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A Within-Country Study of Biased Comparative Judgements About the Severity of Environmental Problems

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Abstract

The spatial and temporal reach of contemporary environmental problems are unparalleled. Collective efforts to address global environmental problems are required but actions to tackle these problems demand initial recognition of their seriousness. Cross-cultural research has shown a reliable bias in comparative judgements about the severity of environmental problems for geographically distant places, with environmental issues perceived to be more severe "there" than "here." The robustness of this effect may have unwarranted consequences since perceiving environmental problems as being worse elsewhere might lead individuals to not take actions in their locality. We conducted a within-country study to test whether this spatial bias would emerge for samples from all Brazilian states (k = 27, N = 4,265; 85% female; Age M = 24; Age SD = 9.67). Providing further support for a biased comparative judgement, we observed that the severity of environmental problems was judged as worse at the country level than at the state level (mean spatial bias score among Brazilian states = 0.54). Only 2% of the variation in spatial bias was attributable to across-state differences. By replicating cross-cultural findings within a single nation, our findings provide further support for the prevalence and generalizability of biased comparative judgements about the severity of environmental problems. We discuss critical future directions for spatial bias research.

Keywords

Highlights

- Individuals tend to believe environmental problems are more severe there than here.
- This biased comparative judgement has been observed cross-culturally.
- Our study confirmed the bias in individuals from all twenty-seven Brazilian states.
- Brazilians rated environmental conditions as worse in Brazil than in their own state.
- Believing environmental problems are worse elsewhere has unwanted real implications.

People make comparisons in their daily lives, particularly in relation to other people. Indeed, social comparison is an omnipresent feature of human social life, and people use information gained from others as comparison standards to decide how to behave, think and feel (Baldwin & Mussweiler, 2018). As noted many decades ago by Festinger (1954), we have a drive to evaluate our opinions and abilities, and this necessity for self-evaluation is based on comparison with other people; predominantly when objective, non-social means of self-evaluation are unavailable. A widely documented aspect of social comparison judgements are above-average and comparative-optimism effects expressed in individuals' pervasive tendency to believe they are better than others and that their future will be better than can possibly be true by overestimating their chance of good fortune and underestimating their risk for misfortune (Chambers & Windschitl, 2004; Shepperd, Klein, Waters, & Weinstein, 2013; Weinstein, 1980). Research indicates that such biases in social comparative judgements—in which people display optimistic bias when comparing their characteristics with the average peer on behaviour, ability, trait or likelihood dimensions—stems from a motivation for self-enhancement (e.g., "I am a better driver than most people"; Alicke & Govorun, 2005; Brown, 2012).

Research examining comparative judgements have emphasized appraisals between the self and other people due to the importance of self–other comparisons regarding abilities, trait and likelihood outcomes in human social life, but similar judgement processes may also apply to other kinds of comparisons. Considering the importance of people–place relationships in human life (see, e.g., Lewicka, 2010, 2011), it is fair to expect that people make comparative judgements between their local surroundings and geographically distant surroundings. In fact, and as reviewed in detail below, an increasing number of studies have documented similar judgement processes when individuals

are asked to compare the environmental quality between geographically distant places, with individuals judging the quality of the natural environmental as better in a proximal location than a distal location.

In the present study we extend this emerging research area by providing a systematic examination of comparative judgements about environmental quality within the context of a single country by asking respondents across all Brazilian states to judge the seriousness of environmental problems in their state and in the whole of Brazil. This investigation begins with a brief review of the relevant literature.

Understanding Biased Comparative Judgements About the Severity of Environmental Problems and Its Consequences

A growing amount of evidence indicates that when asked to make comparative judgements between geographically distant places individuals tend to view the more proximal location as better off than other locations (e.g., García-Mira, Real, & Romay, 2005; Hatfield & Job, 2001; MacDonald, Milfont, & Gavin, 2015; Milfont, 2007, Study 2c; Milfont, Abrahamse, & McCarthy, 2011; Pahl, Harris, Todd, & Rutter, 2005). Similar to above-average and comparative-optimism effects, when making comparative judgements about places individuals are prone to overestimate the environmental quality of the near place while underestimating its environmental problems. To the best of our knowledge, Murch (1971) was first to document this biased comparative judgement when examining perceptions of environmental pollution with 300 residents in Durham, USA. Only 13% of respondents felt that environmental pollution is serious in the Durham community, but 74% reported pollution to be a serious problem nationally, a statistically significant difference ($\chi^2[1] = 226.72$, $p < .001$, $r = .87$, computed by us). This finding indicates that environmental pollution is perceived to be less of an issue in more proximal than more distal locations, even though the areas intersect.

