**Does Size Matter? A Study of Risk Perceptions of Global Population Growth**

**Running head**: *Risk Perceptions of Global Population Growth*

Ian G.J. Dawson1, and Johnnie E.V. Johnson1

 1 Centre for Risk Research, Southampton Business School, University of Southampton, SO17 1BJ, UK.

\*Correspondence should be addressed to Ian G.J. Dawson, Centre for Risk Research, Southampton Business School, University of Southampton, SO17 1BJ, UK. (e-mail: I.G.Dawson@Soton.ac.uk).

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**ABSTRACT**

 The global human population now exceeds seven billion and is projected to reach 10 billion around 2060. While population growth has been associated with certain benefits (e.g., economies of scale, technological advancements), theoretical models, probabilistic projections and empirical evidence also indicate that this growth could increase the *likelihood* of many adverse events (e.g., climate change, resource shortages) and the *impact* of these events, as more people are exposed to the outcomes. While concerns about these issues are well-documented in the academic literature, there is little evidence concerning the public’s perceptions of the risks associated with global population growth (GPG) and how these perceptions are likely to influence related decisions. To address these issues, we conducted a UK-based study that examined respondents’ risk perceptions of GPG, their willingness to embrace mitigation/precautionary behaviors, and reasons for variations in these two factors. We found that GPG is perceived as a moderate-to-high risk, with concerns about the increased likelihood of resource shortages, ecological damage and violent conflict being foremost. Respondents believed that the worst effects of GPG would arrive around 2050 and would be experienced by the world’s poorest people. Respondents who perceived greater levels of risk from GPG were generally those who indicated a greater willingness to embrace mitigation behaviors (e.g., reduce resource consumption) and preventative actions (e.g., support political action to limit growth). We discuss how our findings might be utilized to better manage the potential challenges associated with GPG and we suggest several directions for further research.

**KEYWORDS:** global population growth, psychological distance, risk behavior, risk communication, risk perception

**1. INTRODUCTION**

 Since the nineteenth century the global human population has grown rapidly from one billion to over seven billion people and currently increases by approximately 200,000 people per day.(1) Median variant projections indicate that the population will reach 10 billion shortly after 2060.(2) Based on theoretical models, probabilistic projections and empirical evidence, numerous academics have expressed concerns that this growth may play a pivotal role in increasing the likelihood of adverse events in sociopolitical (e.g., warfare), economic (e.g., energy shortages) and environmental (e.g., climate change) domains.(3-9) Such concerns were brought to public attention after the population reached seven billion in late 2011 (via books, media and internet sites).(10-14) This raises the prospect that the concerns expressed by academics will develop or be exacerbated among lay individuals and that this may influence their related decisions and behaviors.(6,7,10,15-17) However, there is a scarcity of empirical evidence concerning lay individuals’ perceptions of the risk of ‘global population growth’ (GPG). Developing an understanding of these perceptions is important because of their potential to influence decisions that could affect the rate of population growth and/or the impact of the related adverse effects.(6,15,17) Consequently, to shed light on this important area, we present an exploratory study that provides insights into public risk perceptions of GPG, individual willingness to embrace mitigation/precautionary behaviors and some of the underlying reasons for variations in these factors.

**1.1. Potential Drivers of Global Population Growth**

 Extant literature attributes the rapid growth of the global population to several factors that may have operated independently or inter-dependently to increase fertility rates, infant survival and adult longevity. For example, it has been argued that GPG can be attributed to the technological, medical and logistical advances that have improved living and healthcare standards since the industrial revolution.(18) In addition, studies show a positive correlation between high birth rates and low levels of equality for women.(19,20) In short, the evidence suggests that women are more likely to first become pregnant at a young age and have a greater number of children if they live in social systems where power predominantly resides with men, they have limited access to education and are unable to establish financial independence. It has also been suggested that GPG can be partly attributed to religious groups that have actively discouraged the use of contraceptives.(6) Furthermore, other literature indicates that GPG is closely related to poverty because the world’s poorer people generally have less access to family planning education and/or contraceptives and are more likely to raise larger families to provide income via familial labor.(15,21) For example, women in their childbearing years now typically have an average of two children in the world’s more developed countries, compared to six or seven in some of the world’s poorest countries.(22)

**1.2. Potential Effects of Global Population Growth**

 While GPG has often been associated with delivering many benefits for humanity (e.g., greater labor force, economies of scale, increased capacity for innovation and technological advancement), numerous academics have also cited theoretical models, probabilistic projections and/or empirical evidence to assert that further GPG could increase the likelihood of several adverse events at local and/or global levels. These adverse events include, for example: (i) climate change due to increased CO2 emissions, (ii) ecosystem damage and accelerated species extinction resulting from the conversion of bio-diverse areas into urban and agricultural land, (iii) food, water and energy shortages due to increased consumption demands and the depletion/mismanagement of finite resources, (iv) increased violent conflict and rapid migration resulting from greater competition for resources, (v) persistent and/or higher levels of poverty due to increased competition and/or inequitable distribution of resources, and (vi) more deaths and injuries from man-made and natural disasters as greater numbers of people are exposed and opportunities to avoid living in disaster-prone areas are reduced.(3-9,23-26) Scholars argue that these potential outcomes may vary in magnitude and could take effect in a range of temporal, social and geographical contexts during the 21st century.(6)

**1.3. Risk Perceptions and Global Population Growth**

 Historically, debates about the effects of GPG have often been led by participants with highly polarized views about whether GPG primarily elicits adverse or beneficial outcomes.(see 10) More recently, academics and commentators have established a more balanced narrative that recognizes that GPG has (and probably will continue to) simultaneously present risks and benefits.(10,12) They suggest, therefore, that humanity should now concentrate its efforts on instigating measures that manage those risks in order to ensure that they do not negate any associated benefits that have been or may be achieved. Some have highlighted the need for measures that could further slow GPG, such as government funding for family planning education or tackling poverty.(6,27,28) By contrast, others have been more in favor of mitigation behaviors, such as distributing resources more equitably, reducing CO2 emissions or developing adaptive technologies.(10,29,30) No clear consensus has emerged on whether measures to limit GPG or to encourage mitigation behaviors (or both) might prove most effective in reducing the likelihood of the adverse events outlined above. However, in either case, the overarching implication that emerges from the literature is that people, individually or collectively, must be motivated to pursue these courses of action if the challenges of GPG are to be managed effectively.(7) Yet, the question of what will motivate people to pursue such actions remains empirically unanswered. As a first step to addressing this issue, we focused our attention on the role that perceived risk might play in motivating these actions.(17) Our rationale for focusing exclusively on the construct of perceived risk is outlined below.

There is considerable evidence that perceived risk can moderate the willingness to adopt precautionary and mitigation behaviors.(31-35) For example, those with higher levels of perceived risk of certain diseases are more likely to adopt protective behaviors, such as vaccinations, and the perceived threat of terrorism often causes individuals to avoid specific areas and modes of travel.(31,36) Equally, different levels of risk perception can moderate policy support for issues such as the location of nuclear facilities and measures to tackle climate change.(37,38) Perceived risk clearly plays an important role in influencing risk management behaviors. Consequently, the perceived risk of the effects of GPG could have a substantial influence on the extent to which individuals are motivated to adopt related preventative and mitigation actions. Some academics have already supported this notion, suggesting that awareness of the challenges brought about by GPG might influence decision-making in favor of using public and private funds to reduce the growth rate and to generate political will to address the associated issues.(39,40) However, there remains a dearth of empirical research examining the perception of the risk of GPG amongst the lay population and exploring the extent to which such perceptions influence willingness to adjust related behaviors.

