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Anthropomorphising nature in times of crisis: A serial mediation model from connectedness to nature via anthropomorphism on support for COVID-19 travel restrictions

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1. Introduction

The COVID-19 pandemic has resulted in widespread travel restrictions to reduce the spread of the virus. It is therefore necessary to understand factors that lead to support for these imposed travel restrictions. Given the reduced environmental impact (e.g., reduced pollution) resulting from travel restrictions, these restrictions can be viewed through a pro-environmental lens. This study aimed to examine the influence of the well-supported predictor of pro-environmental behaviour, connectedness to nature, on support for COVID-19 travel restrictions. To understand why connectedness to nature may predict support for travel restrictions, mediators of this relationship were examined. Anthropomorphism of nature is reasoned to accompany connectedness to nature, and can involve anthropomorphism in various forms (i.e., generalised, and context-specific anthropomorphism). This study (N=270) examined a mediation model whereby anthropomorphism of nature (general) and anthropomorphism of nature in COVID-19 (context-specific) were serial mediators of the relationship between connectedness to nature and support for travel restrictions. Individual pathways of the model were significant, as were the indirect effects, providing support for the serial mediation model, with these predictors accounting for 13% of the variance in support for COVID-19 travel restrictions. Implications of this research are discussed and include promotion of connectedness to nature as well as considering anthropomorphic message framing.

1. Introduction

The COVID-19 pandemic has brought with it widespread restrictions on personal travel which have been in place for many populations across the world. This has included international travel, as well as travel domestically within one’s country. At times there have also been restrictions on travel away from one’s home, limiting the reasons one is allowed out as well as the permissible distances one can travel. These restrictions have varied by jurisdiction and other factors such as the number of cases in the area, and have been in place in an effort to stop, or slow, the spread of the virus (Wilder-Smith & Freedman, 2020). Reasons for supporting restricted travel during the COVID-19 pandemic may be varied and can centre on health motivations (e.g., Kallbekken & Saelen, 2021; Naumann et al., 2020). That said, when in place, travel restrictions have resulted in a reduction in the use of cars, buses, trains, and aircraft (Zambrano-Monserrat et al., 2020). As such, the restrictions on travel have resulted in pro-environmental outcomes such as reduced noise and air pollution (Gillingham et al., 2020; Muhammad et al., 2020; Zambrano-Monserrat et al., 2020). Given the importance of restricting travel during a global pandemic such as COVID-19, it is necessary to develop an understanding of factors that underpin support of such measures. This study investigates the role of connectedness to nature in predicting support for travel restrictions in place due to COVID-19, and examines the serial mediation of this relationship by two forms of anthropomorphism of nature.

1.1. Connectedness to nature

Connectedness to nature refers to the perceived closeness in one’s relationship to nature, and represents the expansion of the self to include nature (e.g., Brügger et al., 2011; Mayer & Frantz, 2004; Nisbet et al., 2009; Schultz, 2001). There is considerable prior research that demonstrates the important role of connectedness to nature in motivating pro-environmental behaviours (e.g., Otto et al., 2021; Neaman et al., 2021; Whithburn et al., 2020). In fact, connectedness to nature accounts for more variance in pro-environmental behaviours than other known variables, including multi-variable models (Steg & Vlek, 2009). Given that COVID-19 travel restrictions result in positive environmen-
tal consequences, e.g., reduced pollution (Gillingham et al., 2020; Muhammad et al., 2020; Zambrano-Monserrate et al., 2020), these travel restrictions can be perceived as a pro-environmental action. As such, we expect that connectedness to nature will predict increased support for COVID-19 travel restrictions. One mechanism for why connectedness to nature supports pro-environmental actions is via anthropomorphism.

1.2. Anthropomorphism of nature

Anthropomorphism refers to the attribution of human-like qualities to non-human animals and objects (Guthrie, 2002). Anthropomorphism of nature therefore corresponds to the extent that human-like qualities are applied to nature (Tam, 2014). This can include the attribution of human-like mental capacities including emotion, cognition, and intentionality (Waytz et al., 2010; Tam, 2014). When nature is anthropomorphised, nature is therefore perceived to require similar moral consideration as other humans (Gray et al., 2007; Waytz et al., 2010). As such, anthropomorphism of nature predicts pro-environmental actions (e.g., Retton & Nateléich, 2019; Cooremane & Geuens, 2019; Tam et al., 2013), and this may be due to an expression of this care and concern, or perhaps out of fear of retaliation by an angry or vengeful nature.