In another earlier work, Musson (1974) documented the biased comparative judgement when examining attitudes to population growth in a survey with 660 people from the South Buckinghamshire region in the UK. Respondents were asked to answer yes or no to the questions "Do you think Great Britain is over-populated or not?" and "Do you think your area is over-populated or not?." A total of 74% of the respondents gave a positive response to the "Great Britain" question while only 48% gave a positive response to the "your area" question, a statistically significant difference ($\chi^2[1] = 93.699$, $p < .001$, $r = .38$; computed by us), indicating that over-population is perceived to be less of an issue in more proximal than more distal locations. Another UK survey asked 347 students to rate on a seven-point pollution scale (1 = not at all polluted, 7 = extremely polluted) two questions varying the geographic location: "On average, would you say that beaches [in this town / in Britain] are polluted?" (Bonaiuto, Breakwell, & Cano, 1996). Supporting the biased comparative judgement, beach pollution was perceived to be worse "in Britain" ($M = 5.42$, $SD = 1.03$) than "in this town" ($M = 4.82$, $SD = 1.33$).

There is increasing evidence for the cross-cultural replicability of this effect. When asking the question "How would you rate the overall quality of the environment (a) of the world as a whole and (b) here in your local community?," a cross-cultural study with representative samples from 12 industrialized and 12 developing countries found that respondents (N = 29,708) generally judged global environmental problems as more severe than local environmental problems—particularly so in samples from industrialized countries (Dunlap, Gallup, & Gallup, 1993, Figure 4). When judging the perceived seriousness of seven environmental problems (water pollution, atmospheric pollution, the effects of acid rain, global warming, noise pollution, deforestation and holes in the ozone layer), participants from Australia, England and Slovakia (N = 363) rated environmental problems to be more serious as the geographical distance increased (myself/town, country, continent, world; Uzzell, 2000, Study 2). An 18-nation study conducted by Gifford et al. (2009) asked 3,232 participants to rate the current state of 20 aspects of the environment (e.g., availability of fresh drinking water, effects of human population on the environment, state of fisheries) in their local area, country and globally. The biased comparative judgement was observed in 15 countries; only Russia and Romania showed the opposite effect of assessing global conditions as better off than local conditions, and India showed no local–global distinction.

Two further cross-cultural studies more relevant to the present study were conducted by Schultz and colleagues. In the first study, Schultz et al. (2005, Table 2) reported that participants from six countries (Brazil, Czech Republic, Germany, India, New Zealand, and Russia; N = 988) rated the seriousness of six environmental problems—deforestation, water pollution, air pollution, land pollution, overpopulation, global warming—as more serious globally than locally. In the most comprehensive cross-cultural examination of biased comparative judgements about the severity of environmental problems to date, Schultz et al. (2014) reported two studies involving 4,408 respondents across 30 samples from 26 countries to test the generalizability of the effect. They asked respondents to rate the seriousness of the same six environmental problems listed above both in their community and worldwide. Partially replicating findings reported by Gifford et al. (2009), Romania was the only country where seriousness of environmental problems was perceived as worse locally than globally; findings from all other countries (including Russia) confirmed biased comparative judgements.

Beyond documenting the effect, scholars have discussed its consequences for solving environmental problems. In the conclusion of their 18-nation study, Gifford et al. (2009) noted that such biased judgements "would seem to dampen enthusiasm for helping to solve local environmental problems, because they are discounted, at least in relation to environmental problems at larger scales" (p. 9). Similarly, Milfont et al. (2011) concluded that this effect is consequential because the more people believe that consequences of environmental problems are far away geographically, the less likely they would be willing to act locally. It is intuitive to assert that if global environmental problems are seen

as more serious than local environmental problems, individuals would be less motivated to engage in actions aimed at addressing local issues since increasing spatial (as well as social, temporal and certainty) distance negatively impacts pro-environmental actions (see Evans, Milfont, & Lawrence, 2014; Milfont, Evans, Sibley, Ries, & Cunningham, 2014; Spence, Poortinga, & Pidgeon, 2012; Stanley, Millin, Mickleson, & Milfont, 2018).

Measuring Biased Comparative Judgements About the Severity of Environmental Problems

Research has used two primary methods for measuring social comparative judgements (see Chambers & Windschitl, 2004). Research using a *direct method* asks participants to directly compare their behaviour, ability, trait or likelihood with that of others (e.g., "How intelligent are you compared with your co-workers?," "Compared with the average person in your town, how likely are you to get a cold?"). If the comparative judgement is unbiased, responses to such questions should centre on an average response. Research using an *indirect method* asks participants to make two absolute judgements—one judgement about themselves (e.g., "How intelligent are you?," "How likely are you to get a cold?") and another judgement about others (e.g., "How intelligent are your co-workers?," "How likely are the average person in your town to get a cold?")—and a difference score is then calculated between the two absolute judgements. If the comparative judgement is unbiased, the difference score should be zero. Across both methods questions can also differ regarding the specificity of the target (i.e., more specific targets such as "co-workers" or more abstract targets such as "the average person"), but the extant evidence from either method as well as across levels of specificity indicates systematic biases in social comparative judgements because responses do not centre on the average or on a difference score of zero.