**1.5. The Perceived Risk of Global Population Growth among UK Residents**

 To study the perceived risk of GPG we believed that it would be important to recruit a sample of people whom one may reasonably expect to hold some prior knowledge of GPG and the related issues. These individuals would have had the opportunity to make subjective evaluations of the topic and to formulate related perceptions. Consequently, we recruited a sample of lay UK residents because we believed that they would hold such prior knowledge for two reasons. First, since late 2011, the issue of GPG has been subject to public discussion and media interest in the UK. The passing of the ‘seven billion milestone’ and the potential implication of further population growth were highlighted in newspapers, media broadcasts, dedicated internet sites and in public lectures by prominent UK figures (e.g., [14,41,42]). For example, in 2013 the BBC broadcast a lecture/documentary by Hans Rosling titled ‘*Don’t Panic: The Truth About Population’*. The BBC also launched a 30-part radio series called ‘*Shared Planet’* which examined the impact of GPG on the natural world.(12,43) Also in 2013, two books about GPG that targeted a lay audience were published by UK authors.(10,11) Hence, there is reasonable cause to believe that many UK residents are aware of GPG and the related issues. Second, the UK population has grown substantially since the industrial revolution and, like the global population, is forecast to continue growing until the end of the 21st Century.(44) Hence, UK residents have experienced and continue to experience population growth. Consequently, they are not a group that could disregard or attenuate the issue because it is one that does not concern them. These reasons gave us cause to believe that there is likely to be some awareness of GPG and its potential effects among UK residents.

 The remainder of this paper summarizes our study examining the perceptions of the risk related to GPG among a sample of UK residents. The study provides novel insights into the respondents’ risk perceptions, their willingness to adopt precautionary behaviors, and the extent to which these factors may be moderated by other factors such as knowledge, experience and the perceived temporal, geographic and social distance of the effects of GPG.

**2. METHOD**

**2.1. Procedure and Sample**

 Between 29 May and 25 June 2014 a telephone questionnaire of UK residents (i.e., England, Northern Ireland, Scotland and Wales) aged 18 years and older was conducted by Opinion Research Services (ORS), an experienced UK-based social research practice. A nonprobability quota sample (*N* = 300) was obtained to ensure the key socio-demographic characteristics of age, gender, national residence and working status were represented. To ensure that the sample was representative at a regional level, a stratified sample of 12 regions across the UK was selected. The study was conducted and supervised by trained market research interviewers and each telephone interview took approximately 20 minutes.

The sample consisted of 51% male and 49% female respondents, with a mean age of 49 years, and over 60% of respondents were in in full or part-time employment (see Table I). These sample characteristics approximate the population characteristics identified in the 2011 UK Census.(45,46) The proportion of residents from each country in the sample (England 83%, Scotland 9%, Wales 5%, and Northern Ireland 3%) was approximately equal to the proportions of residents from each country in the UK population (84%, 8%, 5% and 3% respectively).(47)

[Insert Table I about here]

 The questionnaire was designed to examine public perceptions and knowledge of GPG, willingness to adopt mitigation/precautionary behaviors and insights into underlying reasons for variations in these factors. The questionnaire featured 47 questions concerning population growth. In some cases, these were developed from similar items employed by Leiserowitz and Spence, Poortinga and Pidgeon to explore perceptions of climate change.(48,49) The questionnaire also featured 14 questions concerning socio-demographic characteristics. Respondents were advised that the questionnaire was being conducted to “… *develop a better understanding of people’s knowledge, opinions and perceptions of human population growth*” and they were specifically instructed that the questionnaire “… *primarily focuses on the growth of the global human population and not on the population of just one country or region. Hence, unless you are asked otherwise, please answer all questions in relation to the global human population*.”

**2.2. Risk Perception**

 Nine questions assessed respondents’ perceptions of risk related to GPG. Two of these asked respondents to indicate, using an 11-point scale ranging from 0 (not at all) to 10 (extremely) the extent to which they were worried about (fearful of) GPG. Seven questions, employing the same 11-point scale, examined the extent to which respondents were concerned that GPG will increase: (i) the rate of climate change, (ii) water and food shortages, (iii) energy shortages, (iv) the extinction of animal species, (v) the rate of damage to ecosystems, (vi) the number of people killed or injured in man-made and natural disasters, and (vii) the number of violent conflicts in the world.

**2.3. Affective Responses**

 Studies have shown that affect, defined as “… *the specific quality of ‘goodness’ or ‘badness’ (1) experienced as a feeling state (with or without consciousness) (2) demarcating a positive or negative quality of a stimulus*”([50] p. S35), plays a key role in risk perceptions.(51-53). Stimuli and concepts are often encoded and represented by mental images (e.g., pictures, sounds) and/or by symbolic cognitions (e.g., phrases, numbers) that, via learning and experience, are ‘tagged’ with varying magnitudes of affect.(51,54) Importantly, individuals often rely on the affect that they associate with focal items (e.g., cigarettes) or concepts (e.g., nuclear power) to make fast and efficient estimates of the probability that the item or concept will elicit an adverse outcome.(52) Consequently, important insights into the perceived risk of certain items and concepts can be gained by eliciting respondents’ affective imagery (i.e. “… *evaluative feelings of good/positive or bad/negative associated with particular concepts or stimuli*.” ([48] p. 1436) associated with those items and concepts.

 Consistent with an established method of assessing affective imagery,(48,55) our respondents were asked, “*What is the first thought or image that comes into your mind when you think of global human population growth*?”

**2.4. Psychological Distance**

 Psychological distance refers to the extent to which individuals mentally construe a target item, event or concept as being distant from themselves in that moment in time on various physical (e.g., geographic) and abstract (e.g., time) dimensions.(56) We employed various measures to assess the extent to which respondents construed the potential effects of GPG to be geographically, socially and temporally distant from themselves. Perceived geographic distance was assessed via two questions. These asked respondents to use a scale ranging from 0 (completely disagree) to 10 (completely agree) to express their view that during this century GPG will have a worse effect on (1) other communities than it will have on their own local community and (2) other countries than it will on the country in which they live. Perceived social distance was assessed via one question that asked respondents to indicate, using the same scale, the extent to which they agreed that during this century GPG will have a worse effect on other people than it would on themselves. Temporal distance was measured by the question “*When, if at all, do you think that the worst effects of global population growth will be experienced by humanity?*” Respondents could choose one of seven categorical options: (i) Have already passed, (ii) Are being felt now, (iii- v) Will be felt in (iii) 25 years (iv) 50 years (v) more than 50 years from now, (vi) Will never be felt, and (vii) Don’t know.

**2.5. Willingness to Employ Mitigation and Precautionary Behaviors**

 Seven questions assessed respondents’ willingness to adopt precautionary/mitigation behaviors if they “… *thought it might help humanity to cope better with any future changes brought about by global population growth*.” Four of these questions assessed willingness to adjust their behavior as consumers. In particular, respondents were asked, using a scale ranging from 0 (completely unwilling) to 10 (completely willing), to what extent they would be willing to reduce the amount: (1) of water and food that they consume, (2) that they travel using vehicles powered by fossil fuels, (3) of material goods that they buy, and (4) that they use goods and services that are unfriendly to the environment. Respondents’ willingness to support precautionary measures to limit GPG was assessed by asking them to what extent they would be willing to: (1) pay more taxes to fund government projects aimed at reducing GPG, (2) vote for a political party that wanted to spend more public money on reducing GPG, and (3) donate money to a charity that works to reduce GPG.