Anthropomorphism of nature is positively related to connectedness to nature, and while there is some evidence to support that anthropomorphism leads to connectedness (e.g., Tam et al., 2013), the reverse may also hold. Namely, the extension of qualities outwards from the self and onto what is being connected to is a mechanism for creating psychological connections to social groups (e.g., Mummendeny & Wenzel, 1999; Wenzel et al., 2007; Bianchi et al., 2009; van Veelen et al., 2011; Otten & Epstude, 2006). This projection outwards from the self is demonstrated across a host of contexts and social groups and demonstrates that such projection is a fundamental aspect of social connectedness. Given that anthropomorphism of nature involves the projection of human-like qualities onto nature, we therefore believe that connectedness to nature can also lead to the anthropomorphism of nature.

1.3. Anthropomorphism of nature in the context of COVID-19

While there is ample evidence of a general tendency to anthropomorphise nature, anthropomorphism directed specifically toward nature also takes on context-specific variants. Anthropomorphism of nature in the context of COVID-19 refers to the attribution of human-like qualities to nature specifically regarding the COVID-19 pandemic. Within the context of the COVID-19 pandemic nature has been anthropomorphised, for example, by the Secretary General of the United Nations, António Guterres, when they said that ‘nature is sending us a clear message’ with the COVID-19 pandemic (Harvey, 2020). Adding that ‘nature always strikes back – and it is already doing so with growing force and fury’ (Harvey, 2020) is further demonstration of anthropomorphism of nature in the context of COVID-19 and explicitly speaks of a vengeful nature. Other examples of this context-specific anthropomorphism abound in popular discourse during the pandemic, whereby nature has been purported as ‘healing’ itself with the resulting widespread restrictions resulting from COVID-19 (e.g., Rennex, 2020), or with respect to lockdown restrictions whereby nature has ‘sent us to our rooms to think about what we’ve done’ (e.g., Ward, 2020). Thus, while there is evidence of the anthropomorphism of nature in the context of COVID-19, individuals may vary in the extent to which they engage in this specific type of anthropomorphism. It is expected that anthropomorphism of nature in the context of COVID-19 will be positively related to the general tendency to anthropomorphise nature, such that those who generally anthropomorphise nature are more likely to also anthropomorphise nature in the COVID-19 context.

1.4. The current study

Given the pro-environmental outcomes resulting from restricting travel, the current study seeks to demonstrate the predictive role of connectedness to nature in support for COVID-19 travel restrictions. Further, this study also sought to demonstrate the serial mediation of this relationship by two forms of anthropomorphism of nature, firstly, a general anthropomorphism of nature that is reasoned to occur as a consequence of connectedness to nature, and secondly, a by the specific COVID-19 anthropomorphism of nature. As the anthropomorphism of nature can arise from connectedness to nature, and lead to support for pro-environmental positions, these two forms of anthropomorphism are reasoned to account for the effect that connectedness to nature has on support for travel restrictions. It is proposed that the anthropomorphism of nature in the COVID-19 context arises from a general tendency to anthropomorphise nature and provides a framework for individuals to understand why the restrictions are necessary, i.e., to consider or otherwise appease nature. It is hypothesised that the relationship between connectedness to nature and support for COVID-19 travel restrictions will be serially mediated by anthropomorphism of nature and anthropomorphism of nature in the COVID-19 context.

