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The perceived relationship between population growth and current ecological problems using repertory grid technique

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ABSTRACT

Population growth (PG) is one of the main drivers of environmental deterioration. Understanding lay perception of PG is important for mobilizing public opinion and support for environmental protection.

A range of real-life current ecological problems, including PG, was presented to a sample of a hundred Israeli students without environmental education. We employed George Kelly's repertory grid technique along with principal component analysis to: (a) examine risk perceptions about PG in relation to various ecological problems and (b) identify the perceived risk attributes that influence risk perception of PG.

We found that: (a) PG severity was perceived as extremely modest, and that very few respondents viewed it as a catalyst of all other ecological problems that warranted prevention. (b) The most significant predictors of risk evaluation were the perceived certainty of the risk and the level of emotional response it evoked.

PG emerges as an idiosyncratic type of risk that is as psychologically distant as possible from most other ecological problems. This reflects a profound lack of understanding of the long-term effects of PG and the underlying causes behind many of today's ecological problems. The importance of raising awareness about demographic factors in environmental degradation is discussed.

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population growth; ecological risk perception; repertory grid technique

Introduction

Population growth (PG) is one of the main drivers of environmental deterioration (Ehrlich and Holdren 1971; Oskamp 2000; Swim *et al.* 2011). The mounting ecological consequences caused by steady demographic expansion include air and water pollution, soil deterioration, accelerated extinction of biodiversity, climate change and destruction of other interdependent ecosystems that sustain life (Bandura 2002; UNEP, 2005). In fact, it is difficult to think of a single environmental problem that is not directly or indirectly related to an increase in population size or density. Beck and Kolankiewicz (2000) review some of the world's greatest scientists and conservationists, who warn against the threat of PG on human survival. Wilson (1999), the noted Harvard biologist wrote: "The raging monster upon the land is population growth. In its presence, sustainability is but a fragile theoretical concept." (p. 328). Rees

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(2014), the originator of the "ecological footprint" concept, wrote: "On a planet already in overshoot, there is no possibility of raising even the present world population" (p. 3).

Despite the central causative role of population increase in ecological challenges, in recent years, relatively little attention has been paid to the issue in the popular media, or even by leading environmental science and policy institutions (Pielke and Sarewitz 2005), and the topic is definitely not among the priorities of environmental organizations (Beck and Kolankiewicz 2000; Bridgeman 2017). Political scientists have documented a pattern of "retreat" that took place among environmentalists around the world, replaced with a complacency regarding overpopulation's impact on national (Pakulski *et al.* 1998; Beck and Kolankiewicz 2000) and global levels (Weld 2012). Commentators from other disciplines have pointed to psychological and sociological factors that explain the low level of public engagement surrounding questions of population and sustainability. Beyond the controversy it evokes (Beck and Kolankiewicz 2000; Vlek and Steg 2007), humans' evolutionary imperative to reproduce (Pratarelli 2008; Bridgeman 2003; Rees, 2014), along with lack of understanding about the nature of exponential functions (Bartlett 1998), contribute to denial and/or reticence regarding demographic issues. Bridgeman (2017) argues that "a first step in ending population growth is to become aware of the problem" (p. 387). Nonetheless, most of the research on PG has been conducted from a demographic or political perspective rather than from a psychological point of view. Inquiries to better understand people's perception of the issue have the potential to contribute in increasing awareness about the risks associated with rapid PG (Swim *et al.* 2011).

Israel offers a particularly relevant place to glean insights about the psychological factors behind population denial and reviving interest in demography as a pressing environmental challenge. In fact, overpopulation was never an issue on the radar screen of the country's robust environmental movement. Orenstein (2004) argued that there were three essential reasons why Israeli environmental scholars and activists were hesitant to broach the subject of PG on a policy level: (a) disagreement as to whether it was indeed a significant environmental factor—relative to consumption; (b) acknowledgement that other exigencies, such as security and economic challenges, took precedence; and (c) fear of alienating the public by raising a controversial issue. The volatility of demography as a political issue has been widely documented (Portugese 1999; Tal 2016) with significant backlash and consequences for the rare voices of political or societal leaders who questioned the sustainability of the country's rapid demographic growth.

In recent years, Israel's increasingly high population densities have increased the profile of demographic pressures' negative impacts. The country's loss of open spaces, biodiversity, and water resources, along with lack of progress in climate change mitigation, and noise pollution can all be attributed to population pressures. Yet, these dynamics do not appear to have changed the absence of this issue from the public environmental agenda.

The aims of this research, therefore, were: (a) to examine risk perceptions about PG in relation to ecological problems and (b) to identify the perceived risk attributes that influence risk perception of PG.

