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How well do psychologists' research methods equip them to identify the impacts of climate change on behaviour? A methodological investigation with particular reference to the effects of temperature on violent behaviour

A thesis presented in partial fulfilment of the requirements for the degree of

Doctor of Philosophy
in
Psychology

at Massey University, Albany,
New Zealand

Matthew Neil Williams
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Abstract

The Earth’s temperature is rising, and it is extremely likely that human activities are primarily to blame (IPCC, 2013b). A changing climate could have serious consequences for human behaviour and psychological functioning. Research concerned with the psychological impacts of climate change is challenging, however, given the paucity of data showing how human behaviour has responded to sustained climate changes in the past. In this thesis, I critique the suitability of psychologists’ mainstream methodological strategies for engaging in research concerned with the impacts of climate change. In doing so, I draw heavily on a specific “testbed” of psychological research relevant to climate change: Research concerned with the impact of temperature on the incidence of intra- and interpersonal violence. In identifying methodological problems I draw both on published literature as well as an empirical engagement in research in this area. The empirical component constitutes an analysis of the relationship between temperature and the incidence of assault, suicide, and self-harm resulting in hospitalisation in New Zealand. In this analysis I found that irregular day-to-day variation in temperature had a positive relationship with all three forms of violence. However, there was less evidence that more sustained (seasonal or geographical) differences in temperature led to increased violence, making it difficult to predict the effects of sustained increases in temperature in the future. In the methodological critique section of this thesis, I point out several methodological problems that may hamper psychologists’ capacity to produce effective and useful research concerned with the impacts of climate change. These problems include the use of measurement and analysis strategies that limit our ability to convey the sizes of effects; the use of theories and analyses that limit our ability to make predictions; and the inadequate reporting of uncertainty. Finally, I recommend that psychologists studying climate change impacts should consider using categorisations of behaviour rather than psychometric scales that lack clear units of measurement; use statistics that effectively communicate effect size; apply theories that facilitate prediction-making; carefully take into account the role of time when generating predictions; and account for multiple sources of uncertainty that affect the confidence of our conclusions.
Acknowledgements

This thesis may have my name on it, but many people have contributed to it. First thanks go to my supervisors Stephen Hill and John Spicer, who have been patient and helpful sources of wisdom throughout. I couldn’t have asked for two better supervisors, and I certainly hope this isn’t the last time we work together. I’d also like to thank the editors and reviewers who provided helpful feedback on the journal articles presented as part of this thesis. Any errors that remain are my own. Earlier in the process of my PhD, several organisations were very helpful in providing me with data, including the New Zealand Police, the Ministry of Health, the National Institute of Water and Atmospheric Research (NIWA), and Statistics New Zealand. Of particular help were Lynn Jenner, Gavin Knight, Steve Darroch, and Ruth Wallis (NZ Police); Jane Perrott and Chris Lewis (Ministry of Health); and Richard Speirs (Statistics NZ).

Margaret Roberts, Jaimie Veale, and Kirsty Furness were of great help when proofreading this thesis. Alison McKinlay deserves a lot thanks for sharing an office with me over these last few stressful months. Even more importantly, having the company of you four (and many others) also going through the trials and tribulations of doctorate study helped a lot. I’d also like to thank the inhabitants of the talkstats.com forums. What little I know about statistics is mostly thanks to all of you.

My parents Anneke and David have been amazing sources of love and support (and are great proofreaders too!) Thanks also to my brother and sister, Martin and Amy, for always being excellent and hilarious company. While writing of family, I’d also like to acknowledge my uncle Herman Gerhardus van Gysen, a researcher much more accomplished than I who sadly died at the age of just 45. Herman’s research was mainly focused on spline models in geodesy. I used spline models briefly in this thesis (see section 3.4.1), and I’m sure my analyses would have been much improved if I’d had him around to talk with.

Some PhD students manage to focus solely on their research for years at a time; I am not one of those students. I’d like to thank the volleyball crew for always being there when I needed a break and some exercise. The same goes for the longtime friends like Kris, Nick, and Rob who’ve been there since I first decided I’d like to spend another year… or two… at university.

Last but not least, I’d like to thank my wonderful partner Jessica. Finally, it’s time for us to have a holiday.
This thesis takes the form of a partial thesis-by-publications format. Specifically, the empirical section of the thesis is presented as three journal articles. Studies One and Two were both published (in print and online) in *Climatic Change* in 2015. Study Three was published in *Psychology, Health, & Medicine* as an advance online publication in 2015. The final two chapters of this thesis (the methodological critique and methodological recommendations chapters) have not been submitted for publication. I chose not to structure these chapters as manuscripts in order to take advantage of the extra freedom in terms of space and format that a thesis allows. An additional short commentary article that I published in 2013 along with my supervisors, but that does not form a part of the main narrative of this thesis, is included in Appendix D.

The publishers of the three main articles presented in this thesis (Springer for *Climatic Change* and Taylor & Francis for *Psychology, Health & Medicine*) both provide authors with the right to include published articles in a thesis or dissertation. I contacted both publishers to confirm that this was acceptable in my specific case (i.e., a thesis that will ultimately be accessible online, with minor formatting changes to the articles presented). Representatives of both Springer and Taylor & Francis kindly confirmed that this was acceptable. The commentary article presented in Appendix D was published in an open access journal (the *Western Journal of Emergency Medicine*), meaning that it could be reproduced without obtaining permission from the publisher.

The work presented in this thesis is my own. I designed the empirical studies, collected data, selected and conducted data analyses, and wrote all of the chapters presented. My supervisors Stephen Hill and John Spicer helped me to select an appropriate structure, provided feedback on my writing, and provided valuable advice with respect to conceptual issues. They were therefore included as co-authors for the publications included in this thesis.

Ethical approval for the empirical studies reported in this thesis was obtained from the Massey University Human Ethics Committee, Southern B Application 10/54.

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<tr>
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<tbody>
<tr>
<td>ANOVA/ANCOVA</td>
<td>Analysis of variance/Analysis of covariance</td>
</tr>
<tr>
<td>AWS</td>
<td>Automatic Weather Station</td>
</tr>
<tr>
<td>CI</td>
<td>Confidence interval</td>
</tr>
<tr>
<td>df</td>
<td>Degrees of freedom</td>
</tr>
<tr>
<td>ENSO</td>
<td>El Niño Southern Oscillation</td>
</tr>
<tr>
<td>ICD</td>
<td>International Classification of Diseases</td>
</tr>
<tr>
<td>IPCC</td>
<td>Intergovernmental Panel on Climate Change</td>
</tr>
<tr>
<td>M</td>
<td>Mean</td>
</tr>
<tr>
<td>MJ/m²</td>
<td>Megajoules per square metre (of radiation)</td>
</tr>
<tr>
<td>NASA</td>
<td>National Aeronautics and Space Administration</td>
</tr>
<tr>
<td>NIWA</td>
<td>National Institute of Water and Atmospheric Research</td>
</tr>
<tr>
<td>NZ</td>
<td>New Zealand</td>
</tr>
<tr>
<td>RCP</td>
<td>Representative Concentration Pathway</td>
</tr>
<tr>
<td>SD</td>
<td>Standard deviation</td>
</tr>
<tr>
<td>SI</td>
<td>International System of Units</td>
</tr>
<tr>
<td>SOI</td>
<td>Southern Oscillation Index</td>
</tr>
<tr>
<td>Tmean</td>
<td>Mean temperature</td>
</tr>
<tr>
<td>US/USA</td>
<td>United States of America</td>
</tr>
<tr>
<td>VCN</td>
<td>Virtual Climate Network</td>
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