

# The 8 billion milestone: Risk perceptions of global population growth among UK and US residents

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## Abstract

In November 2022, the global human population reached 8 billion and is projected to reach 10 billion by 2060. Theories, models, and evidence indicate that global population growth (GPG) increases the likelihood of many adverse outcomes, such as biodiversity loss, climate change, mass migrations, wars, and resource shortages. A small body of research indicates that many individuals are concerned about the effects of GPG, and these concerns are strongly related to the willingness to engage in mitigative and preventative actions. However, scientific understanding of the factors that influence GPG risk perceptions remains limited. To help address this research gap, we conducted a study of the perceived risk of GPG among UK and US residents ( $N = 1029$ ) shortly after the “8 billion milestone.” Our results confirmed that GPG is perceived as a moderate-to-high risk and these perceptions have a strong positive relationship with the willingness to engage in and support risk management actions. Our participants believed that the worst effects of GPG were yet to come but would largely be geographically and socially remote. Despite their willingness to engage in risk management actions, our participants reported low self-efficacy and that governments (cf. individuals and communities) have the greatest capacity to influence GPG. Risk perceptions were strongly predicted by worldviews and were higher among our UK (cf. US) participants. We also found that the perceived benefits of GPG were low and found no evidence to suggest that risk perceptions were affected by exposure to media coverage of the 8 billion milestone.

## KEYWORDS

global population growth, risk behavior, risk communication, risk perception, worldviews

## 1 | INTRODUCTION

On November 15, 2022, the United Nations Department of Economic and Social Affairs reported that the global human population had reached 8 billion (UNDESA, 2022). Hence, in less than 100 years, the global population had quadrupled, growing at an average rate close to 200,000 people per day (Cohen, 2003). Probabilistic projections indicate that the global population will exceed 10 billion by 2060, potentially surpassing 11 billion by 2100 (UNDESA, 2022). Theories, models, and empirical evidence indicate that this growth has, and will continue to, play a central role in the realization of a

range of adverse events that include human-induced climate change, zoonosis, wars, mass migrations, biodiversity loss, resource shortages, and famines (e.g., Chamie, 2022; Chaurasia, 2020; Crist et al., 2017; Ganivet, 2020; Goldstone, 2002; Obenauer et al., 2017; Tilman et al., 2017; Walker, 2016). A separate but much smaller body of research also shows that many individuals are concerned about the role that global population growth (GPG) plays in increasing the likelihood of these adverse events, and that these concerns are positively related to their willingness of individuals to engage in behaviors that could help to manage the risks and challenges associated with GPG (Alkather & Carmi, 2019; Carmi &

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Tal, 2019; Dawson, 2018; Dawson & Johnson, 2014, 2017). However, research on public perceptions of GPG is in its infancy and, consequently, there is limited scientific understanding of this phenomenon. To help address this research gap, we conducted an empirical study directly after the “8 billion milestone” that further examined public perceptions of GPG. Our study assessed the impact of these perceptions on the willingness to engage in related mitigation actions and to support preventative measures and assessed the extent to which previously unexamined factors (e.g., worldviews, country of residence, benefit perceptions) influence risk perceptions and behavioral intentions.

## 1.1 | Drivers and effects of global population growth

The rapid growth of the human population over the past few centuries has been attributed to a range of factors that have led to increases in fertility rates, infant survival, and/or adult longevity (Wiens, 2016). These factors include the improved living standards brought about by the industrial revolution (Dorling, 2013), limited equality and opportunities for many women (Hartmann et al., 2015), and the denunciation of contraceptives by some religions (Mora, 2014). A small number of scholars have contended that population growth has the potential to deliver many benefits (e.g., economies of scale, economic growth, rapid technological developments), which can all contribute to improved living standards and greater longevity (Boserup, 2017; Simon, 1990, 2019). However, a much larger body of literature suggests that GPG has also started to play a central role in increasing the likelihood of many local and global adverse events. These events include climate change, habit destruction, biodiversity loss, species extinction, resources depletion, violent conflicts, rapid mass migrations, exacerbated social inequalities, droughts, famines, unsustainable waste pollution, and increased human exposure to natural disasters (Ahlburg, 1996, Bongaarts, 2016; Chamie, 2022; Chaurasia, 2020; Crist et al., 2017; Ganivet, 2020; Goldstone, 2002; Hall et al., 2017; McNabb, 2019; Obenauer et al., 2017; Tilman et al., 2017; Walker, 2016; Wiens, 2016). It has been posited that, during this century, there is the potential for these adverse events to increase in frequency and/or intensity across various geographic and social contexts as the global population continues to grow (Mora, 2014; Wiens, 2016). Moreover, it has been argued that GPG is a key driver in the potential commencement of the Anthropocene, a distinct geological epoch that is characterized by humanity’s deleterious impact on the Earth’s ecosystems and geology (Fischer-Kowalski et al., 2014; Gowdy & Krall, 2013).

## 1.2 | Risk perceptions and behavioral responses to global population growth

Although GPG can elicit many benefits, several scholars and commentators have argued that there is an urgent need for

humanity to focus its efforts on managing the associated risks (e.g., Dodson et al., 2020; Engelman et al., 2020; Ganivet, 2020; Mora, 2014; Nekola et al., 2013; Turner, 2009). Some of the proposed risk management approaches focus on further slowing the rate of GPG using preventative controls, such as funding economic development or increasing the availability of family planning resources in countries with high fertility rates (Anderson, 2019; Bongaarts, 2016; Perkins, 2017). Conversely, other approaches focus on promoting engagement in mitigation behaviors, such as decreasing resource consumption and investing in the development of technologies that reduce humanity’s environmental impacts (Dorling, 2013; Nekola et al., 2013). While both approaches have the potential to make substantial contributions to the risk management process, the central tenet of both strategies is that individuals must be motivated to develop, engage in, and/or support these actions. However, research on the extent to which people are concerned about GPG-related risks, and therefore, are motivated to engage in related preventative and precautionary behaviors remains in its infancy (Bandura, 2002; Clayton et al., 2017; Dawson & Johnson, 2014).

A large body of research has shown that risk perceptions have a strong positive relationship with engagement in preventative and precautionary actions (e.g., Brewer et al., 2007; Dawson & Hanoch, 2022; Ferrer & Klein, 2015; Loewenstein et al., 2001; Siegrist & Árvai, 2020; Slovic et al., 2004; Weinstein, 1984). For example, studies have found that support for action on climate change is often greatest among individuals with heightened risk perceptions of environmental issues (Leiserowitz, 2006; O’Connor et al., 1999) and that perceived risks are important drivers for the acceptance of state implemented measures to control pandemics (Siegrist et al., 2021). Hence, there is value in developing empirical insights into the role that risk perceptions might play in motivating preventative and precautionary responses to GPG (Alkather & Carmi, 2019; Bridgeman, 2017; Dawson & Johnson, 2014).