Background

Population growth as an environmental problem

The steady increase in the world's population size is causing irreversible harm to the planet's environment (Bandura 2002). A litany of studies confirms the simple equation: "more

people – less nature". For instance, research published by the World Wildlife Fund (2014) reported extraordinarily grave deterioration, that is, a decline of some 52% of the wildlife on the planet between the years 1970 and 2010. The primary driver of this devastation is habitat loss caused by burgeoning human populations and associated development. A variety of estimates calculating the rate of species loss have been published, but all point to alarming extirpation: The one thousand international experts, convened under the *Millennium Ecosystem Assessment*, reached a consensus estimate of 24 species lost per day, or 8,700 species a year (2005).

The link between PG and the rise in greenhouse gas emission is not only intuitive, but has also been confirmed in a number of empirical studies (O'Neil and Wexler 2000, O'Neil *et al.* 2012; Spears 2015; Scovronick *et al.* 2017). A recent survey published in *Science* that assessed the most important things individuals could do to reduce their carbon footprint, calculated that the benefits of having one less child was orders of magnitude greater than the next closest measures such as foregoing flights on jet airplanes (Perkins 2017). Other global problems, such as overfishing (Mora *et al.* 2009; Uniyal *et al.* 2016) and desertification (Tal and Cohen 2007) intuitively and empirically are the direct results of population pressures.

Israel's demographic circumstances are idiosyncratic for a developing country: The country's 3.1 total fertility rates are almost double the birth rates for OECD countries. The result is a steady 2% PG and a population density that exceeds other countries such as Japan or Belgium. This makes the country a "microcosm" that reflects the global dynamics of overpopulation. With a demographic doubling time of roughly 30 years, the environmental and social impacts are increasingly conspicuous: from overcrowded classrooms, courtrooms, highways and hospitals, to biodiversity loss and a steady increase in the country's aggregate carbon footprint (Tal 2017).

Rees (2014, p. 12) noted that there is no escape from rewriting a social contract within each of the countries, in which state-assisted family planning programs must be implemented to stabilize/reduce human populations. He advocates that global sustainability be achieved through managing and stabilizing domestic population on a bio-regional basis. In applying the "think globally, act locally" principle to the overpopulation problem, it is crucial to study locality-specific predicaments of overpopulation, including the psychological and sociological barriers and misconceptions.

It should be noted that there are additional factors that contribute to environmental degradation. The main ones are affluence/consumption and non-sustainable/polluting technologies (Ehrlich and Holdren 1971; Vlek and Steg 2007). But even if there are disagreements regarding the relative contribution of affluence versus PG, there is still a consensus among scientists that stabilizing population is a sine qua non for sustainable development (Sachs 2015; Incropera 2015). Finally, studying perceptions of PG is especially important in view of the concept that "it may be easier to achieve environmental sustainability by reducing population than by trying to reduce enduringly overconsumption by burgeoning populations" (Bandura 2002, p. 3).

Evaluation and prioritization of environmental risks by lay public

Public opinion is of great importance in determining priorities for addressing societal problems in general, and environmental problems in particular. Unfortunately, environmental problems are complex, and even experts, let alone the general public, do not always agree on

their causes, implications, and priorities (Slovic *et al.* 1986; Sjoberg 1999; Slimack and Dietz 2006). Studies examining how environmental problems are perceived by the lay public point to biases and misconceptions, reflected in unwarranted attention to small risks and neglect of larger ones (Fischhoff and Morgan 2013). Understanding how the layperson refers to and prioritizes environmental problems, including inherent biases and misconceptions, has tremendous value for understanding how to engage them in efforts to influence decision makers.

Many studies have been conducted to learn about the factors that influence the perception of risk. They report of several risk attributes that strongly affect risk evaluation, and trigger engagement in protective or preventive action. For example, Paterson and Neufeld (1987), and later, Axelrod and Lehman (1993), maintain that what determines risk perception is its perceived severity, its immediacy, and certainty of realization. Lewonstein *et al.* (2001) noted two key factors that affect decisions regarding subsequent precautionary, self-protective behavior: personal experience with a threat and the lapse of time between the behavioral decision and realization of the outcome (for a comprehensive review, see Slovic, 2016).