**2.6. Knowledge**

 Possessing accurate subjective knowledge of population size and growth rates might be important for obtaining a veridical perspective on relative increases in GPG over time and for appreciating how the growth might influence related issues (e.g., increases in CO2 emissions). Respondents’ knowledge of the current size, projected size and estimated growth rate of the global population was assessed by asking them to state, to the nearest billion, how many people scientists estimate live today. Responses were recorded in fifteen categories ranging from ‘less than 1 billion’, ‘2 billion’, etc. to ‘more than 12 billion’ or ‘don’t know’. They were also asked, to the nearest billion, how many people scientists estimate will be living in the year 2050. Responses were recorded using the same fifteen categories. They were also asked to state, to the nearest thousand, how many people scientists estimate the global population increases by each day. Responses were recorded in nine categories ranging from ‘less than 10,000’ to ‘more than 300,000’ or ‘don’t know’.

**2.7. Information Exposure**

 An individual’s subjective knowledge of population growth statistics may be influenced by the extent to which they are exposed to information about this topic. Consequently, respondents were asked approximately how many (1) reports/articles they had seen/read in the media or internet and (2) books they had read during the last five years that had specifically focused on the topic of GPG. Responses were categorized into one of five groups: ‘none’, ‘1 or 2’, ‘3 to 10’, ‘more than 10’, and ‘don’t know’.

**2.8. Experience**

 Four questions assessed the extent to which respondents believed that they had directly experienced/observed population growth or changes that are typically related to population growth. Before answering, respondents were advised that these “… *questions will be about population growth in your local area and in your country of residence* …” Respondents were asked to use a scale ranging from 0 (completely disagree) to 10 (completely agree) to indicate their agreement with the following statements: (1) during the last 10 years I have noticed an increase in the number of buildings (such as houses, shops, offices, etc.) in the area where I live, (2) the population of the village/town/city that I live in has increased substantially during the time I have lived here, (3) the population of England/N. Ireland/Scotland/Wales has increased substantially during the time I have lived here, and (4) during the last 10 years I have experienced an increase in congestion in public spaces. Respondents were also offered the option of stating that ‘I haven’t lived here long enough to observe a change’.

**2.9. Opinions**

 A series of questions were employed to gauge respondents’ opinions regarding other population growth-related issues. The questions elicited respondents’ beliefs about whether: (i) individuals, communities or governments had the greatest ability to influence global population levels, (ii) national governments are doing enough to address GPG, (iii) it is important for people to take into account the size of the global population when deciding how many children to have, (iv) GPG will have a worse effect on the world’s poorer (cf. richer) people, and (v) practicing environmentally-friendly behaviors is a better way to protect the natural environment than trying to limit population size.

A further set of questions elicited respondents’ views concerning the causes of GPG. In particular, they were asked if they believed that GPG had occurred because of: (1) technological and medical advancements, (2) insufficient availability of family planning education and contraceptives, (3) religious groups that discourage the use of contraceptives, (4) inequitable rights/opportunities for women, and (5) the human desires for reproduction and longevity.

**2.10. Data Preparation and Analysis**

The affective responses were coded using content analysis. Scales were formed for single constructs (e.g., risk perception) from the respective response data and, where appropriate, assessed for reliability using Cronbach’s α. Multiple regressions were then performed to assess the relationships between risk perceptions and the other key variables. Additional tests (e.g., moderation) were conducted to examine potential interactions between variables.

**3. RESULTS**

**3.1. Descriptive Statistics and Formation of Scales**

*3.1.1. Risk Perception*

 The mean responses to the nine items that assessed the respondent’s perceived risk of GPG are displayed in Table II. All means exceeded the mid-point on the scale, with concern about increases to water/food shortages, energy shortages, species extinction, ecosystem damage and violent conflicts all exceeding a mean score of 7.2. All nine items were combined to form one scale, labeled as “overall perceived risk” (Cronbach’s α = 0.92). The scale mean was 6.9 (*SD* = 1.83), indicating that UK residents perceive GPG as a moderate-to-high risk event.

[Insert Table II about here]

*3.1.2. Affective Responses*

 The respondent’s affective thoughts/images were organized into categories using an inductive content analysis (*n* = 284; 16 respondents failed to articulate an image/thought). The reliability of the coding scheme was tested using an independent judge who coded 90 randomly selected units (i.e., 30% of the dataset). Inter-rater reliability (Cohen's κ= 0.78) was “*excellent*”.(57) Consequently, codes assigned by the first coder were used in the subsequent analysis.

 The coding scheme categorized the responses into 15 distinct themes associated with GPG. Five, nine and one of these themes were categorized by negative, neutral and positive associations, respectively. Negative themes were those that characterized population growth as problematic and/or a driver of adverse consequences. For example, one category of negative thought/image characterized the current population growth rate as exceeding an arbitrarily-defined acceptable level (e.g., “*too big, too fast*”, “*out of control*”) and another category referred to the potential adverse outcome(s) of GPG (e.g., “*starvation*”, “*strain on all the global resources*”). Neutral themes were those that simply acknowledged the existence of GPG or that identified a related image or concept, but did not indicate whether these were construed in a positive/negative manner. For example, one neutral category was characterized by descriptions of the growth process (e.g., “*it’s increasing*”, “*steady increase*”) and another category by nominal items/concepts (e.g., “*a globe*”, “*China*”, “*politics*”). Only one response was categorized as a positive theme (i.e., “*not enough of us*”).

 Ninety percent of all respondents’ images/thoughts were categorized into five of the coding themes: ‘negative - population growing too fast/big’ (37%), ‘negative - adverse outcome’ (9%), ‘neutral – nominal image, item or concept’ (19%), ‘neutral – population growing’ (18%) and ‘neutral – named country/continent’ (7%). Approximately 2% of the remaining responses were coded into other negative themes (e.g., ‘failure of humanity’) and 8% into other neutral themes (e.g., ‘population size statistics’).

*3.1.3. Psychological Distance*

 Mean responses to the three items used to assess the perceived geographic and social distance of the adverse consequences of GPG are shown in Table II. All means exceeded 7.2, indicating that our UK respondents largely perceived the *worst* effects of GPG to be geographically and socially distant. These three items were combined to create a single ‘geo-social distance’ scale (Cronbach’s α = 0.86), with higher scores indicating a larger psychological distance.

 The respondents also believed that the worst effects of GPG would manifest in the future (see Figure 1), with a large proportion of the respondents stating that the worst effects would be felt in 25 years from now (46%) and 50 years from now (27%). For the purposes of our regression analysis (Section 3.2), the categorical responses to this ‘temporal distance’ question were recoded onto a five-point scale, with the responses coded as: ‘have already passed’, ‘will never be felt’ and ‘don’t know’ = 1, ‘felt in more than 50 years’ = 2, ‘felt in 50 years’ = 3, ‘felt in 25 years’ = 4 and ‘are being felt now’ = 5. Hence, higher scores represented a higher perceived proximity/closeness of the worst effect of GPG.

[Insert Figure 1 about here]

*3.1.4. Willingness to Employ Mitigation and Precautionary Behaviors*

 Mean responses to the four questions assessing willingness to employ mitigation behaviors and the three questions assessing willingness to take precautionary action are displayed in Table II. The first four questions were combined into one scale labeled ‘mitigation behavior’ (Cronbach’s *α* = 0.84) and this had an overall mean of 6.81 (*SD* = 1.92). The latter three questions were combined into one scale labeled ‘precautionary control’ (Cronbach’s *α* = 0.78) and this had an overall mean of 5.16 (*SD* = 2.31).

*3.1.5. Knowledge*

 ‘Correct’ answers to the three questions related to the current size, projected size and growth rate of the global population were each allocated a score of one; hence, the maximum score available was three. An answer to the ‘current size’ of the global population question was deemed ‘correct’ if the respondent answered six, seven or eight billion (the population in mid-2014 was approximately 7.2 billion, and we allowed a tolerance of +/- one billion from seven billion). An answer eight, nine, or ten billion to the ‘projected size’ of the global population question was considered ‘correct’ (the United States Census Bureau projects a median global population of approximately 9.4 Billion in 2050, so we allowed a tolerance of +/- one billion from nine billion). An answer of between 150,000 and 249,000 to the ‘daily growth rate’ of the global population question was deemed correct (the rate is estimated at approximately 200,000, so we allowed a tolerance of +/- approximately 50,000 from this figure).