In 2014, Dawson and Johnson (2017) conducted a study that examined UK residents’ risk perceptions of GPG. To measure perceived risk, they used a series of questionnaire items that examined the extent to which their participants were concerned that GPG would increase the likelihood of a range of adverse events, such as climate change, resource shortages, violent conflicts, and species extinctions. Across all these items, the sample’s mean score on a 11-point scale was 6.9, leading Dawson and Johnson to conclude that GPG was perceived as a “*moderate-to-high*” global risk at that time. They also used a series of questionnaire items to assess their participants willingness to engage in various actions that could mitigate the potential adverse effects of GPG (e.g., consume less material goods) and willingness to support actions to reduce further GPG (e.g., donate money to a charity that works to reduce GPG). They found a greater willingness among their sample to engage in mitigation actions than to support GPG control measures, and found that both types of actions were positively related to perceived risk. Dawson and Johnson’s study identified that negative

affect associated with GPG (e.g., worry, fear), personal experience of localized population growth (e.g., increased congestion, infrastructure development), and psychological distance (the extent to which the adverse effects of GPG were perceived to be geographically and socially proximate) were the three strongest predictors of higher GPG risk perceptions. Consistent with Dawson and Johnson (2017), Carmi and Tal (2019) also found that negative affect was a significant predictor of high perceived risk of GPG among Israeli students. Interestingly, Dawson and Johnson's study found that risk perceptions were not predicted by knowledge of GPG (e.g., current and projected global population size), nor by the participant's number of children.

Notably, although Dawson and Johnson (2017) assessed the extent to which a wide range of variables (e.g., experience, knowledge, psychological distance of GPG) influenced risk perceptions, they found that these variables only accounted for 19% of the variance in risk perceptions. Thus, their study left much scope for developing a more comprehensive understanding of the factors that influence GPG risk perceptions and behavioral responses.

### 1.3 | The present study

While the small amount of research on GPG risk perceptions has provided important preliminary insights into this phenomenon, there remains much scope to extend this knowledge. Hence, shortly after the UN's declaration of the 8 billion milestone, we conducted a study that assessed public perceptions of GPG and the influence that these perceptions have on the willingness to engage in mitigation behaviors and to support preventative measures. We extended Dawson and Johnson's (2017) study by also examining how GPG risk perceptions might be influenced by the additional factors of worldviews, perceived benefits, recent exposure to information on the 8 billion milestone, and cross-cultural differences. Our rationale for also focusing on these additional variables was as follows:

#### 1.3.1 | Worldviews and global population growth

Worldviews can be defined as orientating dispositions, characterized by values, beliefs, and cultural cognitions that guide individual responses in complex situations. Worldviews often mediate subjective views on social relations, with individuals typically being either more group-oriented (egalitarianism-communitarian) or individual-oriented (individualism-hierarchical) (Dake, 1991, 1992; Dake & Wildavsky, 1991; Siegrist et al., 2021). Multiple studies have found that worldviews can have a significant influence on risk perceptions and risk behaviors for a variety of social, political, and environmental issues (Corner et al., 2014; Leiserowitz, 2006; Peters & Slovic, 1996; Siegrist et al., 2021). For example, Lacroix and Gifford (2018) found that egalitarian-communitarian (cf. individualism-hierarchical)

worldviews were correlated with higher risk perceptions of climate change and with a greater perceived self-efficacy for engagement in energy conservation behaviors. Given that GPG can substantially influence social, economic, and environmental conditions, we posited that worldviews might be correlated with GPG risk perceptions and the willingness to engage in behaviors that could influence the potential impacts of GPG.

#### 1.3.2 | Perceived benefits and global population growth

While many theoretical models, probabilistic projections, and empirical studies suggest that future GPG will increase the likelihood of many adverse outcomes, some scholars and commentators have been keen to highlight that there are potential benefits associated with GPG. They have typically argued that GPG results in (1) more people to produce innovative solutions to social, economic, and environmental challenges, (2) a larger workforce that increases economic growth and improves living standards, (3) a reduction in the per capita cost of funding public goods and services, and (4) a larger pool of individuals who can support and care for other humans in need (English, 2017; Simon, 1990, 2019). Studies in contexts such as industrial safety and health have found that benefit perceptions can be inversely related to risk perceptions, thus opening the possibility that GPG risk perceptions may be attenuated by GPG benefit perceptions (Alhakami & Slovic, 1994; Finucane et al., 2000). Indeed, Dawson and Johnson (2017) acknowledged that one limitation of their research was that they had not examined both the perceived risks and benefits of GPG. Hence, we elected to assess GPG benefit perceptions in our study.

#### 1.3.3 | The 8 billion milestone

The extent to which an individual is exposed to information about GPG could influence their risk/benefit perceptions of GPG and their willingness to adopt mitigation behaviors or support preventative actions (Dawson, 2018). Although Dawson and Johnson (2017) did not find a relationship between information exposure and perceived risk, their study was conducted 3 years after the "7 billion milestone," and therefore, the extent to which GPG was being highlighted on the Internet and in the media at that time may have been relatively limited. We conducted our study within 3 weeks of the "8 billion milestone" when media attention on GPG had been relatively high (e.g., Hart, 2022; Hegarty, 2022; Lukpat & Sugden, 2022; Pavia, 2022; Subramaniam, 2022; Vidal, 2022). We considered it plausible that this increased level of media/Internet coverage could have raised public awareness of GPG and of the related issues, and consequently, impacted risk/benefit perceptions. Indeed, research evidence shows risk perceptions can be heightened by recent exposure to information about potential adverse events or outcomes (Johnson & Tversky, 1983; Keller et al., 2006; Visschers et al., 2009).

Hence, we assessed whether GPG risk perceptions were relatively high following the 8 billion milestone.

### 1.3.4 | Cross-cultural differences in perceptions of global population growth

Dawson and Johnson (2017) only explored risk perceptions in the United Kingdom, so we were keen to assess whether perceptions of GPG would vary between nations. Hence, to facilitate a cross-cultural comparison, we recruited representative samples from both the United Kingdom and the United States. We specifically recruited samples from these two countries for three key reasons. First, individuals from both countries would probably have been exposed to media reports concerning the 8 billion milestone (e.g., Hart, 2022; Hegarty, 2022; Lukpat & Sugden, 2022; Pavia, 2022; Subramaniam, 2022; Vidal, 2022), and therefore, would have had the opportunity to obtain knowledge, form perceptions, and make subjective judgments about GPG, the associated issues, and potential responses. Second, both nations share some cultural similarities (e.g., Western, English-speaking, industrialized, democratic political systems) and have experienced similar demographic trends in recent decades (the populations of both the United Kingdom and United States have continuously grown, but the growth rate is currently slowing down, and the two populations are aging: Office for National Statistics, 2022; Epstein & Lofquist, 2021; Jones, 2020). However, evidence suggests that the topic of population growth and related issues (e.g., family planning, abortion) has generally been more politicized in the United States than in the United Kingdom, with some US social, political, and religious groups promoting pronatalist ideologies and arguing that the risks posed by GPG have been wildly exaggerated (Bernstein, 2005; King & Elliott, 1997; Kuhlemann, 2019; Mora, 2014; Perry et al., 2022). By contrast, GPG has largely been ignored in UK political discourse. However, it has become a common theme in UK mainstream media reports and among environmental movements, which have professed that GPG is a key driver of issues such as climate change, habitat destruction, and species extinctions. These arguments have been championed in the United Kingdom by high-profile naturalists (e.g., David Attenborough, Chris Packham) and notable national figures (e.g., Prince Philip, King Charles) (Attenborough, 2020; The Prince of Wales, 1992; Kuhlemann, 2018; Philip, 1990). Thus, it seems plausible that this has raised awareness of GPG among the UK public and potentially has given credence to the notion that GPG is a primary driver of global risks. Third, population density in the United Kingdom (277 people per km<sup>2</sup>) is considerably higher than in the United States (36 people per km<sup>2</sup>) (The World Bank, 2021). Given that Dawson and Johnson (2017) found that the perceived risk of GPG was positively related to personal experiences of changes resulting from localized population growth (e.g., traffic congestion, increased housing development), it seems reasonable to infer that higher population density in the United Kingdom might influence UK residents to more frequently experience

changes from localized population growth, and therefore, to have greater concerns about GPG than US residents. Hence, there are reasons to believe that public perceptions of GPG may differ between the United Kingdom and the United States, with UK residents potentially having higher risk perceptions of GPG than their US counterparts.