When it comes to ecological risk (ER), risk assessment produces even greater complications. Acknowledging this, Bohm and Pfister (2000, 2005) noted that environmental threats are characterized by several distinctive features that include the *complexity of the processes involved* and the *time-deferred negative outcomes*. They further noted that, in most cases, negative outcomes are processes and/or outcomes that are geographically distant and do not only affect the individual, but ultimately have an impact on the collective. Dessai *et al.* (2004) discussed three prime risk characteristics that shape threat perception: the extent of personal potential harm, the immediacy, and the likelihood of the threat realization. Thus, for example, Leiserowitz (2005) attribute Americans' general estimates of climate change as constituting a moderate risk to the perceived temporal and geographical remoteness of environmental threats.

If environmental risk assessment is a daunting task, environmental risk prioritization is even more challenging, especially for lay people. Yet, in a world with limited resources for risk management, setting priorities cannot be avoided. Previous studies show that risk evaluation and prioritization often do not correlate (Dunlap and Scarce 1991; Dunlap *et al.* 1993; Tengs *et al.* 1995). The present study considers the relative importance of PG in relation to the prioritization of other environmental threats. After describing the rationale and goals for the research, the risk attributes chosen for the evaluation process will be characterized and the list of ecological problems to which PG is compared, will be analyzed and explained.

Study goals and rationale

The present study aims to assess the risk attributes that affect high risk perception of PG, and to measure the degree of perceived similarity between the PG and other environmental problems. Our theoretical framework is based on the premise that: (a) one of the first critical steps in ranking risks is their classification (Fischoff and Morgan 2013), and (b) ranking risks requires grouping them into a manageable number of categories (Morgan *et al.* 2000). Furthermore, since "risk is a multiattribute concept, one must choose a set of risk attributes against which to evaluate each category" (Morgan *et al.* 2000, p. 49). Therefore, we sought a tool that would allow us to use various risk attributes as a multivariable measure of similarity. According to this rational, we expect that if PG is perceived as related to other ecological problems, then their perceived attributes are expected to be similar.

Methods

Sample and sampling procedure

The sample included 100 students studying at Tel Hai College in Israel's northern Galilee. Research assistants recruited students according to the inclusion criteria (representation of gender and discipline), and exclusion criterion (environment-related studies). The disciplines included computer sciences and engineering (24%), economics (22%), education (22%), nutritional science and food engineering (16%), biotechnology (7%), and psychology or social work (9%). Women comprised 47% of respondents, with ages ranging between 19 and 39, with a mean of 24.6 years and standard deviation of 2.98 years. Year of study was distributed as follows: 38% first year, 37% second year, and the remaining 25% third or fourth years. The questionnaire was computerized using Qualtrics software that ensured that: (a) questions had to be fully answered (no missing data) and (b) items were presented in random order. The procedure was carried out in a classroom in the presence of a research assistant. Mean time for filling out the questionnaire was 25 minutes, for which each student received ILS 40 (USD 12).

Determining the main environmental problems in Israel

To know how laypeople perceive the problem of PG in the context of other, current real-life environmental problems, it was necessary to define the salient ecological hazards. So, to this end, we sought an official list, detailing Israel's current and central environmental problems. In 2010, Israel's Environmental Protection Ministry issued a report, written by many of the most senior environmental experts in Israel, entitled "*State of the Environment in Israel: Indicators, Data and Trends.*" In parallel, the Samuel Neaman Institute, based at the Technion, Israel Institute of Technology in Haifa, issued an independent report detailing national environmental priorities of Israel (Rosental *et al.* 2011). According to these reports, the following list constituted Israel's ten most severe problems, reflecting the direct consequences of anthropogenic destruction of environmental quality and environmentally irresponsible conduct (in random order).

- Soil pollution, resulting from industrial waste, pesticides, fertilizers or oil leaks from gas stations
- Industrial air pollution (factories, power plants, and industry)
- Transportation-related air pollution
- Pollution of water sources and groundwater by sewage, pesticides, or fuels
- Pollution of the Mediterranean Sea
- Drop in the water level of the Dead Sea, receding water line and formation of sinkholes
- Loss of green and open spaces due to development and construction
- Loss of biodiversity
- Disposal of waste and accumulation of garbage in public areas and in nature
- Long-term drought (consecutive years of decreased rainfall) and water shortages

Interestingly, increased population was not mentioned as an environmental problem so, for purposes of the present research, we added an eleventh problem: PG and increasing population density. We also added earthquakes and fires: earthquakes because they represent the only ecological problem that is not caused by human

activities, and fires because exactly at the time of the sampling, a state of emergency was declared in the country due to a wave of fires; some of which were caused by weather conditions and negligence, and some by suspected arson attacks. We therefore ended up with 13 problems, most of which are typical and central in other parts of the developed world and a few that are specific (local) to Israel.