2. Method

2.1. Participants

Participants were 270 English speaking adults residing in Australia, aged between 19 and 84 (M= 48.36, SD=15.87). Like other research in the field (e.g., Mackay et al., 2021), the gender distribution of the sample consisted of 75% female, 22.5% male, 4% nonbinary or gender diverse, and 1.4% prefer not to say. The majority of the participants described their ethnicity as Australian (62%), followed by English Australian (10.5%), and then those with two or more ethnicities (6.2%). The sample was relatively well educated, with the highest education of the sample being the completion of a postgraduate degree (37%), followed by an undergraduate degree (31.5%), completion of a TAFE course or apprenticeship (13%), and completion of high school (12.3%). The participants’ industry of employment consisted most commonly of Education and Training (14.9%), followed by Health Care and Social Assistance (14.1%), with the remainder of participants across the other Australian and New Zealand Standard Industry Classifications (ANZSIC), while 17.4% of the sample was retired, 9.8% were students, 4.7% unemployed, and 3.6% a stay-at-home parent.

Participants were recruited via paid advertisements on the social media platform Facebook between 23 August 2020 and 1 October 2020, and were offered the opportunity to enter a prize draw to win a AUS$50 gift card upon completion of the study.

2.2. Materials

The online survey was hosted on Qualtrics and, in addition to demographic items, contained the following measures.

**Connectedness to Nature.** The 14-item Connectedness to Nature Scale (Mayer & Frantz, 2004) was used to measure this construct. Items were scored on a 5-point Likert scale from 1 (strongly disagree) to 5 (strongly agree), with a mean calculated across the items after recoding three reverse-scored items. Higher scores indicate a greater connectedness to nature. Example items include “Like a tree can be part of a forest, I feel embedded within the broader natural world” and “I often feel disconnected from nature” (reversed). As with prior research (e.g., Mayer & Frantz, 2004; a=.84), this measure demonstrated excellent internal consistency reliability in the current study (a=.86).

**Anthropomorphism of Nature.** Five items used by Tam (2019) were used to measure anthropomorphism of nature, with a mean of the five items calculated to represent this construct. Items were assessed on an 11-point sliding scale from 0 (not at all) to 10.
(very much), with higher scores indicating greater anthropomorphism of nature. An example item is “To what extent does nature have a mind of its own?”. These items demonstrated excellent internal consistency in prior research ($\alpha=.97$; Tam, 2019), and similarly within the current study ($\alpha=.88$).

**Anthropomorphism of Nature in the Context of COVID-19.** Seven items were developed for this study to assess the extent to which individuals anthropomorphise nature in the context of the COVID-19 pandemic. Items were constructed to highlight the intentional capacities of nature with respect to the COVID-19 pandemic. Items were assessed on a 7-point scale from 1 (strongly disagree) to 7 (strongly agree), with higher scores indicating greater context-specific anthropomorphism. Mean scores were calculated, after recoding one reverse-scored item. Example items from this measure include “Nature is sending us a message with the COVID-19 pandemic,” “It was the will of nature that caused the COVID-19 pandemic,” and “The COVID-19 pandemic did not occur through any intention of nature” (reversed). See Appendix for the full list of these items. These items demonstrated excellent internal consistency reliability, $\alpha=.87$.

**Support for Travel Restrictions.** Thirteen items were written to assess support for COVID-19 travel restrictions, including restrictions of both work and leisure travel. These items included travel via private means (e.g., car) as well as publicly accessible means (e.g., public transport, air travel). Items were assessed on an 11-point sliding scale from 0 (not at all) to 10 (very much). A mean score was calculated, after recoding two reverse-scored items, with higher scores indicating greater support for COVID-19 travel restrictions. Example items include “I support/supported restrictions on travelling by car for leisure activities when travel was restricted during the COVID-19 pandemic,” “I support/supported restrictions around air travel for work during the COVID-19 pandemic,” and “During the COVID-19 pandemic, governments should not try and restrict the movements of their people for work” (reversed). See Appendix for the full list of these items. These items demonstrated excellent internal consistency reliability, $\alpha=.92$.

### 2.3 Procedure

Human ethics approval was first obtained from the university ethics committee. Interested participants clicked on the social media advertisement for a study titled ‘Nature and Perceptions of COVID-19’ and were taken to the survey hosted on Qualtrics. Participants were presented with the study Explanatory Statement which explained the general purpose of the study as well as the anonymous nature of the project. Information on data storage and other relevant information was also provided. Interested participants could then proceed to complete the study measures, in the following order: support for travel restrictions, anthropomorphism of nature, anthropomorphism of nature in the context of COVID-19, connectedness to nature, and demographics. An open-ended question at the end of the study was included to gauge experimental demand, whereby participants were asked to indicate what they thought the study was trying to find out. (No participants correctly indicated the hypothesis of the study or were removed for this reason). Upon completion, participants were thanked for their time and given the opportunity to enter the prize draw by following a separate link to collect their contact details.

