.W., & **Rossiter, L.** (2001a). Guided imagery and memory: Implications for psychotherapists. *Journal of Counseling Psychology*, 48, 123-132.
- Arbuthnott, K.D., Arbuthnott, D.W., & **Rossiter, L.** (2001b). Laboratory research, treatment innovation, and practice guidelines: A reply to Enns and Courtois. *Journal of Counseling Psychology*, 48, 140-143.
- Arbuthnott, K.D., & **Frank, J.E.** (2000a). Executive control in set switching: Residual switch cost and task-set inhibition. *Canadian Journal of Experimental Psychology*, 54, 33-41.
- Arbuthnott, K.D., & **Frank, J.E.** (2000b). Trail Making Test, Part B as a measure of executive control: Validation using a set-switching paradigm. *The Journal of Clinical and Experimental Neuropsychology*, 22, 518-528.
- Arbuthnott, K.D., & Campbell, J.I.D. (2000) Cognitive inhibition in selection and sequential retrieval. *Memory & Cognition*, 28, 331-340.
- Arbuthnott, K.D., & Arbuthnott, D.W. (1999). The best intentions: Prospective remembering in psychotherapy. *Psychotherapy*, 36, 247-256.
- Arbuthnott, K.D. (1996). To repeat or not to repeat: Repetition facilitation and inhibition in sequential retrieval. *Journal of Experimental Psychology: General*, 125, 261-283.
- Arbuthnott, K.D., & Campbell, J.I.D. (1996). Effects of operand order and problem repetition on error priming in cognitive arithmetic. *Canadian Journal of Experimental Psychology*, 50, 182-195.
- Campbell, J.I.D., & Arbuthnott, K.D. (1996). Inhibitory Processes in Sequential Retrieval: Evidence from Variable-Lag Repetition Priming. *Brain and Cognition*, 30, 59-80.
- Arbuthnott, K.D. (1995). Inhibitory mechanisms in cognition: Phenomena and models. *Cahiers de Psychologie Cognitive/Current Psychology of Cognition*, 14, 3-45.

Selected Conference Presentations

(students in bold)

- Ballman, C.J.**, & Arbuthnott, K.D. (2021). Emotions and actions: Eco-anxiety and pro-environmental behaviours. Poster presented at annual CPA conference (virtual), June, 2021.
- Scott, L., Herriot, T., Havelock, J., Vaisey, J., & Arbuthnott, K. (2016). Grassland matters: Fostering a community of concern in Saskatchewan. Paper presentation at the 11th Prairie Conservation and Endangered Species Conference, Saskatoon, SK., Feb. 16-18, 2016.
- Arbuthnott, K. & **Scerbe, A.** (2014). A bird in the hand: Loss aversion and resistance to pro-environmental behaviour. Paper presented at the CPA annual conference, Vancouver, June, 2014.
- Brooks, A.**, & Arbuthnott, K. (2014). Season and nature-related mood effects. Paper presented at the CPA annual conference, Vancouver, June, 2014.
- Brooks, A.**, & Arbuthnott, K. (2014). Views of nature: Season and mood. Poster presented at the CPA annual conference, Vancouver, June, 2014.

- Arbuthnott, K.D. (2014). The joy of frugality: Waste minimization and well-being. SK Waste Minimization Conference, Regina, May 8, 2014.
- Stewart, L. & Arbuthnott, K. (2013). Simplistic vs. complex approaches: the PFRA story. Paper presented at PCAG meeting, Esterhazy, SK., Sept. 21, 2013.
- Arbuthnott, K., & **Heidt, C.** (2013). What we think improves our well-being. Talk presented at the CPA annual conference, Quebec City, June 13-15, 2013.
- Lawrie, T., & Arbuthnott, K. (2013). What mechanisms underlie 'soft fascination' in attention restoration. Poster presented at the CPA annual conference, Quebec City, June 13-15, 2013.
- Scerbe, A.**, & Arbuthnott, K. (2013). The effects of time and money on behaviour in commons dilemma tasks. Talk presented at the CPA annual conference, Quebec City, June 13-15, 2013.
- Arbuthnott, K., & **Lawrie, T.** (2012). Encouraging pro-environmental behaviour: The influence of goal frame and self-determination motivation. Poster presented at the CPA annual conference, Halifax, NS, June 14-16, 2012.
- Arbuthnott, K., & **Devoe, D.** (2012). Mental models of biodiversity. Poster presented at the CPA annual conference, Halifax, NS, June 14-16, 2012.
- Heidt, C.**, & Arbuthnott, K.D. (2012). Indoor/outdoor location, nature connection, and well-being. Poster presented at the CPA annual conference, Halifax, NS, June 14-16, 2012.
- Heidt, C., Vracar, N., Arbuthnott, K., LaBrash, M., & Sangster, S.** (2012). Fruit for Thought: Bringing together wasted fruit and hunger. Poster presented at the Canadian Alliance for Community-Service Learning Conference, Saskatoon, SK, May 10-12, 2012.
- Arbuthnott, K., Sutter, G., & **Lawrie, T.** (2011). The role of natural history museums in environmental education. Workshop presented at the national conference of the Canadian Network for Environmental Education and Communication, Regina, SK, June 8-11, 2011.
- Arbuthnott, K.D., **Shearer, R.L., & Lawrie, T.L.** (2010). Goal priming and resource harvesting decisions. Poster presented at the annual meeting of CSBBCS, Halifax, NS, June 11-13, 2010.
- Cote, L.** & Arbuthnott, K.D. (2010). Self-control effort as a function of Stroop congruence probability. Poster presented at the annual meeting of CSBBCS, Halifax, NS, June 11-13, 2010.
- Dolter, B. & Arbuthnott, K. (2010). Cultural Identity, Ethics and Support for the Nuclear Industry in Saskatchewan. Paper presented at the Innovations in Qualitative Research Conference, Saskatoon, SK, June 8-9, 2010.
- Dolter, B., **Arthur, D., Cameron, J., & Arbuthnott, K.** (2010). Persuasive Communication in the UDP Public Consultation Process. Poser presented at the Innovations in Qualitative Research Conference, Saskatoon, SK, June 8-9, 2010.
- Maciag, T., Hepting, D.H., Jaffe, J., Arbuthnott, K., & Dormuth, D.** (2010). Social shopping using food spimes. Paper presented at the International Environmental Modelling and Software Society (iEMSs) Congress, Ottawa, July 5-8, 2010.
- Lawrie, T.** & Arbuthnott, K.D. (2009). The role of featural versus configural processing in the cross-race effect. Poster presented at the BASICS annual conference, Banff, AB, May 1-2, 2009.
- Arbuthnott, K.D. (2008). Environmental behaviour change: Attention, intention, and action. Paper presented at the Regional Centre for Expertise on Education for Sustainable Development Conference of the Americas, Regina, SK, May 25-27, 2008.
- Arbuthnott, K.D., & **Brown, A.A.** (2008). The use of autobiographical knowledge in age estimation. Poster presented at the annual meeting of BBCS, London, ON, June 19-21, 2008.
- Arbuthnott, K.D., & **Brown, A.A.** (2008). Flexible control of emotional expression: Individual differences in effort or working memory? Poster presented at the annual meeting of BBCS, London, ON, June 19-21, 2008.

- McIntyre, A.**, & Arbuthnott, K.D. (2008). Self-regulation depletion: An examination of underlying mechanisms. Poster presented at the annual meeting of BBCS, London, ON, June 19-21, 2008.
- Brown, A.**, & Arbuthnott, K.D. (2007). Mood, autobiographical memory, and verbal learning. Poster presented at the annual meeting of BBCS, Victoria, B.C., June, 2007.
- Kratzig, G.**, & Arbuthnott, K.D. (2007). Age-related differences in metacognitive calibration: Comparisons of confidence and accuracy in metacognition. Poster presented at the annual Banff Annual Seminar in Cognitive Science (BASICS), Banff, AB, May, 2007.
- Arbuthnott, K., **Socket, A.**, & **Kealy, K.** (2006) Experience and attention. Poster presented at the Canadian Society of Brain, Behaviour, and Cognitive Science annual meeting, Saskatoon, July, 2006.
- Arbuthnott, K., & **Stoneham, J.** (2006). Emotional self-regulation and task switching. Poster presented at the Canadian Society of Brain, Behaviour, and Cognitive Science annual meeting, Saskatoon, July, 2006.
- Jackiw, L.B.**, Arbuthnott, K.D., Pfeifer, J.E., & Meissner, C.A. (2006). "They" all look alike to me: Identifying the cross-race Effect in a Canadian population. Poster presented at the annual American Psychology & Law Society conference, St. Petersburg, Florida, March, 2006.
- Krätzig, G.P.**, & Arbuthnott, K.D. (2005). *Perceptual learning style and learning proficiency: A test of the hypothesis*. Poster presented at the Canadian Society of Brain, Behaviour, and Cognitive Science annual meeting, Montreal, July, 2005.
- Hutchings, V.**, Alfano, D., & Arbuthnott, K.D. (2004). *Ecological validity in neuropsychological assessment*. Poster presented at the annual meeting of the Canadian Psychological Association, St. John's, Newfoundland, June, 2004 (Abstract published in *Canadian Psychologist*).
- Hutchings, V.**, Alfano, D., & Arbuthnott, K.D. (2004). *Continuing education as a buffer against age-related cognitive decline*. Poster presented at the 24th annual meeting of the National Academy of Neuropsychology, Seattle, WA, November, 2004. (Abstract published in *Archives of Clinical Neuropsychology*.)

Academic Scholarships and Awards

- Awarded the St. Edmund Campion medal for 2021
- Awarded a CFI Leaders Opportunity Fund Grant to develop the Regina Integrative Cognitive Experimentation (RICE) Lab with C. Oriet and D. Hepting in 2006
- Awarded a 4-year NSERC research operating grant, April, 1998; renewed April, 2002 (deferred 1 year in 2004 due to illness); renewed April, 2007.
- Awarded a 3-year SSHRC research grant, April, 2002
- Awarded a NSERC RTI grant, April, 2003 (with D. Hepting, Computer Science).
- Recipient of the Psychological Society of Saskatchewan 1996 doctoral research award.
- Nominated for the 1996 Governor General's gold medal for the University of Saskatchewan.
- Recipient of several University of Saskatchewan Scholarships during undergraduate and graduate education



Surveys

Escalation of commitment to fossil fuels

Katherine D. Arbutnott^{a,*}, Brett Dolter^b^a *Campion College, University of Regina, Regina, SK, Canada*^b *York University, Toronto, ON, Canada*

ARTICLE INFO

Article history:

Received 27 April 2012

Received in revised form 9 January 2013

Accepted 2 February 2013

Available online xxxx

Keywords:

Escalation of commitment

Sunk cost

Energy investment

Path dependency

ABSTRACT

The use of fossil fuels has been a great boon to human civilization. However, given the issue of climate change, it has become clear that this is a time-limited strategy and that we will at some point need to severely curtail, and perhaps ultimately eliminate, this strategy of meeting our energy needs. Given this long-term perspective, the authors argue that continued public investment in fossil fuel industries and infrastructures reflects escalation of commitment, continued investment in a failing strategy. In this context, this paper reviews the research on escalation of commitment and factors that encourage de-escalation, highlighting strategies that citizens can use to encourage politicians and public administrators to protect long-term civic well-being by shifting investments away from fossil fuel industries.

© 2013 Elsevier B.V. All rights reserved.

1. Introduction

The purpose of this paper is to apply the psychological construct of escalation of commitment to the case of public investment in fossil fuels. Escalation of commitment (also known as the sunk cost fallacy) is an ubiquitous human reasoning error that can be colloquially described as ‘throwing good money after bad’. More formally, in choice situations, previous investment in an option greatly increases the likelihood that a person will again select that option, even when better (i.e., more profitable) alternatives are available. Kahneman (2002, 2011) describes this effect as an unwillingness to change directions once money, and perhaps effort (Cunha and Caldieraro, 2009; Soman, 2001), has been invested in a particular choice.

Researchers began to study the escalation of commitment phenomenon in the 1970s and 1980s (e.g., Arkes and Blumer, 1985; Brockner et al., 1986; Rubin and Brockner, 1975; Staw, 1976). Escalation of commitment is robustly observed in both laboratory (e.g., Staw, 1976) and real-world (e.g., Ross and Staw, 1986, 1993) studies. In laboratory studies, researchers measure escalation cost as the difference in benefits between the previous choice and the more beneficial alternative. Evidence indicates that the magnitude of previous investments influences the amount of future investments in that option. This ubiquitous effect indicates that previous investments reduce the flexibility of decision makers, impairing their ability to adapt to changing circumstances.

Escalation of commitment is observed for individual, group, and public decisions. Individual examples abound in the area of financial

investments, with people being much more likely to sell stocks with a winning history (i.e., immediate financial gain) than a losing history (i.e., at a loss to the investor; Odean, 1998; Scheffrin and Statman, 1985), even though winning stocks are more likely to generate future profits. Public examples include decisions to remain in losing wars (e.g., Vietnam, Iraq, Afghanistan) in order to justify the lost lives of slain soldiers (e.g., Boettcher and Cobb, 2009; Schott et al., 2011).

The authors assert that continued public investment in fossil fuel extraction and use, given what we now know about the long-term consequences of atmospheric build-up of greenhouse gas emissions such as CO₂, is an example of escalation of commitment. In North America there are several examples of such investment, including government support for pipelines to transport fossil fuels (e.g., Keystone XL, Northern Gateway), and government regulations and subsidies designed to facilitate non-conventional extraction methods (e.g., fracking, oil sands).

There is no doubt that the discovery of fossil fuels (coal, oil, natural gas), and development of the countless tools that operate by their stored energy, has been a great boon to humanity. Since the industrial revolution, fossil fuels have enabled economic growth that has greatly increased the ease and scope of life for increasing numbers of people (Ayres et al., 2003). Much of modern civilization (i.e., cultural infrastructure and processes) is based on these technologies, and it is likely that we could not have achieved the complexity of modern civilization without them (Hall et al., 2009; Price, 1995). For consumers, fossil fuel technologies supply the energy for temperature management of our buildings, the production of inexpensive food, local and global transportation, and other technological and domestic tools. For producers, fossil fuels supply both the means of production (e.g., electricity for factories), and enable global transport of inputs and products.

* Corresponding author at: Campion College, University of Regina, 3737 Wascana Parkway, Regina, SK, Canada S4S 0A2.

E-mail address: katherine.arbutnott@uregina.ca (K.D. Arbutnott).

However, it is becoming increasingly clear that this material progress has not been without cost. Continuing on this path of increasing fossil fuel production and use is time limited because the burning of fossil fuels is creating potentially catastrophic climate change. The consequences of rising atmospheric concentration of CO₂ has become particularly clear in the last two decades (e.g., Muller, 2012; Sokolov et al., 2009) and the inevitable conclusion associated with this issue is that human culture, which includes economic systems, will need to adapt to changing conditions by transforming our societies to function without the use of, or at least with much less, fossil fuel (e.g., Dorian et al., 2006; Nuttall and Manz, 2008). Although the timeline for when we need to accomplish this transition is uncertain, evidence suggests that this change should be made sooner rather than later in order to avoid the most disastrous atmospheric, biological, and geopolitical consequences of climate change (e.g., Barnett, 2007; McCarty, 2002). We believe that large-scale commitment of public funds, such as subsidies and incentive-based royalty and regulatory structures to encourage fossil fuel industries, constitute escalation of commitment to fossil fuels and, in our view, should no longer be publicly supported.

It is our assertion that the ability to flexibly shift national energy policy to avoid the worst consequences of climate change is hampered by the influence of the escalation of commitment error on government and private-sector decisions. We hope this review of the escalation of commitment literature can introduce potential strategies to aid us with this dilemma.

2. Theoretical Explanations & De-Escalation Strategies

Escalation of commitment is an example of a general decision-making bias that favors familiarity. Choices that result in the status quo are a general default in human decision making (e.g., Anderson, 2003; Samuelson and Zeckhauser, 1988), especially for complex or difficult decisions (Fleming et al., 2010). Why is this the case? A central reason is that such choices demand considerable cognitive effort, particularly when a decision opposes the status quo option (Fleming et al., 2010). The prevailing dual process model of human reasoning posits two systems of human thought (e.g., Evans, 2003; Kahneman, 2002; Kokis et al., 2002). System 1 intuition operates automatically and quickly, based largely on memory (e.g., habit, well-practiced skills and knowledge) and innate abilities (e.g., perception, emotion). Given that this processing is based largely on memory, we are intuitively biased to prefer events we have experienced in the past. System 2 reasoning, in contrast, requires effortful and controlled attention and is constrained by process limitations (i.e., working memory capacity). As biological organisms, we are evolutionarily inclined to conserve energy (both physical and mental), resulting in the primacy of System 1 intuition in decision-making. Thus, we are disinclined to expend effort if a solution or decision is readily produced from our memory, such as memory of previous effortful decisions we have made, so our 'default position' is to take no action or maintain the status quo (e.g., Anderson, 2003). The tendency to accept System 1 intuitions without reflection (reconsideration by System 2 reasoning) varies by individuals (Kokis et al., 2002; Stanovich and West, 1998), and how a decision is presented or "framed" (e.g., Kahneman, 1992; Thaler & Sunstein, 2008). However, for all humans System 1 intuition influences thought and action to a greater extent than System 2 reasoning.

2.1. Loss Aversion

In addition to this general status quo bias, researchers hypothesize several specific reasons to explain escalation of commitment (e.g., Molden and Hui, 2011). One explanation is related to loss aversion (Arkes and Blumer, 1985; Kahneman, 2002.): We invest more resources in a strategy that is not turning out well because we hope that, with more resources, we have a chance of recouping our original

investments. In other words, we choose to procrastinate—rather than accepting a sure loss by admitting a mistake now, we invest in the low-probability hope that our original choice will be successful in the future (Tykocinski and Ortmann, 2011). In the public sphere, this leads to statements about continued investments in failing strategies such as former Saskatchewan premier Grant Devine's "you don't say whoa in a mudhole" (Saskatoon Star Phoenix, 2006). Devine made this comment in the midst of the 1980s recession to support his policy of providing generous public incentives to businesses and subsidies to homeowners, despite the growing deficit and unemployment in the province. This policy drove the provincial government to the brink of bankruptcy, which was resolved only by a decade of rigorous budgetary restraint by subsequent governments. This outcome might well have been averted, or at least moderated, by ceasing the failing spending program earlier. Unfortunately, this is not a unique narrative in the history of public governance.

Organizations attempt to discourage the loss aversion bias by establishing supervision and regulatory procedures to ensure that undue attention is not given to previous investments. Specifically, decision-makers indicate a minimum outcome at the time of strategy selection, and if this minimum result is not achieved, the choice is abandoned (e.g., Bialogorski et al., 2006; Simonson and Staw, 1992). Such strategies encourage greater System 2 reasoning, thereby decreasing the likelihood of an erroneous decision based entirely on System 1 intuitions.

A similar causal theory focuses on social rather than financial cost: Admitting failure damages self-esteem and public reputation (Brockner, 1992; Silvanathan et al., 2008; Staw, 1976; Tykocinski and Ortmann, 2011). As with economic losses, decision-makers postpone admission of failure by continued investment in the original strategy, with its unlikely possibility of a positive outcome, in contrast to the sure loss associated with a change decision. Consistent with this hypothesized cause, those responsible for a previous decision show increased escalation of commitment (Karlsson et al., 2005b). Organizational strategies designed to diffuse responsibility over several individuals offer some protection from escalation (e.g., Bialogorski et al., 2006; McNamara et al., 2002; Seibert and Goltz, 2001; Simonson and Staw, 1992; Whyte, 1991).

2.2. Information Quality

A third theoretical explanation for escalation of commitment is associated with ambiguous information for both past outcomes and future probabilities (Karlsson et al., 2005b). The issue of climate change is rife with uncertainty (Weitzman, 2011). Given System 1 intuition biases toward maintaining the status quo, this uncertainty can be used strategically by those whose interests are threatened by a transition away from fossil fuels (e.g., Jacques et al., 2008). If the available information makes it difficult to recognize either the failure of a current strategy (Bragger et al., 2003) or the viable alternatives (Harvey and Victoravich, 2009), we favor maintenance of the status quo (Anderson, 2003) for reasons discussed at the beginning of this section. In contrast, continued support for a previous choice is reduced when unambiguous feedback about the performance of the original decision or the relative prognosis of an alternate choice is provided (Bragger et al., 2003; Karlsson et al., 2005a; but see Fox et al., 2009). Similarly, when a person's previous experience suggests that ambiguous negative feedback is sufficient to indicate a failed selection, escalation of commitment effects are not observed, at least in some contexts (e.g., Garland et al., 1990). There is also evidence that, with clear information, people behave co-operatively to reduce climate change (Milinski et al., 2006).

Complicating matters, when decision-makers are also responsible for generating information relevant to the selection, the bias toward previous decisions can also influence the quality of information about alternatives. For instance, Jaccard (2005) notes, "Another

source of inertia is the psychological attachment of key decision makers to the energy system they already know. This influences the focus of research and development, and the major investments in infrastructure and productive systems that ultimately determine the character of our future energy system. Even when the risk may be objectively comparable between two alternatives, risks can seem more manageable with the technologies and resources we already know.” (p. 25).