Criteria for evaluating the severity of population growth

The major challenge in facilitating comparisons between PG and other ecological problems involves providing consistent risk attributes that can be relevant, comprehensive, and not lengthy, in order to be cognitively tractable. The criteria used to compare PG and other environmental problems are the most cited criteria for evaluations of ER severity. Each of them served as a dimension of similarity. We used seven criteria so the comparisons would be based on a seven-dimensional basis. Note that none of the criteria are objective measures, but rather subjective evaluations, that is, the person's perceptions of different risks' attributes.

The seven criteria selected to be applied in the present study are as follows:

1. Perceived certainty at which the risk is expected to be realized. This criterion represents the perceived probability of occurrence or realization of the threat, and it is usually positively related to high risk evaluation (Paterson and Neufeld 1987; McDaniels *et al.* 1995; Axelrod *et al.* 1999; Lewonstein *et al.* 2001);
2. Perceived imminence of the threat, that is, the perceived timing of occurrence of the event, where stronger sense of imminence is related to higher severity evaluation (Johnson and Tversky, 1984; Paterson and Neufeld 1987; McDaniels *et al.* 1995; Axelrod *et al.* 1999). Frequently, imminence represents the temporal distance of the risk;
3. Spatial proximity, that is, representing the perceived geographic distance or localization of the risk relative to the person (Slovic 2016);
4. The perceived potential for personal harm, which is another important predictor of ER perception. It assesses the extent to which a person thinks that the event may be harmful to him/herself (Axelrod *et al.* 1999. McDaniels *et al.* 1995).
5. Risk predictability is another risk criterion that measures how (well a person feels that) the impacts on natural environments, associated with the event, can be predicted (Axelrod *et al.* 1999; McDaniels *et al.* 1995);
6. Another predictor of risk perception is the emotionality related to the risk; specifically, the level of the negative emotion (i.e., anger, sadness, fear, disgust, etc.) a person feels when thinking about the event (risk) and its impacts on natural environments (Johnson and Tversky 1983; Slovic *et al.* 2004; Bohm and Pfister 2000, 2005)
7. Finally, in today's media-dominated world, the evaluation of riskiness also depends on the perceived media attention dedicated to the risk (McDaniels *et al.* 1995; Axelrod *et al.* 1999).

These seven risk criteria were used to evaluate perceived similarities between environmental problems and the increase in population size and density. The wording of each question in the instrument was adopted from studies, cited above, that used comparable criteria. The exact wording of the questions that examined each of the 13 risks is presented in Table 1. In the computerized questionnaire, the order in which each of the risk types and the risk criteria were presented, was randomly changed from subject to subject.

Table 1. Dimensional evaluation scales* and questions measuring perceptions of various ecological risks**.

Certainty	In your opinion, to what degree does _____ pose a certain threat to humans and the environment?
Geographical proximity	In your opinion, does _____ directly affect the place where you live?
Imminence	In your opinion, to what extent does _____ pose an immediate danger to humans and their natural environment?
Personal harm	In your opinion, to what extent do the negative effects of _____ pose a threat to you personally?
Emotional involvement	In your opinion, to what extent does _____ cause you to experience a negative emotion (such as sadness, anger, fear, disgust)?
Predictability	In your opinion, to what extent can _____ and its effect on humans and their natural environment be anticipated?
Media cover	In your opinion, to what extent does the media report on _____ and its negative effects on humans and their natural environment?

*Each scale ranged from 1 = not at all to 7 = absolutely.
**Each question was repeated (13 times) for each of the ecological risks.

Evaluation of ecological risk severity and prioritization for risk prevention

Evaluation of aggregate absolute severity (for each of the 13 risks) was measured by asking the respondent: "To what extent do you see … as serious?" Theoretically, a person could assign the highest score (mark "7") to all the 13 risks.

Another aspect of risk evaluation was examined by asking the respondents to prioritize. We did that in two different ways: First, we asked the participants to rank the 13 ER's in order of perceived severity (To assign "1" to the most serious, and "13" to the least serious risk). In this way, respondents could not assign a high evaluated severity to all of the risks. Second, the following question was presented: "If you had ILS 100 to contribute that would eliminate one of the ecological problems, which one would you choose?" This was done in order to identify the attributes of their *personal* choice that may not necessarily indicate of perceived severity. For further analyses and discussion, this ER was referred to as "the chosen risk."

Predictors of perceived severity of population growth

Three groups of predictors were included in the model: The first group of variables is perceived risk attributes, presented in Table 1. The second group includes demographic variables such as age, gender, year of study, and socioeconomic status. The third group includes three items measuring subjective environmental knowledge, and one question where respondents report the number of academic courses related to environment taken throughout their studies (see Table 2 for details). The last question was designed to consider previous non-academic or informal exposure to environmental content or the study of elective courses related to ecology.