By gathering data from UK and US samples and by examining a broad range of variables, our study provided confirmatory and novel insights into the factors that influence GPG risk perceptions and the willingness to adopt precautionary and preventative behaviors. More specifically, the aim of our study was to broadly address the following questions:

1. To what extent is GPG perceived as a risk and/or benefit following the UN's declaration of the 8 billion milestone?
2. To what extent do risk perceptions of GPG influence an individual's willingness to engage in mitigation actions and to support preventative actions?
3. To what extent do risk perceptions of GPG differ between the United Kingdom and United States?
4. What factors influence risk perceptions of GPG?

## 2 | METHOD

### 2.1 | Procedure and sample

On December 7, 2022 (3 weeks after the 8 billion milestone), an online questionnaire was administered to 1029 UK ( $n = 515$ ) and US ( $n = 514$ ) residents aged 18 years and older via the research platform *Prolific* (Peer et al., 2017). We used the following prescreening criteria to recruit *Prolific* participants: (a) previously completed at least 10 studies on *Prolific*, and (b) obtained a minimum approval rating of 99% from all past studies completed on *Prolific*. We used *Prolific*'s "representative sample" function to ensure that the sample's distribution of age, gender, and ethnicity approximated the most recent census data from both regions. The sample's mean age was 45.7 ( $SD = 16.2$ ), and 48.2% of participants identified as male, 50.7% identified as female, and 1.1% either identified as "other" (e.g., nonbinary) or declined to provide gender identity data. Full details of the samples' demographic characteristics, split by national residency, are displayed in Table 1.

### 2.2 | Materials

The questionnaire's introductory statement informed the participants that there were being invited to "... participate in a study regarding global population growth." The statement explained that the survey contains questions "... about your views and knowledge of the growth of the global human population and some related topics" and that they should "note that this survey 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 notified otherwise,

**TABLE 1** Demographic characteristics of sample ( $N = 1029$ ).

Characteristic		United Kingdom	United States	Total
<b>Gender</b>	Male	248 (48.2%)	248 (48.2%)	496 (48.2%)
	Female	265 (51.5%)	257 (50.0%)	522 (50.7%)
	Other	1 (0.2%)	7 (1.4%)	8 (0.8%)
	Not stated	1 (0.2%)	2 (0.4%)	3 (0.3%)
<b>Age (mean)</b>		45.91 ( $SD = 16.22$ )	45.44 ( $SD = 16.08$ )	45.68 ( $SD = 16.15$ )
<b>Ethnicity</b>	White	440 (85.4%)	397 (77.2%)	837 (81.3%)
	Black/African American	15 (2.9%)	65 (12.6%)	80 (7.8%)
	Asian	38 (7.4%)	27 (5.3%)	65 (6.3%)
	Other ethnic identity	16 (3.1%)	21 (4.1%)	37 (3.6%)
	Not stated	6 (1.2%)	4 (0.8%)	10 (1.0%)
<b>Employment status</b>	Working full time	203 (39.4%)	215 (41.8%)	418 (40.6%)
	Working part time	66 (12.8%)	52 (10.1%)	118 (11.5%)
	Self-employed (full or part time)	64 (12.4%)	64 (12.5%)	128 (12.4%)
	Student	25 (4.9%)	20 (3.9%)	45 (4.4%)
	Retired	82 (15.9%)	65 (12.6%)	147 (14.3%)
	Unemployed	26 (5.0%)	40 (7.8%)	66 (6.4%)
	Permanently sick or disabled	19 (3.7%)	23 (4.5%)	42 (4.1%)
	Homemaker	23 (4.5%)	27 (5.3%)	50 (4.9%)
<b>Education</b>	Other	7 (1.4%)	8 (1.6%)	15 (1.5%)
	Bachelor's degree or higher	289 (56.1%)	284 (55.3%)	573 (55.7%)
	No bachelor's degree	226 (43.9%)	230 (44.7%)	456 (44.3%)

please answer all questions in relation to the global human population.” The questionnaire featured 59 items of relevance to GPG, 11 items concerning sociodemographic variables, and an attention check question (Oppenheimer et al., 2009). None of the participants failed the attention check. While most of the items were largely based on those used in the GPG questionnaire designed by Dawson and Johnson (2017), additional items were included to measure other variables, including benefit perceptions and worldviews. Full details of the questionnaire items are now provided.

### 2.2.1 | Risk perception

As per Dawson and Johnson (2017), our participants used an 11-point scale (0 = not at all, 10 = extremely) to indicate the extent to which they were worried about GPG, fearful of GPG, and concerned that GPG will exacerbate (i) climate change, (ii) water/food shortages, (iii) energy shortages, (iv) animal extinctions, (v) ecosystem damage, (vi) disaster-related deaths, and (vii) the quantity of violent conflicts in the world.

### 2.2.2 | Affective responses

Affect is defined as a feeling state that demarks, with varying magnitude, the positive or negative quality of a stimulus

(Slovic et al., 2005). Individuals often rely on affective responses (sometimes unconsciously) when making fast evaluations of the extent to which a focal stimulus is risky or beneficial (Finucane et al., 2000). Consequently, assessments of affective reactions to specific stimulus can provide important insights into the perceived risk of the focal stimulus. In line with established approaches for eliciting affective imagery (Dawson & Johnson, 2017; Leiserowitz, 2005; Peters & Slovic, 1996), we asked participants to write down the first thought or image that came to mind when thinking of GPG, and then to use an 11-point scale (0 = very negative, 10 = very positive) to indicate how they felt about the thought/image.

### 2.2.3 | Psychological distance

Individuals can mentally construe a target stimulus or event as being distant from themselves on concrete (e.g., geographic) and abstract (e.g., temporal) dimensions (Spence et al., 2012; Trope et al., 2007). As per Dawson and Johnson (2017), our participants used an 11-point scale (0 = completely disagree, 10 = completely agree) to respond to statements concerning the perceived geographic and social distance of the potential effects of GPG. The two statements concerning geographic distance were “during this century GPG will have a worse effect on (1) other communities than on my local community, and (2) other countries than on the country where I live.” The

statement regarding the social distance of GPG was “during this century GPG will have a worse effect on other people than it will on me.” To assess the perceived temporal distance of the effects of GPG, participants were asked when, if at all, did they think the worst effects of GPG would be experienced by humanity. Participants could select either: (i) don’t know, (ii) will never be felt, (iii) have already passed, (iv) are being felt now, or will be felt in (v) 25 years, (vi) 50 years, or (vii) more than 50 years from now.

#### 2.2.4 | Willingness to employ mitigation behaviors and support preventative actions

As per Dawson and Johnson (2017), our participants responded to seven questions that assessed their willingness to engage in mitigation behaviors and support preventative actions that could help humanity better manage the potential challenges of GPG. Using an 11-point scale (0 = completely unwilling, 10 = completely willing), participants indicated the extent to which they would be willing to engage in four types of mitigation behaviors: (1) reduce water and food consumption, (2) reduce travel in vehicles that use fossil fuels, (3) reduce material good consumption, and (4) reduce consumption of environmentally harmful products. Using the same scale, participants indicated the extent to which they would be willing to support three types of preventative actions: (1) pay higher taxes to fund GPG reduction, (2) vote for a political party that would spend more money on GPG reduction, and (3) donate to a charity that works to reduce GPG.