   The majority of research that has documented biased comparative judgements about the severity of environmental problems has employed an indirect method by asking participants to make two absolute judgements about the environmental quality or seriousness of environmental problems in a geographically near place and a distant place (e.g., Bonaiuto et al., 1996; Dunlap et al., 1993; Musson, 1974; Uzzell, 2000). More recent research has employed the same approach of calculating a difference score from the absolute judgements and interpreting the resulting score as indicative of a systematic bias if it differs from zero. For example, Gifford et al. (2009) calculated comparative judgment scores by subtracting average global from average local rating scores of participants' judgements of 20 aspects of the environment. With this difference score, zero represented judgements of no local–global distinction, values above zero represented the expected biased effect, and values below zero represented an opposite biased effect with global environmental conditions viewed as better than local ones. Similarly, Schultz et al. (2014) asked participants to judge the severity of six environmental problems in their community and worldwide, and then calculated a difference score between these

two absolute judgements with values above or below zero indicating biased comparative judgements. Similar to research on social comparative judgements, the extant evidence indicates systematic biases in *place* comparative judgements because difference scores differ from zero.

When employing the indirect method for measuring biased comparative judgements about the severity of environmental problems, researchers have typically asked respondents to make absolute judgements contrasting the seriousness of local versus national problems (e.g., Bonaiuto et al., 1996; Murch, 1971; Musson, 1974), local versus global problems (Dunlap et al., 1993; Schultz et al., 2014), or local versus national versus global environmental problems (Coquet, Mercier, & Fleury-Bahi, 2019; Gifford et al., 2009; Milfont et al., 2011). Regardless of the comparison made, research findings indicate that individuals tend to view the environmental quality of the more proximal location as better off than that of the more distal location. Although we follow this extant research, we discuss issues with this approach in the Discussion section.

The Present Study

The broader network of findings currently supports the observation that individuals' comparative judgements regarding the environmental quality between geographically distant places is biased towards a belief that the environment of a proximal location is comparatively better off than the environment of a distal location. This effect has been termed "environmental hyperopia" (Uzzell, 2000), "spatial optimism" or "optimistic spatial bias" (Gifford et al., 2009), or "spatial bias" (Gifford et al., 2009; Schultz et al., 2014). Following Schultz et al. (2014), we refer to biased comparative judgements about the severity of environmental problems simply as *spatial bias*.

The main contributions of this study are twofold. First, we provide the first systematic within-country study of spatial bias. In their seminal article, Norenzayan and Heine (2005, p. 763) defined psychological universals as "core mental attributes that are shared at some conceptual level by all or nearly all non-brain-damaged adult human beings across cultures." These authors further argued that "the discovery of genuine psychological universals entails the generalization of psychological findings across disparate populations having different ecologies, languages, belief systems, and social practices" (p. 763). The balance of findings from single-country and cross-cultural studies support the replicability of spatial bias across distinct participant samples and measurement tools, and provides support for the generalizability of this effect. Extending past research and the scientific generalizability of the effect, we conducted a large study across all federative units or states in Brazil to test whether spatial bias replicates in respondents from all regions of a single country. We examined whether biased comparative judgements would emerge when asking respondents to rate the severity of environmental problems in the state they live in and in their country. Brazil is a continent-sized country both in terms of territory (8,515,759 km^2) and population (207,660,929 inhabitants). By showing evidence

of spatial bias within this large country, and testing whether levels of spatial bias vary across states in Brazil, we can provide further evidence as to the generalizability of this bias.

The second main contribution of this study concerns the measure assessing spatial bias. As noted above, Schultz et al. (2005, 2014) asked respondents to rate the seriousness of environmental problems in their *community* and *worldwide*, and the findings indicated the scale was equivalent in their cross-cultural samples; that is, measurement invariance results indicated participants responded to the items in similar ways, allowing mean comparisons (see Milfont & Fischer, 2010). We extend their work by asking respondents to rate the seriousness of environmental problems in their *state* and *nationally*, by adding "climate change" as an additional environmental problem, and by examining the extent to which the scale is invariant across samples from all 27 states in Brazil.

Method

Participants and Procedure

Data for this article were collected as part of the World Relationships Study, which recruited participants from 39 countries using Facebook advertisements (for details, see Milfont, Thomson, & Yuki, 2020; Thomson et al., 2018). A question asking respondents to indicate the Brazilian state they resided in was on the last page of the 6-page survey, which led to missing data. We increased the sample size across the Brazilian regions by using an online tool to identify the respondents' states from their IP addresses (http://www.bulkseotools.com/bulk-ip-to-location.php). The final sample comprised 4,265 respondents. Most respondents were female (85%; $n_{females}$ = 3,643; n_{males} = 574; 47 participants did not report gender) and the average age was 24 (M = 24.12, SD = 9.67; 15 respondents did not report age). Table 1 presents a sample description for each Brazilian state.

Table 1

Demographic Characteristics of Each Sample, and Mean Scores of Perceived Severity of State and National Environmental Problems