Multiple regression analysis with backward variable exclusion was then used to detect the significant predictors of a high risk evaluation for PG.

Perceived attributes of population growth and perceived similarities to other ecological problems

The similarity between PG and the rest of the ecological problems is based on the apparent likeness in their perceived attributes. This was assessed using two complementary methods. The first was principal component analysis (PCA), which yields a visual representation of the location of PG relative to perceptions of other ER's (Figure 1), allowing for

Table 2. Descriptive statistics of background ecological knowledge variables.

	Mean	SD	Median	Range
An index of self-reported (subjective) environmental knowledge*, Cronbach's $\alpha = 0.854$				
I feel that I understand the reasons for various environmental problems.	3.09	1.04	3.00	1–5
I feel that I know the solutions to environmental problems.	2.50	0.95	3.00	1–5
I consider myself to have a lot of environmental knowledge.	2.61	0.95	3.00	1–5
A single item measure of academic environmental background				
Number of environmentally-related courses taken.	0.30	0.745	0	0–3

*The scale range was 1 = I do not agree at all, …, 5 = I completely agree.

characterization and comparison of perceived risk attributes. The second method involved calculating matches between the perceived attributes of PG and those reported regarding other ERs (Table 3). Matches between the risks, generated with WebGrid Plus, reflect the percentage of maximum possible matches (Gaines and Shaw 2010). The matches are calculated in a spatial manner using the Minkowski metric with the power of 1.0 (standard city block metric). For further explanation of the calculation method, see Shaw (1979, p. 180).

Results

Perception of risk severity

Figure 2 shows the mean scores of perceived severities of ER's (in descending order). Repeated measures ANOVA shows that mean severity of PG was significantly lower than all other risks.

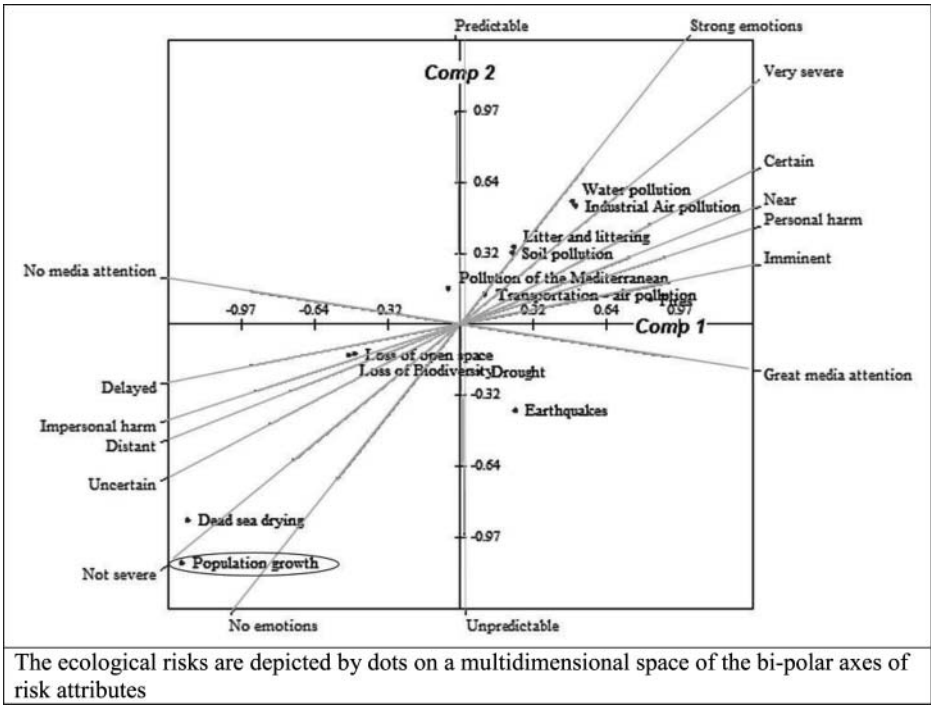

Figure 1. Multidimensional scaling representation of population growth versus other ecological risks. The ecological risks are depicted by dots on a multidimensional space of the bi-polar axes of risk attributes.

Table 3. Matches between ecological risks based on perceived risk attributes (% similarity in descending order).