De-escalation strategies related to information quality focus on encouraging individuals (Simonson and Staw, 1992) and teams (Schulz-Hardt et al., 2002) to elaborate the costs and benefits associated with various alternatives. However, such strategies show mixed results, likely because decision makers are not biased in their exposure to information about alternative strategies but do show biased evaluation of information associated with the options (Schultze et al., 2012). Schultze et al. observed that decision-makers choose to examine information that both supports and opposes their current choice, but evaluate information favorable to their choice as more accurate and more important than opposing information (consistent with the affective aspects of System 1 intuition biases). This evidence is consistent with case studies of commitment escalation in the real world (e.g., Ross and Staw, 1986, 1993). Ross and Staw analyzed two situations (the Expo 1986 world fair in Canada and the Shoreham nuclear plant in New York) in which public officials progressively invested both money and reputation in projects with greatly escalating costs and declining probability of success. In both cases, decision-makers consistently overestimated the potential benefits and underestimated the costs associated with continuing the project.

Self-knowledge deficits also influences escalation of commitment: We consistently underestimate the likelihood that we will commit reasoning errors (Ku, 2008) because we place too much confidence in System 1 intuitions (Kahneman, 2002), while believing ourselves to be rational actors (Alicke, 1985). Thus, the quality of information available to a decision-maker, both about available choices and about the fallibility of human reasoning, provides an important potential avenue of intervention.

2.3. Group Decision-Making

Groups, as well as individuals, are vulnerable to escalation of commitment errors and several additional characteristics of groups appear to influence the effect. For example, group cohesion such as loyalty and affiliative feeling between group members increases escalation of commitment (Dietz-Uhler, 1996). In some cases, groups escalate commitment more than individuals, and show longer persistence to an original choice despite consistent negative feedback (Seibert and Goltz, 2001), an effect that has also been documented in field observations of escalating public commitments (Ross and Staw, 1986, 1993).

Biased evaluation can be countered in group decisions to some degree by the presence of individuals with an alternative preference or group procedures that include a ‘devil’s advocate’ role (Greitemeyer et al., 2009) because deciding in the face of conflicting preferences encourages reflective System 2 reasoning. Similarly, individual decision-makers can also be encouraged to consider the information available to them from multiple perspectives (i.e., their own and that of opponents). While this strategy can provide a means to moderate the influence of escalation of commitment, contexts that enhance System 1 intuition biases may limit the benefits of perspective-taking strategies. For example, negative social attributions such as justifying decisions to opponents (Ross and Staw, 1993) or experiencing even subtle disrespect (Thompson et al., 1998) tends to increase escalation of commitment. Discussion-between-opponent strategies potentially take advantage of System 1 intuition biases—each side examines evidence and produces arguments based on their System 1 intuitions. However, for this strategy to be effective, each side must also engage

System 2 reasoning in order to control their automatic tendency to dismiss opponents’ arguments and evidence.

3. Application to Fossil Fuel Investments

3.1. Path Dependencies and Carbon Lock-In

In economics, the influence of previous investments on future development decisions is often referred to as ‘path dependency’ (e.g. Jaccard, 2005), ‘carbon lock-in’ (Unruh, 2000, 2002; Unruh and Carrillo-Hermosilla, 2006), or more generally ‘inertial forces’ (e.g., Berkhout, 2002; Jaccard, 2005). Jaccard (2005) argues that ‘path dependencies’ (i.e., existing infrastructure, technology, and institutional norms) strongly favor future investment in fossil fuels relative to renewable energy sources.

The influence of ‘path dependency’ on energy investment may persist even when renewable energy sources become cost-competitive with fossil fuel sources (Cavallo, 2007; Sims et al., 2003). They also persist despite acknowledgement that a switch to renewable energy sources would likely accelerate cost declines through the ‘learning-by-doing’ effect (Arrow, 1962; McDonald and Schratzenholzer, 2001; Rivers and Jaccard, 2006) and by encouraging positive network externalities (Katz and Shapiro, 1985).

Path dependencies can be understood in terms of both existing physical structures such as installed pipeline capacity and oil refineries, and existing social systems such as institutional norms, standards, and decision-making strategies. In the electricity sector, there is an institutional norm that favors “centralized, large-scale power technology” which is quite amenable to coal-fired and natural-gas fired electricity plants (Smith et al., 2005: 1493).

Unruh (2000, 2002) describes escalation of commitment to fossil fuels as ‘carbon lock-in’, and outlines how industrial ‘innovation’ tends to improve and perpetuate existing systems rather than choosing to adopt products and processes that will make their current products obsolete. In this context, Unruh and his colleagues (Könnölä et al., 2006; Unruh, 2000, 2002; Unruh and Carrillo-Hermosilla, 2006) distinguish between continuity and discontinuity adaptations. Continuity changes involve incremental alterations and additions to products and procedures that preserve the existing technologies and institutional structures (e.g., unconventional oil extraction), whereas discontinuity changes involve replacement of existing technological systems (e.g., renewable energy). If, as currently appears to be the case, a current choice, even with incremental adjustments, is not the best option to solve a problem, then continuity changes reflect escalation of commitment. As stated by Könnölä et al. (2006), “Dealing with global climate change ... will require nearly 90% reductions in carbon dioxide emissions by industrialized countries, something that currently appears to be beyond the scope of continuity approaches in the energy sector.” (p. 241).

Scientists and engineers have developed carbon-neutral alternatives to reduce greenhouse gas emissions (Pacala and Socolow, 2004), including technologies designed to provide electricity from renewable resources such as solar, wind, hydro, and geothermal energy. Development of ways to reduce energy use is even more advanced (e.g., Khudhair and Farid, 2004). Some writers (e.g., Dincer, 2000) argue that, given our current knowledge of the consequences associated with burning fossil fuels, such technologies now provide a clearly more beneficial strategy. Others are skeptical that renewable energy can displace fossil fuels while maintaining the same material standard of living (Hall et al., 2009). Hall et al. (2009) do not believe that renewable energy can offer an “energy return on investment” high enough to sustain the complexity of our current social structure. If this is the case, and a move away from fossil fuels requires a conscious “degrowth” of our material standard of living (Martínez-Alier et al., 2010), then it is also useful to ask whether commitment to economic growth is another example of escalation of commitment.

It is also useful to recognize that a discontinuous shift to renewable energy would affect diverse social actors quite differently; the owners of fossil fuel companies will experience great costs, while citizens in regions that will bear the worst impacts of climate change will experience benefits. We cannot preclude the possibility that governments, by continuing to invest in the fossil fuel industry, are working to achieve a “wise compromise” between these interests (Giampietro et al., 2006). However, we can encourage and support our public officials to avoid the escalation of commitment error when deciding on future energy and economic policy.

3.2. Carbon De-Escalation Strategies

Shifting our infrastructures from dependence on fossil fuels to other energy sources will undoubtedly require short-term disruption of both production systems and lifestyles in most developed countries (e.g., Farrell and Brandt, 2006; Nuttall and Manz, 2008), and will, at the least, require considerable changes in our habitual routines and operational procedures. Changing tacks and moving policy and investment away from fossil fuels is likely to be difficult for government and business leaders in part because admitting failure in a previous choice can result in loss of public reputation (e.g., Tykocinski and Ortmann, 2011). This component is likely to affect politicians most strongly, because as a group they make highly public decisions about the investment of public resources and the job of a politician is inherently uncertain. Thus, admission of error in a previous decision can have great consequences for their lives. However, if changing strategy in light of shifting conditions is necessary, postponing the inevitable can ultimately result in even worse consequences for politicians, as was the case for Saskatchewan premier Grant Devine, whose party was not only swept from office in the next election, but has yet to make a comeback in the province almost 30 years later.

For the purpose of shifting the strategy of investing public resources in fossil fuels, four primary ways to reduce public escalation of commitment arise from the research: 1) reduce financial threat (e.g., job security) associated with abandoning an earlier decision and shifting to an alternative, 2) reduce social threat (e.g., reputation), 3) ensure the availability and balanced evaluation of unambiguous information related to all options, and 4) ensure respectful debate between supporters of different options. The implications of the first two strategies for the case of fossil fuels will be discussed together, followed by a discussion of the role of information and decision-making procedures. In these discussions, we primarily address our comments to citizens and government officials because, as discussed above, for fossil fuel producers the costs associated with a transition from fossil fuels may dominate benefits associated with climate change mitigation.

3.2.1. Financial and Reputation Threats

Given our dependence on fossil fuels, there is no way to eliminate the financial disruption associated with reducing and shifting from fossil fuel consumption for anyone, including our decision-makers. However, in the case of public investments in the fossil fuel industry, the resources we are investing and the security that is threatened are both ours collectively (e.g., Milinski et al., 2006). Since the consequences of public investment in fossil fuels (e.g., subsidies to oil companies, royalty structures benefiting resource exploration, building infrastructure such as pipelines and roads) risk leading us to catastrophic climate change, we believe that fossil fuel investment has now become a failing long-term strategy. Despite this, we continue to see evidence of extensive reinvestment in fossil fuel industries and technologies. For example, the current North American debate about building pipelines (e.g., Keystone XL, Northern Gateway) to transport bitumen from the Athabasca oil sands is a question of whether or not to continue to invest our public resources (ecological as well as financial) in fossil fuels. In the future, as climate change

worsens, it is likely that there will be both reputation and financial costs for encouraging fossil fuel use, both for the fossil fuel industries and for politicians who enabled such decisions. The rise of such consequences can already be detected in the changing international reputation of Canada (e.g., Canadian International Council, 2012) due to its persistent efforts to undermine and delay international agreements to reduce dependency on fossil fuels.

Ironically, politicians' concern for their reputation is likely to focus on the threat associated with CHANGING strategy, rather than with shifting to more defensible alternatives. In democratic countries with competitive political systems, it has become common practice to vilify candidates who change their decisions about an issue, associating them with labels connoting poor leadership such as ‘inconsistent’, ‘wishy-washy’, and ‘flip-flopsters’. This highlights the one element of both financial and reputation threat that the public CAN influence; The electorate can ameliorate job-related threats associated with changing the public strategy for elected officials. Citizens can work to shift electoral decision-making strategy from valuing consistent positions on issues to valuing thoughtful decision-making (and communication of such reasoning) from our leaders, even when that results in changing directions on particular issues. Politicians would be well-advised to take the approach of John Maynard Keynes who once quipped, “When the facts change, I change my mind. What do you do, sir?” And citizens would be well-advised to value, rather than denigrate, such adaptability. As Mark Jaccard (2005) states, “If we really want to move toward a sustainable energy system, we need to be more realistic about these constraints facing politicians. We need to think carefully about our objectives and the trade-offs they imply...so that politicians are not faced with career-ending decisions if they are committed to the objectives. ... To ensure its endurance, the [energy] system would need to be flexible and thus adaptable to changing circumstances.” (p. 262).

Persistent calls for greater transparency in government decisions suggests that there is a public appetite for such communication. However, such communication is virtually impossible in ‘30-second soundbites’, and thus new modes of public communication are needed for this purpose. Longer interview formats, such as CBC radio’s ‘The House’, perhaps provide an example of the type of media communication necessary for this purpose.

If democratic electorates can develop ways to value and reward thorough and transparent decision-making in our leaders, we will reduce the conditions that lead to escalation of commitment and research suggests that this will increase the likelihood of de-escalation (e.g., Simonson and Staw, 1992). It will undoubtedly be more effortful to consider the merits of decisions on a case-by-case basis (System 2 reasoning), rather than using a heuristic judgment strategy such as assuming that changes of position indicate weak character (System 1 intuition). The challenge is to reshape our decision-making contexts in order to enhance System 2 reasoning (e.g., Kahneman and Knetsch, 1992; Milinski et al., 2006; Thaler and Benartzi, 2004). Journalists and other media experts are particularly important here (e.g., Antilla, 2005). One important strategy is to convince journalists (and provide them with the time and financial resources) to avoid reporting heuristic or ideologically-motivated judgments of political opponents, and instead to encourage us to value moments when leaders thoughtfully reconsider their previous decisions.¹ In essence, this represents holding leaders accountable for their decision processes, rather than decision outcomes alone, a strategy that has proven successful in limiting escalation of commitment in both the lab and in businesses (Simonson and Staw, 1992).

¹ This is of course, made difficult by concentration of media ownership in the hands of companies with particular value positions on the issue of climate change. For example, Rupert Murdoch’s News Corporation has at times systematically advocated a position of climate change skepticism (McKnight, 2010). This, perhaps, provides one of the best arguments for publicly-funding media, such as the UK’s BBC and Canada’s CBC.

3.2.2. Information Quality and Evaluation

Research indicates that the other factor important to minimize escalation of commitment is the quality of information available to decision makers. This is potentially a difficult issue, given current competitive strategies of manipulating what information is publicly available (e.g., ‘staying on message’), framing how given information is presented (e.g., ‘branding’), as well as the incompatible value positions that result from different epistemologies (Giampietro et al., 2006). With respect to fossil fuel industries, there are also deliberate efforts to maximize confusion about the risks associated with this current strategy (e.g., Jacques et al., 2008) and the state of development for alternative technologies (e.g., Sovacool, 2009) thereby biasing further our System 1 intuition tendencies. But the quality of information available to decision-makers is clearly key (e.g., Milinski et al., 2006), and we need to develop ways to get a full-spectrum of relevant information to both the public and to our decision-makers. Clear information about both the benefits and risks associated with future investment in fossil fuels, energy conservation, and renewable energy options is vital to our collective well-being. Developing specific strategies to enable this are beyond the authors’ competence (cognitive psychology and ecological economics, respectively), but we strongly encourage educators, journalists, and other communication professionals to take on this problem.

Ideally, information informing policy decisions should be clear and unambiguous. However, although we have developed great expertise in calculating probabilities based on past performance, prediction of the future is never completely unambiguous. Furthermore, at the present, public knowledge about fossil fuel options is much greater than knowledge of alternatives, both because of our history with the former, and because of relative silence about the latter. In the case of the most likely alternatives to fossil fuels, renewable energy sources, information is available (e.g., Dincer, 2000; Jacobsson and Johnson, 2000; Nema et al., 2009; Viebahn et al., 2007) but not widely known.² Information about energy conservation options such as zero-net buildings, retrofits of existing buildings, and co-generation plants is better known, but also is not widely disseminated. Furthermore, given the recent development of these technologies relative to our long history with fossil fuels, information about these alternatives changes very rapidly. Thus, although good quality information both about the relative risks and benefits associated with future reliance on fossil fuels vs. alternative energy sources is central to encouraging de-escalation of commitment, there are considerable challenges to both the collection and dissemination of this information.

Biased evaluation of the available information is a second important issue. As discussed above, decision-makers judge information related to the benefits of strategies in which they have invested and the costs of alternatives as more accurate and important than information about the costs of strategies they have invested in or the benefits of alternatives (Schultze et al., 2012). Thus, decision-making processes that encourage thorough and balanced consideration of all information can help to prevent escalation of commitment to public investment in fossil fuels (Greitemeyer et al., 2009).

Finding ways to present and evaluate evidence about costs and benefits associated with different energy strategies is further complicated by the fact that different interests influence what is considered evidence, as discussed in post-normal science (e.g., Funtowicz and Ravetz, 1994; Giampietro et al., 2006). In uncertain situations, individuals and groups embrace incompatible value stances and different epistemologies, and thus have different ideas about how to structure and solve problems, including what information is relevant. Giampietro et al. (2006) argue that scientists and leaders need to

become facilitators, providing both expertise to the public and learning from the public in an iterative process.

For political decisions, both oversight and collective decision-making could be provided by democratic legislatures in which elected representatives reflect at least two distinct political/social perspectives. Ideally, democratic governance institutions were designed to encourage thoughtful discussion of opposing views, similar to that proposed in Greitemeyer et al.’s (2009) ‘devil’s advocate’ procedure. In the Canadian parliament, for example, an official opposition is assigned the role of challenging the decisions of the ruling party, and members of different political parties usually adhere to different principles so minority parties typically contain members with genuinely opposed positions on any decision. However, the value of such debates is limited by the willingness of opponents to actively consider each others’ arguments (which requires System 2 reasoning), a situation that our current polarized political systems work against (e.g., Graham et al., 2009). Furthermore, both the factors of group cohesion (i.e., party affiliation; Gunia et al., 2009) and response to public opposition (Thompson et al., 1998) have been observed to increase escalation of commitment, perhaps counteracting the moderating influence of parliamentary democracy on commitment to losing courses of action. For instance, changes designed to reduce diverse discussion of contentious issues, such as the recent Canadian government streamlining of environmental assessments, reduce such protective procedures, potentially increasing the likelihood of biased decision-making errors.

Government studies on whether to support projects such as the Gateway pipeline can also use deliberative methods of collective decision-making to provide input into the policy-making process (this is the approach advocated by Norgaard, 2007). These analyses can use multiple assessment criteria in order to recognize the presence of actors with different values and epistemological systems (Giampietro et al., 2001, 2006). As discussed, the inclusion of genuine or assigned dissenters in a decision-making process can highlight the assumptions associated with alternative values, preferences and epistemologies, and reduce the tendency to escalate failing commitments (Greitemeyer et al., 2009), provided participants actively engage in thoughtful debate.

However, given the state of oil industry sponsorship of dominant political parties, at least in North American systems (e.g., Farnsworth and Holden, 2006; McMenamin, 2012; Wells and McMahan, 2012), information about alternatives may not be receiving adequate attention in parliamentary or public debates. This situation is exacerbated by actions designed to bias the information available to assess the prospects associated with both the fossil fuel industry and alternative technologies, such as information generated by climate change deniers (Jacques et al., 2008) and government policies designed to prevent the collection and dissemination of relevant data (e.g., Munroe, 2010; Nature editorial, 2012). For example, in recent years the Canadian federal government has reassigned federally-employed climate scientists to other projects and eliminated funding for the Foundation for Climate and Atmospheric Sciences, which has resulted in the closure of research facilities monitoring atmospheric conditions (e.g., Polar Environment Climate Strategy Network, PEARL) and fresh water ecosystems (Experimental Lakes Area, ELA). This takes the biasing of information relevant to alternative choices beyond biased assessment of existing information to the biased selection of information, essentially preventing adequate informational input to decision processes. Given the importance of quality information processing to avoid escalation of commitment errors, reducing public tolerance for political strategies designed to impair access to information is an important goal.

With specific reference to fossil fuel industries, Könnölä et al. (2006) propose ‘prospective voluntary agreements’ negotiated between governments, industries, and other stakeholders (e.g., insurers, service providers) as a solution to decrease ‘techno-institutional lock-in’. As they describe it, this process would involve mandating technology diversity and developing mutually-acceptable visions for

² Efforts continue to expand the availability of this information. For example, the IPCC has recently released a document entitled *Renewable Energy Sources and Climate Mitigation* (IPCC, 2012), which provides a comprehensive summary of the state of renewable energy and its ability to meet the challenge of climate change.

implementing alternative technologies and social systems, processes that would require transparent and thorough decision-making processes as well as diffusing responsibility across decision-making groups. Given the evidence that such strategies decrease escalation of commitment in business contexts (e.g., Greitemeyer et al., 2009; Simonson and Staw, 1992), Könnölä et al.'s proposal has considerable merit.

4. Conclusion

Climate science indicates that greenhouse gas emissions from sources such as fossil fuels threaten ecosystems and human societies. In this context, humanity needs to transition from fossil fuel production and use in order to mitigate impacts of climate change. Given this, further public investment in fossil fuel technologies can be considered an escalation of commitment reasoning error. Review of the escalation of commitment research indicates three important strategies available to citizens to encourage decision-makers to de-escalate public investment in fossil fuels: 1) decreasing the threats associated with switching to alternative investments, 2) increasing the quality of information about risks associated with continued fossil fuel investment and the viability of alternative energy strategies, and 3) making use of processes to increase the consideration of information informing energy investment decisions. There is no doubt that, to some degree, resolution of this issue is one of political will rather than information, but the escalation of commitment research suggests that increasing the availability of information about alternatives to both citizens and political decision-makers is a worthwhile strategy. The research also suggests that citizens may be able to influence political and other public decision-making by reducing the political threat of engaging in genuine reasoned debate and adaptive decision-making. Furthermore, acting to ensure unbiased consideration of available information is also essential, and can perhaps be accomplished by protecting the beneficial decision-making procedures enshrined in parliamentary and legislative traditions.