 Based on the above criteria, only 36%, 25% and 8% of respondents were deemed to know the correct size of the current global population, the projected size of the population in 2050, and the daily population growth rate, respectively. Three percent of respondents answered all three questions related to the current size, projected size and growth of the global population correctly, while 18%, 23% and 56% answered two, one and no questions correctly, respectively.

*3.1.6. Information Exposure*

 The proportion of respondents who had seen ‘zero’, ‘one or two’, ‘3 to 10’, and ‘more than 10’ (a) media/internet reports on GPG were 13%, 15.7%, 37.7% and 32.3%, respectively, (with 1.3% of respondents answering ‘don't know’) and (b) books on GPG were 76.7%, 14.6%, 5.7% and 3% respectively. Hence, respondents appeared to gain most information about GPG from media and internet reports (cf. books), with a total of 70% of respondents having seen/read three or more reports. For the purposes of our regression analysis, a respondent’s exposure to reports and books was collapsed into one variable (labeled ‘information exposure’), with scores ranging from 1 to 8; higher scores representing a greater exposure.

*3.1.7. Experience*

 Table II displays the mean answers to the four items used to assess respondents’ direct experience of population growth and the related changes that this can bring. The four mean ratings ranged from 6.33 to 7.54, indicating that our respondents generally believed that they had experienced a noticeable increase in population numbers and an increase in infrastructure and congestion at a local/national level. The four items, combined into one scale labeled ‘direct experience’ (Cronbach’s *α* = 0.75), had a mean of 7.0 (*SD* = 1.92).

*3.1.8. Opinions*

 Approximately half of the respondents believed that governments (50.3%), rather than individuals (27.5%), communities (20.5%) or ‘all equally’ (1.7%), had the greatest ability to influence global population levels (see Figure 2). Respondents were generally of the view that national governments were not doing enough to address GPG, the mean response (scale ranging from ‘0 = not at all’ to ‘10 = extremely’) being 7.34 (*SD* = 2.16).

 Responses to three questions regarding who would experience the worst effects of GPG and what behaviors are most suitable for combating the effects (on an 11-point scale: 0 = completely disagree, 10 = completely agree), are summarized in Figure 3. The most striking of these results is the strength of respondents’ agreement that the worst effects would be experienced by the world’s poorer people (*M* = 8.58, *SD* = 1.89). Consequently, just as respondents construed the potential adverse effects of GPG as geo-socially distant (see section 3.1.3.) they also believed that the adverse effects would be distributed inequitably amongst different socio-economic groups. Figure 3 also shows the extent to which respondents agreed that GPG can be attributed to factors such as family planning access, women’s rights and technological and medical advancements.

[Insert Figure 2 about here]

[Insert Figure 3 about here]

**3.2. Statistical Analysis**

*3.2.1. Risk Perceptions and Global Population Growth*

 A forced entry linear regression was performed, with overall perceived risk as the outcome variable and affective responses, geo-social distance, temporal distance, knowledge, information exposure, experience and number of children1 as the predictors. Age and gender were also included as control variables. The correlations and coefficients are shown in Tables III and IV respectively. The analysis identified affective responses, geo-social distance experience and age as significant predictors of overall perceived risk, with these variables explaining around 19% of the variance.

 The observed relationship between affective responses and overall perceived risk highlights how the mental images and symbolic cognitions that relate to GPG are an important component in the psychological characterization of the potential effects of GPG. The correlation between geo-social distance and overall perceived risk is interesting because it indicates that while respondents generally perceived GPG as a moderate-high risk, these perceptions may currently relate to concerns about more globalized and socially distant (cf. localized and personal) effects. The identification of experience as the strongest predictor of overall perceived risk is also interesting given that the measures used to assess ‘experience’ concerned population growth at the local/national level, while measures of overall perceived risk concerned population growth at the global level. The positive relationship between these variables suggests that respondents who had observed more localized changes relating to population growth may have drawn upon these observations when assessing what might develop on a larger, global scale as GPG increases.

Our analysis also showed that age was positively correlated with overall perceived risk. Consequently, we considered the possibility that the relationship between experience and perceived risk could be influenced by the respondent’s age (i.e. older/younger respondents would probably have acquired more/less direct experience of population growth and, therefore, would have higher/lower risk perceptions of GPG based on their higher/lower accumulated experiences). However, a first-order partial correlation analysis controlling for the effect of age, still identified a positive correlation between direct experience and overall perceived risk, *r* = 0.31, *n* = 290, *p* < 0.001, *R*2 = 0.10, suggesting that the variance in overall perceived risk that was attributable to experience was largely unrelated to differences in respondents’ ages.

[Insert Table III about here]

[Insert Table IV about here]

 The regression also identified that temporal distance, knowledge, information exposure, and number of children2 were not significant predictors of overall perceived risk. The absence of a significant effect for temporal distance indicates that overall risk perceptions were not significantly higher for the respondents who were concerned that the worst effects would occur in the near-term (vs. the future). The finding that knowledge of GPG was not significantly related to perceived risk indicates that deficits in statistical knowledge relating to population size and growth rates did not preclude the respondents from holding an overall sense of concern about the potential adverse consequences of GPG. Our findings also showed that male and older respondents tended to have higher knowledge scores; see Table III. The absence of a significant effect for information exposure indicates that the *quantity* of information to which respondents had been exposed did not influence their perceptions of the risk associated with GPG. In addition, the absence of a significant correlation between information exposure and knowledge suggests that the information respondents had received may not have been effective in communicating statistical information about population sizes and growth rates. These findings point to the possibility that it may be the specific *content* (cf. quantity) of information about GPG that influences risk perceptions; suggesting the need for future research that examines the influence of different content on risk perceptions and knowledge.

Finally, the absence of an effect of number of children on overall perceived risk is interesting because this finding contradicts the inference that is sometimes made that having a larger number of children may be indicative of relatively low levels of concern about the potential adverse effects of GPG.(6,58)

*3.2.2. Risk Behavior and Global Population Growth*

 Mitigation behavior, *r* = 0.21, *N* = 300, *p* < 0.001, and precautionary control, *r* = 0.29, *N* = 300, *p* < 0.001, were both positively correlated with overall perceived risk. There was also a significant difference between the mean score for mitigation behavior and precautionary control, *t*(299) = 13.74; *p* < 0.001 (95%CI: 1.41 to 1.88). This latter finding provides some indication that, in order to help cope with the potential effects of GPG, the respondents may have been more willing to change their behavior than to support precautionary actions to limit GPG. However, we present this inference with some caution because it is possible that the scores on some items (e.g., voting, paying taxes) may have also reflected the respondents’ lower willingness to change certain generic behaviors that relate to strong personal values (e.g., change political allegiance, volunteer to pay more taxes) rather than to the specific issue of GPG.

 In light of the professed importance of embracing mitigation behaviors and/or preventative measures to address the challenges of GPG (see Section 1.3), we performed two regressions, with ‘mitigation behavior’ and ‘precautionary control’ as the respective outcome variables. In both cases the same predictor and control variables from the earlier regression were included (coefficients shown in Table V). Mitigation behavior was found to be positively related to geo-social distance and negatively related to age. In light of our earlier finding that age was positively related to overall perceived risk, we considered the possibility that age may moderate the positive correlation between perceived risk and mitigation behavior. This was confirmed by a moderation analysis using the SPSS macro PROCESS.(59) This analysis revealed that for younger respondents there was a non-significant positive relationship between overall perceived risk and mitigation behavior (*b* = 0.131, 95%CI [-0.050, 0.312], *t* = 1.424, *p* = 0.155). However, when age was at the mean (*b* = 0.274, 95%CI [0.132, 0.416], *t* = 3.796, *p* < 0.001) or at a high level (*b* = 0.417, 95%CI [0.204, 0.630], *t* = 3.854, *p* < 0.001) there was a significant positive relationship between overall perceived risk and mitigation behavior. In other words, the positive relationship between a respondent’s level of perceived risk and their willingness to adopt mitigation behaviors was increasingly evident as age increased, with older (younger) respondents who held low (high) levels of perceived risk being the least (most) willing to adjust their behaviors.