The ecological risk	Similarity between population growth and the ecological risk (%)
Decline in Dead Sea water levels	89.1
Damage to biodiversity	88.6
Loss of open spaces	87.1
Drought and water shortage	81.9
Pollution of the Mediterranean	81.4
Air pollution caused by transportation	78.3
Earthquakes	77.9
Soil pollution	77.6
Litter and littering	77.4
Industrial air pollution	73.6
Water pollution	73.3
Fires	73.1
The "chosen" problem	70.5

On a scale that ranges from 1 (not severe at all) to 7 (very severe), it seems that the perceived severity of PG falls below the midpoint (4), that is, it is considered less than even a moderate risk.

Perceived risk attributes of population growth

Table 4 shows that as an ecological risk, PG is not perceived as *highly certain, proximate*, or *imminently predictable*. It also does not evoke strong negative emotions, and the perceived media coverage is low. Most of the medians are lower than or equal to 4, which represents the midpoint of the scales.

Additional variables tested for their influence on risk perception of population growth

Table 2 presents the mean, standard deviations and reliability of the items used to assess self-report (subjective) ecological understanding and number of courses related to environmental topics taken throughout studies.

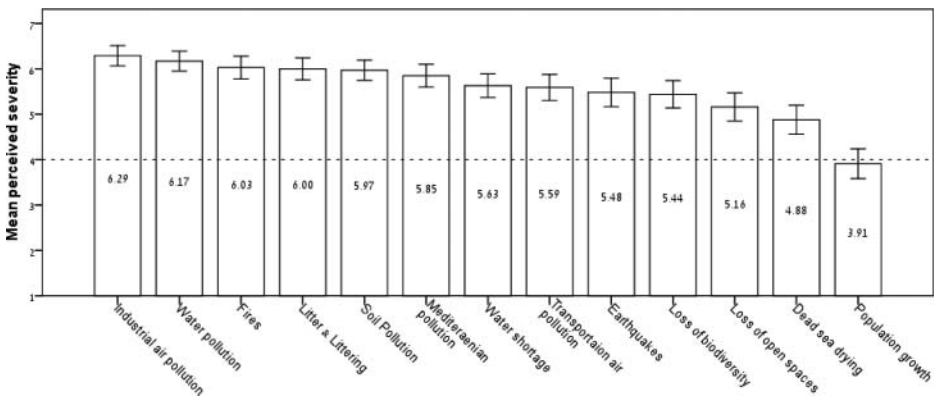

Figure 2. Mean evaluations of severity (± 2 SE) of ecological risks (The dotted reference line represents the midscale).

Table 4. Descriptive statistics of predictors of population growth.

	Mean	SD	Median	Range
Certainty	3.64	1.59	4.00	1–7
Geographical proximity	4.09	1.87	3.00	1–7
Imminence	3.14	1.59	3.00	1–7
Personal harm	3.68	1.68	4.00	1–7
Emotional involvement	3.35	1.79	3.00	1–7
Predictability	4.59	1.65	5.00	1–7
Media cover	2.64	1.55	2.00	1–7

Factors affecting high risk assessment of population growth

A multiple regression analysis, in which the three groups of predictors, detailed previously, were used as predictors of risk evaluation, resulted in an explained variance of 75.8%. Table 5 shows that of the first group of predictors, three were found significant: *emotional involvement, perceived personal harm*, and *perceived imminence*. Among the second group of predictors, the demographic variables, none was found to be significant. The third group, subjective feeling of ownership of ecological knowledge, also did not predict risk perception, whereas the number of courses taken related to ecology (presumably as elective courses) significantly predicted risk perception.

The chosen problems

A breakdown of the chosen problems showed that almost half of the respondents chose the following three ecological risks as most compelling: littering (18%), industrial air pollution (16%), and water pollution (14%). The rest of the choices were: loss of biodiversity (12%), transportation-related air pollution, loss of open space and fires (7% each), drought, earthquakes and PG (5% each), soil pollution (3%), pollution of the Mediterranean (1%), and the drying of the Dead Sea was not chosen by any one.

Table 5. Predictors of risk perception of population growth.

		Unstandardized coefficients		Standardized coefficients		
Group of predictors	Variable	B	SE	Beta	t	p
	Constant	1.887	1.158		1.630	.107
Perceived risk attributes	Certainty	.061	.076	.060	.810	.420
	Geographical proximity	.056	.068	.064	.821	.414
	Imminence	.164	.081	**.159**	2.029	**.046**
	Personal harm	.184	.089	**.190**	2.064	**.042**
	Emotional involvement	.409	.074	**.447**	5.552	**.000**
	Predictability	.100	.062	.101	1.616	.110
	Media cover	.056	.064	.054	.887	.378
Demographic variables	Age	−.062	.033	−.113	−1.872	.065
	Gender (0 = male, 1 = female)	−.260	.200	−.080	−1.298	.198
	Socioeconomic status	−.090	.121	−.046	−.746	.458
Background ecological knowledge	Knowledge	.033	.114	.017	.290	.773
	Number of courses	.379	.136	**.173**	2.790	**.007**

