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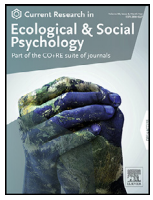
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Exploring the impact of the pandemic on the relationship between individual types and the natural environment: the role of mortality concerns



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ABSTRACT

COVID-19 is a global event that has impacted every individual on earth in some way and can be viewed as a mortality salience trigger. Although there were reports of increased nature exposure across the world, research is needed to understand whether the pandemic event impacted the underlying psychology of the human-nature nexus. Given the likelihood of pandemics and environmental challenges increasing in frequency in the future, there is a need for a deeper understanding of how pandemics impact individuals' relationship with the natural environment in South Africa. To achieve this, the study applied psychological types (grouping individuals based on homogeneity) to explore potential shifts as human nature is neither fixed, nor universal. The study asked: Given the multiple significant impacts of COVID-19 on the African continent, how have perceptions and attitudes towards the natural environment changed within and between types of individuals from 2016 (pre COVID) to 2021 (COVID) in South Africa? In a longitudinal, quantitative study, separate samples 721 in 2016 and 665 in 2021 were obtained. Participants in 2021 were grouped into the same six types using the same criteria, for comparison with the 2016 data. The results showed limited potential for pandemics to act as catalysts for long-term individual change towards increased pro-environmentalism. The study confirmed the main tenets of Terror Management Theory that individuals tend to be driven to uphold worldviews when confronted with mortality. Furthermore, there was a reduced experience of personal control over outcomes that increased reliance on sources of control outside the self as an attempt to buffer against mortality concerns. The study contributes towards Terror Management Theory's application during pandemics, and how that relates to individual environmental attitudes and perceptions.

1. Introduction

Individual psychological distance from the environmental crisis has led humanity to a choice of either addressing our dysfunctional relationship with the natural environment or experiencing runaway climate change and ultimately societal collapse (Spence et al., 2012; McDonald et al., 2015). Psychological research is imperative to inform and address the relationship between individuals and environmental issues such as climate change (Saunders et al., 2005; Clayton et al., 2015; Inauen et al., 2021). Environmental action is impacted by individual characteristics such as attitudes, perceptions (Lorenzoni and Whitmarsh, 2014), worldviews (Fisher, 2013), and mortality salience linked to individual trait responses (Arndt and Solomon, 2003; Wolfe and Tubi, 2018). Mortality salience refers to the increased awareness of one's own mortality that can be triggered by reminders of death, such as those experienced during the COVID-19 pandemic (Greenfield et al., 2021).

The pandemic can be seen as a traumatic event that had the potential to rupture the existential path of individuals (Tomaszek and Muchacka-Cymerman, 2020) due to it functioning as a strong trigger for mortality salience (Pyszczynski et al., 2021). Singla et al. (2021) found that the pandemic was a transformative process for individuals due to increased self-awareness impacting moral values, empathy, and a sense of personal and behavioral responsibility. According to research conducted by Evers et al. (2021) values are able to change rapidly during a collective crisis, and in the case of their study they observed increased collective values, rather than individualistic ones during the COVID-19 pandemic (seen by the instant collective response to the George Floyd incident, see Cappelli, 2020).

There is a need to understand the pandemic's influence on the human-nature nexus that relates to the affective relationship between individuals and the natural environment. This study explored whether a shift in the individual-nature nexus took place between 2016 and 2021

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amongst different individual types of people treating the pandemic as a mortality salience trigger. In this paper we build a research framework discussing the human-nature nexus, mortality salience, and how these concepts relate to the COVID-19 pandemic. The concept of type psychology is introduced, and the six types used in this study are explained. Our methods, procedure and materials discussion sections are followed by a presentation and discussion of significant results at an overall and per type level. Finally, we discuss study limitations and ideas for future research.

1.1. Relationship between types of individuals and the natural environment

As a result of the complex human-nature nexus, individual characteristics and environmental challenges have a mutually reinforcing relationship. Individual attitudes and behaviours, such as having one fewer child, living car-free, avoiding airplane travel, and eating a plant-based diet, are highly effective to reduce an individual's impact on the natural environment (Wynes and Nicholas, 2017), but far too few people engage in these behaviors (Steg and Vlek, 2009; Ertz and Sarigöllü, 2019; Rampedi and Ifegbesan, 2022).

The development of individual types is a pragmatic approach to understand the key differences and similarities between individuals regarding their attitudes that drive perceptions and subsequent behaviors, while not ignoring the complexity inherent in human nature (Doty and Glick, 1994; Fiss, 2011). Types can be constructed on a micro (individual) or macro (cultural) level (McKinney, 1969). Mary Douglas was one of the seminal researchers in type work, based on her cultural theory, and she developed types based on how individuals perceive risk based on social aspects and cultural adherence (Thompson, 1980). The types included the Individualistic where nature is experienced as benevolent and full of potential, Egalitarian that perceived nature is fragile, Hierarchical in which nature is perverse/tolerant, and Fatalistic that experienced nature as unpredictable (Douglas and Wildavsky, 1982; Oltedal et al., 2004). Since then, the field of type psychology has expanded rapidly with more individualised understandings of the human-nature nexus that has included variables such as beliefs, values, worldviews, attitudes, religion, etc. (e.g., Defra, 2008; Leiserowitz et al., 2009; Poortinga and Darnton, 2016; Bernstein and Szuster, 2018; MacDonald et al., 2019). The study by Leiserowitz et al. (2009) explored the human-nature nexus by looking at beliefs about global warming, associated risk perceptions, behavior, traits, relationship to information and policy. They identified six types namely the: Alarmed, Concerned, Cautious, Disengaged, Doubtful, and Dismissive (Leiserowitz et al., 2009). Other studies have used type psychology to explain climate change beliefs (Hall et al., 2018), beliefs about biodiversity and ecosystems (Buijs et al., 2008), pro-environmental behavior (MacDonald et al., 2019), relationships with animals (Teel and Manfredo, 2010), and the relationship between individuals and the natural environment (Bernstein and Szuster, 2018). Type research could provide a deeper understanding of different individual characteristics that influence how they perceive risk and react to mortality threats.