References

- Alicke, M.D., 1985. Global self-evaluation as determined by the desirability and controllability of trait adjectives. *Journal of Personality and Social Psychology* 49, 1621–1630.
- Anderson, C.J., 2003. The psychology of doing nothing: forms of decision avoidance result from reason and emotion. *Psychological Bulletin* 129, 139–167. <http://dx.doi.org/10.1037/0033-2909.129.1.139>.
- Antilla, L., 2005. Climate of scepticism: US newspaper coverage of the science of climate change. *Global Environmental Change* 15, 338–352.
- Arkes, H., Blumer, C., 1985. The psychology of sunk costs. *Organizational Behavior and Human Decision Processes* 35, 124–140.
- Arrow, K., 1962. The economic implications of learning by doing. *Review of Economic Studies* 29, 155–173.
- Ayres, R.U., Ayres, L.W., Warr, B., 2003. Exergy, power and work in the US economy, 1900–1998. *Energy* 28, 219–273.
- Barnett, J., 2007. The geopolitics of climate change. *Geography Compass* 1, 1361–1375. <http://dx.doi.org/10.1111/j.1749-8198.2007.00066.x>.
- Berkhout, F., 2002. Technological regimes, path dependency and the environment. *Global Environmental Change* 12, 1–4.
- Biyalogorski, E., Boulding, W., Staelin, R., 2006. Stuck in the past: why managers persist with new product failures. *The Journal of Marketing* 70, 108–121.
- Boettcher, W., Cobb, M., 2009. "Don't let them die in vain": casualty frames and public tolerance for escalating commitment in Iraq. *Journal of Conflict Resolution* 53, 677–697.
- Bragger, J.D., Hantula, D.A., Bragger, D., Kiman, J., Kutcher, E., 2003. When success breeds failure: history, hysteresis, and delayed exit decisions. *Journal of Applied Psychology* 88, 6–14. <http://dx.doi.org/10.1037/0021-9010.88.1.6>.
- Brockner, J., 1992. The escalation of commitment to a failing course of action: toward theoretical progress. *The Academy of Management Review* 17, 39–61 (<http://www.jstor.org/stable/258647>).
- Brockner, J., Houser, G., Birnbaum, G., Lloyd, K., Deitcher, J., Naithanson, S., Rubin, J.Z., 1986. Escalation of commitment to an ineffective course of action: the effect of feedback having negative implications for self-identity. *Administrative Science Quarterly* 31, 109–126.
- Canadian International Council, 2012. Is the ethical oil campaign helping or hurting Canada's international reputation? (<http://www.opencanada.org/rapid-response/is-the-ethical-oil-campaign-helping-or-hurting-canadas-international-reputation/>).
- Cavallo, A., 2007. Controllable and affordable utility-scale electricity from intermittent wind resources and compressed air energy storage (CAES). *Energy* 32, 120–127.
- Cunha Jr., M., Caldieraro, F., 2009. Sunk-cost effects on purely behavioral investments. *Cognitive Science* 33, 105–113. <http://dx.doi.org/10.1111/j.1551-6709.2008.01005.x>.
- Dietz-Uhler, B., 1996. The escalation of commitment in political decision-making groups: a social identity approach. *European Journal of Social Psychology* 6, 611–629.
- Dincer, I., 2000. Renewable energy and sustainable development: a crucial review. *Renewable and Sustainable Energy Reviews* 4, 157–175. [http://dx.doi.org/10.1016/S1364-0321\(99\)00011-8](http://dx.doi.org/10.1016/S1364-0321(99)00011-8).
- Dorian, J.P., Franssen, H.T., Simbeck, D.R., 2006. Global challenges in energy. *Energy Policy* 34, 1984–1991. <http://dx.doi.org/10.1016/j.enpol.2005.03.010>.
- Evans, J.St.B.T., 2003. In two minds: dual process accounts of reasoning. *Trends in Cognitive Sciences* 7, 454–459. <http://dx.doi.org/10.1016/j.tics.2003.08.012>.
- Farnsworth, K., Holden, C., 2006. The business–social policy nexus: corporate power and corporate inputs into social policy. *Journal of Social Policy* 35, 473–494. <http://dx.doi.org/10.1017/S00472794060009883>.
- Farrell, A.E., Brandt, A.R., 2006. Risks of the oil transition. *Environmental Research Letters* 1, 1–6. <http://dx.doi.org/10.1088/1748-9326/1/1/014004>.
- Fleming, S.M., Thomas, C.L., Dolan, R.J., 2010. Overcoming status quo bias in the human brain. *PNAS* 107, 6005–6009. <http://dx.doi.org/10.1073/pnas.0910380107>.
- Fox, S., Bizman, A., Huberman, O., 2009. Escalation of commitment: the effect and attractiveness of available investment alternatives. *Journal of Business and Psychology* 24, 431–439. <http://dx.doi.org/10.1007/s10869-009-9124-2>.
- Funtowicz, S.O., Ravetz, J.R., 1994. The worth of a songbird: ecological economics as a post-normal science. *Ecological Economics* 10, 197–207.
- Garland, H., Sandefur, C.A., Rogers, A.C., 1990. De-escalation of commitment in oil exploration: when sunk costs and negative feedback coincide. *Journal of Applied Psychology* 6, 721–727.
- Giampietro, M., Mayumi, K., Bukkens, S., 2001. Multiple-scale integrated assessment of societal metabolism: an analytical tool to study development and sustainability. *Environment, Development and Sustainability* 3, 275–307.
- Giampietro, M., Mayumi, K., Munda, G., 2006. Integrated assessment and energy analysis: quality assurance in multi-criteria analysis of sustainability. *Energy* 31 (7), 59–86. <http://dx.doi.org/10.1016/j.energy.2005.03.005>.
- Graham, J., Haidt, J., Nosek, B.A., 2009. Liberals and conservatives rely on different moral foundations. *Journal of Personality and Social Psychology* 96, 1029–1046. <http://dx.doi.org/10.1037/a0015141>.
- Greitemeyer, T., Schulz-Hardt, S., Frey, D., 2009. The effects of authentic and contrived dissent on escalation of commitment in group decision making. *European Journal of Social Psychology* 39, 639–647.
- Gunia, B.C., Sivanathan, N., Galinsky, A.D., 2009. Vicarious entrapment: your sunk costs, my escalation of commitment. *Journal of Experimental Social Psychology* 45, 1238–1244. <http://dx.doi.org/10.1016/j.jesp.2009.07.004>.
- Hall, C., Balogh, S., Murphy, D.J.R., 2009. What is the minimum EROI that a sustainable society must have? *Energies* 2, 25–47.
- Harvey, P., Victoravich, L.M., 2009. The influence of forward-looking antecedents, uncertainty, and anticipatory emotions on project escalation. *Decision Sciences* 40, 759–782. <http://dx.doi.org/10.1111/j.1540-5015.2009.00250.x>.
- IPCC, 2012. Renewable Energy Sources and Climate Change Mitigation: Special Report of the Intergovernmental Panel on Climate Change (IPCC). In: Edenhofer, Ottmar, Pichs Madruga, Ramon, Sokona, Youba (Eds.), Cambridge University Press, Cambridge, UK.
- Jaccard, M., 2005. Sustainable fossil fuels: the unusual suspect in the quest for clean and enduring energy. Cambridge University Press, Cambridge, UK.
- Jacobsson, S., Johnson, A., 2000. The diffusion of renewable energy technology: an analytical framework and key issues for research. *Energy Policy* 28, 625–640. [http://dx.doi.org/10.1016/S0301-4215\(00\)00041-0](http://dx.doi.org/10.1016/S0301-4215(00)00041-0).
- Jacques, P.J., Dunlap, R.E., Freeman, M., 2008. The organisation of denial: conservative think tanks and environmental scepticism. *Environmental Politics* 17, 349–385. <http://dx.doi.org/10.1080/09644010802055576>.
- Kahneman, D., 1992. Reference points, anchors, norms, and mixed feelings. *Organizational Behavior and Human Decision Processes* 51, 296–312.
- Kahneman, D., 2002. Maps of bounded rationality: psychology for behavioral economics. *The American Economic Review* 93, 1449–1475.
- Kahneman, D., 2011. Thinking, Fast and Slow. Doubleday Canada, Toronto.
- Kahneman, D., Knetsch, J.L., 1992. Valuing public goods: the purchase of moral satisfaction. *Journal of Environmental Economics and Management* 22, 57–70. [http://dx.doi.org/10.1016/0095-0696\(92\)90019-5](http://dx.doi.org/10.1016/0095-0696(92)90019-5).
- Karlsson, N., Garling, T., Bonini, N., 2005a. Escalation of commitment with transparent future outcomes. *Experimental Psychology* 52, 67–73. <http://dx.doi.org/10.1027/1618-3169.52.1.67>.
- Karlsson, N., Juliusson, E.A., Garling, T., 2005b. A conceptualization of task dimensions influencing escalation of commitment. *European Journal of Cognitive Psychology* 17, 835–858. <http://dx.doi.org/10.1080/09541440540000004>.
- Katz, M., Shapiro, C., 1985. Network externalities, competition, and compatibility. *The American Economic Review* 75 (3), 424–440.
- Khudhair, A.M., Farid, M.M., 2004. A review on energy conservation in building applications with thermal storage by latent heat using phase change materials. *Energy Conservation and Management* 45, 263–275. [http://dx.doi.org/10.1016/S0196-8904\(03\)00131-6](http://dx.doi.org/10.1016/S0196-8904(03)00131-6).
- Kokis, J.V., Macpherson, R., Toplak, M.E., West, R.F., Stanovich, K.E., 2002. Heuristic and analytic processing: age trends and association with cognitive ability and cognitive styles. *Journal of Experimental Child Psychology* 83, 26–52.
- Könnölä, T., Unruh, G.C., Carrillo-Hermosilla, J., 2006. Prospective voluntary agreements for escaping techno-institutional lock-in. *Ecological Economics* 57, 239–252. <http://dx.doi.org/10.1016/j.ecolecon.2005.04.007>.

- Ku, G., 2008. Before escalation: behavioral and affective forecasting in escalation of commitment. *Personality and Social Psychology Bulletin* 34, 1477–1491. <http://dx.doi.org/10.1177/0146167208322559>.
- Martínez-Alier, J., Pascual, U., Vivien, F.-D., Zaccai, E., 2010. Sustainable de-growth: mapping the context, criticisms and future prospects of an emergent paradigm. *Ecological Economics* 69 (9), 1741–1747. <http://dx.doi.org/10.1016/j.ecolecon.2010.04.017>.
- McCarty, J.P., 2002. Ecological consequences of recent climate change. *Conservation Biology* 15, 320–331. <http://dx.doi.org/10.1046/j.1523-1739.2001.015002320.x>.
- McDonald, A., Schratzenholzer, L., 2001. Learning rates for energy technologies. *Energy Policy* 29, 255–261.
- McKnight, D., 2010. Rupert Murdoch's news corporation: a media institution with a mission. *Historical Journal of Film, Radio and Television* 30 (3), 303–316. <http://dx.doi.org/10.1080/01439685.2010.505021>.
- McMenamin, I., 2012. If money talks, what does it say? Varieties of capitalism and business financing of parties. *World Politics* 64, 1–38. <http://dx.doi.org/10.1017/S004388711100027x>.
- McNamara, G., Moone, H., Bromiley, P., 2002. Banking on commitment: intended and unintended consequences of an organization's attempt to attenuate escalation of commitment. *Academy of Management Journal* 45, 443–452.
- Milinski, M., Semmann, D., Krambeck, H.-J., Marotzke, J., 2006. Stabilizing the earth's climate is not a losing game: supporting evidence from public goods experiments. *Proceedings of the National Academy of Sciences of the United States of America* 103, 3994–3998. <http://dx.doi.org/10.1073/pnas.0504902103>.
- Molden, D.C., Hui, C.M., 2011. Promoting de-escalation of commitment: a regulatory-focus perspective on sunk costs. *Psychological Science* 22, 8–12. <http://dx.doi.org/10.1177/0956797610390386>.
- Muller, R., 2012. Berkley Earth Surface Temperature Study. (retrieved Aug. 13, 2012 from <http://berkeleyearth.org/results-summary/>).
- Munroe, I., 2010. Climate change research in Canada waning: scientists. *CTV.ca News* (April 3, 2010).
- Nature editorial, 2012. Frozen out. *Nature* 483, 6. <http://dx.doi.org/10.1038/483006a> (March 1, 2012).
- Nema, P., Nema, R.K., Rangnekar, S., 2009. A current and future state of art development of hybrid energy system using wind and PV-solar: a review. *Renewable and Sustainable Energy Reviews* 13, 2096–2103. <http://dx.doi.org/10.1016/j.rser.2008.10.006>.
- Norgaard, R., 2007. Deliberative economics. *Ecological Economics* 63, 375–382.
- Nuttall, W.J., Manz, D.L., 2008. A new energy security paradigm for the twenty-first century. *Technological Forecasting and Social Change* 75, 1247–1259. <http://dx.doi.org/10.1016/j.techfore.2008.02.007>.
- Odean, T., 1998. Are investors reluctant to realize their losses? *Journal of Finance* 53, 1775–1798.
- Pacala, S., Socolow, R., 2004. Stabilization wedges: solving the climate problem for the next 50 years with current technologies. *Science* 305 (5686), 968–972.
- Price, D., 1995. Energy and human evolution. *Population and Environment* 16 (4), 301–319.
- Rivers, N., Jaccard, M., 2006. Choice of environmental policy in the presence of learning by doing. *Energy Economics* 28, 223–242.
- Ross, J., Staw, B.M., 1986. Expo 86: an escalation prototype. *Administrative Science Quarterly* 31, 274–297.
- Ross, J., Staw, B.M., 1993. Organizational escalation and exit: lessons from the Shoreham Nuclear Power Plant. *Academy of Management Journal* 36, 701–723.
- Rubin, J.Z., Brockner, J., 1975. Factors affecting entrapment in waiting situations: the Rosencrantz and Guildenstern effect. *Journal of Personality and Social Psychology* 31, 1054–1063.
- Samuelson, W., Zeckhauser, R., 1988. Status quo bias in decision making. *Journal of Risk and Uncertainty* 1, 7–59.
- Saskatoon Star Phoenix, 2006. Investing in innovation (March 22, 2006).
- Scheffrin, H., Statman, M., 1985. The disposition to sell winners too early and ride losers too long: theory and evidence. *Journal of Finance* 40, 777–790.
- Schott, J.P., Scherer, L.D., Lambert, A.J., 2011. Casualties of war and sunk costs: implications for attitude change and persuasion. *Journal of Experimental Social Psychology* 47, 1134–1145. <http://dx.doi.org/10.1016/j.jesp.2011.06.002>.
- Schultze, T., Pfeiffer, F., Schulz-Hardt, S., 2012. Biased information processing in the escalation paradigm: information search and information evaluation as potential mediators of escalating commitment. *Journal of Applied Psychology* 97, 16–32. <http://dx.doi.org/10.1037/a0024739>.
- Schulz-Hardt, S., Jochims, M., Frey, D., 2002. Productive conflict in group decision making: genuine and contrived dissent as strategies to counteract biased information seeking. *Organizational Behavior and Human Decision Processes* 88, 563–586.
- Seibert, S.E., Goltz, S.M., 2001. Comparison of allocations by individuals and interacting groups in an escalation of commitment situation. *Journal of Applied Psychology* 31, 134–156.
- Silvanathan, M., Molden, D.C., Galinsky, A.D., Ku, G., 2008. The promise and peril of self-affirmation in de-escalation of commitment. *Organizational Behavior and Human Decision Processes* 107, 1–14.
- Simonson, I., Staw, B.M., 1992. Deescalation strategies: a comparison of techniques for reducing commitment to losing courses of action. *Journal of Applied Psychology* 77, 419–426.
- Sims, R., Rogner, H.H., Gregory, K., 2003. Carbon emission and mitigation cost comparisons between fossil fuel, nuclear and renewable energy resources for electricity generation. *Energy Policy* 31, 1315–1326.
- Smith, A., Stirling, A., Berkhout, F., 2005. The governance of sustainable socio-technical transitions. *Research Policy* 34, 1491–1510. <http://dx.doi.org/10.1016/j.respol.2005.07.005>.
- Sokolov, A.P., Stone, P.H., Forest, C.E., Prinn, R., Sarofim, M.C., Webster, M., et al., 2009. Probabilistic forecast for 21st century climate based on uncertainties in emissions (without policy) and climate parameters. *Journal of Climate* 22, 5175–5204. <http://dx.doi.org/10.1175/2009JCL12863.1>.
- Soman, D., 2001. The mental accounting of sunk time costs: why time is not like money. *Journal of Behavioral Decision Making* 14, 160–185.
- Sovacool, B.K., 2009. The cultural barriers to renewable energy and energy efficiency in the United States. *Technology in Society* 31, 365–373. <http://dx.doi.org/10.1016/j.techsoc.2009.10.009>.
- Stanovich, K.E., West, R.F., 1998. Individual differences in rational thought. *Journal of Experimental Psychology: General* 127, 162–188. <http://dx.doi.org/10.1037/0096-3445.127.2.161>.
- Staw, B.M., 1976. Knee-deep in the Big Muddy: a study of escalation of commitment to a chosen course of action. *Organizational Behavior and Human Performance* 16, 27–44.
- Thaler, R.H., Benartzi, S., 2004. Save more tomorrow: using behavioral economics to increase employee saving. *Journal of Political Economy* 112, S164–S187.
- Thaler, R.H., Sunstein, C.R., 2008. *Nudge: Improving decisions about health, wealth, and happiness*. Yale University Press.
- Thompson, L., Kray, L.J., Lind, E.A., 1998. Cohesion and respect: an examination of group decision making in social and escalation dilemmas. *Journal of Experimental Social Psychology* 34, 289–311.
- Tykocinski, O.E., Ortmann, A., 2011. The lingering effects of our past experiences: the sunk cost fallacy and the inaction–inertia effect. *Social and Personality Psychology Compass* 5 (9), 653–664. <http://dx.doi.org/10.1111/j.1751-9004.2011.00369x>.
- Unruh, G.C., 2000. Understanding carbon lock-in. *Energy Policy* 28, 817–830.
- Unruh, G.C., 2002. Escaping carbon lock-in. *Energy Policy* 30, 317–325.
- Unruh, G.C., Carrillo-Hermosilla, J., 2006. Globalizing carbon lock-in. *Energy Policy* 34, 1185–1197. <http://dx.doi.org/10.1016/j.enpol.2004.10.013>.
- Viebahn, P., Nitsch, J., Fischedick, M., Esken, A., Schüwer, D., Supersberger, N., Zuberbühler, U., Edenhofer, O., 2007. Comparison of carbon capture and storage with renewable energy technologies regarding structural, economic, and ecological aspects in Germany. *International Journal of Greenhouse Gas Control* 1, 121–133. [http://dx.doi.org/10.1016/S1750-5836\(07\)00024-2](http://dx.doi.org/10.1016/S1750-5836(07)00024-2).
- Weitzman, M.L., 2011. Fat-tailed uncertainty in the economics of catastrophic climate change. *Review of Environmental Economics and Policy* 5 (2), 275–292.
- Wells, P., McMahon, T., 2012. How Ottawa runs on oil: suddenly western money and influence are driving everything that happens in the nation's capital. *Macleans* (March 23. <http://www2/macleans.ca/2012/03/23/oil-power/>).
- Whyte, G., 1991. Diffusion of responsibility: effects on the escalation tendency. *Journal of Applied Psychology* 76, 408–415.

"Psychology Works" Fact Sheet: Climate Change and Anxiety

Posted on [December 10, 2020](#)

Experiencing Anxiety Related to Climate Change

Climate change is a "long-term change in the average weather patterns that have come to define Earth's local, regional, and global climates."[\[1\]](#) Because of the uncertainty and severity of climate change, people are seeking treatment for negative feelings related to climate-related events and the future of our planet. These negative feelings may include a sense of powerlessness and hopelessness about the current and future state of the natural environment, one's own quality of life in relation to climate-related events, and about general human health and wellbeing.

What Contributes to Anxiety Related to Climate Change?

Feelings of anxiety about the state of the Earth's climate can be experienced before, during, and after a climate-related event[\[2\]](#):

Before a Climate-related Event

Warnings of climate-related events, such as hurricanes, storms, and wildfires, can cause acute worry about personal safety, the safety of loved ones, and/or the safety of homes and other property. Worry may also be experienced when people consider the possibility of impending and serious environmental problems—in the body of environmental psychology literature, this is known as *habitual ecological worrying*[\[3\]](#). Individuals experiencing this type of worry may cope better by adopting pro-environmental attitudes and actions. Sometimes this form of worry can become less constructive if it is associated with feelings of loss, helplessness, frustration, and an inability to improve the situation. In the environmental psychology literature, this is known as *eco-anxiety*[\[4\]](#)

During a Climate-related Event

Human mental health can be significantly affected during a rapid climate-related event. Victims of these events may quickly and unexpectedly lose property and belongings. Some may also lose family members and friends to disasters caused by climate change. Human mental health can also be impacted by climate-related events that occur gradually over time. For example, those who live in areas of the world where climate change has significantly affected landscapes and livelihoods tend to report a deep sadness, or *solastalgia*, about environmental change.

After a Climate-related Event

When a loss of friends and family, community, homes and belongings, employment, and economic certainty occurs because of a climate-related event, the results can be far-reaching and long-lasting. Outcomes may include depression, post-traumatic stress disorder (PTSD), grief, despair, aggression, interpersonal difficulties, substance abuse, and even suicide. In some cases, individuals may develop a condition called the *climate change delusion*,^[5] characterized by a belief that one's actions, no matter how insignificant, will have a serious negative effect on those suffering through climate-related events.

Who is Most Vulnerable?

Gifford and Gifford (2016) reference studies indicating that anxiety related to climate change tends to strongly affect children, older adults, individuals with pre-existing mental health conditions, and people with fewer economic resources. For example:

- Children with anxiety about climate change may experience symptoms such as low mood, anxiety, nightmares, flashbacks, social withdrawal, and difficulty being separated from caregivers. These symptoms have been shown to be more severe in children than adults and may persist later in life.
- Older adults can be more physically vulnerable to changes in the climate around them, and are sometimes less able to employ effective coping mechanisms, such as pro-environmental behaviours, during times of distress.
- People with fewer economic resources may also be more vulnerable to climate-related events as a result of their living conditions, employment conditions or status, a lack of access to resources, goods and services, and inability to engage in pro-active eco-conscious behaviours.
- Individuals living in countries with fewer resources available to protect people against the ramifications of climate-related events may become more severely affected by climate change.

How can Psychologists Help People who are Experiencing Anxiety about Climate Change?

Psychologists have the knowledge and expertise to help people process the negative effects of climate change on mental health, as well as to encourage effective and positive behavior.^[6]

Psychological Practice and Services

Although some people may cope with their concerns about climate change by engaging in some form of climate-related activism (e.g., avoiding the use of single-use plastics, recycling, using less water, and so on), others may cope by disengaging or worrying excessively. Psychological therapies can help individuals experiencing anxiety about the climate to gain control over their worries, decrease their anxiety, and improve their overall quality of life. Therapies that can be effective are:

- Cognitive re-evaluation therapy to help correct thinking patterns that cause and increase worry
- Problem-solving training to learn better ways to solve everyday problems
- Exposure therapy to help confront and control, rather than avoid and be controlled by, fear
- Progressive relaxation to help decrease some of the physical symptoms of anxiety.^[7]

For children, youth and young adults who have experienced a climate-related event or are experiencing anxiety about the climate, psychologists working in schools, colleges, and universities are available for support in school and academic settings.