Perceived similarities between population growth and other ecological problems

Multidimensional analyses based on the perceived risk attributes found that the risk that was perceived as most similar to PG was the decline in the Dead Sea water level (Table 3 and Figure 1). By contrast, water and industrial air pollution are the most dissimilar risks in terms of their perceived risk attributes. The greatest conceptual distance was between attributes of the chosen problem (i.e., the prototype problem that respondents defined as the one they would choose to deal with) and those characterizing PG. In other words, of all the problems presented, these two were the most dissimilar. Of the current real-life environmental problems, PG was perceived at the greatest distance from fires.

Figure 1 presents the PCA depicting the intercorrelation between the risks, based on the dimensional evaluation data. The figure displays the loading of each risk onto the two factors extracted by a varimax rotation. The environmental risks appear as points in the plane, and the distance between them reflects the difference in the evaluations of the risks' attributes. Since the proximity is multidimensional and the figure is two-dimensional, the similarities presented in Table 3 are more accurate.

Discussion

Lay perception of population growth in relation to other ecological problems

The first goal of this study was to examine how people perceive PG in relation to a range of other ecological problems. When a list of current real-life environmental problems was presented to laypeople, the severity of PG was considered to be extremely modest; in fact, the least severe of all the ecological problems evaluated. In addition, when asked to choose a single ecological problem that was worth preventing, only 5% chose PG. Additionally, very few respondents viewed PG as a catalyst for all other problems that warranted prevention.

To understand this finding, one should look at the perceived risk attributes of PG: On every measure or criterion for high risk evaluation, the problem of PG was perceived as low, or moderate at best. This finding is not new, and is consistent with previously mentioned theoretical and qualitative explanations presented in the literature regarding the public's downplaying of the population issue (Slimack and Dietz 2006). The novelty of this study involves the empirical identification of predictors of risk perception for a variety of problems, including PG. The associated insights allow for a more informed evaluation of how to present population issues, so that they resonate with the public as environmental priorities.

Factors that affect high risk perception of population growth

The strong fit emerging from the regression analysis (>75%), explaining the variability of the perception of risk severity indicated that the use of this particular model was appropriate for examining the factors affecting risk perception, which was our second goal. We found that the emotional response evoked among respondents by the risk had a strong and significant influence on risk evaluation.

The notion that emotions are a key element in risk assessment is not new, but it is demonstrated quantitatively in the present study. Slovic *et al.* (2004) theorized that feelings are a strong driving force for action (i.e., risk prevention) and described them as the "spring of action." In many ecological contexts, the negative emotions elicited and how they drive

action are easily recognizable. For example, it is easy to understand how environmental problems such as air, water, and soil pollution, or water shortage, induce feelings of fear. The ability of species extinction, loss of open space, polluted seas, or the shrinking Dead Sea to produce negative emotions such as sorrow, sadness, or anger is also intuitive. Population growth, however, does not necessarily evoke specific negative feelings—at least not directly. This is not surprising in a society conditioned to perceive PG as a positive phenomenon and an indicator of societal success. Slovic *et al.* (2004) note that *affect*, like other heuristics, can generally be adaptive but "occasionally get us into trouble." In the present case, the *lack of affect* may get us into bigger trouble. It seems that a fundamental reason for the minimal perception of PG's severity stems from its inability to induce negative emotions. When such an emotion does arise, however, even if only slightly, its effect on risk perceptions is considerable. This finding is important in the context of affecting attitudinal or behavioral change. It suggests an underlying strategy for overcoming present barriers to reforming pro-natal public policies: changing the traditionally positive associations accompanying PG into a phenomenon that is seen as posing an existential threat and a danger that must be immediately addressed.

Such a dramatic reversal is not impossible. In their review of the history of the environmental movements' relation to PG, Beck and Kolankiewicz (2000) document the emergence of a large coalition of environmental groups during the 1970s that endorsed population stabilization and embraced demography as an environmental issue. This perspective profoundly influenced the news and media: "Suddenly after more than twenty years of the baby boom, journalists and politicians were treating population growth as something that could and should be tamed rather than as a natural, inevitable force beyond human and humane control." (p. 125). Indeed, during the course of the 1970s, the US fertility rates fell below replacement levels, which indicate that emotional barriers can be overcome. Furthermore, this study's results suggest that reviving a robust discourse about the environmental and social impacts of overpopulation could produce dramatic shifts in PG risk perception.