Brazilian State	n	Gender (% Female)	Mean Age	Environmental Problem Severity (State)	Cronbach's Alpha (State)	Environmental Problem Severity (National)	Cronbach's Alpha (National)	Spatial Bias	t*	df	Cohen's d
1. Acre	41	80	30	1.98	.91	1.45	.93	0.53	5.11	40	0.80
2. Alagoas	177	82	21	2.01	.89	1.43	.92	0.58	12.00	176	0.90
3. Amapá	111	78	29	2.05	.89	1.42	.93	0.63	8.91	110	0.85
4. Amazonas	116	88	26	1.68	.84	1.36	.85	0.32	6.94	115	0.64
5. Bahia	224	89	22	1.92	.88	1.39	.92	0.53	10.41	223	0.70
6. Ceara	213	88	23	1.90	.88	1.37	.91	0.53	11.59	212	0.79
7. Distrito Federal	164	85	26	1.84	.87	1.33	.89	0.50	9.08	162	0.71
8. Espirito Santo	148	78	24	1.86	.84	1.39	.91	0.47	8.59	147	0.71
9. Goiás	182	86	24	1.87	.86	1.36	.92	0.50	9.88	181	0.73
10. Maranhão	137	90	25	1.84	.85	1.34	.85	0.50	9.87	136	0.84
11. Mato Grosso	134	88	27	1.86	.86	1.37	.85	0.50	8.80	133	0.76
12. Mato Grosso do Sul	143	85	25	2.09	.92	1.50	.89	0.60	8.20	142	0.69
13. Minas Gerais	245	84	22	1.90	.91	1.40	.92	0.50	11.17	244	0.71
14. Pará	103	93	33	1.83	.87	1.39	.89	0.45	6.68	101	0.66
15. Paraíba	148	89	26	1.95	.90	1.41	.90	0.55	9.06	147	0.74
16. Paraná	333	82	22	1.99	.90	1.40	.91	0.59	14.31	332	0.78
17. Pernambuco	202	89	23	1.91	.87	1.44	.92	0.47	10.01	200	0.71
18. Piauí	121	88	27	1.97	.87	1.32	.91	0.66	9.77	120	0.89
19. Rio de Janeiro	176	84	23	1.76	.87	1.50	.91	0.27	5.34	174	0.40
20. Rio Grande do Norte	139	83	22	2.07	.90	1.44	.91	0.63	10.73	138	0.91
21. Rio Grande do Sul	176	86	22	1.95	.91	1.47	.93	0.48	8.28	175	0.62
22. Rondônia	136	89	28	1.92	.88	1.37	.89	0.55	9.78	135	0.84
23. Roraima	81	80	25	2.12	.89	1.37	.91	0.74	8.35	80	0.93
24. Santa Catarina	153	88	22	2.05	.90	1.47	.95	0.58	9.54	152	0.77
25. São Paulo	237	84	23	1.72	.91	1.43	.95	0.29	6.92	236	0.45
26. Sergipe	129	83	25	1.94	.89	1.49	.92	0.44	6.30	128	0.55
27. Tocantins	96	84	27	2.11	.86	1.31	.85	0.81	10.89	95	1.11
Overall sample	4,265	85	24	1.92	.89	1.41	.91	0.51			

Note. Responses were recorded on a four-point scale, with lower scores indicating greater severity of environmental problems (i.e., 1 = *very serious*, 2 = *moderately serious*, 3 = *slightly serious*, 4 = *not serious*). Scores for spatial bias were computed by subtracting average national from average state scores (state minus national). All values for spatial bias are above zero indicating that state environmental conditions are viewed as better than national environmental conditions. *Results from one-sample *t*-tests (Bonferroni adjusted α = .0019) confirmed the difference scores for each state significantly differed from zero (*p* < .00001).

Measure

To assess spatial bias, we employed an expanded version of the measure used by Schultz et al. (2005, 2014) to assess participants' absolute judgement about the seriousness of environmental problems in their Brazilian state and in the whole of Brazil. While Schultz and colleagues used a six-item measure, we added "climate change" as an additional item (see Milfont et al., 2011). Belief in the seriousness of local environmental problems was measured by asking respondents "How serious are the following environmental problems in *your state*?," and listing seven environmental problems: deforestation, water pollution, air pollution, land pollution, overpopulation, global warming, and climate change. Responses were recorded using a four-point scale (1 = *very serious*, 2 = *moderately serious*, 3 = *slightly serious*, 4 = *not serious*). To measure the belief in the seriousness of national environmental problems, the leading question was worded "How serious are the following environmental problems in *Brazil*?." Both scales had high internal consistency across all Brazilian states (see Table 1). These measures were presented to participants at the end of the broader survey, just before the page with demographic questions.

Following the indirect method for assessing biased comparative judgements (Chambers & Windschitl, 2004) and the approach used in previous studies examining spatial bias (Gifford et al., 2009; Schultz et al., 2014), a difference score was computed between the two absolute judgements. In brief, biased comparative judgements about the seriousness of environmental problems is simply the discrepancy between how serious an individual judges state environmental problems to be, and how serious the individual judges national environmental problems to be. Hence, spatial bias was calculated as the difference between the state and national scores (average state minus average national; e.g., Schultz et al., 2014). A difference score equal to zero represents judgement of no state–national distinction, while values other than zero represent biased comparative judgements. Values above zero represent the expected effect, and values below zero represent an opposite effect with local environmental problems judged as more serious than national environmental problems.

Results

Measurement Invariance

Before comparing respondents' scores, we first tested whether respondents from each state interpreted and responded to the scale items in the same way. Testing for measurement invariance is a prerequisite for meaningful group comparisons (e.g., see Milfont & Fischer, 2010). For example, the notion of deforestation might be such a foreign concept to respondents in some states that the non-salience of the issue impacts the way they respond to the item, compared with respondents for whom deforestation is a much more

salient issue (beyond simple differences in deforestation concern). If interpretation issues such as this exist, this may limit the comparability of the aggregated group-level means.