1.2. Terror management theory and the human-nature nexus

Terror Management Theory (TMT) was developed by social psychologists Jeff Greenberg, Sheldon Solomon, and Tom Pyszczynski in the 1980's (Pyszczynski, et al., 2015). It draws on the work of cultural anthropologist Ernest Becker's ideas about the relationship between meaning in life, cultural beliefs, self-esteem, and how these coalesce to influence anxiety about one's mortality (Becker, 1973). TMT posits that humans have a unique and innate need for self-preservation and therefore engage in behaviors to help manage existential terror related to the, generally unconscious, awareness of death (Greenberg et al., 1986; Solomon et al., 1991). This terror of death is largely repressed until made salient (Solomon et al., 1991). Mortality salience is a fear that influences thoughts, affect, and behavior using a range of psychological mechanisms (Solomon et al., 2015). Therefore, TMT deals with death-anxiety that is the general fear or anxiety related to the thought of one's own death (Rosenblatt et al., 1989) which is different to death uncertainty that is focused on the lack of certainty about a particular situation or outcome typically observed in patients with advanced diseases (Mishel, 1999). Death uncertainty has been found to interact with hope in advanced lung cancer patients where they hold onto hope indirectly such as leaving a legacy or holding onto values (Borneman et al., 2014). Death uncertainty evolves over time (Wright et al., 2009) whereas death-anxiety exists regardless of whether individuals are chronically ill or not (Rosenblatt et al., 1989). Studies related to death-anxiety have shown that moral principles, as part of psychological structures, assist to reduce anxiety about death (Rosenblatt et al., 1989; Greenberg et al., 1997).

1.2.1. Self-esteem and cultural worldviews

The mechanisms of self-esteem and cultural worldviews act as anxiety buffers against existential threat (Greenberg et al., 1997). A cultural worldview is a symbolic understanding of reality that attributes order, perpetuity, and constancy to the world. A sense of personal value and immortality can be achieved by following cultural guidelines (Pyszczynski et al., 1999). Self-esteem is the knowledge that one is meeting the standards inherent in one's cultural worldview (Pyszczynski et al., 1999). The anxiety-buffer hypothesis proposes that increased self-esteem or faith in one's cultural worldview reduces anxiety and related behavior in response to mortality threats (Greenberg et al., 1997). The mortality salience hypothesis posits that when psychological mechanisms provide protection against the terror of one's mortality, then mortality reminders would increase the desire to maintain these mechanisms (Greenberg et al., 1997).

When people are reminded of their own mortality, their attachment to their cultural worldviews is enhanced triggering the terror management effect (Solomon et al., 1991). The range of mortality salience effects include in-group bias and prejudice against out-groups, aggression, prosocial behavior, social unanimity, striving for belonging and uniqueness, meeting cultural standards of value, and avoidance of self-focused attention (Greenberg et al., 1997). The buffering mechanism of cultural worldviews to protect individuals from anxiety about death was first demonstrated in studies by Rosenblatt et al. (1989) that showed that when mortality salience is activated, people are encouraged to maintain their cultural-anxiety buffer and therefore are likely to be punitive towards those that oppose their worldviews, and are munificent towards those that uphold it.

1.2.2. Individual traits and mortality salience

Individual traits moderate mortality salience effects. Individuals who are high in authoritarianism responded to mortality salience with increased prejudice against those who have different attitudes (Greenberg et al., 1990; Motyl et al., 2010). Depressed individuals tend to defend their worldview more intensely when mortality is made salient because of their fragile relationship with cultural worldviews and self-esteem (Greenberg et al., 1997). Arndt and Solomon (2003) found that when mortality salience is activated, individuals high in neuroticism have a decreased need for personal control compared to those low in neuroticism who report an increased need for personal control indicating the complex relationship between mortality salience and individual traits.

1.2.3. Proximal and distal defenses

The dual-process model in TMT deals with the proximal or distal nature of defenses based on the accessible conscious and unconscious reminders of mortality (Pyszczynski et al., 1999). The mechanisms employed aim to manage the fear of death that is overwhelming and disturbing, and to maintain psychological equanimity. Proximal defenses

are logical, deal with conscious reminders of morality, repress, create cognitive distortions, or deny thoughts, tend to occur directly after the induction of mortality salience, and do not get activated by subliminal death stimuli (Pyszczynski et al., 1999). Distal defenses are experiential in nature, activated by the implicit knowledge of death, occur after a distraction from mortality salience, but immediately in response to subliminal death stimuli, and embed the person as a valuable member of an eternal immortal reality (Pyszczynski et al., 1999).