Psychological Science

Psychological research can provide answers to existing and emerging climate-related questions. Whether the focus is to change destructive behaviors, like minimizing the use of motor vehicles, or to embrace beneficial actions, like using public transit, psychological research is key to understanding how people think about the environment and economic issues.[8]

Advocacy

Individuals, organizations, and all levels of government have a critical role to play in both understanding and addressing the relationship between climate change, health, the economy, and the behaviour of individuals. Effective responses to climate change will require promoting behavioural change at the individual and collective levels. Environmental psychologists can assist organizations and government in the development of education programs and public policies that overcome the discrepancies between what people understand about climate change and their everyday behaviours related to the environment.[9] For those experiencing anxiety and other mental health issues, appropriate funding for mental health services at all levels of society is important.

Knowledge Mobilization

To increase awareness of climate change as well as promote more responsibility and behaviour change on the part of Canadians, understanding how people process information and make decisions is important. Accurate and consistent information about climate change should be provided to individuals by trusted and knowledgeable organizations in an encouraging manner. Messages should be motivating and focus on the positive outcomes of prevention strategies, rather than be discouraging or frightening.

For More Information:

More information on the intersections between psychology and climate change can be found in these references:

- Gifford, R. (2011). The dragons of inaction: Psychological barriers that limit climate change mitigation and adaptation. *American Psychologist* 66, 290–302.
- Steg, L., & Vlek, C. (2008). Encouraging pro-environmental behaviour: An integrative review and research agenda. *Journal of Environmental Psychology*, 29, 309-317.

You can consult a registered psychologist to find out whether psychological interventions might be helpful for you.

For the names and locations of provincial and territorial psychological associations, please visit

<https://cpa.ca/public/whatisapsychologist/PTassociations/>

This fact sheet has been prepared for the Canadian Psychological Association by Dr. Lindsay J. McCunn, Vancouver Island University, Mr. Alexander Bjornson, Vancouver Island University, and Dr. Robert Gifford, University of Victoria.

Date: December 1st, 2020

Please contact us with questions or comments about any of the *Psychology Works* Fact Sheets at factsheets@cpa.ca

Canadian Psychological Association
141 Laurier Avenue West, Suite 702

Ottawa ON K1P 5J3

Tel: 613-237-2144 or toll free (in Canada): 1-888-472-0657

[1] <https://climate.nasa.gov/resources/global-warming-vs-climate-change/>

[2] Gifford, E., & Gifford, R. (2016). The largely unacknowledged impact of climate change on mental health. *Bulletin of the Atomic Scientists*, 72, 292-297.

[3] Verplanken, B., & D. Roy. (2013). "My worries are rational, climate change is not": Habitual ecological worrying is an adaptive response." *PLoS ONE*, 8(9), e74708.

[4] Rabinowitz, P. M., & A. Poljak. (2003). "Host-environment medicine: A primary care model for the age of genomics." *Journal of General Internal Medicine*, 18(3), 222-227.

[5] National Wildlife Federation. (2011). The psychological effects of global warming on the United States and why the U.S. mental health care system is not adequately prepared. National Forum and Research Report, February 2012. https://www.nwf.org/pdf/Reports/Psych_Effects_Climate_Change_Full_3_23.pdf.

[6] <https://www.theguardian.com/environment/2020/oct/08/anxiety-climate-crisis-trauma-paralysing-effect-psychologists>

[7] https://cpa.ca/docs/File/Publications/FactSheets/PsychologyWorksFactSheet_GeneralizedAnxietyDisorder.pdf

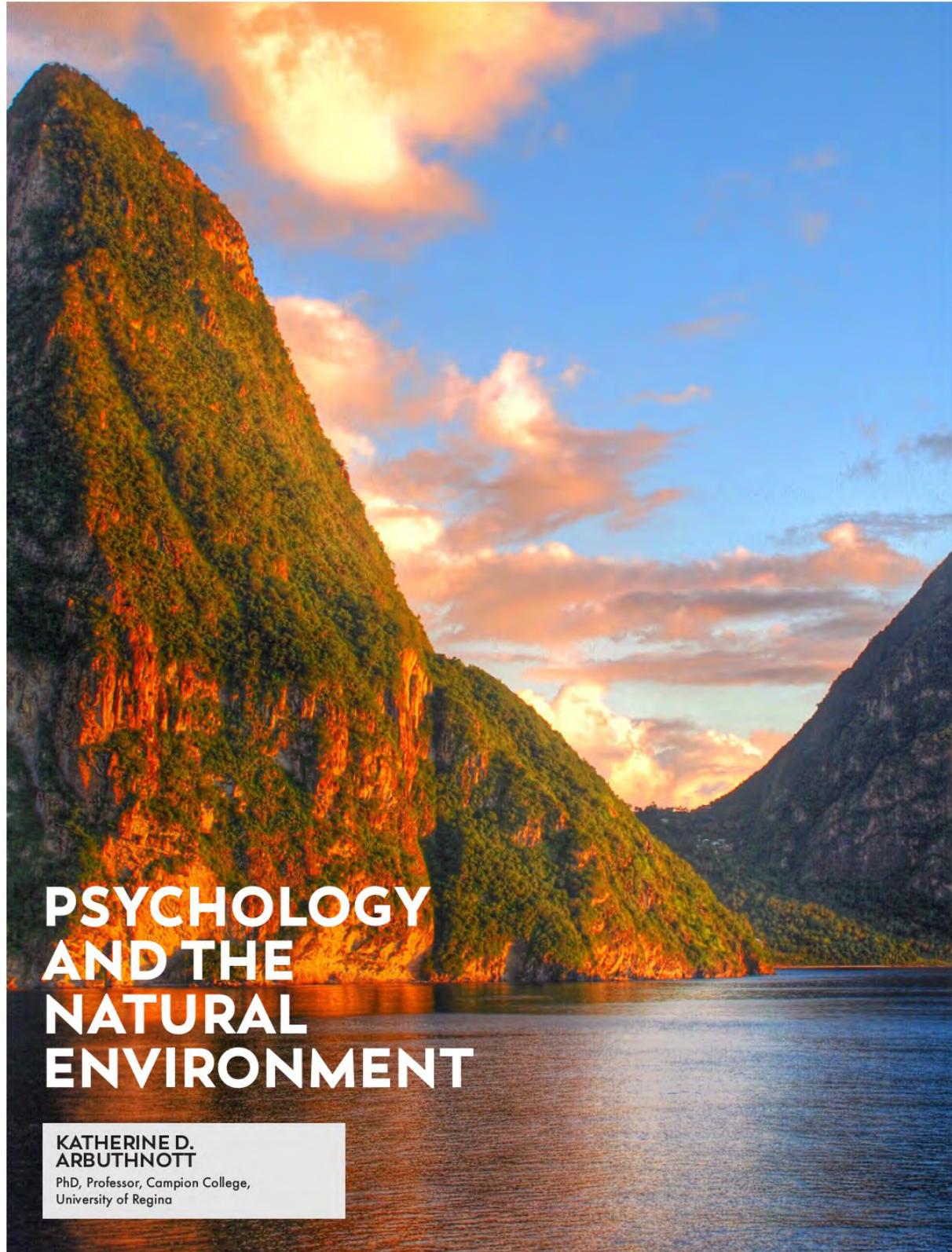
[8]

<https://cpa.ca/docs/File/Government%20Relations/Canadian%20Psychological%20Association's%202020%20Pre%20Budget%20Submission.pdf>

[9]

<https://cpa.ca/docs/File/Government%20Relations/Canadian%20Psychological%20Association's%202020%20Pre%20Budget%20Submission.pdf>

CLIMATE CHANGE



PSYCHOLOGY AND THE NATURAL ENVIRONMENT

**KATHERINE D.
ARBUTHNOTT**

PhD, Professor, Campion College,
University of Regina

Why should psychologists involve themselves in the problems associated with climate change? The discipline of psychology is essential in crafting effective actions to mitigate and adapt to climate change, as has been well articulated over the past decade.¹⁻⁶ But, beyond such multidisciplinary collaboration, the central goals of psychology itself are impacted by the health of the natural environment.

Psychology is a very diverse discipline, encompassing research and application ranging from physiology to human cultures. Although the specific goals of each area differ, psychologists are united in developing, disseminating, and using knowledge to improve peoples' health and welfare. There is now strong evidence that several aspects of human health and well-being are significantly influenced by contact with the natural environment, including physical, emotional, cognitive, and social health. Thus, environmental issues, including climate change, are central to psychology.

Health Effects of Nature Contact: Thumbnail Sketches

Research across the globe indicates that people who live close to natural landscapes live longer and enjoy better health in those extra years.⁷⁻⁸ Nearby vegetation improves air quality, protects us from intense heat, and facilitates healthy behaviors, such as exercise and interacting with others.⁹ Frequent contact with nature reduces both acute and chronic stress,¹⁰⁻¹³ and the incidence of chronic illness, including cardiovascular¹² and respiratory diseases.^{8,13}

Exposure to natural landscapes and other species improves our emotional

experience almost immediately.¹⁴⁻¹⁸ Over the long term, living closer to natural landscapes reduces the risk of mental health problems, including depression, anxiety, and stress disorders.¹⁹⁻²⁰ Frequent access to natural areas seems to be particularly important for children: one study found that Danish children who lived in areas with good quality greenspace for the first ten years of their lives were much less likely to suffer from a wide range of emotional and psychiatric illnesses in their adolescence and adulthood than children whose neighbourhoods were devoid of natural areas.²¹

Considerable evidence also exists that contact with nature improves cognitive performance, especially in tasks involving attention²²⁻²⁴ and self-control.²⁵⁻²⁷ Effective concentration and self-control have many important practical implications for human welfare, including improved school achievement,²⁸ slower cognitive deterioration in seniors,²⁹ and better decision making, even under trying circumstances.³⁰⁻³¹ More recently, research also indicates that contact with the natural world increases prosocial behaviors such as generosity, helpfulness, and cooperation.³²⁻³⁴ Practically, this could facilitate the creation and maintenance of strong interpersonal relationships, which are known to influence human health in many ways.³⁵⁻³⁶ The quality of natural landscapes in neighbourhoods is also correlated with rates of aggression and crime.^{27,37-39}

Scattered throughout this research is evidence that having frequent access to natural landscapes reduces the health inequalities associated with poverty and other types of deprivation. This has been observed for physical health,^{8,12,40} chronic stress,^{40,41,44} and school achievement.⁴²

We don't yet know exactly how nature influences such diverse aspects of human health. Given the range of effects, several processes are likely at play, including physiological, psychological, cognitive, behavioural, and even aesthetic factors.^{40,43} For example, physiologically, time spent in natural environments increases the activity of immune cells,⁴⁵ and biodiversity may increase the health of our microbiome.⁴⁶ Whatever the mechanism, these widespread and robust effects of nature on human health are important to psychological research and practice.

Conclusion

This is just a small sample of the burgeoning evidence of how human interaction with the natural world influences well-being. This evidence indicates that the continued destruction and degradation of our natural landscapes and biodiversity is a critical psychological issue. Our mission as psychologists is to increase and use our knowledge to improve human welfare and we now know that one powerful means to accomplish this is to regularly spend time in contact with nature. Thus, protection and preservation of the natural world is a direct psychological imperative. Moreover, the evidence indicating that several health and achievement imbalances associated with poverty are reduced with the availability of healthy nature in poor neighbourhoods means that environmental protection also serves the social justice goals of psychology. Thus, psychologists should involve themselves with climate change both to increase the likelihood of success for climate actions generally,^{2,3} and to enable us to fulfill our disciplinary mandate to improve human health and well-being.

FOR A COMPLETE LIST OF REFERENCES,
PLEASE GO TO CPA.CA/PSYNOOPSIS

CLIMATE CHANGE



ADDRESSING CLIMATE CHANGE IN CANADA: THE IMPORTANCE OF PSYCHOLOGICAL SCIENCE

A POSITION PAPER OF THE CANADIAN
PSYCHOLOGICAL ASSOCIATION

APPROVED BY BOARD OF DIRECTORS
– JANUARY 19, 2021

Prepared by:

Lindsay McCunn, PhD, Chair
Robert Gifford, PhD
Jennifer A. Veitch, PhD
Katherine Arbuthnott, PhD
Jiaying Zhao, PhD
Paul Arnold-Schutta, MA
Charlotte Young, MA
Nicole Jardine, BSc



The Canadian Psychological Association (CPA) is the national association for the science, practice, and education of psychology in Canada. The CPA's vision is a society where understanding of diverse human needs, behaviours and aspirations drive legislation, policies and programs for individuals, organizations and communities. We aim to accomplish this by advancing research, knowledge and the application of psychology in the service of society through advocacy, support and collaboration.

The CPA is committed to working with government, and other health and science stakeholders, to advocate for evidence-based policies that best meet the needs of the public it serves. In this position paper, the CPA draws upon the science and practice of psychology, particularly in the areas of mental health, environmental psychology and behaviour change, to inform how Canada responds to climate change threats.

Societal responses to climate change include limiting the degree of climate change by reducing greenhouse gas emissions, mitigating the effects of climate change, and adapting to new conditions. Psychological science is key to the success of these efforts. Research findings in the field of environmental psychology demonstrate how natural and built settings affect human health and wellness and how human behaviour and individual decision-making in turn affect the natural and built environment. An understanding of human behaviour and decision-making must inform government policies that aim to conserve nature, promote energy-efficient building practices, and help Canadians make environmentally sustainable decisions in all their activities.

The Impact of Human Behaviour on the Environment

- Individuals are more likely to take pro-environmental action when they know what to do and believe that they can do it.
- Those who hold more materialistic values have lower wellbeing, and are less likely to hold pro-environmental attitudes and behave eco-consciously. However, individuals who affiliate with others, and have a sense of community, and have greater wellbeing behave in more pro-environmental ways.
- Many individuals tend to justify their behaviours, which can limit good intentions toward the environment. Recognizing this can be important for overcoming barriers to climate action.
- It can be difficult for many people to understand their own carbon footprint. It is also challenging for consumers to identify products that are the least and most environmentally harmful.
- Developing a sense of global identity can motivate people to act in pro-environmental ways.

The Impact of the Natural Environment on Mental Health and Wellbeing

- Natural landscapes increase positive emotions and reduce negative emotions.

CLIMATE CHANGE

- Living near to a natural landscape reduces the risk of depression, anxiety, and stress in the long-term. Children who live near to nature cope better with stress and develop psychological resilience. Those who do not grow up near nature are more likely to be diagnosed with an emotional illness later in life.
- How often one encounters a natural landscape is more important to mental health than how much time is spent in it. Green spaces should be widely distributed in cities and towns, accessible to residents of all ages and abilities.
- Contact with nature increases pro-social behaviours like helpfulness and generosity, and improves attention, working memory, and self-control.
- Successful community-based, culturally-responsive disaster preparedness programs integrate emotional and mental health factors.

The Impact of the Built Environment on Mental Health and Wellbeing

- Most people spend most of their time indoors and buildings significantly affect behaviour, health, and well-being. Green buildings (those designed according to the principles of the Green Building movement) enhance satisfaction with the environment and sleep quality, and those who visit, live, or work in them find them more visually and physically pleasing. Some studies suggest that green buildings positively affect job satisfaction and employer-assessed productivity.
- While technologies exist to dramatically reduce building energy use, more research is needed to ensure that interior conditions in buildings that use these technologies support the well-being of those who use them.

Because of these and other key research findings, the CPA recommends that:

1. **Communications to the public, by federal, provincial and territorial governments, about human behaviour and the environment should:**

- Emphasize that climate change, and its many impacts, is happening now everywhere .
- Increase public literacy about environmental issues so that consumers better understand how the products they use affect the environment.
- Empower and support, rather than frighten, people into changing their behaviour towards the environment. Use visual images to talk about climate change and ones that are not overtly frightening. Promote hope, not despair.
- Show the important personal, social, and economic benefits of climate-positive actions.
- Foster a global identity—the environment depends on the collective action of all the planet's people.
- Promote the importance of the natural environment to human health and wellbeing.
- Remind citizens that every climate-positive action helps.

2. **Climate policy undertaken by federal, provincial and/or territorial governments must:**

- Be informed by psychological science so that climate change programs, national building codes, regulations, and incentive programs for energy-efficient technologies, are based on the latest understandings of human behaviour and behaviour change.
- Preserve and protect natural landscapes and parks in all areas of the country, including those in urban areas. Natural areas significantly benefit mental health and well-being for individuals, families and communities.
- Ensure that energy-efficient indoor settings support health and well-being as defined by the World Health Organization¹, and that such policies be included in the *National Energy Code of Canada for Buildings* and the *National Building Code of Canada*.

- Recognize and reward those individuals and organizations who make extraordinary efforts toward environmental sustainability.
- Ensure that risk management and emergency preparedness plans following a climate event support the displacement and relocation of people, as well as the delivery of mental health and crisis responses services.

3. **Federal, provincial, and territorial governments support research that addresses the relationship between health, wellbeing, human behaviour and climate change with particular attention to:**

- Social norms, pro-environmental attitudes, and environmentally-adaptive behaviours at the individual, community, corporate, and national levels and how these can promote effective programs and policies that reduce carbon-producing behaviours.
- Cross-cultural research on values and factors that can create a stronger culture of nature conservation in Canada.
- Increase our understanding of how to prepare individuals to cope with extreme climate events.
- The complex relationship between climate change and mental health, including how to treat climate-related mental health problems (e.g. eco-anxiety, stress disorders following an environmental event).
- How to increase climate change literacy among Canadians.
- Identifying barriers to pro-environmental behaviour that hinder the pro-climate choices of individuals, organizations, and communities.
- Rigorously evaluating ways in which communities can help individuals and organizations engage in environmentally sustainable behaviour. ■

FOR A COMPLETE LIST OF REFERENCES,
PLEASE GO TO CPA.CA/PSYNOPSIS

Climate anxiety in children and young people and their beliefs about government responses to climate change: a global survey

Caroline Hickman*, Elizabeth Marks*, Panu Pihkala, Susan Clayton, R Eric Lewandowski, Elouise E Mayall, Britt Wray, Catriona Mellor, Lise van Susteren



Summary

Background Climate change has important implications for the health and futures of children and young people, yet they have little power to limit its harm, making them vulnerable to climate anxiety. This is the first large-scale investigation of climate anxiety in children and young people globally and its relationship with perceived government response.

Methods We surveyed 10 000 children and young people (aged 16–25 years) in ten countries (Australia, Brazil, Finland, France, India, Nigeria, Philippines, Portugal, the UK, and the USA; 1000 participants per country). Invitations to complete the survey were sent via the platform Kantar between May 18 and June 7, 2021. Data were collected on participants' thoughts and feelings about climate change, and government responses to climate change. Descriptive statistics were calculated for each aspect of climate anxiety, and Pearson's correlation analysis was done to evaluate whether climate-related distress, functioning, and negative beliefs about climate change were linked to thoughts and feelings about government response.

Findings Respondents across all countries were worried about climate change (59% were very or extremely worried and 84% were at least moderately worried). More than 50% reported each of the following emotions: sad, anxious, angry, powerless, helpless, and guilty. More than 45% of respondents said their feelings about climate change negatively affected their daily life and functioning, and many reported a high number of negative thoughts about climate change (eg, 75% said that they think the future is frightening and 83% said that they think people have failed to take care of the planet). Respondents rated governmental responses to climate change negatively and reported greater feelings of betrayal than of reassurance. Climate anxiety and distress were correlated with perceived inadequate government response and associated feelings of betrayal.

Interpretation Climate anxiety and dissatisfaction with government responses are widespread in children and young people in countries across the world and impact their daily functioning. A perceived failure by governments to respond to the climate crisis is associated with increased distress. There is an urgent need for further research into the emotional impact of climate change on children and young people and for governments to validate their distress by taking urgent action on climate change.

Funding AVAAZ.

Copyright © 2021 The Author(s). Published by Elsevier Ltd. This is an Open Access article under the CC BY-NC-ND 4.0 license.

Introduction

Climate anxiety and eco-anxiety (distress relating to the climate and ecological crises) are gaining attention worldwide as people become increasingly aware of the current and future global threats associated with our warming planet.¹ The climate crisis has important long-term implications for physical and mental health as a result of acute and chronic environmental changes, from storms and wildfires to changing landscapes, and increasing temperatures.² Climate anxiety is complex,³ and is recognised to often be based on constructive or practical anxiety.¹ Although painful and distressing, climate anxiety is rational and does not imply mental illness. Anxiety is an emotion that alerts us to danger,

which can cause us to search for more information about the situation and find potential solutions. In threatening and uncertain situations such as the climate crisis, this response can be seen as what is sometimes referred to as practical anxiety^{1,4} because it has the beneficial effect of leading people to reassess their behaviour in order to respond appropriately. However, because the climate crisis is so complex and lacks a clear solution, anxiety can easily become too intense and even overwhelming.^{5–7}

Climate anxiety can be connected to many emotions, including worry,⁸ fear,⁹ anger,¹⁰ grief, despair, guilt, and shame,¹¹ as well as hope,¹² although the presence of these vary between individuals. As research in this field emerges, certain emotions have received more attention,

Lancet Planet Health 2021; 5: e863–73

*Joint first authors

Department of Social & Policy Sciences (C Hickman MSc) and Department of Psychology (E Marks ClinPsyD), University of Bath, Bath, UK; Faculty of Theology and Helsinki Institute of Sustainability Science, University of Helsinki, Helsinki, Finland (P Pihkala PhD); Department of Psychology, The College of Wooster, Wooster, OH, USA (Prof S Clayton PhD); Department of Child and Adolescent Psychiatry, NYU Langone Health, New York, NY, USA (R E Lewandowski PhD); School of Environmental Sciences, University of East Anglia, Norwich, UK (E E Mayall BSc); Stanford University Center for Innovation in Global Health and Stanford and Woods Institute for the Environment, Stanford University, Stanford, CA, USA (B Wray PhD); Centre on Climate Change and Planetary Health, London School of Hygiene & Tropical Medicine, London, UK (B Wray); Oxford Health NHS Foundation Trust, Oxford, UK (C Mellor MBChB); Climate Psychiatry Alliance, Washington, DC, USA (L van Susteren MD); Climate Psychology Alliance, Washington, DC, USA (L van Susteren)

Correspondence to: Ms Caroline Hickman, Department of Social & Policy Sciences, University of Bath, Bath BA2 7AY, UK c.l.hickman@bath.ac.uk

Research in context

Evidence before this study

Previous studies have shown that psychological distress about climate change exists, with affective, cognitive, and behavioural dimensions. The direct impacts of climate change disproportionately burden children and young people, at the same time as they are developing psychologically, physically, socially, and neurologically. Emerging evidence suggests that young people are also more burdened by the indirect impacts of climate change, such as climate anxiety, which affects psychosocial health and wellbeing, and might exacerbate pre-existing mental health problems in some children. Before the study (between 2016 and 2021), several of the coauthors had conducted a range of conceptually guided explorations of the scarce literature on children's emotions in relation to climate change, and existing psychological measures of climate anxiety, in English and Finnish. Findings from these searches, and resulting publications, inform this study. We also considered legal reports from the past 2 years relating to human rights and climate change.