### 3. Results

#### 3.1 Descriptive statistics and preliminary analyses

All data analyses were conducted using IBM SPSS v27. The following table contains descriptive statistics and bivariate correlations of the study variables (see Table 1). Support for travel restrictions was relatively high in the sample, while both generalised and COVID-19 anthropomorphism of nature were around the scale midpoint. All interrelations between variables were positive, with the exception of a negative relation between general anthropomorphism of nature and support for travel restrictions.

### 3.2 Inferential statistics

Hayes’ (2018) PROCESS macro v3.5.6 (model 6) was used to test the serial mediation of the relationship between connectedness to nature and support for COVID-19 travel restrictions mediated by anthropomorphism of nature and anthropomorphism of nature in the COVID-19 context. This approach allows the indirect effect passing sequentially through each of these mediators to be tested. Bootstrapping (5000 samples) was applied to obtain bias-corrected 95% confidence intervals of the indirect effects, with mediation occurring when the CIs do not cross zero (Hayes, 2018).

It was found that Connectedness to Nature significantly predicted Anthropomorphism of Nature ($b=1.32$, $t(268)=4.98$, $p<.001$; path a1), and explained 8.5% of variance in this variable ($F(1,268)=24.57$, $p<.001$). Connectedness to Nature ($b=.37$, $t(267)=3.34$, $p<.001$) and Anthropomorphism of Nature ($b=.24$, $t(267)=9.88$, $p<.001$) also significantly predicted Anthropomorphism of Nature in COVID-19 (paths a2, and d’, respectively). These predictors accounted for 34% of the variance in Anthropomorphism of Nature in COVID-19 ($F(2,267)=69.88$, $p<.001$). Connectedness to Nature ($b=.84$, $t(266)=4.56$, $p<.001$), Anthropomorphism of Nature ($b=.21$, $t(266)=4.50$, $p<.001$), and Anthropomorphism of Nature in COVID-19 ($b=.27$, $t(266)=2.65$, $p=.009$) all significantly predicted Support for Travel Restrictions (paths c’, b1, and b2, respectively). These predictors accounted for 12.8% of the variance in Support for Travel Restrictions ($F(3,266)=13.02$, $p<.001$). See Figure 1.

There were three indirect effects for this model. The first indirect effect showed that Anthropomorphism of Nature mediated the relationship between Connectedness to Nature and Support for Travel Restrictions, indirect effect=.28, SE=.09, 95% CI [.46, .12]. The second indirect effect showed that Anthropomorphism of Nature in COVID-19 mediated the relationship between Connectedness to Nature and Support for Travel Restrictions, indirect effect=.10, SE=.06, 95% CI [.02, .22]. The third indirect effect showed that the relationship between Connectedness to Nature and Support for Travel Restrictions was serially mediated by Anthropomorphism of Nature and Anthropomorphism of Nature in the COVID-19 Context, indirect effect=.08, SE=.04, 95% CI [.02, .17].

### 4. Discussion

We have examined COVID-19 travel restrictions through a pro-environmental lens and provided evidence for the predictive role of connectedness to nature in supporting COVID-19 travel restrictions. Further, we have provided evidence of the explanatory role that both a generalised anthropomorphism (namely, anthropomorphism of nature) and a context-specific anthropomorphism (anthropomorphism of nature in COVID-19) have in this relation. In line with prior literature (e.g., Tam et al., 2013) we have shown a positive relationship between connectedness to nature, anthropomorphism of nature, and pro-environmental support. We have added to the literature by considering both generalised as well as context-specific anthropomorphism, as well as applying this to the real-world issue of support for COVID-19 travel restrictions.