Global crises such as natural disasters, wars, and pandemics are death cues that emphasize individual mortality. The COVID-19 pandemic made mortality highly salient with an onslaught of fear-inducing information, combined with potential personal threats such as loss of income, and lack of social contact, making it difficult for individuals to manage the terror of death (Pyszczynski et al., 2021). This had an impact on both proximal and distal defenses. Proximally the pandemic increased death anxiety through explicit awareness of personal vulnerability, while undermining distal defenses that hampered the anxiety-buffering mechanism that people would typically use to defend against mortality threats (Pyszczynski et al., 2021). The contrasting impacts of the pandemic was that the behaviors that would reduce personal vulnerability, impeded the ability of individuals to find meaning and self-esteem in their lives (Pyszczynski et al., 2021).

1.2.4. Mortality salience and human-nature nexus

Research has shown that mortality salience impacts the relationship between individuals and the natural environment by, for example, increasing exploitation and consumption of natural resources (Kasser and Sheldon, 2000). Combined with self-esteem it increased materialism (Rahimah et al., 2020), impacted consumer choices (Akil et al., 2018), created a reduced connection to non-humans (Goldenberg et al., 2001), increased climate change denial (Dickinson, 2009), was capable of both limiting as well as advancing climate action (Wolfe and Tubi, 2018), impacted pro-environmental behavior based on norm salience (Fritsche et al., 2010), reduced motivation to protect the natural environment for its intrinsic value (Fritsche and Häfner, 2012), and impacted environmental concern depending on whether or not the natural environment was a source of self-esteem (Vess and Arndt, 2008). For a systematic review of TMT and nature/ environmental research see Smith et al. (2022). From a TMT perspective the pandemic can be treated as a mortality reminder (Pyszczynski et al., 2021; Evers et al., 2021). The pandemic provided an opportunity for the exploration of mortality salience in relation to the relationship between individuals and the natural environment.

1.3. The pandemic and the human-nature nexus

Although not mortality salience studies per se, research conducted during the pandemic explored the relationship between individuals and nature. The pandemic impacted nature activities based on “Nurture and Recreation” values and “Inspiration and Nourishment” values. (Morse et al., 2020). The pandemic also had a positive impact on the relationship between intention and pro-environmental behavior (Zebardast and Radaei, 2022), and increased environmental awareness dependent on the belief that the pandemic was caused by human intrusion into nature (Daryanto et al., 2022). An exploratory study by Haasova, et al. (2020) showed a relationship between connectedness with nature, individual representations, behavioral tendencies, and the perceived impact of the pandemic on one’s life and the lives of others. According to Lucarelli et al. (2020), there were no differences in environmental intentions or pro-environmental behavior prior to and following COVID-19. A study by Stahl (2022) suggested that increased interactions with nature did not correspond to an increase in human-nature connection during COVID-19. As a result of this inconsistency in findings, it is likely that the impact of the pandemic on the nexus between humans and nature requires further investigation.

Table 1
Summary of key differences between types.

Type	Summary of key differences
Disconnected type	Poorly connected to nature Lacked an environmental worldview Apathetic Survivalist
Uncommitted type	Moderate concern about the natural environment Concern about animal exploitation and extinction Reduced sense of personal accountability
Alarmed type	Moderate-high affective relationship with the natural environment Low-moderate apathy Perceived urgency in both environmental and animal issues
Believer type	Affective relationship to the natural environment contrasted with their dominant social paradigm Belief in human ingenuity through technology to solve environmental and animal issues Shift responsibility for issues to future generations
Concerned type	Closest relationship with the natural environment Strongest environmental worldview
Pleasure-seeker type	Weak affective relationship with the natural environment Low environmental worldview Not concerned about environmental issues Individuals not responsibility for environment issues

1.4. The current study

This study extends previous work done on the human-nature nexus in South Africa that identified six types of human-nature relationships in 2016 through K-means cluster analysis (Marais-Potgieter and Thatcher, 2020). Table 1 provides a summary of the main differences between the Disconnected, Uncommitted, Alarmed, Believer, Concerned and Pleasure-seeker types.

COVID-19 had multiple significant impacts on mortality beliefs with reduced hospital beds, lower GDP, diabetes as a co-morbidity, and higher average age being significant risk factors for mortality on different continents (Zahid and Perna, 2021), 9.1% of the population in sub-Saharan Africa being plunged into extreme poverty, and 31.8 million people severely food deprived after an 8-week lockdown (Teachout and Zipfel, 2020), food security impacts due to reduced seed availability, reduced labor, finance, and farm input access (Nchanji and Lutomia, 2021), mental health related to anxiety, depression and post-traumatic stress disorders (Semo and Frissa, 2020), gender-based domestic poly-violence (Nduna and Tshona, 2021), and litter which amplified three times as lockdowns were alleviated (Ryan et al., 2020) on the African continent. Given these broad social and individual impacts, this study asked how the individual types’ perceptions and attitudes towards the natural environment have changed from 2016 (pre COVID) to 2021 (COVID) in South Africa.

Although there are various criticisms leveled against TMT by Martin and van den Bos (2014) and responded to by Pyszczynski et al. (2015), this study aimed to add to existing TMT literature related to critique regarding applicability across cultures, and that the theory aims to explain the smorgasbord of human behavior. Our study aimed to extend the theory’s applicability to South Africa (rather than mostly in western, educated, industrialized, rich, democratic countries), and more specifically to individual relationships with the natural environment. Furthermore, by applying individual types to understand shifts, it expands TMT to include individual worldviews.