[Insert Table V about here]

*3.2.3. Opinions*

 Agreement amongst respondents that GPG is attributable to technological and medical advancements (*M* = 7.82, *SD* = 1.95) was significantly greater, *t*s(296-299) ≥ 6.37; *p*s < 0.001, than for all of the other four potentially influential factors (i.e., family planning access, *M* = 6.68, *SD* = 2.44; religious discouragement of contraceptives, *M* = 6.0, *SD* = 2.55; women’s rights, *M* = 5.29, *SD* = 2.64; desire for reproduction and longevity, *M* = 6.91, *SD* = 2.15). Moreover, agreement that GPG is attributable to a lack of equal opportunities for women was significantly lower, *t*s(294-297) ≥ 4.74; *p*s < 0.001, than for all of the other four factors (Bonferroni corrections, *p* = 0.05/4 = 0.0125, were employed for all tests). This latter finding points towards the possibility that our respondents may have had a limited appreciation of the extent to which a lack of equal opportunities for women can drive population growth. Hence, improving public understanding of the relationship between women’s rights and population growth could be an important goal for parties that wish to increase public support for addressing either or both of these issues.

**4. DISCUSSION**

 Generally, our respondents perceived GPG as a moderate-to-high risk, with the foremost concerns being about the increased likelihood of ecological damage, resource shortages and violent conflict. These levels of concern existed despite respondents’ relatively low levels of knowledge of population size and growth statistics. Respondents also tended to believe that the worst effects of GPG would arrive around the middle of the 21st century and be experienced by the world’s poorest people. Perceptions of the risk associated with GPG tended to increase with age but, more so, with increases in personal experiences of changes that could be attributed to local/national population growth. As previously observed in studies in other domains, higher levels of perceived risk associated with GPG were also associated with a greater willingness to employ mitigation and preventative actions. Specifically, our results suggest that the respondents may have been more in favor of employing mitigation behaviors to cope with the potential effects of GPG than providing personal support for measures to reduce population growth. Moreover, the positive correlation between risk perceptions and willingness to adopt mitigation behaviors was moderated by age, with the older respondents who had relatively low risk perceptions being the least willing to adjust their behaviors.

 Just under half of the respondents held negative affective associations with GPG. Consistent with the issues highlighted by the literature, these negative associations were primarily characterized by concerns that the human population is too large and/or growing too fast and/or that this increases the likelihood of adverse events such as famines, environmental degradation and resource shortages. Just over half of the respondents held more neutral affective associations, but their mean overall perceived risk score exceeded 6.5, suggesting that they were still concerned about the issue. This data points towards the possibility that such concerns can be encoded via deliberative rather than affective cognitions, highlighting a potential avenue for future research in which affective and deliberative representations of the perceived risks are examined in greater detail. Moreover, the data we obtained that assessed affective responses to GPG provides some indication that the proportion of the UK population that holds positive affective views of GPG may be negligible. However, because we did not employ any closed-ended items that gave respondents the opportunity to indicate any positive perceptions of GPG, we do not have any direct evidence of the positive views of GPG might exist.

 Our results show that there is substantial scope for improving the extent to which lay individuals are aware of population size and growth statistics. Despite allowing broad tolerances for determining the correct answers to our questions about these statistics, the proportion of respondents with correct answers was relatively low. Similarly, a study by Meffe also suggests that accurate knowledge of the global population size and growth rate is typically not widespread.(60) Interestingly, we found that knowledge levels were not related to the quantity of information that respondents had received, suggesting that the information which has been available in the UK may not have effectively communicated the relevant statistics. Ensuring that individuals have a veridical understanding of population growth statistics may seem far less relevant than ensuring that people understand the potential effects of population growth. However, without a veridical awareness of the size and growth data, future changes in size and growth may have little meaning to those who had little understanding of past statistics. It has been argued that apathy towards the extent to which such statistics relate to anthropogenic stressors in social, natural and climatic contexts could attenuate the motivation to adopt precautionary actions.(6,60) Future studies aimed at better understanding the causes of such apathy or of limited awareness might further explore why our results showed that statistical knowledge tended to be lowest among respondents who were older or female.

 A large proportion of respondents believed that: (a) the worst effects of population growth are yet to come, (b) national governments (cf. individuals or communities) are best placed to address the issue, and (c) that national governments are not doing enough to address GPG. Taken together, these findings suggest that our respondents hold concerns about the potential future adverse effects of GPG and believe that those best equipped to tackle the issue (i.e., governments) are not taking sufficient action. An obvious inference to make from these findings is that governments should do more to address GPG and, in doing so, would receive public support. Yet, paradoxically, our study only found moderate willingness to: (i) vote for political parties that would work towards reducing GPG, and (ii) pay more taxes to support efforts to reduce GPG. These findings may be of particular concern to groups that wish to see greater governmental action on population growth because, in the absence of public support for politically-driven efforts to address GPG, policy makers operating in democratic systems may have little incentive to take substantial action. Hence, these groups may need to increase public awareness of the important role that individual/voter support can play in motivating political action to address GPG.

Importantly, our study identified that the willingness to change behavior was positively associated with risk perceptions. For parties interested in tackling the challenges of GPG via behavioral change, this finding sheds some light on a potentially fruitful mechanism for motivating action. However, deliberately raising public risk perceptions, with a view to provoking behavioral change, has several potential pitfalls and may be ethically questionable. For example, a failure to communicate an evidence-based and balanced view of the risks, benefits and uncertainties of GPG could lead to criticism and distrust of the communicator and, therefore, dismissal of the intended message.(61) Similarly, provoking heightened risk perceptions through ‘fear appeals’ can result in defensive avoidance of the message.(62,63) However, this does not suggest that people should be discouraged from considering the potential adverse consequences of GPG. Rather, it suggests that care is needed in selecting the content of risk communications so that trust between all parties is maintained/developed and the recipient is not misled, thus, enabling informed decisions.

**4.1. Limitations and Future Directions**

 There are some limitations to our study. First, while our sample was demographically representative of the UK population, the sample size does restrict the extent to which the findings can be considered representative of the whole population.(64) Nonetheless, the confidence intervals do indicate that we can be 95 percent confident that our sample means lie within the population means. Second, it should be acknowledged that the respondents’ risk perceptions may have been influenced by the relatively recent publicity concerning GPG(65) and, therefore, future studies might examine the influence of such publicity on perceptions of GPG. Third, we found that risk perceptions of GPG are positively correlated with personal experiences that could be attributed to local and/or national population growth. We suggested that this association may have arisen because these localized changes are construed negatively and, therefore, are used as an indicator of the extent to which the effects of future GPG may also be negative. However, we recognize it is also possible that individuals who perceive GPG as a greater risk may be more sensitive to perceiving such localized changes (a case of ‘believing is seeing’ rather than ‘seeing is believing’). Both interpretations could be explored in future research, for example, by comparing perceptions between countries in which the population is growing (e.g., the U.K.) and countries in which it is declining (e.g., Japan). Fourth, in recognition that ‘correlation does not prove causation,’ the associations identified in our analysis should be investigated further with a view to identifying more potential moderating or mediating mechanisms. For example, while we identified that age moderates the relationship between risk perceptions and willingness to adopt mitigation behaviors, it remains unclear as to why this is the case. Similarly, our regression model only accounted for approximately 19% of the variance in perceived risk, so there is clearly scope to identify other factors that account for the variance. Fifth, we elected to specifically study the perceived risk of GPG with a view to better understanding public concerns about GPG and the potential implications of such perceptions. We recognize that by focusing solely on perceive risk as a potential antecedent of behavioral change our study does not account for all factors (e.g., perceived benefits of GPG, choice architecture, uncertainties in scientific projections) that might influence GPG-related behaviors, nor does our study examine the potential influence of question framing (e.g., ‘GPG will adversely affect others more than me’ vs. ‘GPG will adversely affect me more than others’) on the results obtained. Finally, in light of the far reaching and potentially inequitable effects of GPG, it would also be a valuable exercise to assess risk perceptions using cross-national comparisons to assess the possible influence of national wealth, cultural values and other variations in national population demographics (e.g., rate of growth/decline, population density).