Interestingly, while the overall relationship between connectedness to nature, anthropomorphism of nature in COVID-19, and support for travel restrictions was positive, generalised anthropomorphism of nature negatively predicted support for travel restrictions. This suggests there are competing motivations resulting from anthropomorphising nature. The first of these might be to act to appease nature, namely by engaging in actions that would lessen the negative impacts of human action, i.e., engaging in pro-environmental actions or holding positive attitudes such as supporting travel restrictions. This aligns with prior research (e.g., Tam et al., 2013; Cooremans & Geuens, 2019; Ketron &
Nisbet, 2019) that has demonstrated positive relationships between anthropomorphism of nature and pro-environmental actions. The second might be not acting, and instead leaving nature to fulfil their intention of retaliating against those (or the species) which have been perceived to harm nature. In fact, prior literature has demonstrated that the anthropomorphism of nature has decreased support for human victims of a natural disaster (Sacchi et al., 2013), suggesting that anthropomorphism can lead to not interfering with the intention of nature. Given that support for COVID-19 travel restrictions is undoubtedly desirable given the ongoing COVID-19 pandemic, promoting the context-specific anthropomorphism of nature (anthropomorphism of nature in COVID-19) seems more fruitful at achieving these ends than promoting a generalised anthropomorphism of nature.

We also acknowledge that these reasons for supporting restricted travel are just some of the potential reasons to support travel restrictions during the COVID-19 pandemic, with health motivations likely to be also regarded by participants (e.g., Kallbekken & Saelen, 2021; Naumann et al., 2020). While the position of the variables in our model hold theoretically, we have only cross-sectional data limiting the causal conclusions that can be drawn. Future studies would benefit from examining these constructs within an experimental framework, and to consider the likely recursive nature of the relationship between the predictor variables in our model. Given prior literature has demonstrated the role of nature exposure in enhancing connectedness to nature (e.g., Otto & Pensini, 2017; Pensini et al., 2016; Mayer et al., 2009) this seems a promising option, albeit perhaps challenging amidst COVID-19 restrictions. Interventions that allow for virtual or imagined nature exposure (e.g., Nguyen & Bryner, 2018), or other methods such as mindfulness meditation that have been shown to increase connectedness to nature (e.g., Nisbet et al., 2019) may prove more realistic in circumstances where access to natural spaces is limited. Anthropomorhic message framing highlighting nature’s intention in bringing about the COVID-19 pandemic may also be a useful avenue for increasing support for travel restrictions, and one that can be considered in COVID-19 discourse. Future research would also benefit from assessing actual compliance behaviour, as well as support for punishments of those breaking travel restrictions. Given that COVID-19 travel restrictions may be conceptualised via their pro-environmental impacts, future research would also benefit from examining this more closely. Highlighting the pro-environmental aspect of travel restrictions may lead to increased support for such restrictions, at least in those who are more connected to nature or who engage in greater anthropomorphism of nature specifically around COVID-19.

4.1. Conclusion

Overall, we have provided evidence that support for COVID-19 travel restrictions can be interpreted through a pro-environmental lens. Support for COVID-19 travel restrictions was found to be predicted from feelings of connectedness to nature, with this relationship accounted for by both general anthropomorphism of nature and context-specific anthropomorphism of nature (anthropomorphism of nature in COVID-19). Future research would benefit from experimentally demonstrating the pathways in the model to provide causal evidence, as well as highlighting the pro-environmental aspect of COVID-19 travel restrictions to increase their support. In total, this is a promising avenue for both future research as well as in enhancing support for the ongoing travel restrictions that are required to mitigate the COVID-19 pandemic.

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.

Appendix

Items to assess Anthropomorphism of Nature in the Context of COVID-19

1. Nature is sending us a message with the COVID-19 pandemic.
2. Nature has been given a chance to heal itself with the widespread restrictions due to COVID-19.
3. The COVID-19 pandemic occurred because nature was upset.
4. It was the will of nature that caused the COVID-19 pandemic.
5. The COVID-19 pandemic did not occur through any intention of nature.
6. Nature has been given a chance to heal itself with the loss of human life as a result of COVID-19.
7. COVID-19 is a response from Nature, who has had enough of how poorly we’ve treated her.