2. Method

Two surveys were conducted online. One pre-pandemic in 2016 and another during the pandemic in 2021 in South Africa. The purpose of the 2016 study was to develop types to understand the relationship that individuals have with the biosphere in South Africa forming a base for further exploration in 2021.

2.1. Participants

Convenience sampling was used that is a non-probability sampling technique where individuals participate based on their accessibility and willingness to participate (Creswell, 2018). Due to the data gathering method, the sample included mainly urban, literate individuals with Internet access, and was likely to include individuals with higher carbon footprints (rural and those with reduced incomes are likely to lack desktop internet access), but potentially excluded those living in remote rural areas or informal urban settlements. No criteria were set regarding inclusion to obtain the maximum variation possible. 721 respondents were retained for analysis in 2016 and 655 in 2021. The sample from 2021 was post-weighted by age, gender, and ethnicity to match the demographic profile of 2016 to compare the two study periods. The participants were not the same individuals in 2021 as in 2016, but they were grouped into the same types based on their responses to the survey.

2.2. Procedure

For both studies social media marketing was used to invite individuals across South Africa (no limitations were placed on areas) to participate. Invitations were made through an advertising banner placed on Facebook. Using social media as a recruitment tool is becoming increasingly popular (Topolovec-Vranic and Natarajan, 2016). Social media have a wide reach, with Facebook being the fourth most visited site in South Africa according to Alexa.com (American web traffic analysis organization), with 21 million users (Pienaar, 2018). A risk of Facebook recruitment is cross-participant communication (Gelinas et al., 2017). This possible risk was managed by switching off the comment function on the Facebook invitation. An online survey tool (Alida) was used to deploy the participant information sheet and survey. Individuals could either scroll past, or click on the banner to be directed to the participant information sheet. If participants agreed to participate, they were guided to the online questionnaire battery. Questionnaires and questions were rotated. Data quality was checked and duplicate information removed from the data set, and all those with identical responses across items were removed. A lucky draw, as a separate survey option, was offered as compensation for their time. The fieldwork took place between 26 February and 31 May in 2016 and 21 May and 10 June in 2021. Due to anonymity, matching participants between 2016 and 2021 was not possible.

2.3. Materials

2.3.1. The environmental issues and attitudes questionnaire (EIAQ)

To understand environmental awareness, attitudes, and concern the EIAQ was self-developed to include global concerns (i.e., climate change) and issues specific to South Africa (i.e., canned lion hunting). The sections included ratings of environmental and animal (awareness, concerns, and accountability) and general attitudes.

The awareness sections explored environmental and animal issues where 1 = I am now less aware (where an individual might have stopped following latest developments on an issue) than before to 3 = I am more aware than before. The concerns sections explored environmental and animal issues (e.g. biodiversity loss; vivisection), from 1 = Not at all concerned to 5 = Extremely concerned. The accountability sections asked the extent to which participants felt they had control over the items, from 1 = I have no control over this to 3 = I have a direct impact. Attitudes explored, for example, whether participants believed individuals could contribute to a better environment or it is government's responsibility, from 1 = Strongly disagree to 5 = Strongly agree. The 3-point scales were used based on need for simplicity, less cognitive burden, more accurate categorical data versus the 5-point scales which were used in instances were more granularity was required, and a greater range of measurement was needed (for an analysis see Joshi et al., 2015).

Varimax (orthogonal) rotation factor analysis was conducted on the EIAQ in 2016 to determine underlying dimensions in the data for further analysis. The environmental concern subscale yielded four factors (shown as α = 2016 and 2021): human-centric (α = 0.781 and 0.813), climate-centric (α = 0.816 and 0.855), resource-centric (α = 0.737 and 0.829), and science-centric (α = 0.643 and 0.704). The animal concern subscale yielded two factors (shown as α = 2016 and 2021): animal exploitation (α = 0.890 and 0.874) and animal extinction (α = 0.886 and 0.875). The attitudes subscale had five factors (shown as α = 2016 and 2021): shifting responsibility (α = 0.896 and 0.914), individual contribution (α = 0.703 and 0.689), government's responsibility (α = 0.810 and 0.808), technological solutions (α = 0.815 and 0.854), and apathetic attitudes (α = 0.712 and 0.811). The EIAQ appeared to have sufficient face validity (that it measures what it was intended to measure) based on the self-explanatory nature of the items.

2.3.2. The connectedness to nature scale (CNS)

Measuring affect allows for the understanding of the underlying emotional processes that impact environmental attitudes and perceptions. Affect in the form of empathy impacts the relationship between certain personality traits and connectedness to nature (Di Fabio and Kenny, 2021). The CNS (Mayer and Frantz, 2004) measured these aspects as connectedness to nature using 14 items that included feelings such as a sense of community, egalitarianism, and belongingness to nature. Participants responded on a 5-point scale, where 1 = strongly disagree and 5 = strongly agree. The test–retest reliability was r = 0.79 (Mayer and Frantz, 2004). In 2016 the Cronbach α = 0.826 and in 2021 α = 0.825.

2.3.3. The new ecological paradigm scale (NEP)

Worldviews represent an individual's inner experience of the outer world (Dunlap, 2008). The NEP was selected based on its extensive use for measuring environmental worldviews, and use in emerging economies (Hawcroft and Milfont, 2010). It used 15 items to determine the ecological paradigm (8 items) versus the dominant social paradigm (7 items) (Dunlap, 2008). Participants responded on a 5-point scale, where 1 = strongly disagree and 5 = strongly agree. In 2016 Cronbach α = 0.726 and in 2021 α = 0.737.