**5. CONCLUSION**

 Numerous studies and academic papers highlight a mounting concern that GPG may increase the probability of a range of adverse and potentially catastrophic events. Efforts to minimize these probabilities may depend, as is implied by our findings, on the extent to which (a) individuals perceive GPG as a factor that could generate such adversity and (b) these perceptions motivate individuals to embrace mitigation or precautionary actions. Hence, developing an empirically informed understanding of the perceived risk of GPG is a pressing goal. Our study has taken the first step towards this important task and highlights a number of key avenues for future research.

**REFERENCES**

1. United States Census Bureau. *World Population: 1950 – 2050*. Available at: https://www.census.gov/population/international/data/idb/worldpopgraph.php Accessed on July 10, 2015.

2. United Nations Department of Economic and Social Affairs. *World Population Prospects: The 2012 Revision.* Available at: http://esa.un.org/unpd/wpp/index.htm Accessed on July 10, 2015.

3. Campbell M, Cleland J, Ezeh A, Prata N. Return of the population growth factor. *Science*. 2007; 315: 1501-2.

4. Ezeh AC, Bongaarts J, Mberu B. Global population trends and policy options. *The Lancet*. 2012; 380(9837): 142-8.

5. Lee R. The Outlook for Population Growth. *Science*. 2011; 333 (6042): 569-73. doi: 10.1126/science.1208859.

6. Mora C. Revisiting the Environmental and Socioeconomic Effects of Population Growth: a Fundamental but Fading Issue in Modern Scientific, Public, and Political Circles. *Ecology & Society*. 2014; 19 (1): 38.

7. Nekola JC, Allen CD, Brown JH, Burger JR, Davidson AD, Fristoe TS, et al. The Malthusian–Darwinian dynamic and the trajectory of civilization. *Trends in Ecology & Evolution*. 2013; 28(3) :127-30. doi: http://dx.doi.org/10.1016/j.tree.2012.12.001.

8. Satterthwaite D. The implications of population growth and urbanization for climate change. *Environment & Urbanization*. 2009; 21(2): 545-67. doi: 10.1177/0956247809344361.

9. Turner A. Population priorities: The challenge of continued rapid population growth. *Philosophical Transactions of the Royal Society B: Biological Sciences*. 2009; 364(1532): 2977-84. doi: 10.1098/rstb.2009.0183

10. Dorling D. *Population 10 Billion: The Coming Demographic Crisis and How to Survive it*. London, UK: Constable and Robinson Ltd.; 2013.

11. Emmott S. *10 Billion*. London, UK: Penguin Books Ltd.; 2013.

12. BBC. *Don't Panic: The Truth About Population*. BBC; 2013. Broadcast on November 7, 2013.

13. *The World at 7 Billion*. http://www.unfpa.org/world-7-billion. Accessed July 10, 2015.

14. *7 Billion and Me*. http://www.7billionandme.org/. Accessed July 10, 2015.

15. Cohen JE. Human Population: The Next Half Century. *Science*. 2003; 302(5648): 1172-5. doi: 10.1126/science.1088665.

16. Cohen J. Population growth and earth's human carrying capacity. *Science*. 1995; 269(5222): 341-6. doi: 10.1126/science.7618100.

17. Dawson IGJ, Johnson JEV. Growing Pains: How Risk Perception and Risk Communication Research Can Help to Manage the Challenges of Global Population Growth. *Risk Analysis*. 2014:n/a-n/a. doi: 10.1111/risa.12180.

18. Omran AR. The Epidemiological Transition: A Theory of the Epidemiology of Population Change. *The Milbank Memorial Fund Quarterly*. 1971; 49: 509-38.

19. Cassen RH. Population and development: A survey. *World Development*. 1976; 4(10–11): 785-830. doi: http://dx.doi.org/10.1016/0305-750X(76)90073-5.

20. Lutz W. The future of world population. *Population Bulletin*. 1994; 49(1): 1-47.

21. Kibirige JS. Population growth, poverty and health. *Social Science & Medicine*. 1997; 45(2): 247-59. doi: http://dx.doi.org/10.1016/S0277-9536(96)00341-3.

22. The World Bank. *Fertility Rate: Total Births per Woman*. http://data.worldbank.org/indicator/SP.DYN.TFRT.IN?order=wbapi\_data\_value\_2011+wbapi\_data\_value&sort=asc. Accessed July 10, 2015.

23. Borlaug N. Feeding a world of 10 billion people: The miracle ahead. *In Vitro Cellular & Developmental Biology - Plant*. 2002; 38(2): 221-8. doi: 10.1079/ivp2001279.

24. Eiser R, Bostrom A, Burton I, Johnston DM, McClure J, Paton D, et al. Risk interpretation and action: A conceptual framework for responses to natural hazards. *International Journal of Disaster Risk Reduction*. 2012; 1(0): 5-16. doi: http://dx.doi.org/10.1016/j.ijdrr.2012.05.002.

25. Goldstone JA. Population and security: How demographic change can lead to violent conflict. *Journal of International Affairs*. 2002; 56: 3-22.

26. Travis JMJ. Climate change and habitat destruction: A deadly anthropogenic cocktail. *Proceeding of the Royal Society of London: Biological Sciences*. 2003; 270: 467-73.

27. Ehrlich PR, Ehrlich AH. The population bomb revisited. *The Electronic Journal of Sustainable Development*. 2009; 1(3): 63-71.

28. Engelman R, Cincotta RP, Dye B, Gardner-Outlaw T, Wisnewski J. People in the balance: Population and natural resources at the turn of the millennium. *Population Action International*. 2000: 31.

29. Oskamp S. A sustainable future for humanity? How can psychology help? *American Psychologist*. 2000; 55(5): 496-508.

30. Smith HJ. The Shape We're In. *Science*. 2003; 302(5648): 1171. doi: 10.1126/science.302.5648.1171.

31. Brewer NT, Chapman GB, Gibbons FX, Gerrard M, McCaul KD, Weinstein ND. Meta-analysis of the relationship between risk perception and health behavior: The example of vaccination. *Health Psychology*. 2007; 26(2): 136-45.

32. Brewer NT, Weinstein, N.D., Cuite, C.L. & Herrington Jr., J.E. Risk perceptions and their relations to risk behavior. *Annals of Behavioral Medicine*. 2004; 27(22): 125-30.

33. Floyd DL, Prentice-Dunn, S. & Rogers, R.W. A meta-analysis of research on protection motivation theory. *Journal of Applied Social Psychology*. 2000; 30: 407-29.

34. Slovic P. Are trivial risks the greatest risks of all? *Journal of Risk Research*. 1999; 2(4): 281-8. doi: 10.1080/136698799376727.