Added value of this study

To our knowledge, this is the largest and most international survey of climate anxiety in children and young people to date. It shows that the psychological (emotional, cognitive,

social, and functional) burdens of climate change are being felt by large proportions of young people around the world. Furthermore, it is the first study to offer insight into how young people's perception of governments' responses to climate change is associated with their own emotional and psychological reactions. These reactions are reported by young people from a diverse set of countries with a range of incomes and differing levels of direct exposure to severe effects of climate change.

Implications of all the available evidence

Distress about climate change is associated with young people perceiving that they have no future, that humanity is doomed, and that governments are failing to respond adequately, and with feelings of betrayal and abandonment by governments and adults. Climate change and government inaction are chronic stressors that could have considerable, long-lasting, and incremental negative implications for the mental health of children and young people. The failure of governments to adequately address climate change and the impact on younger generations potentially constitutes moral injury. Nations must respond to protect the mental health of children and young people by engaging in ethical, collective, policy-based action against climate change.

especially climate grief, worry, and fear, tied to current and anticipated losses. Research into other emotions has only begun more recently, such as how people might feel guilty for their own contributions to climate change or feel shame about the climate damage caused by humanity more broadly. Complex and sometimes competing feelings are often experienced together and can fluctuate in response to personal and world events.^{13,14} These experiences have been argued to be understandable, congruent, and healthy responses to the threats we face, but such threats can be experienced as an unremitting psychological stressor.¹³

Substantial levels of climate-related distress are reported globally,¹⁵ with children and young people particularly vulnerable.¹⁶ This distress is understandable, given that a 2021 review found that children of present and future generations will bear an unacceptably high disease burden from climate change,¹⁷ and a 2021 UNICEF report estimates that one billion children are at extremely high risk as a result.¹⁸ Qualitative research has found that many children have pessimistic views of climate futures.¹⁹ Interviews conducted with children in various countries between 2016 and 2021 found intense forms of climate and eco-anxiety.^{3,13} Parents and educators also report hearing great concern about climate change from young people.^{20,21} Quantitative research on a global scale is missing but is vital considering that contemporary children will live with the climate crisis for their whole lives.

Climate change poses a risk to mental health that can be understood through stress–vulnerability models of

health.²² Exposure to chronic stress in childhood has a long-lasting impact and increases the risk of developing mental health problems. Understanding the stress of climate change requires understanding how multiple factors interact. Changing climate and weather-related disasters have diverse impacts, both direct (eg, destruction and trauma) and indirect (eg, strained personal and public resources, interrupted community functioning),² as well as resulting in climate anxiety. Children and young people are thus facing numerous stressors but have few resources to mitigate or avoid them. This experience is compounded by additional psychosocial risk factors, such as inadequate social services for many children around the world.²³ Children facing a future severely damaged by climate change will need support.²⁴

The psychological stress of climate change is also grounded in relational factors; studies among children have shown that they often experience an additional layer of confusion, betrayal, and abandonment because of adult inaction towards climate change.^{3,25} Children are now turning to legal action based on government failure to protect ecosystems, young citizens, and their futures.²⁶ Failure of governments to protect them from harm from climate change could be argued to be a failure of human rights and a failure of ethical responsibility to care,²⁷ leading to moral injury (the distressing psychological aftermath experienced when one perpetrates or witnesses actions that violate moral or core beliefs).²⁸ This might include an awareness of or failure to prevent harmful unethical behaviour. Research is required to understand

the relationship between children and young people's climate anxiety and their feelings about the adequacy of governmental response.

This study aimed to better understand the feelings, thoughts, and functional impacts associated with climate change among young people globally. It explores and discusses the relationships between climate-related distress and perceived government responses. We aimed to answer the following research questions: how children and young people around the world report emotional, cognitive, and functional responses to climate change; how children and young people around the world perceive governmental responses to climate change and whether those perceptions suggest feelings of betrayal or of reassurance; and whether relationships exist between the cognitive and emotional responses to climate change and the perceptions of governmental responses.

Methods

Study design and participants

Data were collected from 10 000 young people via the participant recruitment platform Kantar. Participants were drawn from Kantar's LifePoints online research panel (45 million people from 42 countries in 26 languages). Additional respondents were sourced from other double opt-in panels (ie, after registering to join a panel, respondents are required to click on a confirmation email) in the Kantar network in some countries (appendix p 2). The LifePoints panel draws membership from anyone who voluntarily signs up, as long as they pass quality checks that detect fraudulent panellists. Kantar uses a diverse set of recruitment sources (opt-in email, co-registration, e-newsletter campaigns, internal and external affiliate networks, and social media) specifically to maximise inclusivity. All panel members are reminded at regular intervals to complete surveys as part of their membership and to collect points.

For this study, participants were eligible if they were aged 16–25 years and living in one of the ten countries selected (Australia, Brazil, Finland, France, India, Nigeria, Philippines, Portugal, the UK, and the USA). These countries were chosen to reflect populations from different countries, representing a range of cultures, incomes, climates, climate vulnerabilities, and exposure to differing intensities of climate-related events.

Invitations to participate were available to eligible panellists between May 18 and June 7, 2021. Before accessing surveys, participants were informed of the survey length but not the topic. 15 543 people began the survey and 10 000 (68%) completed it. Data quality tools removed fraudulent survey data, such as from respondents who attempted to complete the survey multiple times, or those completing it far more quickly than the average. Data collection ended in each country once 1000 complete, anonymised responses were obtained. Quota sampling was used, based on age,

gender, and region. There was an approximately even split in terms of gender (51·4% male, 48·6% female) and age group (49% aged 16–20; 51% aged 21–25 years; mean age 20·82 years [SD 2·54]; appendix p 2). Because quota sampling did not lead to complete representativeness by country, collected data were weighted based on statistics from the Organisation for Economic Co-operation and Development for each country by age group, gender, and region. All reported findings are based on these weighted data. The study was approved by the University of Bath Psychology Ethics Committee (#21-090).

Procedures

A survey was developed by 11 international consultants with expertise in climate change emotions, clinical and environmental psychology, psychotherapy, psychiatry, human rights law, child and adolescent mental health, and young people with lived experience of climate anxiety. The group met weekly for 2 months (February to March, 2021), reviewing existing climate anxiety measures and evidence for the psychological impact on young people. Several of the main authors had recently completed and published articles with targeted literature searches into climate and eco-anxiety,^{1,4,6} which were synthesised and used to generate survey items. These were discussed and refined iteratively, leading to eight broad questions about emotional, functional, and psychological experiences related to climate change and governmental response. The survey was piloted with 17 young people, with resulting adjustments to language and scaling. The survey domains were: climate-related worry (level of worry about climate change); climate-related functional impact (feelings about climate change negatively affecting functioning); climate-related emotions (presence of 14 positive and negative key emotions about climate change); climate-related thoughts (presence of seven key negative thoughts about climate change); experience of being ignored or dismissed when talking about climate change; beliefs about government response to climate change (presence of nine positive and negative key beliefs); and emotional impact of government response to climate change (presence and intensity of feelings related to reassurance and betrayal). The individual questions are shown in the appendix (pp 3–4). Items were developed to be clear and have appropriate equivalents in different cultures and languages, and they were translated as required.

Statistical analysis

Descriptive statistics were calculated for the following constructs: worry, climate-related functional impairment, climate-related emotions, negative thoughts about climate change, experience of having one's climate change concerns dismissed, and beliefs about and emotional impact of governmental responses to climate change. Differences between the countries were cautiously explored. Pearson's correlation analysis was

See Online for appendix

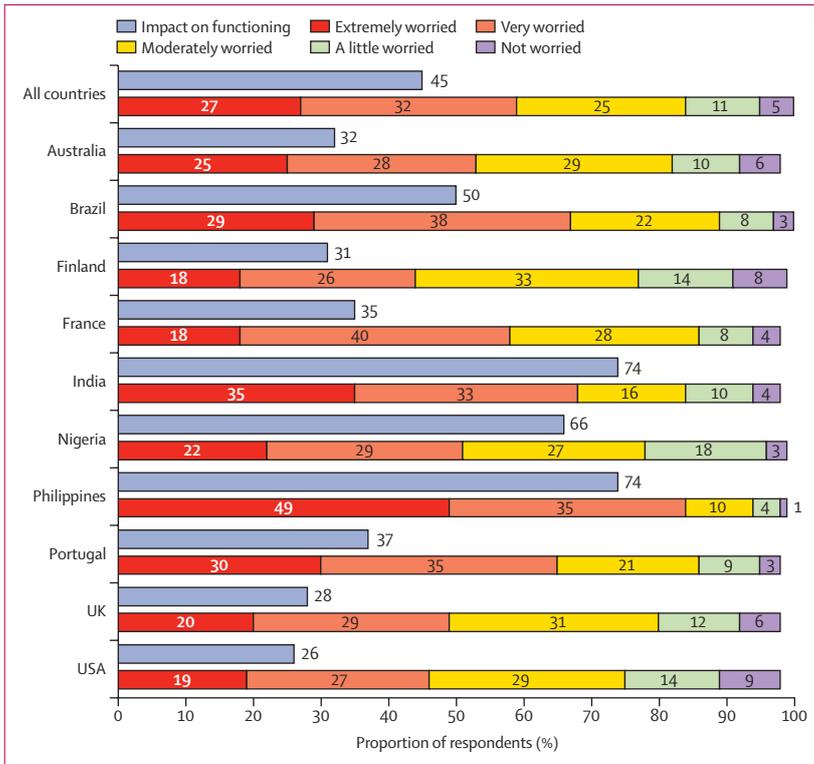


Figure 1: Worry about climate change and impact on functioning
 The graph shows the proportion of the sample reporting a negative impact on functioning from their feelings about climate change and various levels of worry about climate change. Data are shown for the whole sample (n=10 000) and by country (n=1000 per country)

done to explore whether climate-related distress, functioning, and negative beliefs about climate change were linked to thoughts and feelings about government response.

To allow for comparison between constructs, scales were made from items within each domain (climate-related thoughts, beliefs about government response, emotional impact of government response). Negative thoughts about climate change were summed to create an overall score (ranging from 0 to 7), based on evidence that people with higher levels of concern about climate change tend to report more negative thoughts.²⁹ Perceptions that government has failed to respond adequately were recorded and summed to form a variable called negative beliefs about government response. Nine statements were included, each of which was scored 1 or 2. Items were reverse-coded such that a higher number always indicated a more negative evaluation of the government’s response (ie, 9 was the most positive possible response and 18 was the most negative possible response).

Emotional impacts of government response were split into two scales reflecting a positive or a negative emotional response. The reassurance scale was constructed from the mean of the four positive feelings items scored on a scale from 1 to 5 (“I am reassured by governments’ action on climate change” and each of “When I think about how my

government is or how other governments are responding to climate change I feel valued/protected/hopeful”). Cronbach’s α was 0.82. The betrayal scale was constructed from the mean of the six negative feelings items scored on a scale from 1 to 5 (“When I think about how my government is or how other governments are responding to climate change I feel anguished/abandoned/afraid/angry/ashamed/belittled”). Cronbach’s α was 0.89. The label betrayal scale was chosen because it reflects the type of distress commonly experienced (anger, anxiety, anguish, and so on) when individuals are harmed by deliberate acts of omission or perpetration by the institutions upon which they rely for support, protection, or even survival.³⁰

Questions regarding government action were phrased broadly as “my government is/other governments are” in order to assess how children and young people experience global inaction by governments in power. Even if their own country was perceived to be responding well, negative thoughts and feelings would persist if other countries were ignoring or downplaying climate change. By allowing respondents to indicate dissatisfaction or distress towards governments generally (rather than tied to their own government), it was felt that individuals could answer more openly, regardless of country of residence.

We report aggregate results for all respondents, and results by country. Aggregated results combining all countries are offered to provide a picture of the overall findings, while recognising that such results are not globally representative because sample sizes were the same for each country and not weighted by population size. Due to the size of the sample and number of comparisons, we only report findings that are significant at the $p \leq 0.001$ level. All analyses were conducted using SPSS version 27.

Role of the funding source

AVAAZ arranged for data collection to be conducted by Kantar. It had no role in data analysis, data interpretation, or writing of the report.

Results

In response to our first research question, which was how children and young people around the world report emotional, cognitive, and functional responses to climate change, respondents across all countries reported a large amount of worry, with almost 60% saying they felt “very” or “extremely” worried about climate change (mean score of 3.7 on a scale from 1 to 5 [SD 1.7]). More than 45% of respondents said their feelings about climate change negatively affected their daily lives; the proportion of respondents varied by country but was consistently high (figure 1; appendix p 4). Countries expressing more worry and a greater impact on functioning tended to be poorer, in the Global South, and more directly impacted by climate change; in the Global North, Portugal (which had dramatic increases in wildfires since 2017) showed the highest level of worry.

Many respondents reported negative emotions; feeling afraid, sad, anxious, angry, powerless, helpless, and guilty were each reported by more than 50% of respondents (table 1; appendix p 5). The emotions least often reported were optimism and indifference. Respondents also reported a range of negative beliefs,

	All countries	UK	Australia	USA	India	Philippines	Nigeria	France	Finland	Portugal	Brazil
Sad											
Yes	6669 (66.7%)	631	641	569	735	909	615	638	536	705	690
No	3152 (31.5%)	345	332	414	256	87	362	338	442	273	303
Prefer not to say	176 (1.8%)	24	27	17	8	3	22	24	22	22	7
Helpless											
Yes	5095 (50.9%)	546	595	462	634	636	438	511	541	327	405
No	4720 (47.2)	437	381	519	351	356	549	449	444	647	587
Prefer not to say	186 (1.9%)	18	24	19	15	8	13	39	15	26	9
Anxious											
Yes	6181 (61.8%)	599	650	578	640	830	660	501	493	605	625
No	3641 (36.4%)	380	324	405	339	165	331	467	486	372	372
Prefer not to say	180 (1.8%)	21	26	16	21	6	10	32	21	23	4
Afraid											
Yes	6734 (67.3%)	615	644	542	743	897	658	667	536	707	725
No	3111 (31.1%)	364	325	441	246	98	334	309	445	279	270
Prefer not to say	156 (1.6%)	20	31	17	11	5	9	24	19	15	5
Optimistic											
Yes	3089 (30.9%)	253	274	242	456	460	473	227	263	223	218
No	6663 (66.6%)	717	696	731	522	524	512	739	683	763	776
Prefer not to say	250 (2.5%)	30	31	28	23	16	15	34	54	13	6
Angry											
Yes	5685 (56.8%)	553	574	482	623	702	433	604	485	589	640
No	4125 (41.3%)	420	397	494	362	283	558	363	493	400	355
Prefer not to say	192 (1.9%)	26	29	23	16	15	10	34	22	12	5
Guilty											
Yes	5020 (50.2%)	528	506	417	572	744	282	511	434	538	488
No	4793 (47.9%)	447	471	563	408	250	710	461	543	436	504
Prefer not to say	187 (1.9%)	25	23	20	20	6	8	28	23	26	8
Ashamed											
Yes	4562 (45.6%)	514	531	442	495	682	206	480	383	393	436
No	5249 (52.5%)	467	445	534	485	313	772	495	589	592	557
Prefer not to say	191 (1.9%)	18	25	24	20	6	22	26	28	15	7
Hurt											
Yes	4283 (42.8%)	414	445	383	611	781	448	311	250	336	304
No	5496 (55%)	561	524	597	378	212	538	649	717	633	687
Prefer not to say	219 (2.2%)	24	30	20	11	7	14	40	33	31	9
Depressed											
Yes	3864 (38.6%)	365	402	343	532	525	340	224	329	387	417
No	5940 (59.4%)	610	566	635	456	458	648	746	649	598	574
Prefer not to say	198 (2.0%)	25	32	22	13	17	12	31	22	15	9
Despair											
Yes	4418 (44.2%)	410	421	332	520	581	392	492	494	368	408
No	5348 (53.5%)	556	540	636	450	405	598	478	490	611	584
Prefer not to say	233 (2.3%)	33	38	32	30	14	10	30	17	21	8
Grief											
Yes	4151 (41.5%)	353	400	352	549	624	320	452	578	231	292
No	5632 (56.3%)	622	569	621	428	362	667	526	403	739	695
Prefer not to say	216 (2.2%)	25	30	27	23	14	13	22	19	30	13

(Table 1 continues on next page)

(Continued from previous page)

	All countries	UK	Australia	USA	India	Philippines	Nigeria	France	Finland	Portugal	Brazil
Powerless											
Yes	5598 (56%)	554	606	482	589	643	426	683	471	577	567
No	4210 (42.1%)	425	371	498	398	350	557	292	505	390	424
Prefer not to say	192 (1.9%)	21	24	20	13	7	16	25	24	33	9
Indifferent											
Yes	2902 (29%)	259	295	261	463	481	305	181	300	150	207
No	6827 (68.3%)	704	654	711	515	502	678	785	664	834	780
Prefer not to say	272 (2.7%)	37	52	29	22	17	17	34	36	16	12

Data are number (%) of respondents in the whole sample (n=10 000) or number within each country (n=1000 in each country). Participants were asked "Does climate change make you feel any of the following?"

Table 1: Emotions about climate change

	All countries	UK	Australia	USA	India	Philippines	Nigeria	France	Finland	Portugal	Brazil
I am hesitant to have children											
Yes	3908 (39.1%)	378	432	356	407	473	232	367	422	365	476
No	5700 (57.0%)	579	535	599	531	506	751	578	536	586	499
Prefer not to say	390 (3.9%)	43	33	46	62	21	17	54	42	48	24
Humanity is doomed											
Yes	5566 (55.7%)	510	504	457	740	733	422	480	431	616	673
No	4065 (40.7%)	448	442	492	234	251	557	449	530	357	305
Prefer not to say	366 (3.7%)	41	54	50	26	16	21	71	39	26	22
The future is frightening											
Yes	7549 (75.5%)	725	763	679	804	915	702	738	562	806	855
No	2219 (22.2%)	248	206	283	179	76	289	226	404	170	138
Prefer not to say	231 (2.3%)	27	31	38	16	9	10	36	34	24	6
I won't have access to the same opportunities that my parents had											
Yes	5487 (54.9%)	531	572	439	671	705	493	610	425	537	504
No	4210 (42.1%)	438	396	516	307	282	501	331	539	416	484
Prefer not to say	305 (3.0%)	31	32	45	22	13	6	60	37	47	12
My family's security will be threatened (eg, economic, social, or physical security)											
Yes	5167 (51.7%)	393	483	348	652	769	553	496	296	524	653
No	4516 (45.2%)	566	469	616	321	215	431	440	675	443	340
Prefer not to say	317 (3.2%)	41	48	36	27	16	16	64	29	33	7
The things I most value will be destroyed											
Yes	5483 (54.8%)	470	523	423	692	736	535	450	425	587	642
No	4162 (41.6%)	487	429	539	285	251	457	475	526	370	343
Prefer not to say	357 (3.6%)	43	48	38	24	14	8	76	48	43	15
People have failed to take care of the planet											
Yes	8256 (82.6%)	795	807	780	860	927	757	768	750	889	923
No	1533 (15.3%)	175	165	191	124	64	241	195	220	89	69
Prefer not to say	210 (2.1%)	29	28	29	16	9	2	37	29	22	9
When I try to talk about climate change other people have ignored or dismissed me											
Yes	3928 (39.3%)	355	392	304	597	465	476	238	294	342	465
No	4189 (41.9%)	384	346	393	316	455	379	533	524	475	384
I don't talk to other people about climate change	1884 (18.8%)	262	262	303	87	80	146	229	182	183	150

Data are number (%) of respondents in the whole sample (n=10 000) or number within each country (n=1000 in each country). Participants were asked "Does climate change make you think any of the following?"