2.4. Ethical considerations

Ethical clearance (number H15/11/15 and H21/03/14) was granted from the University of the Witwatersrand's Human Research Ethics Committee. The participant information sheet contained detailed information about the study and contact details of the lead researcher should participants have any questions before participating. Participation was voluntary. All records were anonymised.

2.5. Data analysis

For the EIAQ, CNS and NEP scales, respondents who had identical responses across all items in a question batch were excluded. For the EIAQ environment and animal subscales, responses of 'no opinion' were recoded as ' not at all concerned'. For the EIAQ attitudes subscales, responses of 'don't know' were recoded as 'neither agree/disagree'. The final subscales were formed by averaging the scores of the items making up the subscale.

For 2021, respondents were classified into one of six types based on a discriminant analysis model developed in 2016 (Marais-Potgieter, 2020). The seven scales used for the discriminant analysis model to group individuals into a type were connectedness to nature, and the EIAQ shifting responsibility, individual contribution, apathetic attitudes, human-centric, resource-centric, and science-centric. Respondents who did not have scores for one or more of the seven scales used to classify respondents into a type were excluded. Appendix 1 shows the demographics between study periods and that there were no significant

differences between surveys within any of the types for age, gender, or ethnicity. There was a significant, weak, association, between type and survey year ($p = 0.013$; Cramer's $V = 0.12$): 2021 had a greater proportion of Believers, and a lower proportion of Alarmed respondents. Furthermore, the 2021 study had a greater proportion of unemployed and self-employed individuals.

The association between survey (2016/2021) and the other study variables was determined as follows: The X^2 test was used to assess the relationships between survey and categorical variables. Fisher's exact test was used for 2 × 2 tables or where the requirements for the X^2 test could not be met. The strength of the associations was measured by Cramer's V and the phi coefficient respectively. The following scale of interpretation was used: >0.50 indicated a high/strong association, 0.30 to 0.49 a moderate association, 0.10 to 0.29 a weak association, and below 0.10 little if any association. The relationship between survey and continuous variables was assessed by the independent samples *t*-test. Where the data did not meet the assumptions of the *t*-test, a non-parametric alternative, the Wilcoxon rank sum test was used. The strength of the associations was measured by the Cohen's d for parametric tests and the r-value for non-parametric tests. The following scale of interpretation was used: >0.80 indicated a large effect, 0.50 to 0.79 a moderate effect, 0.20 to 0.49 a small effect, and below 0.20 a near zero effect. Overall, the false discovery rate was controlled by the Benjamini-Hochberg procedure. The 5% significance level was used.

3. Results

Table 2 shows significant results at an overall level, as well as per individual type. Significant shifts occurred at an overall level for environmental awareness, environmental concerns and accountability (water scarcity, climate change, natural resource depletion, over consumption, natural disasters), animal concerns, as well as attitudes and perception environment (shifting responsibility, role of technology). Significant shifts per type occurred for environmental concerns (climate-centric and resource-centric), natural disasters, animal concerns, animal concerns accountability (domestic welfare), attitudes and perception environment (shifting responsibility, role of technology), and connection to nature.

3.1. Environmental awareness

Table 2 shows that there was a significant, weak, association, between environmental awareness and year ($p<0.00$; Cramer's $V = 0.11$) where 2021 had a greater proportion of "same level of awareness", and a lower proportion of "more awareness", compared to 2016. There were no significant differences between type.

3.2. Environmental concerns and accountability

Overall, there were no significant shifts in the median scores for environmental concerns. For the climate-centric scale there was a significant, but small, increase in the median score for the Concerned type. Although the resource-centric scale was used to classify respondents into types, there was a significant, but small, decrease in median score for the Pleasure-seeker type.

For environmental concerns accountability, there was a significant, weak, association between concern about water scarcity and year ($p<0.00$; Cramer's $V = 0.14$) where 2021 showed a lower level of personal accountability compared to 2016. This shift was not significant within any of the types. Similar results were found for natural resource depletion, and overconsumption. There was a significant, weak, association between concern about climate change and year ($p<0.00$; Cramer's $V = 0.11$) where 2021 showed a higher level of personal accountability compared to 2016. There was a significant, weak, association between

Table 2
Overall and type shifts between 2016 and 2021.

ENVIRONMENTAL AWARENESS	**Overall**		
	2016	2021	
n	721	665	
	%	%	p
More aware	65.1*	58.2*	<0.00*
Same aware	28.6*	36.1*	($V = 0.11$)
Less aware	2.6	4.1	
I don't know	3.7	1.5	
ENVIRONMENTAL CONCERNS	**Concerned**		
	2016	2021	
n	170	153	
	M	M	p
Climate-centric	4.4 (3.8–4.6)	4.6 (4.0–5.0)	<0.00* ($r = 0.22$)
	Pleasure-seeker		
	2016	2021	
n	76	93	
	M	M	p
Resource-centric	3.5 (2.8–4.0)	2.8 (2.5–3.5)	<0.00 ($r = 0.28$)*
ENVIRONMENTAL CONCERNS ACCOUNTABILITY	**Overall**		
	2016	2021	
n	677	587	
	%	%	p
Water scarcity			
Direct impact	37.4*	27.1*	<0.00*
Small impact	42.5	43.3	($V = 0.14$)
No control	19.7*	27.6*	
I don't know	0.4	2.0	
n	562	502	
Climate change			
Direct impact	10.5*	15.6*	<0.00*
Small impact	35.1*	40.6*	($V = 0.11$)
No control	48.6*	39.5*	
I don't know	5.9	4.2	
n	631	541	
Natural resource depletion			
Direct impact	26.6*	17.5*	<0.00*
Small impact	41.8	4.,9	($V = 0.11$)
No control	28.1	32.9	
I don't know	3.5	3.7	
n	483	435	
Over consumption			
Direct impact	45.1*	29.5*	<0.00*
Small impact	40.2*	53.9*	($V = 0.18$)
No control	13.0	15.6	
I don't know	1.7	1.0	
n	353	388	
Natural disasters			
Direct impact	4.3	8.5	<0.00*
Small impact	8.2*	17.8*	($V = 0.18$)
No control	82.7*	71.0*	
I don't know	4.8	2.8	