#### 2.2.5 | Knowledge

Individuals with accurate knowledge of current population levels and projections may be better placed to understand the impact of future GPG on the likelihood of adverse outcomes (Dawson, 2018). Consistent with Dawson and Johnson (2017), we used two questions to assess, respectively, our participants’ knowledge of the current global population size and the projected size in 2050 (15 categorical response options ranged from “1 billion” to “more than 12 billion” or “don’t know”) and a third question to assess their knowledge of the annual growth rate (nine response options ranged from “less than 10,000” to “more than 300,000” or don’t know). We included this latter question because we were cognizant that participants who knew the current global population size and knew the project size in 2050 may not necessarily know when and at what rate the population growth is currently occurring/will occur (e.g., they may wrongly believe that current GPG rate is static, and that huge growth is predicted to occur between 2040 and 2050).

#### 2.2.6 | Information exposure

In line with the measures used by Dawson and Johnson (2017), we assessed our participants’ exposure to GPG infor-

mation by asking them to state approximately how many GPG-focused (1) media or Internet reports/articles they had seen/read in the last 5 years, (2) books they had seen/read in the last 5 years, and (3) media or Internet reports/articles they had seen/read in the last month. Participants could respond to each question with: “none,” “1 or 2’,” “3 or 4’”, ... or “more than 10’.”

#### 2.2.7 | Experience

As per Dawson and Johnson (2017), our participants used an 11-point scale (0 = completely disagree, 10 = completely agree) to respond to four statements concerning the extent to which they had directly experienced/observed population growth or changes potentially related to population growth in their “local area and country of residence.” For example, one statement was: “The population of the country that I live in has increased substantially during the time I have lived here.” Participants could indicate if they had not lived in the country long enough to notice such changes.

#### 2.2.8 | Worldviews

To assess worldviews, we presented our participants with nine statements used by Smith and Leiserowitz (2014) to assess egalitarianism and individualism. For example, one of the statements on egalitarianism was “The world would be a more peaceful place if its wealth were divided more equally among nations,” and a statement on individualism was “People should be allowed to make as much money as they can, even if it means some make millions while others live in poverty.” Participants used an 11-point scale (0 = completely disagree, 10 = completely agree) to indicate their level of agreement with each statement.

#### 2.2.9 | Benefit perceptions

To provide data of GPG benefit perceptions, our participants used an 11-point scale (0 = completely disagree, 10 = completely agree) to report the extent to which they agreed that when the global population grows (1) *the natural environment benefits because more sustainable and environmentally-friendly technologies are developed*, (2) *living standards increase because the global economy grows*, (3) *public services (e.g., education, healthcare) improve because there are more people to share the cost of funding these services*, and (4) *less people suffer or die because there are more people to respond to crises and disasters (e.g., pandemics, floods, earthquakes)*. We developed these four statements based on the reasoning and evidence that is often presented in articles reporting the potential advantages of GPG (e.g., Ahlburg, 1998; English, 2017; Simon, 1990, 2019).

### 2.2.10 | Opinions

Consistent with Dawson and Johnson (2017), we presented our participants with statements about potential causes, effects, and responses to GPG. The statements concerned (i) whether national governments were doing enough to tackle GPG, (ii) whether GPG should be considered during family planning decisions, (iii) whether GPG would affect the world's poorer people more than richer people, (iv) whether behavior change can protect the natural environment better than limiting GPG, (v) whether the participant believed they had the ability to influence any negative effects of GPG, and (vi) what factors were responsible for driving GPG. Participants responded to these statements on an 11-point scale (0 = completely disagree, 10 = completely agree). We also asked our participants whether people in their generation, younger generations or older generations, should take the greatest responsibility for addressing any challenges associated with GPG, and whether individuals, communities or governments have the greatest ability to influence GPG.

## 2.3 | Data preparation and analysis

Content analysis was used to inductively code the responses to the affective imagery question and the coding scheme was subjected to intercoder reliability analysis. Responses to the questionnaire items were aggregated to form single construct scales (e.g., worldviews, psychological distance, perceived benefits) and assessed for reliability using Cronbach's  $\alpha$ . The relationships between risk perceptions and the different constructs were then assessed using a variety of inferential statistical tests (e.g., multiple regressions, ANOVAs, moderation analysis).

## 3 | RESULTS

### 3.1 | Descriptive statistics, scale formations, and preliminary analysis

#### 3.1.1 | Risk perception

Table 2 shows the mean responses to the nine items used to assess the perceived risk of GPG. Mean responses for all items exceeded the midpoint on the response scale, with concerns about ecosystem damage, water/food shortages, and climate change all having mean responses above 7.4. Mean responses to all items were aggregated to form a single scale entitled "overall perceived risk" (Cronbach's  $\alpha = 0.92$ ). The scale mean was 6.9 ( $SD = 1.9$ ), indicating that the participants perceived GPG as presenting a moderate-to-high risk. A  $t$ -test identified that the overall perceived risk of GPG was significantly greater,  $t(999.80) = 3.61$ ;  $p < .001$ , among UK residents ( $M = 7.1$ ,  $SD = 1.6$ ) than among US residents ( $M = 6.7$ ,  $SD = 2.1$ ).

#### 3.1.2 | Affective responses

A total of 1028 participants wrote down a description of the first thought/image that came to mind when they thought of GPG (known hereafter as "affect-described") and provided a scale rating for this thought/image (known hereafter as "affect-rating"). All affect-described responses were coded using inductive content analysis and, to determine the coding scheme's reliability, a random sample of 30% of the responses (155 UK and 155 US participants) was subsequently coded by an independent researcher. Reliability analysis identified a Cronbach's Alpha of 0.87 and a Cohen's Kappa (which accounts for the possibility of agreement by chance) of 0.62, representing a "good" level of agreement between the two sets of coding (Fleiss et al., 2013).

In the first level of content analysis, each affect-described response was categorized based on whether the overall gist of the response was negative, neutral, or positive about GPG. In the second level, they were categorized based on the broad topic(s) mentioned in the response and, when relevant, in the third/final level, the response was categorized based on the semantic subtheme. For example, a participant whose articulated their affective response as "overcrowded cities, pollution and rivers full of plastic" was categorized as "negative—too much growth—environmental damage." Based on this analytical process, each response was assigned one of 43 distinct codes. A total of 572 (55.6%) affective responses were assigned a first-level categorization of negative, 451 (43.8%) of neutral, and 5 (0.5%) of positive. The three most frequently assigned codes were "negative—too much growth—general" (22.8% of all responses), "negative—too much growth—resource shortages" (11.7%), and "neutral—population growing—general" (9.1%). The proportion of negative and neutral affect-described responses did not vary between the UK and US participants,  $X^2 = 1.17$ ,  $df = 1$ ,  $p = 0.279$ . Likewise, the order of the three most frequently assigned codes in both the UK and the US samples was consistent with the order observed in the whole sample.