Table 2: Negative beliefs about climate change and dismissal

	All countries	UK	Australia	USA	India	Philippines	Nigeria	France	Finland	Portugal	Brazil
Taking my concerns seriously enough											
Yes	3003 (30.0%)	265	291	214	426	418	302	273	341	264	209
No	6382 (63.8%)	653	627	699	530	559	672	633	562	677	770
Prefer not to say	617 (6.2%)	82	82	87	45	23	26	94	97	59	22
Doing enough to avoid a climate catastrophe											
Yes	3076 (30.8%)	262	308	242	437	422	363	260	300	283	199
No	6442 (64.4%)	686	625	678	523	559	609	667	644	670	781
Prefer not to say	483 (4.8%)	53	67	80	40	19	28	73	56	47	20
Dismissing people's distress											
Yes	6010 (60.1%)	580	637	586	586	534	580	574	481	648	804
No	3399 (34.0%)	348	291	341	362	427	381	333	447	293	176
Prefer not to say	591 (5.9%)	72	72	73	52	39	40	93	71	59	20
Acting in line with climate science											
Yes	3645 (36.5%)	321	334	278	527	524	398	281	382	379	221
No	5719 (57.2%)	607	589	631	424	448	570	614	523	562	751
Prefer not to say	636 (6.4%)	72	77	90	49	28	33	104	95	60	28
Protecting me, the planet, and/or future generations											
Yes	3306 (33.1%)	314	315	250	490	467	351	273	338	330	178
No	6105 (61.0%)	624	614	674	471	502	617	618	575	616	794
Prefer not to say	591 (5.9%)	63	71	76	40	31	32	109	87	54	28
Can be trusted											
Yes	3126 (31.3%)	278	296	213	505	404	311	234	345	323	217
No	6157 (61.6%)	645	621	676	446	550	642	660	558	607	752
Prefer not to say	718 (7.2%)	77	83	111	49	46	47	106	97	71	31
Lying about the effectiveness of the actions they are taking											
Yes	6437 (64.4%)	613	657	620	674	686	659	582	543	623	780
No	2894 (28.9%)	315	267	291	288	285	284	295	367	305	197
Prefer not to say	669 (6.7%)	72	76	89	38	29	57	123	90	72	23
Failing young people across the world											
Yes	6489 (64.9%)	648	674	630	714	679	644	549	467	694	790
No	2977 (29.8%)	293	265	293	243	298	306	357	468	266	188
Prefer not to say	534 (5.3%)	59	61	77	43	23	51	94	64	40	22
Betraying me and/or future generations											
Yes	5847 (58.5%)	572	595	563	663	563	551	487	462	621	770
No	3467 (34.7%)	347	324	353	288	392	403	388	459	316	197
Prefer not to say	686 (6.9%)	81	81	84	49	45	46	125	79	62	34

Data are number (%) of respondents in the whole sample (n=10 000) or number within each country (n=1000 in each country). Participants were asked "In relation to climate change I believe that my government is/other governments are...".

Table 3: Government-related beliefs

with 75% saying the future was frightening (table 2; appendix p 6). Among those who said they talked with others about climate change (81% of the sample), almost half (48%) reported that other people had ignored or dismissed them (table 2). Results for thoughts and feelings about climate change varied considerably by country but negative feelings were strikingly present in all populations.

Pertaining to our second research question, which was how children and young people around the world perceive governmental responses to climate change, participants tended to rate government response negatively (mean score 14.96 on the 9–18 scale [SD 2.57]). More than half

of respondents agreed with the negative statements (59–64%) and considerably less than half agreed with the positive statements (30–37%; table 3; appendix p 7). Across all countries, participants reported greater feelings of betrayal (mean score 2.7 [SD 1.0]) than of reassurance (2.22 [SD 0.93]; $p < 0.0001$) and pairwise *t* tests showed that betrayal ratings were significantly higher than reassurance ratings within each country ($p < 0.0001$; figure 2; mean scores by country are shown on appendix p 8).

To better understand patterns underlying responses to climate change, Pearson's correlation coefficients were calculated to explore correlations among variables

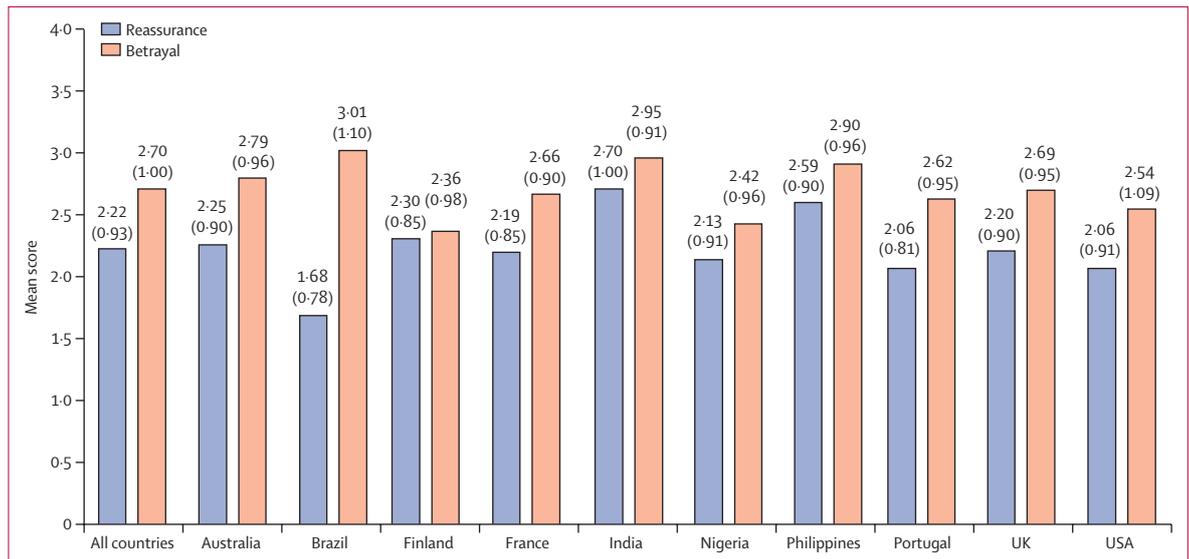


Figure 2: Feelings of reassurance and betrayal relating to government response to climate change
Data are shown for the whole sample (n=10 000) and by country (n=1000 per country). The values on the graph are mean (SD).

	1	2	3	4	5	6
1: Worried about climate change	..	..	..	..	..	..
2: Negative thoughts about climate change	0.48	..	..	..	..	..
3: Negative beliefs about government response	0.21	0.26	..	..	..	..
4: Feeling betrayed by government	0.43	0.47	0.36	..	..	..
5: Feeling reassured by government	0.01 (NS)	-0.04	-0.59	-0.02 (NS)	..	..
6: Negative functional impact	0.22	0.32	-0.1	0.25	0.21	..

Correlation coefficients (r) are shown. All correlations reported are significant at the p<0.0001 level unless otherwise indicated by NS. NS=not significant.

Table 4: Correlation matrix for the study variables

(table 4). Of note, negative thoughts, worry about climate change, and impact on functioning were all positively correlated and showed correlations with feelings of betrayed and negative beliefs about government response. Feelings of reassurance were not significantly correlated with worry and showed a very low but significant correlation with negative thoughts; the reassurance scale possibly confounded people who were not worried about climate change and people who were worried but considered the governmental response adequate. The relationship between negative thoughts and betrayal could be explained by the fact that they were both associated with worry about climate change. For this reason, a partial correlation was calculated while holding the level of worry constant. The correlation remained

significant ($r=0.32$, $p<0.0001$), suggesting that even among people feeling the same level of worry about climate change, those who reported feeling betrayed by the governmental response reported an increased number of negative thoughts. Similarly, negative thoughts remained significantly correlated with a perception of government failure while holding worry constant ($r=0.19$, $p<0.0001$).

Discussion

According to our study, children and young people in countries around the world report climate anxiety and other distressing emotions and thoughts about climate change that impact their daily lives. This distress was associated with beliefs about inadequate governmental response and feelings of betrayal. A large proportion of children and young people around the world report emotional distress and a wide range of painful, complex emotions (sad, afraid, angry, powerless, helpless, guilty, ashamed, despair, hurt, grief, and depressed). Similarly, large numbers report experiencing some functional impact and have pessimistic beliefs about the future (people have failed to care for the planet; the future is frightening; humanity is doomed; they won't have access to the same opportunities their parents had; things they value will be destroyed; security is threatened; and they are hesitant to have children). These results reinforce findings of earlier empirical research and expand on previous findings by showing the extensive, global nature of this distress, as well as its impact on functioning. Climate distress is clearly evident both in countries that are already experiencing extensive physical impacts of climate change, such as the Philippines, a nation that is highly vulnerable to coastal flooding and typhoons. It is

also evident in countries where the direct impacts are still less severe, such as the UK, where populations are relatively protected from extreme weather events. Distress appears to be greater when young people believe that government response is inadequate, which leads us to argue that the failure of governments to adequately reduce, prevent, or mitigate climate change is contributing to psychological distress, moral injury, and injustice.

Such high levels of distress, functional impact, and feelings of betrayal will negatively affect the mental health of children and young people. Climate anxiety might not constitute a mental illness, but the realities of climate change alongside governmental failures to act are chronic, long-term, and potentially inescapable stressors. These factors are likely to increase the risk of developing mental health problems, particularly in more vulnerable individuals such as children and young people, who often face multiple life stressors without having the power to reduce, prevent, or avoid such stressors.^{2,18,22,23} As severe weather events linked with climate change persist, intensify, and accelerate, it follows that, in the absence of mitigating factors, mental health impacts will follow the same pattern. We are already seeing increased severe climatic events that act as the precipitating and perpetuating factors of psychological distress; as of September, 2021, numerous unprecedented weather events have occurred since our data collection (including the heat dome and wildfires in the Pacific Northwest, catastrophic storms and floods in Germany, Iran, China, London, and New York, and heat records repeatedly broken in Northern Ireland and North America).

Factors known to protect against mental health problems include psychosocial resources, coping skills, and agency to address and mitigate stressors. In the context of climate anxiety, this protection would come in the form of having one's feelings and views heard, validated, respected, and acted upon, particularly by those in positions of power and upon whom we are dependent, accompanied by collective pro-environmental actions. However, this survey shows that large numbers of young people globally regard governments as failing to acknowledge or act on the crisis in a coherent, urgent way, or respond to their alarm. This is experienced as betrayal and abandonment, not just of the individual but of young people and future generations generally. The results here reflect and expand upon the findings of an earlier interview study, in which young people described their feelings about climate change as being "stranded by the generational gap" and feeling "frustrated by unequal power, betrayed and angry, disillusioned with authority, drawing battle lines".²⁵

Defence mechanisms against the anxiety provoked by climate change have been well documented, including dismissing, ignoring, disavowing, rationalising, and negating the experiences of others.²⁷ These behaviours, when exhibited by adults and governments, could be seen as leading to a culture of uncare.²⁷ Thus, climate anxiety in

children and young people should not be seen as simply caused by ecological disaster, it is also correlated with more powerful others (in this case, governments) failing to act on the threats being faced. Our findings are in line with this argument and, alongside pre-existing evidence, lend weight to the proposal that climate distress in children and young people can be regarded as unjust and involving moral injury.²⁸ Young people's awareness of climate change and the inaction of governments are seen here to be associated with negative psychological sequelae. Moral injury has been described as "a sign of mental health, not disorder... a sign that one's conscience is alive",²⁷ yet it inflicts considerable hurt and wounding because governments are transgressing fundamental moral beliefs about care, compassion, planetary health, and ecological belonging. This sense of the personal, collective, and ecological perspective is summarised in the words of one 16-year-old: "I think it's different for young people. For us the destruction of the planet is personal".¹³

By endangering and harming fundamental human needs, the climate crisis is also a human rights issue. Legal bodies recognise an intersection between human rights, climate change, and climate anxiety. Subjecting young people to climate anxiety and moral injury can be regarded as cruel, inhuman, degrading, or even torturous.^{31,32} This provides further understanding for the current phenomenon of climate criminology,³³ in which children and young people are voicing their concerns through legal cases as an attempt to have their distress legitimised and validated legally in the face of government inaction.

A complete understanding of climate anxiety in children and young people must encompass these relational, psychosocial, cultural, ethical, legal, and political factors. Current narratives risk individualising the so-called problem of climate anxiety, with suggestions that the best response is for the individual to take action.³ Our results suggest that such action needs to particularly be taken by those in power. To protect the mental health and wellbeing of young people, those in power can act to reduce stress and distress by recognising, understanding, and validating the fears and pain of young people, acknowledging their rights, and placing them at the centre of policy making.²³ Before we can offer younger generations a message of hope, we must first acknowledge the obstacles that must be overcome.¹²

Limitations of this study include the use of non-standardised measures to investigate the experience of climate anxiety and how people think and feel about government responses, which are complex and nuanced subjects. Unfortunately, no appropriate standardised measures existed for our purposes. The construct of climate anxiety itself is new and complex, with varying definitions across the literature. Although our results show that many young people report difficult thoughts, emotions, and functional impairment related to climate change, we cannot indicate how severe this is in

comparison to normative samples. We aimed to investigate whether certain emotions and thoughts were present across different countries in the world, rather than to assess the degree to which these thoughts and feelings are felt. Therefore, we chose to use a three-factor response scale (yes, no, or prefer not to say) to encourage a high response rate and to facilitate valid responses from those less familiar with Likert scales. Although dichotomous response scales can exaggerate acquiescence, having a third, neutral option can mitigate this. This is supported by our finding that statements on negative emotions and beliefs were more commonly endorsed than positive or neutral statements.

Without measures of mental health, these results cannot assess how or whether climate anxiety is affecting mental health outcomes in these populations. The study did not measure the severity of climate anxiety by any psychological scale, although it should be noted that some results related to youth cognitions indicate strong emotions, such as the belief that “humanity is doomed”. Of note, the data were based on equal sample sizes per country and were not weighted according to population size, so aggregated results must be interpreted with caution because they are not globally representative. However, more populous countries (eg, India with more than 1.3 billion people) reported greater levels of worry, functional impairment, negative beliefs, and so on, indicating that our aggregated findings are probably a conservative estimate of distress levels globally. Other limitations arose from the use of an online polling company, for which completion required internet access, and sometimes the ability to speak English. Thus, although the samples should not be biased towards those who are especially concerned about climate change, they are not fully representative of the countries’ populations. Finally, the polling company provided data on gender defined only as male or female, which fails to recognise the non-binary nature of gender.

This study’s strengths include its large sample size and global reach, and it is a novel and timely investigation into climate anxiety and perceived government response. It offers good representation within countries by using a polling company with proven inclusive participant selection and minimisation of respondent bias by not advertising the nature of the study (eg, climate-related) in advance. We present the results as an initial attempt to quantify the global scale of the psychological impact of climate change and of inadequate government responses upon young people.

To conclude, our findings suggest that climate change, climate anxiety, and inadequate government response are all chronic stressors that could threaten the mental health and wellbeing of children and young people around the world. This survey offers a preliminary overview; further, detailed research is required to explore the complexities and wide variety of climate feelings. Climate anxiety is a collective experience,²⁷ and based on our results, children and young people would

benefit from having a social discourse in which their thoughts and feelings are respected and validated, and their concerns are acted upon by people in positions of power. Climate anxiety indicates the care and empathy that young people have for our world. As one young person said: “I don’t want to die. But I don’t want to live in a world that doesn’t care about children and animals.”¹³

As a research team, we were disturbed by the scale of emotional and psychological effects of climate change upon the children of the world, and the number who reported feeling hopeless and frightened about the future of humanity. We wish that these results had not been quite so devastating. The global scale of this study is sufficient to warrant a warning to governments and adults around the world, and it underscores an urgent need for greater responsiveness to children and young people’s concerns, more in-depth research, and immediate action on climate change.

Contributors

All authors contributed to the study design and conceptualisation. Literature searches were done by CH, PP, and SC. The underlying data were verified and analysed by SC, REL, EM, and EEM. The manuscript was drafted by CH, PP, EM, REL, SC, EEM, CM, and BW. All authors revised and commented on the manuscript and approved the final version. All authors had full access to the data and accept responsibility for publication.

Declaration of interests

We declare no competing interests.

Data sharing

Individual, unidentified participant data that underlie these results will be made available, beginning 3 months and ending 5 years after publication, to researchers who provide a methodologically sound proposal, to achieve aims in said approved proposal. Proposals will be considered by a small team of the authors and requests should be directed to c.l.hickman@bath.ac.uk, e.marks@bath.ac.uk, or panu.pihkala@helsinki.fi. To gain access, data requestors must sign a data access agreement.

Acknowledgments

AVAAZ paid for the costs of the survey and arranged for data collection to be conducted by an independent recruitment platform (Kantar). We acknowledge Judith Anderson (Climate Psychology Alliance) and Natasa Mavronicola (University of Birmingham, Birmingham, UK).

References

- Pihkala P. Anxiety and the ecological crisis: an analysis of eco-anxiety and climate anxiety. *Sustainability* 2020; **12**: 7836.
- Berry HL, Waite TD, Dear KB, Capon AG, Murray V. The case for systems thinking about climate change and mental health. *Nat Clim Chang* 2018; **8**: 282–90.
- Hickman C. We need to (find a way to) talk about ... eco-anxiety. *J Soc Work Pract* 2020; **34**: 411–24.
- Verplanken B, Marks E, Dobromir AI. On the nature of eco-anxiety: how constructive or unconstructive is habitual worry about global warming? *J Environ Psychol* 2020; **72**: 101528.
- Ojala M, Cunsolo A, Ogunbode CA, Middleton J. Anxiety, worry, and grief in a time of environmental and climate crisis: a narrative review. *Annu Rev Environ Resour* 2021; **46**: 1.
- Clayton SD, Karaszia BT. Development and validation of a measure of climate change anxiety. *J Environ Psychol* 2020; **69**: 101434.
- Hogg TL, Stanley SK, O’Brien LV, Wilson MS, Watsford CR. The Hogg eco-anxiety scale: development and validation of a multidimensional scale. *OSF Preprints* 2021; published online June 11. <https://doi.org/10.31219/osf.io/txudb> (preprint).
- Stewart AE. Psychometric properties of the climate change worry scale. *Int J Environ Res Public Health* 2021; **18**: 494.

- 9 McQueen A. The wages of fear? Toward fearing well about climate change. In: Budolfson M, McPherson T, Plunkett D, eds. *Philosophy and climate change*. London: Oxford University Press, 2021.
- 10 Stanley SK, Hogg TL, Leviston Z, Walker I. From anger to action: differential impacts of eco-anxiety, eco-depression, and eco-anger on climate action and wellbeing. *J Clim Chang Health* 2021; **1**: 100003.
- 11 Jensen T. *Ecologies of guilt in environmental rhetorics*. Cham: Palgrave Macmillan, 2019.
- 12 Ojala M. Hope and anticipation in education for a sustainable future. *Futures* 2017; **94**: 76–84.
- 13 Hickman C. Children and climate change: exploring children's feelings about climate change using free association narrative interview methodology. In: Hoggett P, ed. *Climate psychology: on indifference to disaster*. Studies in the psychosocial. Cham: Palgrave Macmillan, 2019: 41–59.
- 14 Pihkala P. Eco-anxiety and environmental education. *Sustainability* 2020; **12**: 10149.
- 15 Susteren LV, Al-Delaimy WK. Psychological impacts of climate change and recommendations. In: Al-Delaimy WK, Ramanathan V, Sánchez Sorondo M, eds. *Health of people, health of planet and our responsibility: climate change, air pollution and health*. Cham: Springer, 2020: 177–92.
- 16 Wu J, Snell G, Samji H. Climate anxiety in young people: a call to action. *Lancet Planet Health* 2020; **4**: e435–36.
- 17 Helldén D, Andersson C, Nilsson M, Ebi KL, Friberg P, Alfvén T. Climate change and child health: a scoping review and an expanded conceptual framework. *Lancet Planet Health* 2021; **5**: e164–75.
- 18 UNICEF. One billion children at 'extremely high risk' of the impacts of the climate crisis. Aug 20, 2021. <https://www.unicef.org/press-releases/onebillion-children-at-extremely-high-risk-of-the-impacts-of-the-climate-crisis-unicef> (accessed Sept 5, 2021).
- 19 Strife SJ. Children's environmental concerns: expressing ecophobia. *J Environ Educ* 2012; **43**: 37–54.
- 20 Baker C, Clayton S, Bragg E. Educating for resilience: parent and teacher perceptions of children's emotional needs in response to climate change. *Environ Educ Res* 2021; **27**: 687–705.
- 21 Verlie B, Clark E, Jarrett T, Supriyono E. Educators' experiences and strategies for responding to ecological distress. *Aust J Environ Educ* 2020; **37**: 132–46.
- 22 Schneiderman N, Ironson G, Siegel SD. Stress and health: psychological, behavioral, and biological determinants. *Annu Rev Clin Psychol* 2005; **1**: 607–28.
- 23 Patel V, Flisher AJ, Hetrick S, McGorry P. Mental health of young people: a global public-health challenge. *Lancet* 2007; **369**: 1302–13.
- 24 Sanson AV, Judith Van Hoorn J, Burke SE. Responding to the impacts of the climate crisis on children and youth. *Child Dev Perspect* 2019; **13**: 201–07.
- 25 Jones CA, Davison A. Disempowering emotions: the role of educational experiences in social responses to climate change. *Geoforum* 2021; **118**: 190–200.
- 26 Salas RN, Jacobs W, Perera F. The case of Juliana v. US—children and the health burdens of climate change. *N Engl J Med* 2019; **380**: 2085–87.
- 27 Weintrobe S. *Psychological roots of the climate crisis: neoliberal exceptionalism and the culture of uncared*. New York, NY: Bloomsbury Academic, 2021.
- 28 Griffin BJ, Purcell N, Burkman K, et al. Moral injury: an integrative review. *J Trauma Stress* 2019; **32**: 350–62.
- 29 Verplanken B, Roy D. "My worries are rational, climate change is not": habitual ecological worrying is an adaptive response. *PLoS One* 2013; **8**: e74708.
- 30 Smidt AM, Freyd JJ. Government-mandated institutional betrayal. *J Trauma Dissociation* 2018; **19**: 491–99.
- 31 UK Government. Human rights act 1998. 1998. <https://www.legislation.gov.uk/ukpga/1998/42/contents> (accessed Sept 2, 2021).
- 32 Mavronicola N. *Torture, inhumanity and degradation under article 3 of the ECHR: absolute rights and absolute wrongs*. Oxford: Bloomsbury Publishing, 2021.
- 33 White R. *Imagining the unthinkable: climate change, ecocide and children*. In: Frauley J, ed. *C Wright Mills and the criminological imagination: prospects for creative inquiry*. New York, NY: Routledge, 2015: 219–40.