35. Weinstein ND, Sandman PM, Roberts NE. Perceived susceptibility and self-protective behaviour: A field experiment to encourage home radon testing. *Health Psychology*. 1991; 10(1): 25-33. PubMed PMID: ISI:A1991EY54900004.

36. Gigerenzer G. Out of the frying pan into the fire: Behavioral reactions to terrorist attacks. *Risk Analysis*. 2006; 26(2): 347-51. doi: 10.1111/j.1539-6924.2006.00753.x.

37. Keller C, Visschers V, Siegrist M. Affective Imagery and Acceptance of Replacing Nuclear Power Plants. *Risk Analysis*. 2012; 32(3): 464-77. doi: 10.1111/j.1539-6924.2011.01691.x.

38. Leiserowitz A. Climate change risk perception and policy preferences: The role of affect, imagery, and values. *Climate Change*. 2006; 77: 45-72.

39. Schindlmayr T. The Media, Public Opinion and Population Assistance: Establishing the Link. *Family Planning Perspectives*. 2001; 33(3): 128-32. doi: 10.2307/2673769.

40. Nisbet MC, Mooney C. Framing Science. *Science*. 2007; 316(5821): 56. doi: 10.1126/science.1142030.

41. Osotimehin B. The world is home to 7 billion people, but how far have we come? *The Guardian*. October 31, 2011.

42. Royal Society for the Encouragement of Arts, Presidents Lecture: *People and Planet*. March, 2011.

43. BBC Radio 4. *Shared Planet*. Broadcast between June 17, 2013 and January 26, 2015.

44. United Nations Department of Economic and Social Affairs. *United Kingdom Population: Medium Variant 1950-2100*. Available from: http://esa.un.org/unpd/wpp/unpp/panel\_population.htm

45. Office for National Statistics. *2011 Census, Key Statistics and Quick Statistics for local authorities in the United Kingdom - Part 2,* *2013*. Available from: http://www.ons.gov.uk/ons/rel/census/2011-census/key-statistics-and-quick-statistics-for-local-authorities-in-the-united-kingdom---part-2/index.html. Accessed July 10, 2015.

46. Office for National Statistics. *Census: Population Estimates for the United Kingdom*, *27 March 2011*. Available from: http://www.ons.gov.uk/ons/rel/census/2011-census/population-and-household-estimates-for-the-united-kingdom/stb-2011-census--population-estimates-for-the-united-kingdom.html#tab-The-structure-of-the-population-of-the-United-Kingdom. Accessed July 10, 2015.

47. Office for National Statistics. *Population Estimates for UK, England and Wales, Scotland and Northern Ireland, Mid-2013*. Available from http://www.ons.gov.uk/ons/rel/pop-estimate/population-estimates-for-uk--england-and-wales--scotland-and-northern-ireland/2013/index.html. Accessed July 10, 2015.

48. Leiserowitz A. American risk perceptions: Is climate change dangerous? *Risk Analysis*. 2005;25(6):1433-42. doi: 10.1111/j.1540-6261.2005.00690.x

49. Spence A, Poortinga W, Pidgeon N. The Psychological Distance of Climate Change. *Risk Analysis*. 2012; 32(6): 957-72. doi: 10.1111/j.1539-6924.2011.01695.x.

50. Slovic P, Peters, E., Finucane, M.L. & MacGregor, D.G. Affect, risk and decision making. *Health Psychology*. 2005; 24: S35-S40.

51. Dohle S, Keller C, Siegrist M. Examining the Relationship between Affect and Implicit Associations: Implications for Risk Perception. *Risk Analysis*. 2010;30(7):1116-28. doi: 10.1111/j.1539-6924.2010.01404.x.

52. Finucane ML, Alhakami, A., Slovic, P. & Johnson, S.M. The Affect Heuristic in Judgment of Risk and Benefits. *Journal of Behavioral Decision Making*. 2000; 12:1-17.

53. Keller C, Siegrist, M. & Gutscher, H. The role of the affect and availability heuristics in risk communication. *Risk Analysis*. 2006; 26(4): 971-9. doi: 10.1111/j.1539-6924.2006.00773.x

54. Slovic P, Finucane, M.L., Peters, E. & McGregor, D. Risk as analysis and risk as feelings: Some thoughts about affect, reason, risk and rationality. *Risk Analysis*. 2004; 24: 311-22. doi: 10.1111/j.0272-4332.2004.00433.x

55. Peters E, Slovic P. The role of affect and worldviews as orienting dispositions in the perception and acceptance of nuclear power. *Journal of Applied Social Psychology*. 1996; 26: 1427-53.

56. Liberman N, Trope Y. The Psychology of Transcending the Here and Now. *Science*. 2008; 322(5905):1201-5. doi: 10.1126/science.1161958.

57. Fleiss JL, Levin B, Paik MC. Statistical methods for rates and proportions: John Wiley & Sons; 2013.

58. Population Matters. *Have a Small Family*. Available from: http://www.populationmatters.org/what-you-can-do/small-family/. Accessed July 10, 2015.

59. Hayes AF. PROCESS: A versatile computational tool for observed variable moderation, mediation, and conditional process modelling. Available from: http://www.afhayes.com/public/process2012.pdf. Accessed July 2015.

60. Meffe GK. Human Population Control: The Missing Awareness. *Conservation Biology*. 1994; 8(1): 310-3. doi: 10.1046/j.1523-1739.1994.08010310.x.

61. Goodall C. Stephen Emmott’s population book is unscientific and misanthropic. *The Guardian*. July 9, 2013.

62. Keller PA. Converting the unconverted: the effect of inclination and opportunity to discount health-related fear appeals. *Journal of Applied Psychology*. 1999; 84: 403-15.

63. Liberman A, Chaiken S. Defensive processing of personally relevant health messages. *Personality and Social Psychology Bulletin*. 1992; 18: 669-79.

64. Greenberg MR, Weiner MD. Keeping Surveys Valid, Reliable, and Useful: A Tutorial. *Risk Analysis*. 2014; 34(8): 1362-75. doi: 10.1111/risa.12250.

65. Tversky A, Kahneman D. Availability: A heuristic for judging frequency and probability. *Cognitive Psychology*. 1973; 5: 207-32.

**FOOTNOTES**

1. A respondent’s number of children was included in the regression because some scholars and groups have implied that having a larger number of children may be indicative of relatively low levels of concern about the potential adverse effects of GPG.(6,58)

2. An ANCOVA revealed that, even when controlling for age, overall perceived risk did not vary significantly according to a respondent’s number of children, *F*(3, 288) = 0.75; *p* = 0.53: no children (*M* = 6.6, *SD* = 1.84), one child (*M* = 6.82, *SD* = 1.71), two children (*M* = 7.23, *SD* = 1.85), three or more children (*M* = 6.91, *SD* = 1.62).

**TABLES**

**Table I.** Demographic Characteristics of Sample (*N* = 300)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Characteristic |  | % | Characteristic |  | % |
| *Gender* | Male | 51 | *Employment Status* | Working full-time | 42 |
|  | Female | 49 |  | Working part-time | 13 |
|  |  |  |  | Self-employed (full or part-time) | 7 |
| *Age* | 18-24 | 12 |  | Student | 6 |
|  | 25-34 | 14 |  | Retired | 26 |
|  | 35-44 | 11 |  | Unemployed | 2 |
|  | 45-54 | 21 |  | Permanently sick or disabled | 2 |
|  | 55-64 | 20 |  | Homemaker | 2 |
|  | 65-74 | 14 |  | Other | >1 |
|  | 75 and older | 9 |  |  |  |

*Note:* Percentages may not total to 100 due to decimal rounding.