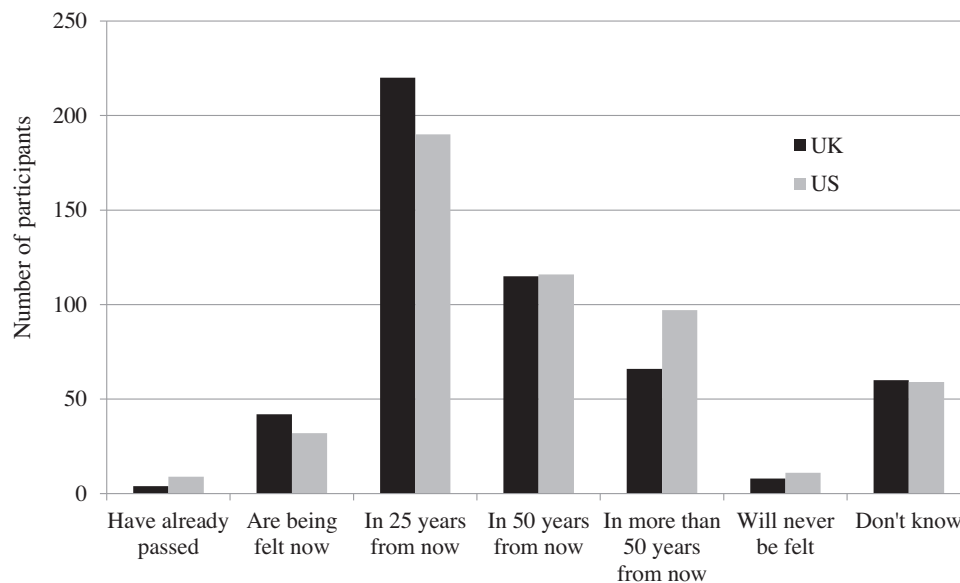
The mean affect-rating score was 3.4 ( $SD = 2.5$ ), indicating that the sample tended toward negative affective reactions when considering GPG. There was no significant difference,  $t(1008.28) = 1.52$ ;  $p = 0.128$ , between the mean affect-rating score among the UK participants ( $M = 3.3$ ,  $SD = 2.3$ ) and the US participants ( $M = 3.5$ ,  $SD = 2.6$ ).

#### 3.1.3 | Psychological distance

Table 3 displays the means for the three items used to measure the perceived social and geographic distance of the potential adverse effects of GPG. The three items were aggregated to produce a "geo-social distance" scale (Cronbach's  $\alpha = 0.90$ ). The scale mean was 6.7 ( $SD = 2.2$ ), indicating that the adverse impacts of GPG were generally perceived as geo-

**TABLE 2** Risk and benefit perceptions of global population growth ( $N = 1029$ ), among UK ( $n = 515$ ) and U.S. residents ( $n = 514$ ). Responses were recorded on an 11-point scale where 0 = *not at all* and 10 = *extremely*.

	UK mean (SD)	US mean (SD)	Total mean (SD)
<b>Risk perceptions</b>			
Worried about GPG	6.53 (2.32)	5.83 (2.75)	6.19 (2.56)
Fearful of GPG	5.91 (2.47)	5.00 (2.83)	5.46 (2.69)
Concerned about increased climate change	7.72 (2.12)	7.31 (2.72)	7.51 (2.45)
Concerned about increased food/water shortages	7.60 (1.94)	7.30 (2.44)	7.45 (2.21)
Concerned about increased energy shortages	7.31 (2.06)	6.66 (2.46)	6.98 (2.29)
Concerned about increased species extinctions	7.46 (2.21)	6.98 (2.69)	7.22 (2.47)
Concerned about increased ecosystem damage	7.52 (2.11)	7.36 (2.46)	7.44 (2.29)
Concerned about increased deaths from disasters	6.63 (2.27)	6.60 (2.47)	6.61 (2.37)
Concerned about increased violent conflicts	7.19 (2.08)	7.06 (2.33)	7.13 (2.21)
<b>Benefit perceptions</b>			
Increased technological developments benefit the environment	3.24 (2.08)	3.19 (2.38)	3.22 (2.32)
Economic growth improves living standards	3.57 (2.10)	3.68 (2.50)	3.63 (2.31)
Public services improve due to increased funding	3.17 (2.07)	3.46 (2.41)	3.32 (2.25)
Death and suffering reduced by larger emergency response networks	2.98 (2.14)	3.17 (2.47)	3.07 (2.31)



**FIGURE 1** Perceived temporal distance of the potential adverse effects of GPG ( $N = 1029$ ). Participants were asked “When, if at all, do you think that the worst effects of global population growth will be experienced by humanity?”

graphically and socially remote. There was no significant difference,  $t(1013.40) = 1.64$ ;  $p = 0.102$ , between the mean geo-social distance score among the UK participants ( $M = 6.8$ ,  $SD = 2.1$ ) and the US participants ( $M = 6.6$ ,  $SD = 2.3$ ).

Figure 1 displays the UK and US participants’ responses to the item concerning the perceived temporal distance of the potential adverse impacts of GPG. Overall, 410 (39.8%) of all participants believed that the worst impacts would occur in 25 years from now, 231 (22.4%) believed that the worst effect would occur in 50 years from now, and 163 (15.8%) believed that they would occur in more than 50 years from now. Hence,

the results showed that more than three-quarters (78%) of the whole sample believed that the worst effects of GPG were yet to be realized. In preparation for our further analysis, the temporal distance data were recoded onto a five-point scale: 1 = “already passed/never/don’t know,” 2 = “more than 50 years,” 3 = “in 50 years,” 4 = “in 25 years,” and 5 = “now.” A  $2 \times 5$  (country  $\times$  temporal distance) cross-tabulated chi-square test identified a significant difference in the responses of UK and US participants,  $X^2 = 9.77$ ,  $df = 4$ ,  $p = 0.044$ , with UK (US) participants tending to indicate that the worst impacts of GPG are more proximate (distant).



**TABLE 3** Mean responses to questions concerning (i) the psychological distance of GPG, (ii) the willingness to adopt mitigation behaviors, (iii) the willingness to support precautionary actions, (iv) direct experience of GPG, and (v) worldviews—egalitarianism and (vi) worldviews—individualism ( $N = 1029$ ). Data displayed separately for UK ( $n = 515$ ) and US residents ( $n = 514$ ). Responses were recorded on an 11-point scale where 0 = *completely disagree* and 10 = *completely agree*.