* Item is reverse-scored

Items to assess Support for Travel Restrictions
1 I did everything I could to comply with travel restrictions during the COVID-19 pandemic.
2 I support/supported the restriction around working from home.
3 I support/supported restrictions around unnecessary commuting during the COVID-19 pandemic.
4 If it was possible, I worked from home during the COVID-19 pandemic.
5 After the COVID-19 pandemic has eased, I would be happy if those who can work from home are given the opportunity to continue to do so.
6 I support/supported restrictions on travelling by car for leisure activities when travel was restricted during the COVID-19 pandemic.
7 I support/supported restrictions on travelling by public transport for leisure activities when travel was restricted during the COVID-19 pandemic.
8 I support/supported restrictions around unnecessary personal travel during the COVID-19 pandemic.
9 I support/supported restrictions around air travel for work during the COVID-19 pandemic.
10 I support/supported restrictions around air travel for leisure during the COVID-19 pandemic.
11 I support punishments for those not abiding by restrictions to unnecessary personal travel during the COVID-19 pandemic.
12 During the COVID-19 pandemic, governments should not try and restrict the movements of their people for work.
13 During the COVID-19 pandemic, governments should not try and restrict the movements of their people for leisure. *

* Item is reverse-scored

References

Bianchi, M., Machonynsky, M., Steffens, M.C., Mummeney, A., 2009. Like me or like us: Is ingroup projection just social projection? Exp. Psychol. 56, 198–205. doi:10.1073/pnas.0900032.

Brügger, A., Kaiser, F.G., Koczen, N., 2011. One for all? Connectedness to nature, inclusion of nature, environmental identity, and implicit association with nature. Eur. Psychol. 16, 324–333. doi:10.1027/1016-9040/a000032.

Cooremans, C., Geuens, M., 2019. Same but different: Using anthropomorphism in the battle against food waste. J. Public Policy Mark. 38, 232–245. doi:10.7721/chilyoutenvi.26.1.0125.

Gillingham, K.T., Knittel, C.R., Li, J., Ovare, M., Reguant, M., 2020. The short-run and long-run effects of Covid-19 on energy and the environment. Joule 4, 1337–1341. doi:10.1016/j.joule.2020.06.010.

Gray, J.H., Gray, K., Wegner, D.M., 2007. Dimensions of mind perception. Science 315 (5812), 619. doi:10.1126/science.1134475.

Guthrie, S. 2002. Animal animism: Evolutionary roots of religious cognition. In: Pyysiainen, L., Anttonen, V. (Eds.), Current approaches in the cognitive science of religion. Bloomsbury Academic, pp. 38–67.

Harvey, F. (2020, December 3). Humanity is waging war on nature, says UN secret- ary general. The Guardian. http://www.theguardian.com/environment/2020/dec/02/humanity-wws-a-war-on-nature-says-un-secretary-general-anthony-guterres

Hays, A.F., 2018. Introduction to mediation, moderation, and conditional process anal- ysis: A regression-based approach. Guilford Publications, New York.

Kalbebekken, S., Saelen, H., 2021. Public support for air travel restrictions to address COVID-19 or climate change. Transp. Res. Part D Transp. Environ. 93, 102767. doi:10.1016/j.trd.2021.102767.

Ketron, S., Naletelich, K., 2019. Anthropomorphic messengers and the sav- ior effect in consumer sustainability behavior. J. Busi. Res. 96, 73–84. doi:10.1016/j.jbusres.2018.11.004.

McKay, C.L.M., Cristofanini, F., Wright, J.D., Neufeld, S.D., Ogawa, H.F., Schmitt, M.T., 2021. Connection to nature and environmental activism: Politicized environmental- ization mediates a relationship between identification with nature and ob- served environmental activist behaviour. Curr. Res. Ecol. Soc. Psychol. 2, 100009. doi:10.1016/j.crespps.2021.100009.

Mayer, F.S., Frantz, C.M., 2004. The connectedness to nature scale: A measure of indi- viduals’ feeling in community with nature. J. Environ. Psychol. 24 (4), 503–515. doi:10.1016/j.enpsy.2004.10.001.