**Table II.** Mean responses to questions concerning perceptions, experiences and knowledge of GPG, and willingness to adopt mitigation and precautionary behaviors.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| *Scale label* | *Scale reliability**(Cronbach’s α)* | *Item response option* | *Item* | *Mean (SD)* |
| Overall perceived risk(*n* = 299-300) | 0.92 | 11-point scale:0 = not at all,10 = extremely | Concerned about increased violent conflicts | 7.35 (2.30) |
| Concerned about increased disaster deaths | 6.62 (2.37) |
|  |  |  | Concerned about increased ecosystem damage | 7.53 (2.18) |
|  |  |  | Concerned about increased species extinction | 7.27 (2.36) |
|  |  |  | Concerned about increased energy shortages | 7.26 (2.23) |
|  |  |  | Concerned about increased food/water shortages | 7.40 (2.12) |
|  |  |  | Concerned about increased climate change | 6.86 (2.34) |
|  |  |  | Fearful of GPG | 5.65 (2.70) |
|  |  |  | Worried about GPG | 6.17 (2.58) |
| Geo-social distance(*n* = 296–298) | 0.86 | 11-point scale:0 = *completely disagree,*10 = *completely agree* | Global population growth will adversely affect other people more than me | 7.40 (2.29) |
| Global population growth will adversely affect other communities more than my local community | 7.24 (2.15) |
|  |  |  | Global population growth will adversely affect other countries more than my country of residence | 7.21 (2.22) |
| Mitigation behavior(*n* = 298–300) | 0.84 | 11-point scale:0 = *completely unwilling*,10 = *completely willing* | Reduce consumption of food and water | 6.67 (2.47) |
| Reduce amount of travel via fossil fuel-powered vehicles | 6.53 (2.43) |
|  |  |  | Reduce quantity of material goods purchased | 6.68 (2.27) |
|  |  |  | Reduce consumption of products and services that are unfriendly to the environment | 7.34 (2.15) |
| Precautionary control(*n* = 294–300) | 0.78 | 11-point scale:0 = *completely unwilling*,10 = *completely willing* | Donate money to charity that works to reduce global population growth | 5.93 (2.73) |
| Pay more taxes to reduce global population growth | 4.49 (2.87) |
| Vote for political party that would spend more public money on reducing global population growth | 5.10 (2.68) |
| Direct experience(*n* = 297–300) | 0.75 | 11-point scale:0 = *completely disagree,*10 = *completely agree* | The population of England/Northern Ireland/Scotland/Wales has increased substantially during the time I have lived here | 7.54 (2.22) |
|  |  |  | The population of the village/town/city that I currently live in has increased substantially during the time I have live here | 6.33 (2.88) |
|  |  |  | During the last 10 years I have noticed an increase in the number of houses, shops, offices, etc. in the area(s) where I live | 7.08 (2.48) |
|  |  |  | During the last 10 years I have experienced an increase in congestion in public spaces | 7.09 (2.54) |

**Table III.** Correlations between Assessed Variables (*n* = 273, using listwise deletion)

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| 1. Overall perceived risk | 1 |  |  |  |  |  |  |  |  |  |
| 2. Affective responses | .250\*\*\* | 1 |  |  |  |  |  |  |  |  |
| 3. Geo-social distance | .220\*\*\* | .065 | 1 |  |  |  |  |  |  |  |
| 4. Temporal distance | .110\* | .145\*\* | .073 | 1 |  |  |  |  |  |  |
| 5. Knowledge | -.041 | .022 | .001 | -.048 | 1 |  |  |  |  |  |
| 6. Information exposure | .066 | .034 | .086 | .040 | .051 | 1 |  |  |  |  |
| 7. Experience | .296\*\*\* | .146\*\* | .052 | .130\* | -.106\* | .030 | 1 |  |  |  |
| 8. Number of children | .057 | .107\* | .013 | .118\* | -.114\* | .049 | -.019 | 1 |  |  |
| 9. Age | .171\*\* | .112\* | .044 | .023 | -.214\*\*\* | .094 | .004 | .471\*\*\* | 1 |  |
| 10. Gender | -.015 | .093 | -.019 | -.055 | .360\*\*\* | .022 | -.020 | -.064 | -.143\*\* | 1 |

\* *p* < 0.05; \*\* *p* < 0.01; \*\*\* *p* < 0.001

Note that temporal distance was scored so that higher scores indicated the more proximate/closer the perceived adverse effects of GPG. Affective responses and gender were coded as binary variables: affective responses (0 = neutral, 1 = negative) and gender (0 = female, 1 = male).

**Table IV.** Regression of Assessed Variables on Overall Perceived Risk (*n* = 273, using listwise deletion)

|  |  |  |
| --- | --- | --- |
|  | Unstandardized coefficients | Standardized coefficients |
|  | *b* |  SE | *β* |
| Affective responses | .595 | .189 | .181\*\* |
| Geo-social distance | .153 | .047 | .183\*\* |
| Temporal distance | .066 | .100 | .038 |
| Knowledge | .029 | .114 | .015 |
| Information exposure | .026 | .069 | .021 |
| Experience | .220 | .049 | .255\*\*\* |
| Number of children | -.052 | .082 | -.040 |
| Age | .015 | .006 | .161\* |
| Gender | -.023 | .197 | -.007 |
| *R2* |  |  | .191 |
| *F*(9,263) |  |  | 6.91\*\*\* |

\* *p* < 0.05; \*\* *p* < 0.01; \*\*\* *p* < 0.001

Variance inflation factor (VIF) and tolerance statistics showed no evidence of multicollinearity. Continuous predictor variables were scored so that higher numerical values corresponded with higher levels on that construct (e.g., higher scores for geo-social distance indicated higher perceived geo-social distance of adverse effects of GPG). Note that temporal distance was scored so that higher scores indicated the more proximate/closer the perceived adverse effects of GPG. Affective responses and gender were coded as binary variables: affective responses (0 = neutral, 1 = negative) and gender (0 = female, 1 = male).

**Table V.** Regressions of Assessed Variables on Willingness to Adopt Mitigation Behaviors and on Willingness to Support Precautionary Controls (n = 273, cases deleted listwise)

|  |  |  |
| --- | --- | --- |
|  | Adopt mitigation behaviors | Support precautionary controls |
|  | Unstandardized coefficients | Standardized coefficients | Unstandardized coefficients | Standardized coefficients |
|  | *b* | SE | *β* | *b* | SE | *β* |
| Affective responses | -.166 | .226 | -.045 | .107 | .282 | .024 |
| Geo-social distance | .186 | .056 | .196\*\* | .089 | .070 | .078 |
| Temporal distance | -.117 | .119 | -.059 | .038 | .149 | .016 |
| Knowledge | -.040 | .136 | -.019 | -.101 | .171 | -.040 |
| Information exposure | .119 | .083 | .086 | .183 | .103 | .109 |
| Experience | .112 | .059 | .115 | -.046 | .073 | -.039 |
| Number of children | .004 | .098 | .003 | -.055 | .122 | -.031 |
| Age | -.018 | .007 | -.169\* | .006 | .009 | .049 |
| Gender | -.404 | .236 | -.109 | -.197 | .295 | -.044 |
| *R2* |  |  | .097 |  |  | .029 |
| *F*(9,263) |  |  | 3.144\*\* |  |  | .811 |

\* *p* < 0.05; \*\* *p* < 0.01. VIF and tolerance statistics showed no evidence of multicollinearity.

**FIGURES**

**Figure 1**. Perceived temporal distance of the potential adverse effects of global population growth (*N* = 300). Respondents were asked “When, if at all, do you think that the worst effects of global population growth will be experienced by humanity?”

**Figure 2.** Beliefs about which entity (individuals, communities, governments, or all equally) has the greatest ability to influence global population levels (*n* = 298).

**Figure 3.** Opinions about some of the causes, effects and behavioral responses to global population growth (*n* = 294–299). Responses were recorded on an 11-point scale where 0 = *completely disagree* and 10 = *completely agree*.