We first ran a confirmatory factor analysis with the overall sample for the state and national scales consisting of all seven items loading onto an Environmental Problem Seriousness factor (Figure 1). Group-level—in our case state-level—effects were controlled for with the CLUSTER IS command in Mplus. As shown in Table 2, both models had good fit to the data and all items had strong and statistically significant loadings to the latent factors.

Figure 1

Confirmatory Factor Model of the Belief Scales Assessing the Severity of Environmental Problems at the State and National Levels
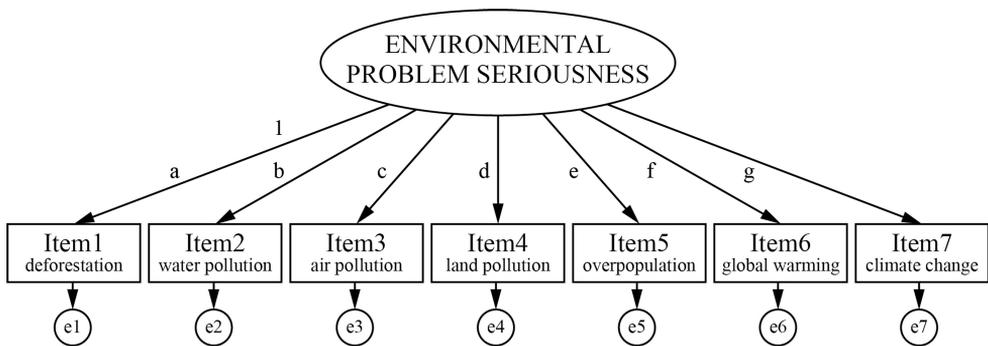

Table 2

Standardized Factor Loadings and Model Fit Statistics for the State and National Environmental Problem Seriousness Scales (N = 4,222)

	Standardized Factor Loadings (All p < .001)							Fit Indices					
Target	**Item 1**	**Item 2**	**Item 3**	**Item 4**	**Item 5**	**Item 6**	**Item 7**	**S-B χ^2**	**df**	**CFI***	**SRMR***	**RMSEA***	**90% CI**
State	0.67	0.74	0.84	0.83	0.63	0.69	0.56	99.77	13	.955	.032	.040	(0.033, 0.047)
National	0.80	0.86	0.89	0.85	0.59	0.77	0.67	172.57	13	.976	.028	.054	(0.047, 0.061)

Note. Asterisks denote robust fit indices. CFI = Comparative Fit Index; SRMR = Standardized Root Mean Square Residual; RMSEA = Root Mean Square Error of Approximation; CI = confidence interval. Item 1 = Deforestation; Item 2 = Water pollution; Item 3 = Air pollution; Item 4 = Land pollution; Item 5 = Overpopulation; Item 6 = Global warming; and Item 7 = Climate change. Considering their conceptual similarity, we allowed the error terms of Item 6 (global warming) and Item 7 (climate change) to correlate in both models as this improved model fit.

We then examined the measurement invariance of the state and national scales using the alignment method in Mplus proposed by Asparouhov and Muthén (2014; see also

Flake & McCoach, 2018; Kim, Cao, Wang, & Nguyen, 2017; Marsh et al., 2018; Muthén & Asparouhov, 2014, 2018) to confirm respondents from all Brazilian states responded to the scale items similarly. Conceptually, the alignment optimization procedure in Mplus is similar to what happens during rotation in an exploratory factor analysis; the software simultaneously searches for parameter estimates—for each and every parameter in each and every group—that minimize non-invariance as much as possible, while at the same time not affecting the overall fit of the model. Also similar to rotation in an exploratory factor analysis, the analysis works to find either highly non-invariant parameters or ones with as little non-invariance as possible (Asparouhov & Muthén, 2014).

In order to compare factor means across groups, models with less than 25% of parameters (factor loadings and intercepts combined) showing non-invariance are used as a rough rule of thumb indicating acceptable invariance (Muthén & Asparouhov, 2014; but see Kim et al., 2017 for a critique of this rule of thumb). Because we have a relatively large number of groups, we selected the FREE alignment estimates (see Asparouhov & Muthén, 2014, p. 9). Alignment optimization provides information about noninvariant items and noninvariant samples per item. We examined the description of group parameter invariance for intercepts and loadings. A fit function contribution value highlights a potential noninvariant item across the groups, with higher values indicating greater likelihood of a noninvariant item; and the R^2-value indicating the degree of invariance in factor loadings and intercepts across groups, with lower values indicating greater likelihood of a noninvariant item (Asparouhov & Muthén, 2014).

Results reported in Table 3 indicates that "climate change" is the item most likely to have noninvariant loadings in both scales, "overpopulation" is the item most likely to be invariant in the intercept for the national scale, and both "deforestation" and "overpopulation" are the items most likely to be invariant in the intercept for the state scale.