Item	UK mean (SD)	US mean (SD)	Total mean (SD)
<b>Psychological distance</b>			
Global population growth will adversely affect other people more than me	6.71 (2.37)	6.53 (2.52)	6.62 (2.45)
Global population growth will adversely affect other communities more than my local community	6.76 (2.27)	6.46 (2.59)	6.61 (2.44)
Global population growth will adversely affect other countries more than my country of residence	7.03 (2.28)	6.83 (2.57)	6.93 (2.43)
<b>Willingness to employ mitigation behaviors</b>			
Reduce consumption of food and water	5.61 (2.57)	5.20 (3.04)	5.40 (2.82)
Reduce amount of travel via fossil fuel-powered vehicles	6.48 (2.45)	6.27 (2.92)	6.37 (2.70)
Reduce quantity of material goods purchased	6.74 (2.36)	6.41 (2.75)	6.58 (2.57)
Reduce consumption of products and services that are unfriendly to the environment	7.21 (2.24)	7.14 (2.43)	7.18 (2.34)
<b>Willingness to support precautionary actions</b>			
Donate money to charity that works to reduce global population growth	4.81 (2.70)	4.77 (3.16)	4.79 (2.94)
Pay more taxes to reduce global population growth	4.19 (2.61)	4.36 (3.04)	4.28 (2.83)
Vote for political party that would spend more public money on reducing global population growth	5.16 (2.64)	5.55 (3.21)	5.35 (2.95)
<b>Direct experience</b>			
The population of the country that I currently live in has increased substantially during the time I have lived here	7.18 (2.17)	6.79 (2.03)	6.98 (2.11)
The population of the village/town/city that I currently live in has increased substantially during the time I have live here	6.68 (2.59)	6.17 (2.69)	6.43 (2.65)
During the last 10 years, I have noticed an increase in the number of buildings in the area where I live	7.43 (2.33)	7.09 (2.50)	7.26 (2.42)
During the last 10 years I have experienced an increase in congestion in public spaces	6.94 (2.32)	6.47 (2.67)	6.71 (2.51)
<b>Worldviews—Egalitarianism</b>			
The world would be a more peaceful place if its wealth were divided more equally among nations	6.73 (2.58)	6.66 (2.94)	6.69 (2.76)
In my ideal society, all basic needs (food, housing, healthcare, education) would be guaranteed by the government for everyone	7.72 (2.36)	7.26 (3.17)	7.49 (2.80)
I believe governments should run programs to get rid of poverty	7.92 (1.94)	7.51 (2.75)	7.71 (2.39)
Discrimination against minorities is still a very serious problem in our society	7.23 (2.53)	7.54 (2.98)	7.38 (2.76)
<b>Worldviews—Individualism</b>			
If the government spent less time trying to fix everyone's problems, we would all be a lot better off	5.99 (2.56)	6.37 (3.07)	6.19 (2.83)
Our government tries to do too many things for too many people. We should just let people take care of themselves	6.48 (2.48)	6.68 (2.90)	6.58 (2.70)
The government interferes too much in our everyday lives	5.44 (2.47)	5.58 (2.98)	5.51 (2.74)
Government regulation of business usually does more harm than good	5.47 (2.45)	6.11 (2.94)	5.79 (2.73)
People should be allowed to make as much money as they can, even if it means some make millions while others live in poverty	6.00 (2.74)	5.59 (3.19)	5.80 (2.98)

### 3.1.4 | Willingness to employ mitigation behaviors and support preventative actions

Table 3 shows the mean responses for the seven items concerning the participants' willingness to adopt mitigation behaviors and to support precautionary actions. The first four

items were aggregated to form a "mitigation behavior" scale (Cronbach's  $\alpha = 0.86$ ;  $M = 6.4$ ,  $SD = 2.2$ ) and the remaining three items were aggregated to form a "precautionary control" scale (Cronbach's  $\alpha = 0.85$ ,  $M = 4.8$ ,  $SD = 2.5$ ). Our analysis identified that there was no significant difference,  $t(999.0) = 2.35$ ;  $p = 0.019$ , in the willingness to adopt

mitigation behaviors between UK ( $M = 6.5$ ,  $SD = 2.1$ ) and US participants ( $M = 6.3$ ,  $SD = 2.3$ ). Likewise, there was no significant difference,  $t(987.1) = 1.11$ ;  $p = 0.266$ , in the willingness to support preventative actions between UK ( $M = 4.7$ ,  $SD = 2.3$ ) and US ( $M = 4.9$ ,  $SD = 2.8$ ) participants.

### 3.1.5 | Knowledge

UNDESA estimated that the world population was approximately 8 billion in November 2022 and projected that it would reach approximately 10 billion around 2058 (UNDESA, 2022). Hence, using a tolerance of  $\pm 1$  billion, we deemed our participants' answers that the world population was currently 7, 8, or 9 billion as "correct," and that the population was projected to be 9, 10, or 11 billion in 2050 as "correct." The global population currently increases by approximately 200,000 people a day. Hence, using a tolerance of  $\pm 50,000$ , we deemed answers that the daily global population grows between 150,000 and 249,000 as "correct." We assigned each correct answer a score of one. Hence, three was the maximum possible total knowledge score.

In accordance with the above criteria, 69.9%, 48.7%, and 21.5% of participants were considered to know the current population size, the projected size for 2050, and the current daily growth rate, respectively. The 11.2%, 39.6%, 27.1%, and 22.2% of participants achieved a total knowledge score of 3, 2, 1, and 0, respectively. There was no significant difference,  $t(1027) = 1.75$ ;  $p = 0.080$ , between the total knowledge scores of the UK ( $M = 1.4$ ,  $SD = 0.9$ ) and US ( $M = 1.5$ ,  $SD = 1.0$ ) participants.

### 3.1.6 | Information exposure

A total of 85.8% (46.6%) of participants reported having seen at least one GPG-related media report in the last 5 years (month), and 18.4% reported having read at least one GPG-related book in the last 5 years. For our subsequent analysis (see Section 3.2), participants' responses to the three information exposure questions were assigned ascending numerical codes (i.e., "none" = 1, "one or two" = 2, "three or four" = 3, etc.) and the responses to the two questions about GPG information exposure in the last 5 years were aggregated into one variable (labeled "longitudinal exposure"). There was no significant difference,  $t(1027) = 0.67$ ;  $p = 0.500$ , between the longitudinal exposure to GPG information among the UK ( $M = 4.8$ ,  $SD = 2.4$ ) and US ( $M = 4.9$ ,  $SD = 2.4$ ) participants. Likewise, there was no significant difference,  $t(1027) = 0.54$ ;  $p = 0.590$ , between the recent exposure to GPG information (i.e., seen in the last month) among the UK ( $M = 1.4$ ,  $SD = 0.9$ ) and US ( $M = 1.5$ ,  $SD = 1.0$ ) participants.

### 3.1.7 | Experience

Table 3 shows the mean responses to the four questions concerning the participants' experience of changes related

to population growth at the local/national level. All means were above 6.4, indicating that the sample had generally noticed increases in people, infrastructure, and congestion in their region of residence. The response to the questions were aggregated to form an "direct experience" scale (Cronbach's  $\alpha = 0.864$ ;  $M = 6.9$ ,  $SD = 2.1$ ). We identified that direct experience was significantly greater,  $t(1027) = 3.35$ ;  $p < 0.001$ , for UK participants ( $M = 7.1$ ,  $SD = 2.0$ ) than for US ( $M = 6.6$ ,  $SD = 2.1$ ) participants.

### 3.1.8 | Worldviews

Table 3 displays the mean responses for the nine items used to assess the participants' worldviews. Of these nine items, the five items concerning individualism were reversed coded so that higher (lower) scores became indicative of greater communitarian (individualism) worldviews. The means for all nine items were then aggregated to form one "worldviews" scale (Cronbach's  $\alpha = 0.91$ ), in which a higher (lower) score indicated a greater tendency toward egalitarian-communitarian (individualism-hierarchical) worldviews. There was no significant difference,  $t(926.37) = 0.26$ ;  $p = 0.797$ , in worldviews between the UK ( $M = 6.6$ ,  $SD = 1.7$ ) and US ( $M = 6.6$ ,  $SD = 2.4$ ) participants.

### 3.1.9 | Benefit perceptions

Table 2 displays mean responses to the four items that assessed the participants' perceived benefits of GPG. All means were below 3.7, indicating that the sample generally perceived GPG as having low benefits. All four items were aggregated to form one scale, labeled as "overall perceived benefit" (Cronbach's  $\alpha = 0.90$ ,  $M = 3.3$ ,  $SD = 2.0$ ). We identified no significant difference,  $t(997.5) = 1.08$ ;  $p = 0.280$ , between the overall perceived benefit among the UK participants ( $M = 3.2$ ,  $SD = 1.8$ ) and the US participants ( $M = 3.4$ ,  $SD = 2.2$ ).