(*continued on next page*)

Table 2 (*continued*)

	Concerned		
n	353	388	
Natural disasters			
Direct impact	3.2*	12.8*	<0.00*
Small impact	5.4*	15.9*	(V = 0.27)
No control	86.0*	70.4*	
I don't know	5.4	1.0	
ANIMAL CONCERNS	**Overall**		
	2016	2021	
n	673	583	
	M	M	p
Animal exploitation	3.8 (3.0–4.3)	3.9 (3.1–4.6)	<0.00* (r = 0.10)
	Uncommitted		
	2016	2021	
n	113	76	
	M	M	p
Animal exploitation	3.8 (3.1–4.3)	4.1 (3.6–4.6)	<0.00* (r = 0.24)
ANIMAL CONCERNS ACCOUNTABILITY	**Alarmed**		
	2016	2021	
n	129	91	
	%	%	p
Domestic animal welfare			
Direct impact	48.1*	27.2*	<0.00*
Small impact	45.7*	53.1*	(V = 0.26)
No control	5.4*	18.4*	
I don't know	0.8	1.3	
ATTITUDES AND PERCEPTION ENVIRONMENT	**Overall**		
	2016	2021	
n	721	665	
	M	M	p
Shifting responsibility	2.3 (0.9)	2.6 (1.0)	<0.00* (d = 0.32)
Role of technology	2.7 (0.8)	2.9 (0.9)	<0.00* (d = 0.24)
	Believer		
	2016	2021	
n	104	137	
	M	M	p
Shifting responsibility	3.4 (3.0–3.9)	3.8 (3.2–4.3)	<0.00* (r = 0.23)
Role of technology	3.2 (0.8)	3.6 (0.9)	<0.00* (d = 0.47)
CONNECTION TO NATURE	**Disconnected**		
	2016	2021	
n	75	71	
	M	M	p
Connection to nature	3.8 (0.7)	4.1 (0.6)	<0.00* (d = 0.46)

EIAQ: Environmental Issues and Attitudes Questionnaire.
CNS: Connectedness to Nature Scale.
* p<0.05.

concern about natural disasters and year (p<0.00; Cramer's V = 0.18) where 2021 showed a higher level of personal accountability compared to 2016. This shift was significant within the Concerned type. There were no shifts for air pollution, rising sea levels, global warming, ozone layer depletion, human overpopulation, loss of nature areas, nuclear energy, waste generation, water pollution, urbanization, use of pesticides, GMOs, biodiversity loss.

3.3. Animal concerns and accountability

There was no significant association between animal concerns awareness and year overall or within any of the types. There was a significant increase in the median score of the Animal Exploitation scale (p<0.00; r = 0.10). This was significant also for the Disconnected type. There was no significant shift in the Animal Extinction score, overall or within any of the types.

For the animal concerns accountability responses there was no significant association between concern about domestic animal welfare and year, however there was a shift towards lower personal accountability within the Alarmed type. There were no shifts for animals used in entertainment, canned lion hunting, legal rights and protection, domestic animal breeding, wild animal breeding, deforestation, over-fishing, whale hunting, dolphin capturing, animal cruelty, factory farming, farm animal welfare, poaching, trophy hunting, animals used for testing or consumer products.

3.4. Attitudes and perception environment

Environmental attitudes and perception had a significant increase in the mean scores of the Shifting Responsibility and Role of Technology subscales p<0.00 (d = 0.32) and p<0.00 (d = 0.24) respectively. These shifts were significant also within the Believer typology. There were no significant shifts in the median Role of Individual, Government or Apathetic Attitudes overall or within any of the types.

3.5. Connectedness to nature

Overall, there were no significant shifts in the mean CNS and NEP scores. Although the CNS score is used to classify respondents into types, there was a significant, small, increase in mean score for the Disconnected type. There was no significant shift in the mean NEP score for any of the types.

4. Discussion

Disasters have the ability to act as catalysts for social change (Cohen, 2020) or to change the existential path of individuals (Tomaszek and Muchacka-Cymerman, 2020). Little research has been conducted, particularly in Africa, that explores the impact of the pandemic on the human-nature nexus, and what that means for environmental challenges. The pandemic did not only function as a distraction from the climate crisis but had the added potential to improve our understanding of the human-nature nexus under times of extreme threat and heightened mortality salience. The study asked: Given the multiple significant impacts of COVID-19 on the African continent, how have perceptions and attitudes towards the environment changed within and between types of individuals from 2016 (pre COVID) to 2021 (COVID) in South Africa?