Table 3

Alignment Fit Statistics

Item	Intercepts			Loadings		
	Fit Function Contribution	R^2		Fit Function Contribution	R^2	
State (specific Brazilian state)						
Deforestation	−161.871	.250		−145.608	.380	
Water pollution	−139.610	.518		−145.105	.338	
Air pollution	−130.444	.793		−127.978	.475	
Land pollution	−124.432	.655		−124.199	.485	
Overpopulation	−181.954	.472		−135.874	.457	
Global warming	−123.143	.833		−137.272	.570	
Climate change	−180.225	.318		−156.656	.309	
National (Brazil as a whole)						
Deforestation	−120.056	.792		−141.712	.741	
Water pollution	−120.343	.722		−129.758	.801	
Air pollution	−117.850	.871		−119.458	.769	
Land pollution	−118.966	.735		−127.294	.500	
Overpopulation	−150.199	.074		−137.229	.509	
Global warming	−120.292	.782		−131.335	.720	
Climate change	−136.907	.401		−143.609	.434	

Note. Results are from the FREE alignment estimates. *R*-square refers to the explained variance/invariance index for each item.

Furthermore, results provided in the Supplementary Materials indicated that only 1% of all parameters for the state scale are non-invariant (i.e., four out of 378), and all loadings and intercepts were invariant for the national scale. In conjunction, these results confirm the measurement invariance of both scales across participants from all Brazilian states, providing support for the equivalence of these scales in our samples.

Examining Spatial Bias With Analysis of Variance

We then examined whether the expected spatial bias effect in beliefs about the severity of environmental problems emerged within Brazil. We conducted a one-way repeated measure analysis of variance (ANOVA) to evaluate the null hypothesis that there was no difference in participants' ratings of the severity of state versus national environmental problems for the overall sample. Rejecting the null hypothesis, the results of the ANOVA indicated a statistically significant comparison effect confirming spatial bias, with environmental problems judged as more serious at the national level ($M = 1.41$, $SD = 0.59$) than the state level ($M = 1.92$, $SD = 0.74$), Wilks' Lambda = .66, $F(1, 4260) = 2225.10$, $p < .001$, $\eta^2 = .34$.

Following Gifford et al. (2009), we then conducted one-sample t-tests (Bonferroni adjusted $\alpha = .0019$) to test whether the difference scores (average state minus average nation) significantly differed from zero. Results reported in the last columns of Table 1 confirm that all difference scores significantly differed from zero and had a medium-to-large effect as shown by Cohen's d above 0.40. Though spatial bias was confirmed across the overall sample and each state, inspection of the results indicates score variability across states. This was confirmed by an interaction between severity ratings and state, when adding Brazilian state as a between-subjects factor in the repeated measures ANOVA conducted above, $F(1, 26) = 4.03$, $p < .001$, $\eta^2 = .02$.

Examining Spatial Bias With Multilevel Analysis

To test for variability of the effect within Brazil more formally, we ran multilevel models in Mplus. Results from an unconditional multilevel model confirmed a substantial degree of spatial bias ($\gamma_{00} = 0.52$, $p < .001$). The mean spatial bias score among Brazilian states is thus 0.52, confirming ratings of environmental problems were rated as much worse at the national than state levels, and there is more variation within the states ($\sigma = 0.50$, $p < .020$) than between the different states ($\tau_{00} = 0.01$, $p = .020$). We calculated the intraclass correlation coefficient (ICC) which indicated that only about 2% of variance in individuals' spatial bias scores could be attributed to state ($\rho = .019$); meaning that there was minimal variability in spatial bias across Brazilian states.

Explaining Variability in Spatial Bias

The small clustering effect indicates that variability in spatial bias is more a result of distinctions among respondents within states than distinctions between respondents from different states. We then added variables in the dataset as individual-level predictors in a fixed-effects multilevel model. The demographic variables included were age, sex (1 = male, 2 = female) and respondents' self-reported household economic level (1 = low, 3 = mid, 5 = high). None of these variables explained variance in spatial bias: sex (β < 0.001, p = .99), age (β = −0.02, p = .19), and income (β < 0.001, p = .98).

We complemented these multilevel analyses by examining state-level predictors of spatial bias. We used three Level-2 variables: the 2016 Human Development Index (HDI) obtained from the Institute for Applied Economic Research (IPEA, 2019), an environmental sustainability indicator developed by Machado (2011, Table 16), and an environmental degradation index developed by Pinto, Coronel, and Conte (2016, Table 5). State-level HDI (β = 0.125, p = .620) and environmental degradation index (β = 0.290, p = .147) were not reliable predictors of variability of spatial bias across states, but a marginal effect was observed for the sustainability index (β = −0.512, p = .052). Combining the Level-1 (sex, age and income) and Level-2 (HDI, environmental degradation index and sustainability index) predictors yielded similar results, and the sustainability index remained a marginal predictor (β = −0.501, p = .059) of spatial bias across states. These findings indicate that greater biased judgements of environmental problems as worse in Brazil than in each state is not influenced by the demographic variables considered, but it is stronger for participants who live in worse-off states in terms of environmental sustainability. However, the within-level (σ = 0.999, p < .001) and between-level (τ_{00} = 0.663, p < .001) residual variances are large and statistically significant, indicating that these variables do not fully explain individual-level and state-level variability in spatial bias in our sample.