Research article

Climate emotions and anxiety among young people in Canada: A national survey and call to action

Lindsay P. Galway^{a,*}, Ellen Field^b^a Department of Health Sciences, PhD, Lakehead University, Thunder Bay, Ontario, Canada^b Department of Education, PhD, Lakehead University, Orillia, Ontario, Canada

ARTICLE INFO

Article History:

Received 21 September 2022

Accepted 6 January 2023

Available online 10 January 2023

Keywords:

Climate anxiety
 Climate emotions
 Climate action
 Climate education
 Youth
 Young people
 Survey

ABSTRACT

Introduction: Young people have a unique positionality in relation to the mental and emotional dimensions of climate change: they have contributed the least to the crisis, they are and will be disproportionately impacted, and they have limited opportunities and invaluable perspectives for influencing action. Evidence increasingly illustrates that young people are particularly vulnerable to climate distress and anxiety.

Methods: The purpose of this study was to generate knowledge about climate emotions and climate anxiety among young people using a representative survey. We surveyed 1000 young people (aged 16–25) across Canada. The online survey asked respondents about: (i) climate emotions and their impacts, (ii) perspectives on the future due to climate change, (iii) perspectives and feelings about government (in)action, (iv) perspectives on supports, programs, and resources needed to cope with climate emotions and anxiety, and (v) perspectives on climate change education (including socio-emotional dimensions). Data were weighted to improve representativeness according to age, gender, and region. Descriptive analyses were conducted, scales were generated, and textual responses were analyzed using thematic analysis.

Results: Young Canadians are experiencing a diversity of challenging climate emotions. At least 56% of respondents reported feeling afraid, sad, anxious, and powerless. 78% reported that climate change impacts their overall mental health and 37% reported that their feelings about climate change negatively impact daily functioning. Data also illustrate that climate change is contributing to negative perceptions about their future. For example, 39% of respondents report hesitation about having children due to climate change, 73% report thinking that the future is frightening, and 76% report that people have failed to take care of the planet. Respondents rated governmental responses to climate change negatively and reported greater feelings of betrayal than of reassurance. The data show that young Canadians need a diversity of coping supports and believe the formal education system should be doing more to support them.

Conclusion: This study adds to the emerging and increasingly concerning evidence base on climate emotions and anxiety among young people. We conclude by summarizing key directions for future research.

© 2023 The Authors. Published by Elsevier Masson SAS. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>)

1. Introduction

Climate change is a formidable threat to human and planetary health and an immense injustice [1]. The mental and emotional health dimensions of climate change are increasingly concerning as extreme events become more severe and common, extractivism and ecosystem destruction advance unheeded, and people become more knowledgeable about climate impacts and injustices [2–4]. Although the connections between the climate crisis and mental and emotional health have historically been overlooked, scholarly work in this realm has grown exponentially in the last decade [5]. One specific line of inquiry within this emerging body of research has focused on the

experiences and implications of climate emotions and climate anxiety. Climate emotions are understood here as feelings, emotions, and affects related to climate change and climate injustices [5,6]. Although there is no consistently agreed-upon definition of climate anxiety, it can be understood as heightened distress related to the climate crisis that is characterised by a constellation of strong and interconnected emotions such as worry, fear, sadness, anger, and powerlessness [7]. Climate anxiety is future-oriented and related to eco-anxiety more broadly; some scholars understand climate anxiety as a specific form of eco-anxiety [8,9]. The lived experiences of climate emotions and climate anxiety are influenced by numerous factors including geographic and social location, experiences of climate impacts, sense of agency and efficacy, and knowledge of climate change and climate injustice [7,10–12] (see [4,5,7–10,13] for recent reviews and discussions around climate/eco-anxiety).

* Corresponding author.

E-mail address: lgalway@lakeheadu.ca (L.P. Galway).

As the American Psychological Association outlines, strong climate emotions and climate anxiety “do not constitute mental illness” [3]; climate anxiety is likely non-pathological for most [3,9]. However, climate anxiety can be paralyzing and problematic [7]. Some evidence indicates that strong emotions and climate anxiety can be problematic for certain people and populations with impacts on functioning and overall well-being [4,14]. Despite the potential for climate emotions and climate anxiety to result in negative consequences for well-being, many scholars and practitioners argue that strong emotional responses are appropriate considering the scale and urgency of the crisis [11,13,15,16]. Particularly concerning, the mental and emotional burden of climate change is disproportionately borne by young people who have contributed the least to rising greenhouse gas emissions (GHG) and the systems and structures that cause and fuel climate change [10,17–19].

There is increasing evidence that climate anxiety is particularly prevalent among, and relevant to, youth and young adults [11,18,20]. Moreover, young people currently have limited opportunities for influencing policy-making on climate change given that decision-making systems generally exclude them [21]. A recent multinational study by Hickman et al. [19] examined climate anxiety in 10,000 young people in 10 countries with varying climate-related vulnerabilities: a concerning proportion of young people reported high levels of distressing emotions, associated impacts on functioning, and negative perceptions of their future. Distressing emotions, climate anxiety, and impacts on functioning were correlated with perceptions of inadequate action by governments and feelings of betrayal [19]. The lack of meaningful and transformative climate action from governments, and the continued lack of reparations for damages and impacts already caused, exacerbates the mental and emotional health impacts of climate change itself. Canada was not included in this global study, conducted by Hickman et al. [19], and no existing empirical and representative survey research has focused on the experiences, perspectives, and needs of young Canadians in relation to climate emotions and/or climate anxiety (at the time of publishing). Canada is a relevant context to explore climate emotions and anxiety among young people. As a country, Canada is warming twice as fast as the rest of the planet and impacts are rapidly unfolding [22]. Moreover, per capita GHG emissions are among the highest in the world, and Canada has a dismal record when it comes to cutting carbon emissions, fossil fuel extraction, and taking responsibility for climate injustices [23]. Calls for rigorous empirical studies prioritizing young people's voices and experiences of climate-induced distress [4], the influential Hickman et al. study [19], and existing knowledge gaps have inspired the research presented herein. Importantly, although the literature on climate emotions and anxiety is rapidly advancing, many unanswered questions remain about lived experiences across diverse contexts and about how to best support young people coping with complex and challenging climate emotions. As Wu et al. argue, existing data in this realm “preclude our ability to take action” [20].

The purpose of this study was to generate knowledge about climate emotions and climate anxiety among young people (aged 16–25) in Canada. We replicated the methods used by Hickman et al. [19] while also expanding on this existing research by collecting perspectives on the supports, programs, and/or resources that young people identify as helpful to cope with climate emotions and climate anxiety, as well as youth perspectives on advances needed in the formal education system. Replicating and expanding on the Hickman et al. [19] study enables global comparisons while addressing knowledge gaps to inform action and making novel contributions to the literature. Furthermore, the data collected here will serve as a robust baseline for longitudinal monitoring of climate emotions and climate anxiety among young people in Canada.

2. Methods

2.1. Study context: climate impacts, (in)justice, and (in)action in Canada

Across the country, climate-related impacts include more extreme heat, less extreme cold, changing growing seasons, shorter snow and ice cover seasons, thinning glaciers, thawing permafrost, rising sea levels, and increased frequency and severity of extreme events [22]. Losses from extreme events are increasing: from 1983 to 2008, the cost of extreme weather events in insured damage averaged \$420 million annually while between 2010 and 2020, it averaged \$2.1 billion annually. For context, in 2021, the province of British Columbia experienced a fatal heat dome with 595 people dying from extreme heat [24]. The heat was followed by 1600 wildfires across the province affecting 9000 km² of forest and increased climate change anxiety among British Columbians [25]. While many parts of Canada have been experiencing severe climate impacts, Canada's action on climate policy is not aligned with calls for GHG reductions. Canada's 2030 reduction plan is consistent with 2°C of warming rather than the Paris Agreement's 1.5°C of warming limit [23]. Canada submitted a Nationally Determined Contribution commitment in 2021 to reduce greenhouse gas emissions by 40–45% below 2005 levels, which would bring Canada's rating from “highly insufficient” (policies on track for 3°C of warming) to “almost sufficient” (policies on track for 2°C of warming) [23]; however, the Canadian government has a track record of missing every climate target that has been set. Moreover, Canada continues to advance fossil fuel extraction, production, and export (crude oil in particular) while providing billions of dollars in subsidies, tax breaks and financial support to the fossil fuel industry annually [26].

Beyond this, the existing inequities in Canada, such as poverty, social inequality, the ongoing effects of colonialism, and systemic racism exacerbate how marginalised peoples experience and adapt to climate impacts [27]. The youth climate justice movement has grown to the largest environmental social movement in history. As many youth activists have continually asserted, climate injustices are not merely environmental issues but are racial and gender injustices [28]. The claims and experiences of youth climate activists are not homogenous and may be better understood as a ‘polyphonic movement’ [29]; however, youth climate activist messaging has a common characteristic that focuses on intergenerational injustices of climate impacts—that is, climate change will affect their futures and adults have not acted with moral responsibility and obligation [28].

2.2. Data collection

Study participants included young people in Canada aged 16–25 ($n = 1000$). Abacus Data, an online Canadian polling and research firm, was contracted to administer the survey. The survey was translated into French (second official language), programmed, and fielded by Abacus Data.

Potential participants were invited to complete the online survey from the Lucid exchange platform marketplace. A set of 21 partner panels, representing a total potential participant pool of approximately 1,000,000 Canadians, was used. The panels are double opt-in survey panels and are blended to address any potential bias that could arise from a panel single source. De-duplication methods were used to ensure that there was no duplication of respondents. The electronic invitation included details about the study and informed consent. Potential participants were not able to access the survey, and no data were collected, before consent was obtained. A unique link was used to track each potential participant and enable the completion of the survey over more than one session. The Lucid exchange platform panel providers compensate survey takers in either cash, gift cards, or reward points. Incentives offered are minimal and unlikely to impact the voluntariness of participation or consent. The data

collection process was compliant with the Canadian Research Insights Council's Public Opinion Research Standards, the ESOMAR Code of Conduct as well as Marketing Research and Intelligence Association standards. The study received ethical approval from the Lakehead University Research Ethics Board.

The survey instrument included 15 questions (a mix of yes/no/prefer not to answer, Likert scale, and open-ended questions) and took 10–15 min to complete. The questions asked about: i) climate emotions and their impacts, ii) perspectives on the future due to climate change, iii) perspectives and feelings about government (in) action, and iv) perspectives on supports, programs, and resources that young people identify as needed to cope with climate emotions and anxiety, and iv) perspectives on climate change education (including socio-emotional dimensions) in the formal education system. Information on age, gender, language, ethnicity, and region were also collected (See Supplemental file, indicating questions replicated from Hickman et al. [19] and additional questions for this study).

Data collection began on February 23, 2022 and ended March 2, 2022 once 1000 complete responses were obtained. The data were weighted (according to 2016 Census data) to improve representativeness of the Canadian population according to age, gender, and region (following the approach used by Hickman et al. [19]). Descriptive findings reported below use weighted data. Prior to weighting, the mean age of respondents was 21.2 years (SD 2.60), 54% were female, 44% were male, and 3% were non-binary or preferred not to answer. Most respondents completed the survey in English (84%). In terms of ethnicity, half of the respondents identified as White/European, 13% as Southeast Asian, 12% as South Asian, 11% as Black, 5% as Indigenous (i.e., Inuit/First Nations/Métis), 5% as Arab and West Asian, 4% as Latin American, and 1% selected 'Other'. We did not weight data by ethnicity as the question in our survey used different population groups than Statistics Canada suggests (following more recent best practices [30]). Statistics Canada is in the process of "consulting partners, stakeholders and the general public to establish a suitable terminology and classification" to describe and gather data on ethnic population and racialized groups [31].

2.3. Data analysis

Descriptive statistics were calculated, and tables and graphs generated where appropriate. We also generated the following 4 scales following Hickman et al. [19]: i) negative thoughts about climate change; ii) beliefs about government response; iii) feeling betrayed by government; and iv) feeling reassured by government. The negative thoughts about climate change scale is a summative score ranging from 0 to 7 including all items for the question, "Does climate change make you think any of the following ...?" where "Yes" was coded as 1 and "No" was coded as "0". The beliefs about the government response scale included 9 items from the question, "In relation to climate change, I believe that my government is ...". In this scale, "Yes" was coded as 2 and "No" was coded as "1". Reverse coding was applied where needed, total score ranged from 9 to 18. The feeling reassured by government scale reports a mean across 4 items measuring specific emotions related to government action indicating feelings of reassurance ("When I think about my government's response to climate change, I feel ... hopeful /valued/protected") and reassurance generally ("I am reassured by my federal government's action on climate change."). All items were measured using a 5-point Likert scale. The feeling betrayed by government scale was constructed from the "negative" emotions in response to government action (i.e., anguished, abandoned, afraid, angry, ashamed, belittled) on a 5-point Likert scale (1=not at all, 5=extremely). The score is a mean across 5 items. Those respondents selecting "Prefer not to say" were excluded resulting in varying sample sizes. Cronbach's alpha was calculated for the betrayal and reassurance scales to assess internal consistency. Finally,

a coding scheme was developed for the responses to all open-ended questions using an iterative thematic analysis approach and NVivo software. Non-responses and nonsensical responses were removed.

2.4. Limitations

There are limitations of this study in terms of design and methods that should be recognized when interpreting findings. First, given the cross-sectional design, data collection was conducted at one point in time. Emotional responses and impacts associated with climate change are likely transient and dynamic over time but our data are unable to capture such trends [32]. Second, the data have been weighted by age, gender, and region thereby increasing confidence that our findings represent experiences and perspectives of our target population (young Canadians aged 16–25) on these factors, thereby reducing potential bias. However, we did not weight by ethnicity such that findings may under or overrepresent some population groups compared to Canadians aged 16–25 overall. Third, all measures are self-reported which may threaten validity. Fourth, as [19] report, the survey instrument uses non-standardised measures and a three-factor scale (yes/no/prefer not to answer) to measure the existence of specific climate emotions (not a Likert scale). Fifth, although these findings are very likely generalizable to Canada and similar contexts, they may not hold in all settings. Finally, although we provided an opportunity for youth to share their experiences and perspectives, the findings are still framed by, interpreted through, and shared from adult perspectives (the researchers).

3. Results

3.1. Climate emotions, climate anxiety, and coping

Overall, the survey data illustrate that young people across Canada are experiencing a diversity of climate emotions at high rates. In terms of specific emotional impacts and responses, young people most commonly report feeling afraid (66%), sad (65%), anxious (63%), helpless (58%), and powerless (56%). The least commonly reported feelings were grief (34%), optimism (21%), and indifference (20%) (Fig. 1). Participants were also asked "I am worried that climate change threatens people and the planet." Nearly half (48%) of all respondents reported feeling "very" or "extremely worried": only 5% reported feeling "not at all" worried.

Given the extent to which young Canadians are experiencing difficult emotions, it is not surprising that young people also reported impacts on daily functioning and overall mental health. Only 22% of respondents reported that climate change does not at all impact their overall mental health and 37% reported that their feelings about climate change negatively affect daily life at least moderately. The survey data also illustrate that climate change is contributing in myriad ways to negative thoughts about their future. For example, 39% report hesitation about having children due to climate change, 48% believe that humanity is doomed, 53% think that they will not have access to the same opportunities that their parents had, 73% report thinking that the future is frightening, and 76% report that people have failed to take care of the planet. The negative thoughts about climate change score was 4.13 out of 7 (SD 2.60) illustrating a generally negative outlook about the future.

Our survey also collected perspectives on the supports, programs, and/or resources that young people think do and/or would help them cope with climate emotions and climate anxiety using an open-ended question. Table 1 summarizes the 8 themes, illustrative examples from the data, and the proportion of respondents coded under each theme. Variations of "don't know" or cases where coders could not make sense of responses were excluded. Also, although talking about climate emotions is likely an important coping mechanism supporting the processing of big and challenging emotions like anxiety,

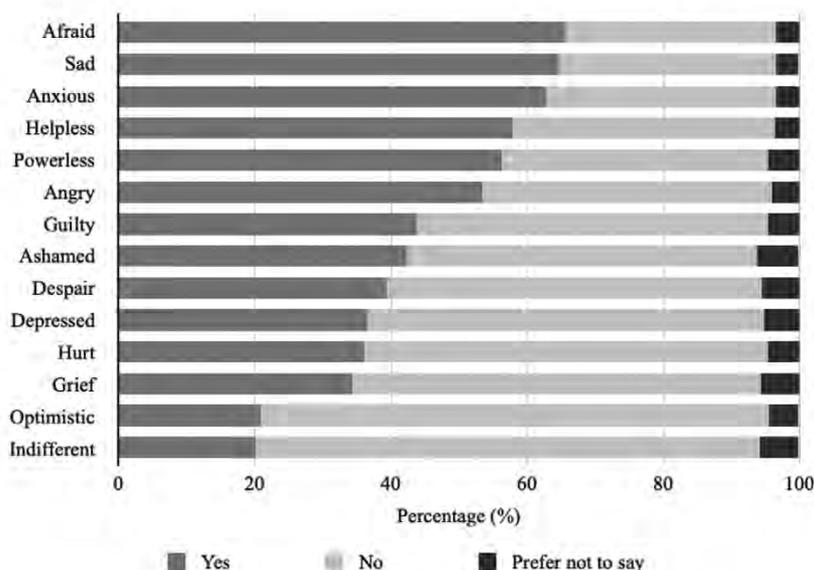


Fig. 1. Climate emotions reported by young people (aged 16–25) in Canada (n = 1000, weighted).

powerlessness, and sadness, 32% of participants reported that they do not talk about climate change with other people and 36% reported that when they do, they feel ignored or dismissed.

3.2. Beliefs and feelings about government (in)action

Our data illustrate that inaction at the systemic and structural levels shape the lived experiences of climate emotions and climate

anxiety among young Canadians. Notably, 64% of survey respondents do not think that the Canadian government is doing enough to avoid climate catastrophe. The beliefs about government response scale indicates a negative perception of the Canadian government’s response to climate change, with a summative score of 14.96 (SD 2.60) on a scale ranging from 9 to 18 (Table 2). The feeling betrayed by government scale is higher than the feeling reassured by government scale, with mean scores of 2.55 (SD 1.00) and 2.19 (SD 0.89).

Table 1

Coding scheme for open-ended question on the kinds of supports, programs, and/or resources that do or would help young people cope with feelings about climate change.

Theme	Illustrative Examples	% of coded responses
Seeking emotional and mental health support from/with others	- "Psychologist" - "Talking with family and friends" - "Support groups about climate change" - "... a community of like-minded people who feel the same as I do, that might make me feel less alone in my efforts to make a difference."	25
Taking individual and collective climate action	- "Trying to take part in initiatives that fight against climate change from the ground, as well as become a less wasteful consumer." - "Donate to charities"	25
Formal education initiatives or programs	- "Programs that educate people about climate change and all the ways we can contribute towards working on a solution." - "Awareness programs" - "Programs where they gave more information about the situation and provided possible long-term solutions."	12
Managing feelings and emotions through activities	- "Meditation" - "I try to go outside on hikes." - "Video games" - "Music and reading are some coping mechanisms I used to help ease my feelings."	11
Not coping/not doing anything to cope	- "I don't cope, I stay miserable." - "Nothing, I suck it up." - "I don't think support programs would help, because trying to make me feel better about things doesn't change the fact that climate change is still happening and no one in power is doing anything to try and change it."	8
Seeking out information and solutions through informal learning	- "Blogs discussing small things I can do to help." - "News Channels that give me hope."	7
Shifting perceptions and positive thinking	- "I just stay optimistic" - "Taking it more seriously"	6
Systemic action needed from governments	- "Maybe if our government started taking climate change seriously. Not just ours in Canada but all of them, worldwide." - "I also think the government taking more accountability and action would greatly improve people's anxieties."	4

*Note: nonsensical responses and "Don't know" were not coded.

Table 2
Beliefs about the federal government’s response to climate change reported by young people (aged 16–25) in Canada (n = 1000, weighted).

In relation to climate change, I believe that my government is ...	Yes (n)	No (n)	Prefer not to say (n)
Doing enough to avoid a climate catastrophe	26.7% (267)	63.8% (638)	9.2% (92)
Taking my concerns seriously enough	26.9% (269)	61.5% (615)	11.9% (116)
Protecting me, the planet and/or future generations	31.8% (319)	57.5% (575)	10.7% (107)
Failing young people across the world	56.4% (564)	33.4% (334)	10.2% (102)
Lying about the effectiveness of the actions they’re taking in relation to climate change	53.5% (535)	34.7% (347)	11.8% (118)
Acting in line with climate science	36.5% (365)	53.2% (532)	10.3% (103)
Can be trusted	31.9% (319)	52.4% (524)	15.8% (158)
Dismissing people’s distress	47.9% (479)	41.3% (413)	10.7% (107)
Betraying me and/or future generations	48.4% (484)	38.9% (389)	12.7% (127)

The Cronbach’s alpha for the betrayal and reassurance scales were 0.88 and 0.82 respectively, illustrating high internal consistency. When asked how the government’s response to climate change makes them feel, 35% of the sample report feeling “not at all” valued, 32% report feeling “not at all” protected.