In this section we discuss the significant shifts that occurred between 2016 and 2021 at an overall and individual type level looking at environmental awareness, environmental concerns and accountability, animal concerns and accountability, attitudes and perception environment, and connectedness to nature. The results from this study contribute to existing research that explored the human-nature nexus, pandemic, and other variables for example that the pandemic had a positive impact on

some aspects of the human-nature nexus depending on whether there was a belief that the pandemic was caused by human intrusion into nature (Daryanto et al., 2022) or whether connectedness to nature impacts support for COVID-19 travel restrictions (Pensini and McMullen, 2022), or how the pandemic relates to the relationship between intention and pro-environmental behavior (Zebardast and Radaei, 2022). For many of the variables assessed no significant shifts occurred suggesting that when faced with disaster, individuals prioritize areas of concern that align with their existing worldviews, supporting the main tenets of TMT.

4.1. Environmental awareness

There was a significant decrease in those that were "more aware" and a significant increase in those that had the "same level of awareness" of environmental issues. This compared to a study that showed COVID-19 having had the greatest impact on sustainable consumption in Brazil and Portugal, followed by environmental awareness and to a lesser extent, social responsibility (Severo et al., 2021). A similar study in Malaysia found a significant and positive impact on environmental awareness, sustainable consumption, and social responsibility (Ali et al., 2021). As a result of COVID-19, public awareness of natural resources such as forests and birdlife increased, while awareness of environmental issues such as climate change did not change according to Rousseau and Deschacht (2020). The lack of increased awareness of environmental issues in our study could potentially be attributed to a decrease in media coverage on key environmental issues, like climate change, while there was increased human-centric pandemic coverage (see Mocatta and Hawley, 2020; Nacu-Schmidt et al., 2020; Rauchfleisch et al.,2021). This finding could also be attributed to the lack of individuals seeing the virus as an indication of environmental stressors (see Tsantopoulos et al., 2021) or that variances in connectedness with nature impacted representations about the pandemic (see Haasova et al., 2020) therefore those more connected already had high environmental awareness prior to the pandemic, and those less connected were guided by other areas of focus (financial, mortality) during the pandemic. Finally, the finding could be a result of the complex social context in which environmental issues are psychologically contrasted with issues of social justice in South Africa (see Marais-Potgieter and Thatcher, 2022).

4.2. Environmental concerns and accountability

For environmental concerns only the Concerned type was more troubled about climate-centric issues and the Pleasure-seeker type was less concerned about resource issues (they were also the least concerned in 2016). These findings support the idea that individuals were driven to uphold worldviews, and when in a situation where mortality is made salient, they tended to respond with predictable, and replicable defenses (see Wolfe and Tubi, 2018). The result for the Concerned type confirmed that COVID-19 increased environmental concern that expands on studies that indicated shifts in environmental concern during the pandemic. Jian et al. (2020) found that fear and uncertainty during the pandemic increased environmental concern and green hotel brand trust, Kenward and Brick (2021) showed higher environmental prioritization was determined less by social identity and more by individual well-being. Schiller et al. (2022) used pre-lockdown data and followed-up during the lockdown and found that mental health was reduced, environmental concern increased, and prejudice against asylum-seekers decreased. This is aligned with the overall worldview profile described per type (Table 1) that indicated the Concerned who had strong environmental worldviews compared to the Pleasure-seeker who had weak environmental worldviews. This finding confirms one of the main tenets of TMT in that when faced with mortality salience, individuals tend to uphold their worldviews (Pyszczynski et al., 2015).

For environmental concerns accountability, there was an overall decrease in the experience of control where participants either felt no control or that they could have a small impact on water scarcity, natural resource depletion, and over consumption suggested individuals felt that the world was not predictable or controllable. These findings could point to memories and perceived lack of control based on the significant water shortages ("day zero threats) experienced in South Africa between 2016 and 2020 (Robins, 2019). Atalay and Meloy (2020) showed that mortality salience after exposure to natural disasters and extreme events had an impact on the appeal of evacuation due to reduced locus of control.

For natural disasters the Concerned type showed an increase in "direct" or "small impact", but 70.4% still felt like they had no control in 2021. There was an increase in individuals that felt like they could have a direct impact on climate change, but most of the sample (83.7% in 2016, 80.1% in 2021) still felt they could only have a small impact or felt like they had no control. A drop in media focus on the climate crisis during the pandemic did not correspond to a decline in public concern, but perhaps only a temporal shift in focus (Leiserowitz et al., 2020). The increase in perceptions of control in our study might be because some individuals felt that behavioral adjustments (masks, social distancing, sanitizing) gave protection during COVID. This finding can also be compared to that of Arndt and Solomon (2003) who found that individual traits impacted the sense of, or need for control. In their study the response to mortality becoming salient, individuals who had high neuroticism reported reduced need for personal control, whereas those low in neuroticism reported the opposite.

4.3. Animal concerns and accountability

The significant increase in concern regarding animal exploitation was potentially linked to the media coverage of how zoonotic diseases originate (see Mocatta and Hawley, 2020). This aligned with the significant increase for the Uncommitted type who tended to be influenced by social dialogues and media (see Marais-Potgieter and Thatcher, 2020). The significant decrease in "direct impact" and "no control" and increase in "small impact" for the Alarmed type pointed to their concern for animals and how the pandemic potentially made them feel more hopeless.

4.4. Attitudes and perception environment

The decreased sense of control possibly explained the increased shift in responsibility, and the role of technology at an overall level, and for the Believer type specifically, as they looked for sources of control outside the self. Again, the significant movement for the Believer type confirmed that their existing worldviews were upheld during the pandemic (see Table 1).