Discussion

People make comparative judgements in relation to other people (e.g., "Compared with the average person in your town, how likely are you to get a cold?") as well as in relation to distinct geographic locations (e.g., "Compared with your town, how would you rate the overall quality of the environment in your country?"). A growing number of studies have reported that individuals tend to judge the quality of the environment as better in a near geographic location compared to a distant location (e.g., Fleury-Bahi, 2008; Lima & Castro, 2005; Milfont et al., 2011; Uzzell, 2000), and this effect has been observed in large cross-cultural studies (Dunlap et al., 1993; Gifford et al., 2009; Schultz et al., 2014).

Replicating and extending previous findings, the present within-country study showed that environmental comparisons are systematically biased: individuals from all 27 states in Brazil rated the severity of environmental problems at the national level

as worse than in the state they reside in (see Table 1). Moreover, results confirmed the equivalence of the measures assessing spatial bias for participants across all 27 Brazilian states. Schultz et al. (2014, Study 2) confirmed the measurement invariance of the original version of this scale (with 6 items, without "climate change") across 1,131 participants from eight countries through the more traditional multigroup confirmatory factor analysis. Our results employing the alignment method (Asparouhov & Muthén, 2014) also confirmed the measurement invariance of both scales, indicating that respondents from all Brazilian states answered equivalently to items assessing their perceptions regarding environmental problems in their state and Brazil as a whole. Together with the cross-cultural findings reported by Schultz et al. (2005, 2014), the results from this study provide further evidence of the psychometric properties of the scale as well as its within-culture validity.

Past large-scale cross-cultural studies (Dunlap et al., 1993; Gifford et al., 2009; Schultz et al., 2014) have confirmed the prevalence of spatial bias across disparate populations using distinct measurement tools, and Schultz et al. (2014) showed that the available cross-cultural scores correlate positively and strongly. Based on these findings, Schultz et al. (2014) argued that spatial bias is a plausible candidate of a universal psychological phenomenon, given it has been observed in many populations and via different measurement strategies (see Norenzayan & Heine, 2005). Here we showed that the same effect emerges when asking respondents to rate the seriousness of environmental problems in their state and nationally, and the biased comparative judgement was high and comparable across respondents from all Brazilian states. Together with past large-scale cross-cultural studies, our within-country findings thus provide further evidence for the possible universality of individuals' tendency to make biased comparative judgements about environmental problems.

Taken as a whole, the empirical evidence indicates that when engaged in referential comparison about the severity of environmental problems, individuals are motivated to perceive environmental conditions in their near surrounding as better than elsewhere. However, this optimistic view of the quality of the local environment is an illusory superiority because individuals' locality is necessarily part of the global environment. To illustrate, respondents' state is part of Brazil and having Brazilians from all states rating environmental problems as worse at the national level than at the state level is unrealistic. Social comparison research has documented above-average and comparative-optimism effects (e.g., Chambers & Windschitl, 2004; Shepperd et al., 2013; Weinstein, 1980), expressed by a self-serving bias of overestimating one's good fortune and underestimating one's risk for misfortune. Following this literature, Schultz et al. (2014) have argued that spatial bias likely expresses a place-serving bias to protect one's perceptions of a valued place by underestimating environmental risks and/or problems in that valued place when compared to a geographically distant place. In other words, it may be functional for individuals to believe environmental conditions near them are better than elsewhere

because discounting local environmental problems tempers having to face the severity of such problems in one's local area (see, e.g., Hatfield & Job, 2001; Schultz et al., 2014).

While intuitively functional from a place-serving standpoint, unrealistically believing environmental conditions are better in their locality than elsewhere might reduce individuals' willingness to act on local environmental problems. Indeed, studies have shown that increasing the psychological distance of environmental problems by perceiving such problems as uncertain and more likely to happen to other people, elsewhere and in the future reduces willingness to act (e.g., Evans et al., 2014; Spence et al., 2012; Stanley et al., 2018). Biased comparative judgements about the severity of environmental problems may have unwanted implications for pro-environmental behaviours. However, although intuitive and conceptually sound, the expected negative impact of spatial bias on pro-environmental actions has not been examined systematically, and the only known study explicitly examining this issue did not observe any reliable associations between spatial bias and pro-environmental behaviours (Schultz et al., 2014). Future studies should consider the practical implications of spatial bias further.

Although the prevalence and strength of spatial bias is robust and perhaps unchallenged on average, there is variability between individuals and there might be boundaries conditions that would weaken or strengthen its impact. Previous studies have shown the effect to be unrelated to dispositional optimism (Milfont et al., 2011), while weakened by perceived controllability (Pahl et al., 2005) and strengthened by individuals' level of environmental concern (Schultz et al., 2014). Since data from this study were gathered as part of an unrelated project, we were unable to include additional variables to test mechanisms that could account for this illusory environmental superiority, and we restricted the analysis to three individual-level variables available in the dataset, plus three variables at the state-level. The environmental sustainability index emerged as a marginal predictor of spatial bias, suggesting that the effect is stronger for participants who live in worse-off states in terms of environmental sustainability. Future research should explore more systematically the boundary conditions of the effect. But it is worth noting that we observed smaller variability of the effect within our Brazilian samples—ICC of 2%—when compared to variability in cross-national comparisons reported by Schultz et al. (2014; ICC = .20 in Study 1 and ICC = .13 in Study 2). This indicates that there are more variations between countries than within a single country, and that cross-national studies would be more suitable for examining boundary conditions of the effect.