3.3. Perspectives on social and emotional dimensions of climate change education

Survey participants were asked their opinions about the formal education system and climate change education. Approximately 65% believe that the education system in Canada should be doing more or a lot more to educate young people about climate change. Similarly, 60% believe that the formal education system should focus more on the social and emotional dimensions of climate change (described as “developing the emotional intelligence and/or interpersonal skills that enable learners to constructively cope with the emotions and feelings about climate change and its impacts and to more effectively collaborate, negotiate, and communicate with others to address climate change”). To elicit detailed perspectives on possible opportunities for integrating social and emotional dimensions into education, we also asked the participants to share their perspectives on “the most important thing the education system can do to support your mental and emotional health in the context of the climate crisis”. Table 3 reports 5 key themes

which illustrate that young Canadians want more climate change content in schools and want to learn about solutions.

4. Discussion and conclusion

Using a national survey and replicating and expanding on the methods and findings from Hickman et al. [19], this study illustrates that climate emotions and climate anxiety are prevalent among 16 to 25 year old Canadians. Overall, our findings illustrate a constellation of challenging climate emotions, negative thoughts around climate change and the future, concerning levels of climate change-related distress, and negative perceptions and emotional consequences of Canada’s response to climate change. The findings also highlight diverse supports that young Canadians are calling for to cope with challenging emotions and advancements needed in the education system to address the growing mental health burden of the climate crisis.

A majority of young Canadians surveyed reported feeling afraid, sad, anxious, helpless, powerless, and angry while a minority reported feeling optimistic in relation to climate change. These findings align closely with the global findings reported by Hickman et al. [19] where feeling afraid, sad, anxious, powerless, and angry were the most commonly reported climate emotions across 10 countries. A small minority, 5% of respondents in our study and across all 10

Table 3
Coding scheme for open-ended question on the most important thing the education system can do to support mental and emotional health in the context of the climate crisis.

Theme	Illustrative Examples	% of coded responses
Increase climate change content in school	- “Launch a variety of environmental programs.” - “Make climate change courses mandatory.” - “Education and accessible resources are key for youth understanding the climate crisis.”	23
Teach solutions	- “Teach about what can be done to help climate change.” - “Educate us on the ways we can contribute to solving the climate crisis.”	16
Provide mental health supports and programming in the education system	- “Offer counselling services.” - “Create student support groups.” - “Teach students about how to cope and take care of their mental and emotional health around the climate crisis.” - Make it feel safe to speak about our feelings and hold a safe space with training.	16
Engage in reassurance, positive, and hopeful messaging	- “Reassure the youth and have resources for them if they want to learn and help.” - “Give supports to individuals who feel distress and help reassure them.”	9
Teach about climate risk and urgency	- “Teach the real reality.” - “Educate about the danger.” - “Be honest and not give students false hope.” - “Simply telling the truth about climate change.”	7

*Note: nonsensical responses and “Don’t know” were not coded.

countries in the Hickman et al. [19] study, reported feeling not at all worried about climate change. Our findings are also consistent with an emerging consensus in the literature highlighting that fear, sadness, anger, powerlessness, and worry about the future are core characteristics of climate anxiety among young people [9]. Although this study adds to the rapidly growing literature on experiences of climate emotions among young people, more work is needed to better understand how lived experiences vary across identity, culture, and context, to better understand those factors influencing experiences and impacts of climate emotions, and to advance our collective understanding of the interplay between climate emotions and (in)action. We plan to further analyze these survey data to better understand how and why climate emotions vary across age, gender, and ethnicity and are currently undertaking qualitative research to complement this work.

Concerningly, our data illustrate that the climate crisis is impacting the overall mental health and daily functioning of young Canadians: 8 in 10 reported that climate change impacts their overall mental health and 4 in 10 reported that their feelings about climate change negatively impact daily functioning. In terms of impacts on daily functioning, our findings align closely with data from Australia (32%), France (35%), and Portugal (37%) but differ markedly from countries in the Global South including Nigeria (66%), India (74%) and the Philippines (75%) as reported by Hickman et al. [19]. Overall, our findings align most closely with the so-called Global North countries suggesting that contributions to GHG emissions, vulnerability, and levels of governmental (in)action that vary across countries and contexts likely play a role in shaping experiences and impacts of climate emotions and climate anxiety among young people. Also noteworthy, beliefs about governmental response to climate change and negative emotional impacts of government response (as measured by the betrayal scale) illustrate consistency with Australian and American data [19]. This is perhaps not surprising given similarities in terms of government failings to take meaningful action against climate change, economies that are heavily reliant on resource extraction, ongoing settler-colonialism, and high levels of per capita GHG emissions.

Like others, we consider strong climate emotions and anxiety appropriate responses to the climate crisis, while also recognizing the mental and emotional that burden young people are bearing [11,33]. Supports, policies, and programmes are necessary to enable young people to cope with climate-related distress, foster emotional resiliency, and prevent harm. However, it is essential to recognize that young Canadians are experiencing distress and mental health consequences *because of* the failure of adults, decision-makers, and governments to adequately address the climate crisis. As one survey participant expressed, “. . .the government taking more accountability and action would greatly improve people's anxieties”. The inaction from adults and the wholly inadequate response to the climate crisis in Canada and globally illustrates a lack of care, and can also be seen as a form of youth mistreatment, harm, and neglect [16]. Echoing the voices and perspectives of young Canadians, we call for urgent and transformative climate action to protect the mental and emotional health of young people.

Our data illustrate that young people feel powerless and betrayed and do not feel cared for, valued, or protected when it comes to climate change and Canada's response. It is therefore also imperative that young people are heard by decision makers, feel heard, and have access to diverse safe spaces to voice their experiences of climate change and priorities for climate action [34]. Beyond a moral imperative, being heard and feeling heard by adults can address feelings of powerlessness and betrayal while building allyship and support through social networks. Implementing participatory models [35] for meaningful youth engagement in decision-making can address structural and actual disempowerment experienced by young people [21,36]. However, existing models of youth engagement—youth

councils for example—can be tokenistic or exploitative if equity and positionality are not considered throughout youth-adult engagement and governance [37] or if adult involvement is not focused on listening to and empowering young people [38]. Another pitfall of youth-adult engagement can occur when adult allies download the responsibility for climate action to young people or future generations. This reinforces a view that young people are isolated, and neglects the role of adults and communities to engage in systemic and societal responses to climate change in conjunction with youth-led movements [39]. Meaningful engagement with young people requires adult-allies that work to support youth empowerment while acknowledging intergenerational injustices, respecting and supporting young people's capabilities, and validating emotional experiences.

An important contribution of this study is hearing young people's perspectives on specific programs and/or resources that can support coping with challenging climate emotions. The most frequently coded theme from our data was *Seeking emotional and mental health support from/with others*, talking with family and friends or seeing a psychologist for example. Notably, approximately two-third of young Canadians reported that they either don't talk to others about climate change or feel dismissed or ignored if they do. Similar findings were reported by in the UK, the USA, and Australia [19] illustrating what we call a 'climate of silence' in these contexts [19,40]. Breaking this constructed silence by creating and offering a diversity of safe spaces for young people to talk about climate change and their experiences of climate emotions is therefore critical [34]. There are a growing number of support groups, networks, and group therapy approaches offering non-judgemental and safe spaces for young people to come together to recognize, voice, and work with their emotions related to the climate crisis. However, these tend to be through non-profit organizations rather than widely available to youth through school programs and may not be accessible to marginalised groups. Our study emphasizes the growing need for accessible initiatives and spaces pointing to the importance of enhanced financial support, research, and policy to expand this work. These findings also highlight the need for increased training and knowledge about climate emotions generally and among professionals who work with young people; educational and mental health professionals in particular [41]. The second most frequently coded theme was *Taking individual and collective climate action*. Our data support the emerging consensus in the literature on the important links between climate emotions and climate action. Specifically, there is emerging evidence indicating that emotions can motivate and promote climate action and that engaging in climate action, collective action in particular, can help people cope with challenging emotions and climate anxiety [42]. Overall, the 8 themes illustrating young people's perspectives on programs and/or resources to support their coping exemplify the three main coping strategies that Ojala has identified working with young people in Northern Europe: "(1) Problem-focused coping, i.e., thinking about, planning, and trying to do something to fight climate change; (2) Emotion-focused coping, for instance getting rid of negative emotions with distancing strategies; (3) Meaning-focused coping and hope, i.e., being able to switch perspective and see both negative and positive trends, and putting trust in more powerful societal actors." [43]

An additional contribution of this work is in identifying possibilities for change within the formal education system. Secondary and post-secondary institutions provide formative learning experiences and the knowledge and skills that young people need for their lives post-graduation; schools are where young people spend much of their time. As reported above, 6 in 10 young Canadians believe that the education system in Canada should do more, or a lot more, to educate them about climate change and should focus more, or a lot more, on the social and emotional dimensions of climate change. We interpret these findings as a call to action from young people and

point to the thematic analysis results as suggested direction from young people to improve their experiences through providing supports within education systems. Specifically, young people want the formal education system to support their mental and emotional health by integrating more climate change content in schools. Respondents suggested a variety of environmental and climate-focused extra-curricular programs and activities, such as making climate change courses mandatory and integrating project-based and design-thinking learning processes focused on addressing climate issues into classroom instruction. The data also indicate that young people want solutions-focused instruction and learning opportunities within the education system. This is supported by analysis of regional curricula across Canada [44] and findings internationally on how to improve climate change education [45]. In the words of one survey participant, "Educate us on the ways we can contribute to solving the climate crisis". Teaching about climate solutions and providing opportunities to take and support climate action may address feelings of powerlessness, betrayal, fear, and worry while also providing opportunities to talk about climate change with peers and adult-allies. Our findings also show that young people want mental health supports within the education system, such as access to counselling services, student support/discussion groups, and instruction that integrates explicit teaching on coping strategies in response to climate change. These findings add to the currently limited research on climate change education gaps in formal education systems [45] and challenge formal education systems to provide relevant knowledge and understanding, skills, and mental or emotional supports that young people indicate they need.

Drawing on our findings and existing knowledge and practice gaps we conclude with a set of directions that we see as priorities for advancing this field of research and protecting the mental and emotional well-being of young people in the context of the climate crisis. First, we argue for additional empirical research on climate emotions among young people across diverse places and cultures, generally, and a focus on understanding the ways in which social location, identity, and marginalization shape climate emotions specifically. Although more survey data and analytical work is certainly needed, qualitative data is also needed to deepen our understanding of complex climate emotions and intersections with identity and (in)action. Therefore, both quantitative and qualitative methodologies are needed and an intersectional approach, rooted in the notion that multiple socially constructed positions intersect to shape experiences [46], will be particularly helpful here. Second, more research is needed on the ways in which youth are (or are not) coping with challenging climate emotions and the ways in which adult-allies can support the development of adaptive and culturally-relevant coping skills within and beyond the formal education system [4]. Relatedly, research to better understand unique challenges and possibilities for schools (primary, secondary, and higher education) to become safe spaces to foster coping skills and emotional resiliency to climate change is currently lacking. Third, there is a growing need for research to better understand the knowledge, attitudes, and skills of mental health professionals and educators in relation to climate change generally and the emotional dimensions of climate change specifically. Robust evidence is needed to inform training and skill-building opportunities with mental health professionals and educators around climate literacy and best practices for supporting young people in relation to the emotional burden of the climate crisis [33]. Fourth, efforts are needed to explicitly examine and learn from the existing interventions aimed at offering non-judgemental and safe spaces for young people to recognize, voice, and process climate emotions with others. Finally, research that not only prioritizes young people's voices and experiences but also empowers young people through the research process itself is promising direction [21]. Participatory methodologies oriented towards conducting research with the people affected by a given issue and aimed at

change are particularly relevant. For example, participatory action research with young people aimed at learning how best to involve them in climate action and policy-making processes or curricular reform that also acknowledges and recognizes emotional dimensions of the climate crisis is a promising direction forward. Participatory action research can also explicitly foster intergenerational relationship building and youth-adult allyship which we see as imperative to both addressing climate distress and co-creating a safe, healthy, and equitable future.

Contributions

LPG and EF contributed to conceptualization, literature synthesis, study design, data collection, data analysis, writing and editing. Both authors had full access to the data and accept responsibility for publications.

Data sharing

Authors will consider making de-identified data available between 5 months and 5 years after publishing to parties submitting rigorous and justified proposals for analysis. Those requesting data would have to sign a data access agreement.

Author agreement statement

We the undersigned declare that this manuscript is original, has not been published before and is not currently being considered for publication elsewhere.

We confirm that the manuscript has been read and approved by all named authors and that there are no other persons who satisfied the criteria for authorship but are not listed. We further confirm that the order of authors listed in the manuscript has been approved by all of us.

We understand that the Corresponding Author is the sole contact for the Editorial process. He/she is responsible for communicating with the other authors about progress, submissions of revisions and final approval of proofs.

Funding

This study was funded by the Social Sciences and Humanities Research Council which had no role in data collection, analysis, or reporting.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Acknowledgements

We would like to thank the Social Sciences and Humanities Research Council and the Canada Research Chair program for supporting this research. We would also like to acknowledge Paul Berger, Carmen Kinniburgh, and Aynsley Klassen for their thoughtful review and copyediting. Finally, we acknowledge Brigitte Champaigne-Klassen for support with thematic data analysis.

Supplementary materials

Supplementary material associated with this article can be found in the online version at [doi:10.1016/j.joclim.2023.100204](https://doi.org/10.1016/j.joclim.2023.100204).

References

- [1] Pörtner H.O., Roberts D.C., Adams H., et al. Climate change 2022: impacts, adaptation and vulnerability. 2022.
- [2] Hayes K, Blashki G, Wiseman J, et al. Climate change and mental health: risks, impacts and priority actions. *Int J Ment Health Syst* 2018;12:1–12.
- [3] Clayton S, Manning C, Krygsmann K, et al. Mental health and our changing climate: impacts, implications, and guidance. Washington, D.C: American Psychological Association and ecoAmerica; 2017 https://scholar.google.com/scholar_lookup?title=Mental%20Health%20and%20Our%20Changing%20Climate%3A%20Impacts%2C%20Implications%2C%20and%20Guidance&author=S.%20Clayton&publication_year=2017 accessed 25 February 2022.
- [4] Ojala M, Cunsolo A, Ogunbode CA, et al. Anxiety, worry, and grief in a time of environmental and climate crisis: a narrative review. *Annu Rev Environ Resour* 2021;46:35–58.
- [5] Pihkala P. Toward a taxonomy of climate emotions. *Front Clim* 2022;3:738154.
- [6] Galway LP, Beery T. Exploring climate emotions in Canada's provincial north. *Front Psychol* 2022;13 <https://www.frontiersin.org/articles/10.3389/fpsyg.2022.920313> 2022, accessed 30 August.
- [7] Ray S.J. A field guide to climate anxiety: how to keep your cool on a warming planet. 2020.
- [8] Coffey Y, Bhullar N, Durkin J, et al. Understanding eco-anxiety: a systematic scoping review of current literature and identified knowledge gaps. *J Clim Change Health* 2021;3:100047.
- [9] Pihkala P. Anxiety and the ecological crisis: an analysis of eco-anxiety and climate anxiety. *Sustainability* 2020;12:7836.
- [10] Cianconi P, Betró S, Janiri L. The impact of climate change on mental health: a systematic descriptive review. *Front Psychiatry* 2020;11:74.
- [11] Crandon TJ, Scott JG, Charlson FJ, et al. A social–ecological perspective on climate anxiety in children and adolescents. *Nat Clim Chang* 2022;12:123–31.
- [12] Clayton S. Climate anxiety: psychological responses to climate change. *J Anxiety Disord* 2020;74:102263.
- [13] Charlson F, Ali S, Augustinavicius J, et al. Global priorities for climate change and mental health research. *Environ Int* 2022;158:106984.
- [14] Searle K, Gow K. Do concerns about climate change lead to distress? *Int J Clim Change Strat Manag* 2010;2:362–79.
- [15] Wullenkord MC, Tröger J, Hamann KRS, et al. Anxiety and climate change: a validation of the Climate Anxiety Scale in a German-speaking quota sample and an investigation of psychological correlates. *Clim Change* 2021;168:20.
- [16] Benoit L, Thomas I, Martin A. Review: ecological awareness, anxiety, and actions among youth and their parents – a qualitative study of newspaper narratives. *Child Adolesc Ment Health* 2022;27:47–58.
- [17] Palinkas LA, Wong M. Global climate change and mental health. *Curr Opin Psychol* 2020;32:12–6.
- [18] Clayton S, Karaszia BT. Development and validation of a measure of climate change anxiety. *J Environ Psychol* 2020;69:101434.
- [19] Hickman C, Marks E, Pihkala P, et al. Climate anxiety in children and young people and their beliefs about government responses to climate change: a global survey. *Lancet Planet Health* 2021;5:e863–73.
- [20] Wu J, Snell G, Samji H. Climate anxiety in young people: a call to action. *Lancet Planet Health* 2020;4:e435–6.
- [21] Arora R, Spikes ET, Waxman-Lee CF, et al. Platforming youth voices in planetary health leadership and advocacy: an untapped reservoir for changemaking. *Lancet Planet Health* 2022;6:e78–80.
- [22] Bush E., Lemmen D.S. Canada's changing climate report; government of Canada. Ottawa, Ontario, 2019.
- [23] Climate Action Tracker. Canada, <https://climateactiontracker.org/countries/canada/> (2022, accessed 29 August 2022).
- [24] Kotyk A., ca ReporterCtvn, F] Contact. 595 people died due to B.C.'s extreme summer heat, latest coroner data reveals. British Columbia, <https://bc.ctvnews.ca/595-people-died-due-to-b-c-s-extreme-summer-heat-latest-coroner-data-reveals-1.5646936> (2021, accessed 30 August 2022).
- [25] Bratu A, Card KG, Closson K, et al. The 2021 Western North American heat dome increased climate change anxiety among British Columbians: results from a natural experiment. *J Clim Change Health* 2022;6:100116.
- [26] FUND EnvironmentalDefence. The running list of federal fossil fuel subsidies in Canada in 2022. Environ Defence 2022 <https://environmentaldefence.ca/federal-fossil-fuel-subsidies-tracking/> (accessed 30 August).
- [27] Berry P., Schnitter R. Health of Canadians in a changing climate: advancing our knowledge for action. Ottawa, ON: Health Canada.
- [28] Karsgaard C, Davidson D. Must we wait for youth to speak out before we listen? International youth perspectives and climate change education. *Educ Rev* 2021;0:1–19.
- [29] Bowman B. They don't quite understand the importance of what we're doing today: the young people's climate strikes as subaltern activism. *Sustain Earth* 2020;3:16.
- [30] Canadian Institute for Health Information. Guidance on the use of standards for race-based and indigenous identity data collection and health reporting in Canada. Ottawa, Canada: Canadian Institute for Health Information; 2022.
- [31] Visible minority concept consultative engagement, <https://www.statcan.gc.ca/en/consultation/2022/visible-minority-concept> (accessed 8 December 2022).
- [32] Brosch T. Affect and emotions as drivers of climate change perception and action: a review. *Curr Opin Behav Sci* 2021;42:15–21.
- [33] Cunsolo A, Harper SL, Minor K, et al. Ecological grief and anxiety: the start of a healthy response to climate change? *Lancet Planet Health* 2020;4:e261–3.
- [34] Hickman C. We need to (find a way to) talk about... Eco-anxiety. *J Soc Work Pract* 2020;34:411–24.
- [35] Hart RA. Stepping back from 'The ladder': reflections on a model of participatory work with children. Springer; 2008. p. 19–31.
- [36] Hart R., Fisher S., Kimiagar B. Beyond projects: involving children in community governance as a fundamental strategy for facing climate change. *Chall Clim Change Children Front* 2014; 92–97.
- [37] Spajic L, Behrens G, Gralak S, et al. Beyond tokenism: meaningful youth engagement in planetary health. *Lancet Planet Health* 2019;3:e373–5.
- [38] Elsen F, Ord J. The role of adults in "youth led" climate groups: enabling empowerment. *Front Political Sci* 2022;3 <https://www.frontiersin.org/articles/10.3389/fpos.2021.641154> (2021, accessed 8 September).
- [39] Wood B. Youth-led climate strikes: fresh opportunities and enduring challenges for youth research - commentary to Bowman. *Fennia* 2020;198:217–22.
- [40] Galway LP, Beery T, Buse C, et al. What drives climate action in Canada's provincial north? Exploring the role of connectedness to nature, climate worry, and talking with friends and family. *Climate* 2021;9:146.
- [41] Allen KA. Climate change, a critical new role for educational and developmental psychologists. *Educ Dev Psychol* 2020;37:1–3.
- [42] Bright ML, Eames C. From apathy through anxiety to action: emotions as motivators for youth climate strike leaders. *Aust J Environ Educ* 2022;38:13–25.
- [43] Ojala M. Young people and global climate change: emotions, coping, and engagement in everyday life. In: Ansell N, Klocker N, Skelton T (eds) *Geographies of global issues: change and threat*. Singapore: Springer, pp. 329–46.
- [44] Wynes S, Nicholas KA. Climate science curricula in Canadian secondary schools focus on human warming, not scientific consensus, impacts or solutions. *PLoS One* 2019;14:e0218305.
- [45] McKenzie M. Climate change education and communication in global review: tracking progress through national submissions to the UNFCCC Secretariat. *Environ Educ Res* 2021;27:631–51.
- [46] Bauer GR. Incorporating intersectionality theory into population health research methodology: challenges and the potential to advance health equity. *Soc Sci Med* 2014;110:10–7.