4.5. Connectedness to nature

Interestingly, while connectedness to nature increased for the Disconnected type, they were still the least connected out of all the types. The fact that their environmental worldviews did not shift meaningfully was in line with TMT that individuals maintain worldviews to protect themselves from the terror of mortality and therefore tended to be defended during times of mortality salience (Greenberg et al., 2014). The Disconnected type most likely experienced increased survival concerns which could be seen as a subset of mortality salience (Greenfield et al., 2021)

The study contributed to existing TMT in that it demonstrated a range of different impacts the pandemic had on individual types based on their worldviews and relationship with the natural environment. The study confirmed that individuals tend to uphold worldviews, and when there is potential mortality salience, respond with substantial, predictable, and replicable defenses (see Wolfe and Tubi, 2018), depending on type. The results related to other work that showed that during times of crisis, like the pandemic, individual worlds become tighter and

smaller, similar to subsistence communities (Greenfield et al., 2021). Within the context of Greenfield et al. (2021) our results posit that if the environment was already important to a particular type, the closing in of their world would include the natural environment. This can be contrasted with a type where survival was important, and therefore, COVID-19 impacted those individuals to focus even more closely on their personal survival. Additionally, Greenfield et al. (2021) suggested that when there are significant sociodemographic changes, those changes impact all other areas of living that could mean that the higher unemployment in our sample during 2021 compared to 2016 had further impacted mortality salience and the ability of certain types of individuals to manage the potential threat of death (Pyszczynski et al., 2021).

The implication for psychology's role in supporting action against environmental issues is that nuanced approaches are required to deal with the psychological responses from individuals, and that working within the worldviews of individuals is likely to be more effective than trying to change them. Additionally, this study suggested that mortality salience, and individual traits and processes could have a significant impact on responses to climate change. Furthermore, it highlights that climate inaction, and the perception of general apathy should be challenged as it cannot be explained as a universal and unchanging human nature as aspects such as mortality salience, worldviews, and other human-nature nexus aspects are complex. A generalised approach reduces the importance of psychological variability between populations, oversimplifies psychological research and its ability to guide policy, does not take aspects of culture into account in individual behavior, and justifies inaction (Atkinson and Jacquet, 2021).

The study had various limitations. The first is that we did not measure behaviors in 2021 that could have provided a broader picture regarding the impact of the pandemic on claimed behaviors. Another limitation was that we were not able to use the same sample of individuals from 2016 due to anonymity, and that there was no qualitative component in 2021 that explored in-depth responses in relation to the pandemic. It is also possible that other social concerns from COVID-19 could have had a greater influence than the health-mortality concerns. We also recommend caution that we did not have data that conclusively linked TMT (or COVID-19) to the trends in the 2016 and 2021 data. Future research could focus on establishing pre-existing worldviews, triggering a pandemic reminder, and then conducting a follow-up measure of worldviews after a delay (see Cox et al., 2020; Smith et al., 2022 for methods).

5. Conclusion

The pandemic had an impact on certain aspects of the human-nature nexus and for specific types. The results suggested that individuals are driven to uphold worldviews, and when threatened they tend to respond with considered, predictable, and replicable defenses as suggested by TMT (Wolfe and Tubi, 2018). The results conclude that psychology needs to work within the psychological boundaries of types for maximum efficacy when addressing environmental challenges.

Ethics & informed consent statement

*The authors declare that ethical approval was received from the University (H210314 – attached)

* The authors confirm that all participants provided informed consent for participation

Appendix

Appendix 1
Sample demographics by individual type.

	Disconnected			Uncommitted			Alarmed			Believer			Concerned			Pleasure-seeker		
Year	2016	2021	p-value	2016	2021	p-value	2016	2021	p-value	2016	2021	p-value	2016	2021	p-value	2016	2021	p-value
n	75	71		120	90		176	121		104	137		170	153		76	93	
	%	%		%	%		%	%		%	%		%	%		%	%	
Age group																		
18 – 25 years	48	28	0.14	24	23	0.41	22	30	0.15	31	28	0.95	11	23	0.01	29	39	0.19
26 – 35 years	24	35		31	33		34	25		38	40		22	21	(V = 0.21)	36	26	
36 – 45 years	17	25		21	25		21	14		20	19		22	21		22	15	
46 – 55 years	8	10		22	13		19	26		9	11		32	30		12	15	
56+ years	3	1		3	6		5	5		3	2		13	5		1	5	
Gender																		
Male	44	52	0.41	41	34	0.32	35	41	0.33	47	41	0.36	30	31	0.90	50	42	0.36
Female	56	47		59	66		65	59		53	59		70	69		50	58	
Population Group																		
Black	64	58	0.06	43	42	0.23	35	19	0.01	57	60	0.52	18	27	0.22	38	35	0.78
Mixed race / Coloured	11	12		9	12		10	9	(V = 0.23)	14	10		9	12		15	10	
Asian / Indian	9	1		12	6		1	5		6	8		4	4		6	9	
White	15	25		33	40		51	60		19	19		64	54		38	43	
Other/Refuse	1	5		4	0		4	7		4	4		5	4		3	4	

* $p<0.0$.

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.

CRediT authorship contribution statement

Andrea Marais-Potgieter: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Project administration, Resources, Visualization, Writing – original draft. **Andrew Thatcher:** Conceptualization, Supervision, Writing – review & editing.

Data availability

Data will be made available on request.

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Supplementary materials

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