### 3.1.10 | Opinions

Table 4 displays the participants' mean responses to the statements concerning the potential causes and effects of GPG. Pairwise tests identified that the participants believed that technological and medical advancements were significantly greater drivers of GPG,  $t_s(1028) \geq 8.468$ ;  $p_s \leq 0.001$ , than either inadequate family planning education/resources, religious discouragement of contraceptive use, lack of equal opportunities for women, or the human desire for reproduction and longevity. Consistent with Dawson and Johnson (2017), we found that participants strongly agreed ( $M = 8.5$ ,  $SD = 2.0$ ) that the worst effects of GPG would be experienced by the world's poorer (cf. richer) people. Low "self-efficacy" was also evident, with participants also indicating that they

**TABLE 4** Participants' opinions concerning the causes, effects, and responses to GPG. Responses were recorded on an 11-point scale where 0 = *completely disagree* and 10 = *completely agree*.

Item	UK mean (SD)	US mean (SD)	Total mean (SD)
<i>Causes of GPG</i>			
GPG is driven by technological and medical advancements	7.42 (1.87)	7.24 (2.05)	7.33 (1.96)
GPG is driven by inadequate family planning education and resources	5.46 (2.55)	5.52 (2.87)	5.49 (2.71)
GPG is driven by religious groups that discourage using contraceptives	5.02 (2.65)	5.09 (2.92)	5.06 (2.79)
GPG is driven by a lack of equal opportunities for women	4.50 (2.84)	4.60 (2.99)	4.55 (2.92)
GPG is driven by the human desire for reproduction and longevity	6.63 (2.11)	6.62 (2.32)	6.63 (2.21)
<i>GPG effects and responses</i>			
GPG will have a worse effect on the world's poorer (cf. richer) people	8.54 (1.81)	8.41 (2.22)	8.48 (2.03)
The environment is best protected by behavior change (cf. GPG reduction)	6.02 (2.44)	6.33 (2.62)	6.18 (2.53)
GPG should be considered when planning how many children to have	5.92 (2.81)	5.75 (2.98)	5.84 (2.90)
I can influence any negative effects that GPG may have during this century	4.07 (2.45)	4.21 (2.74)	4.14 (2.60)
National governments are not doing enough to address GPG	7.01 (2.44)	6.18 (2.90)	6.60 (2.71)

have a limited capacity to influence any negative effects that GPG may have during this century ( $M = 4.1$ ,  $SD = 2.6$ ). Most participants believed that the responsibility for addressing GPG-related challenges primarily lies with their own generation (46.9%) or younger generations (41.7%) rather than with older generations (11.2%). Just under half of the participants indicated that governments (49.2%), rather than individuals (29.3%), or communities (21.4%), had the greatest ability to influence global population levels.

## 3.2 | Statistical analysis and discussion

### 3.2.1 | Risk perceptions and global population growth

We performed a forced entry linear regression, with overall perceived risk as the outcome variable and affect-rating, geo-social distance, temporal distance, knowledge, recent information exposure, longitudinal information exposure, direct experience, perceived benefits, self-efficacy, worldviews, country of residence, and age as the predictor variables. The correlations and coefficients are shown in Tables 5 and 6, respectively.

The analysis identified affect-rating, geo-social distance, temporal distance, direct experience, self-efficacy, worldviews, country of residence, and age as significant predictors of overall perceived risk. Similarly, Dawson and Johnson (2017) had found that the perceived risk of GPG was positively related to negative affect, perceived geo-social distance, greater direct experience, and older age. However, our study also found that temporal distance, self-efficacy, worldviews, and country of residence were positively related to overall perceived risk. Indeed, our regression model explained 45% of the variance in perceived risk, compared to the 19% explained in Dawson and Johnson's model.

The identified relationship between overall perceived risk and temporal distance is interesting because it suggests that our participants' greatest concerns were more about the potential for more distant adverse outcomes than about near-term impacts. Notably, temporal distance was not found to relate to overall perceived risk in Dawson and Johnson's, 2014 study, indicating that public concern about the future impacts of GPG may have increased in recent years. Our finding that overall perceived risk and self-efficacy were positively related is also interesting because one might not expect the individuals who perceive GPG as a high risk to also perceive themselves as being most capable of averting any adverse effects of GPG. One potential explanation for this relationship is that perceiving GPG as a high-risk event may increase an individual's motivation to identify and engage in actions to address the issue. Through this identification process, individuals may develop a greater sense of self-efficacy. To gain a deeper understanding of the factors driving behavioral responses to GPG-related issues, future research could explore whether awareness of behavioral adaptations could moderate the identified relationship between perceived risk and self-efficacy.

Our regression also identified a significant relationship between overall perceived risk and worldviews, with perceived risk being higher (lower) among participants who held more egalitarian-communitarian (individualism-hierarchical) views. This finding resembles those identified in several other studies, where the perceived risk of social, political, and/or environmental issues (e.g., air pollution, climate change, nuclear power, pandemics) has been significantly higher among individuals with egalitarian-communitarian (cf. individualism-hierarchical) worldviews (Kim & Kim, 2019; Peters & Slovic, 1996; Siegrist et al., 2021; Smith & Leiserowitz, 2014). Individuals with egalitarian-communitarian worldviews are hypothesized to advocate for more equal distribution of wealth, resources, risk, and responsibilities, and support a more participatory approach

TABLE 5 Correlations between assessed variables ( $n = 1029$ , using listwise deletion).

	1	2	3	4	5	6	7	8	9	10	11	12	13
1. Overall perceived risk	1												
2. Affect-rating	-0.391***	1											
3. Geo-social distance	0.212***	-0.146***	1										
4. Temporal distance	0.126*	-0.064*	0.156***	1									
5. Knowledge	0.052***	-0.109***	0.102**	0.039	1								
6. Recent information exposure	0.137***	-0.042	0.008	-0.020	0.069	1							
7. Longitudinal information exposure	-0.153***	-0.081**	0.054*	0.010	0.092**	0.560***	1						
8. Direct experience	0.441***	-0.179***	0.062*	0.065*	-0.004	0.084**	0.079**	1					
9. Perceived benefits	-0.234***	0.359***	-0.138***	-0.108***	-0.036	0.037	-0.019	-0.110***	1				
10. Self-efficacy	0.183***	0.113***	-0.029	-0.008	-0.062*	0.124***	0.090**	0.115***	0.296***	1			
11. Worldviews	0.342***	-0.068*	0.136***	0.090**	0.049	-0.013	0.042	0.005	-0.261***	0.114***	1		
12. Country of residence	-0.112***	0.047	-0.051	0.047	0.055*	-0.017	0.021	-0.104***	0.034	0.027	0.008	1	
13. Age	0.098**	-0.057*	0.049	-0.054*	-0.122***	0.029	-0.008	0.074**	-0.113***	-0.128***	-0.085**	-0.015	1

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

For temporal distance, higher scores indicated that the perceived adverse effects of GPG were considered to be further in the future. For affect-rating, higher scores indicated greater positive affect. For worldviews, higher scores indicated greater egalitarian-communitarian (cf. individualism-hierarchical) views.