There remain important theoretical and methodological questions to be addressed in future research. One important direction for future research is a better understanding of the psychological process underlying spatial bias. That is, why do people tend to rate the seriousness of environmental problems in a geographically near place as more worrying than those of a geographically distant place? If this is indeed a form of optimistic bias, then what is the psychological reason for people to wanting to see the local or the proximal as better? As reviewed above, self-enhancement and place-serving motivations

are two candidates and it will be interesting for future studies to directly test the effects of these two motivations. For example, future research could test whether blocking the effect of self-enhancement motivation (e.g., by a manipulation that affirms the participants' positive quality in the self) weakens spatial bias, or whether enhancing the effect of this motivation (e.g., by a manipulation that denies the participants' positive quality in the self) strengthens the effect. Findings from these future studies will also allow us to devise strategies to counteract possible undesirable effects of spatial bias.

Related to the last point, spatial bias concerns psychological distance in comparative judgements of near and distant places. Drawing from construal level theory (Trope & Liberman, 2010), future research could manipulate levels of psychological distance to examine whether biased comparative judgements about environmental problems increase or decrease under conditions of increased psychological distance. Dimensions of psychological distance—spatial, social, temporal and hypothetical—are related (see, e.g., Trope & Liberman, 2010, Figure 2), and previous research has shown that spatial distance (Milfont et al., 2014), social distance (Fleury-Bahi, 2008; Pahl et al., 2005), and temporal distance (Gifford et al., 2009) influence judgements of environmental problems. Notably, spatial and temporal distances are related in environmental appraisals. Beyond documenting cross-cultural evidence of spatial bias, Gifford et al. (2009) also reported a tendency for respondents to judge that environmental conditions will get worse in the future, which they labelled temporal pessimism. Inspection of their Figure 1 indicates a clear association between spatial bias and temporal pessimism: respondents rated environmental problems as worse for increasingly distant spatial levels (local vs. national vs. global), and also rated future environmental conditions as worse than current conditions as the geographical distance increased (see also Coquet et al., 2019, Figures 8 and 9; Milfont et al., 2011, Figure 1). Experimentally testing the impact of psychological distance manipulations on spatial bias (and perhaps also temporal pessimism) regarding environmental conditions is an interesting avenue for future work; this is especially the case because the psychological distance of environmental problems may reduce willingness to act (Spence et al., 2012; Stanley et al., 2018).

There is also another critical issue to be examined in future studies. Spatial bias research asks respondents to make comparative judgements about the severity of environmental problems between geographically distinct places—for example, locally versus nationally (Murch, 1971; Musson, 1974; Schultz et al., 2014), locally versus nationally versus globally (Gifford et al., 2009). This approach departs from research assessing social comparative judgment and might have undesirable consequences. In research studying social comparative judgments or the better-than-average effect, the targets of comparison are of the same nature or scope; this means respondents are asked to compare the self to a specific person (e.g., another person of similar age or gender) or an average person. In contrast, the local–national or national–global comparisons entail targets of a different

scope since respondents are asked to compare a proximal location with an aggregate of different locations (i.e., compare a concrete and known target with an abstract entity).

Aside from the fact that one's local area or state is not clearly physically more distant than one's nation or the globe, the inclusion of states within countries and countries within the globe makes comparative judgements between such targets tricky. Considering that respondents' locality is part of their country, one might argue that the national target will have at least as many environmental problems as contained in the respondent's locality. The same applies for national–global comparisons: respondents' country is part of the globe, which will have at least as many environmental problems as contained in each country. From this perspective, spatial bias is perhaps trivial. A fair examination of this bias would require comparing a proximal, concrete location with a distal, concrete location without geographical overlap (e.g., the local state vs. a distant state). Hence, future research should employ a measure that asks respondents to evaluate environmental conditions in their own state versus another state, or own city/country versus another city/country. If respondents judge environmental problems in their own state as less serious than problems in another state, there will be stronger evidence for systematic biases in *place* comparative judgements.

To conclude, this is the first large scale within-country study examining the prevalence of biased comparative judgements about the severity of environmental problems using theoretical and methodological approaches from previous studies in the area. We do hope this research will inspire subsequent cross-cultural and within-country studies with enhanced theorising and improved measures to confirm the extent to which there is indeed a tendency for individuals to judge the severity of environmental problems as worse elsewhere than nearby.

Supplementary Materials

We present detailed results from the measurement invariance analyses as well as the dataset and codebook in the Supplementary Material (for access see Index of Supplementary Materials below).

Index of Supplementary Materials

Milfont, T. L., & Thomson, R. (2020). *Supplementary materials to "A within-country study of biased comparative judgements about the severity of environmental problems"* [Data and materials]. PsychOpen. https://doi.org/10.23668/psycharchives.4232

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