Two additional, significant (though weaker) predictors affecting PG risk perception, were observed: *personal harm* and *imminence*. In both cases, respondents tended to judge PG as causing little, if any, harm and perceived any associated damage as distant. The low average levels of perceived imminence and personal harm may be understandable, especially in developed, affluent countries. After all, "pressure on the earth's capacity to feed its inhabitants will not change after the birth of a new baby" (Joireman 2005, p. 289). For inhabitants of poor, developing countries, however, the circumstances are different. Ghimire and Mohai (2011) studied the relationship between perceptions of environmental deterioration and fertility behavior in an agriculture-based society, like in Nepal. They found that individuals who identified a decrease in productivity, groundwater table, and water quality during the past three years, were more willing to use contraceptives. Simon (2017) also studied the relationship between fertility decisions and environmental conditions in dryland areas of rural Mexico. He found that improved environmental conditions increased the likelihood of increasing family size. In more humid areas, in contrast, household response to better environmental conditions, in terms of fertility, was insignificant. The findings of the two studies such as Nepal and Mexico imply that people do appreciate the risk posed by expanding populations when they can clearly see how it may be an *imminent* and *personal* existential threat. This can be seen in the case of rural areas, where people are more dependent on the

environment. Such evidence provides independent confirmation of this study's results, identifying significant factors that influence risk perceptions of PG.

This discussion reinforces another point discussed in the literature: the need to tackle the relationship between PG and perceptions of environmental degradation on *a bio-regional basis.* The rationale is that predicaments created by overpopulation are frequently locality-specific (Clayton *et al.* 2016; Bridgman 2017). In other words, the manifestations of PG often vary from region to region. This study's conclusions regarding the impact of immediacy and personal touch can be used to motivate people to act on the population issue by highlighting local evidence.

It is also important to note the statistically significant effect that ecology-related elective courses had on students' risk perception. There are at least two possible explanations for this finding: the first is that formal environmental education fosters the insight that PG poses a serious problem. An alternative explanation is that the students who elected to take ecology-related courses had a higher environmental literacy to begin with. Since neither of these two explanations can be disqualified based on present data, the matter will be left as an interesting subject for future examination. Finally, the finding that subjective environmental knowledge (including self-reported understanding of the reasons for ecological problems) has *no* effect on risk perception, is noteworthy. This reflects deep-rooted misapprehensions about what "environmental knowledge" is, and highlights the absence of the PG issue from public discourse.

The perceived relationship between population growth and environmental problems

The study's final objective was to examine the perceived relationship between PG and environmental problems. In quantitative and visual complementary descriptions, PG emerges as a threat that is exceedingly distant from most other ecological problems, as well as from the "chosen" problem. According to Morgan *et al.* (2000), similarity between elements shows that their perceived attributes share common properties, which are sufficient to define them as a "group." In the present case, water and industrial air pollution share similar attributes with other types of risks, such as transportation, air pollution, and soil pollution. Such risks, in Morgan *et al.*'s words, bear a "family resemblance to an idealized category member referred to as 'prototype'" (p. 51).

By way of contrast, however, PG is located far on the opposite quartile. This seems to leave overpopulation as an idiosyncratic prototype. The only environmental problem to share fundamental characteristics with PG is the declining water level of the Dead Sea; an ER that none of the respondents found worthy of investing money to rescue. Presumably, both problems seem "far away," posing no direct or immediate danger. This perceptual distance reflects a profound lack of understanding of the long-term effects of PG and the underlying causes behind many of today's ecological problems. Moreover, the maximal distance of PG from the chosen problem reveals that PG has the precise qualities that predict it will *not* be chosen as a problem whose solution will inspire investment among the lay public. Ironically, after the fictional "chosen risk," PG was judged as the most distant (and therefore *dissimilar*) relative to fires, the symbolic representation of an alarming, urgent, existential threat.

Conclusion

As the world faces the environmental and social implications of a planet with 11 billion people, reviving PG as a salient ecological issue constitutes a paramount challenge for

environmental advocates. This study's results suggest that alongside political explanations for overpopulation's retreat as a priority environmental issue, psychological factors are also germane: The general public typically does not appreciate the environmental implications of high-density environments and the pernicious impact of rising global population levels on natural resources, biodiversity, and environmental quality. Meaningful progress may be elusive in raising awareness about demographic factors in environmental degradation unless the geographic and temporal immediacy of population impacts on the environment can be more effectively communicated. The fact that respondents with even modest exposures to ecological classes showed greater concern for PG's negative potential effects, confirms the far-reaching influence of environmental education and highlights a critical new direction for sustainability curricula.

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