**TABLE 6** Regression of assessed variables on overall perceived risk ( $n = 1029$ , using listwise deletion).

	Unstandardized coefficients		Standardized coefficients
	<i>b</i>	SE	$\beta$
Affect-rating	-.215	0.019	-0.284***
Geo-social distance	.076	0.020	0.090***
Temporal distance	.079	0.036	0.052*
Knowledge	.026	0.047	0.014
Recent information exposure	.102	0.053	0.055
Longitudinal information exposure	.032	0.022	0.041
Direct experience	.305	0.022	0.335***
Perceived benefits	-.038	0.026	-0.040
Self-efficacy	.117	0.018	0.163***
Worldviews	.251	0.022	0.282***
Country of residence	-.246	0.088	-0.066**
Age	.011	0.003	0.095***
$R^2$			0.451***
$F(12,1016)$			69.646

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

Variance inflation factor (VIF) and tolerance statistics showed no evidence of multicollinearity. For temporal distance, higher scores indicated that the perceived adverse effects of GPG were considered to be further into the future. For affect rating, higher scores indicated greater positive affect. For worldviews, higher scores indicated greater egalitarian-communitarian (cf. individualism-hierarchical) views.

to managing societal and global issues (Dake, 1992; Peters & Slovic, 1996). Hence, it may be that risk perceptions of GPG are higher among egalitarian-communitarians (cf. individualism-hierarchists) because these individuals are more concerned about the extent to which others, as well as themselves, might be adversely affected by GPG and would be responsible for managing these impacts. Indeed, our sample indicated that they generally believed that GPG will adversely affect other people more than themselves (the literature also suggests that the worst impacts of GPG will be experienced in the world's poorest nations: see Ezeh et al., 2012), so this belief may have more heavily accentuated risk perceptions among those participants with greater egalitarian and communitarian values.

Our analysis also identified that country of residence was a significant predictor of overall perceived. This is consistent with our finding that risk perceptions were significantly higher among our UK (cf. US) sample. Previous studies have also identified cross-cultural variations in risk perceptions (e.g., Fontaine & Smith, 1995; Gierlach et al., 2010; Knuth et al., 2014). For example, Dryhurst et al. (2020) found that the perceived risk of COVID-19 varied between European, American, and Asian countries, with the highest risk perceptions being in the United Kingdom. Lorenzoni et al. (2006) found perceptions of climate change differed between UK and US residents, with the later holding more negative affective associations with climate change while also being more skeptical about its existence. Yet, there remains a lack of empirical evidence to explain why risk perceptions of GPG might vary between nations. We found that affect-rating,

worldviews, and direct experience were the three strongest predictors of the overall perceived risk of GPG. Hence, we considered the possibility that each of these three variables may have some influence in our observed relationship between country of residence and perceived risk. To explore this possibility, we performed three moderation tests using the SPSS macro PROCESS (Hayes, 2017), with overall perceived risk as the outcome variable, country of residence as the predictor variable and either affect-rating, worldviews, or direct experience as the moderator. The results showed that neither affect-rating ( $t = 0.05$ ,  $p = 0.960$ ) nor direct experience ( $t = 1.43$ ,  $p = 0.152$ ) moderated the relationship. However, worldviews were found to be a significant moderator of the relationship between country of residence and overall perceived risk ( $t = 3.03$ ,  $p = 0.002$ ). Specifically, when egalitarian-communitarian worldviews were low ( $b = -0.72$ , 95%CI [-1.01, -0.44],  $t = -4.97$ ,  $p < 0.001$ ) or at the mean level ( $b = -0.39$ , 95%CI [-0.61, -0.180],  $t = -3.61$ ,  $p < 0.001$ ), there was a significant negative difference between country of residence and overall perceived risk. However, when egalitarian-communitarian worldviews were high, there was no significant difference between country of residence and overall perceived risk ( $b = -0.08$ , 95%CI [-0.39, 0.23],  $t = -0.51$ ,  $p = 0.612$ ). In other words, the overall perceived risk of GPG was of a virtually identical and relatively high magnitude for UK and US participants with strong egalitarian-communitarian worldviews. Yet, worldviews were associated with much greater variance in overall perceived risk for the US (cf. UK) participants, with perceived risk being the lowest (highest) for US participants

**TABLE 7** Regressions of assessed variables on willingness to adopt mitigation behaviors and on willingness to support precautionary controls ( $N = 1029$ , cases deleted listwise).

	Adopt mitigation behaviors			Support precautionary controls		
	Unstandardized coefficients		Standardized coefficients	Unstandardized coefficients		Standardized coefficients
	<i>b</i>	SE	$\beta$	<i>b</i>	SE	<i>B</i>
Affect-rating	0.009	0.025	0.010	0.007	0.029	0.007
Geo-social distance	0.000	0.025	0.000	0.034	0.029	0.030
Temporal distance	-0.028	0.045	-0.016	0.088	0.052	0.042
Knowledge	<b>-0.015</b>	0.058	-0.006	0.035	0.067	0.013
Recent information exposure	-0.007	0.065	-0.003	0.039	0.076	0.016
Longitudinal information exposure	0.030	0.027	0.033	0.028	0.032	0.027
Direct experience	0.025	0.030	0.023	0.068	0.035	0.055*
Perceived benefits	-0.023	0.032	-0.021	0.035	0.037	0.027
Self-efficacy	0.185	0.023	0.219***	0.213	0.027	0.218***
Worldviews	0.356	0.029	0.339***	0.382	0.034	0.315***
Country of residence	-0.119	0.108	-0.027	0.328	0.126	0.065**
Age	0.012	0.003	0.086***	0.002	0.004	0.014
Overall perceived risk	0.379	0.039	0.321***	0.428	0.045	0.314***
$R^2$			0.404			0.392
$F(13,1015)$			52.844***			50.357***

\* $p < 0.05$ ; \*\* $p < 0.01$ ; \*\*\* $p < 0.001$ . VIF and tolerance statistics showed no evidence of multicollinearity.

with individualism-hierarchists (egalitarian-communitarian) worldviews.

### 3.2.2 | Risk behavior and global population growth

Both mitigation behavior,  $r = 0.50$ ,  $N = 1029$ ,  $p < 0.001$ , and precautionary control,  $r = 0.49$ ,  $N = 1029$ ,  $p < 0.001$ , were positively related to overall perceived risk. As discussed above, the adoption of mitigation behaviors and/or support for preventative measures could prove vital in addressing the challenges of GPG. Hence, we performed two multiple regressions, with mitigation behavior and precautionary control as the respective outcome variables. We included the same predictor variables from the previous regression analysis, with the addition of overall perceived risk as a predictor (coefficients displayed in Table 7).<sup>1</sup> The analysis showed that mitigation behavior was positively related to self-efficacy, worldviews, age, and overall perceived risk. Precautionary control was positively related to direct experience, self-efficacy, worldviews, country of residence, and overall perceived risk. Notably, overall perceived risk, self-efficacy, and worldviews were the three strongest predictors of both

mitigation behavior and precautionary control. This suggests that a willingness to address the challenges of GPG may be greatest among individuals who (a) are concerned about the impacts of GPG, (b) believe that they have the capacity to influence the issue, and (c) hold egalitarian-communitarian views.

We considered the possibility that the relationships between perceived risk and (i) mitigation behavior and (ii) precautionary control could be moderated by self-efficacy and/or worldviews. Moderation analysis identified that neither self-efficacy ( $t = 0.977$ ,  $p = 0.329$ ) nor worldviews ( $t = 0.977$ ,  $p = 0.329$ ) moderated the relationship between overall perceived risk and precautionary control. However, our analysis showed that the relationship between overall perceived risk and mitigation behavior was moderated by self-efficacy ( $t = 3.56$ ,  $p < 0.001$ ). Specifically, as self-efficacy increased from low ( $b = 0.64$ , 95%CI [0.56, 0.73],  $t = 15.41$ ,  $p < 0.001$ ), to medium ( $b = 0.53$ , 95%CI [0.46, 0.59],  $t = 16.61$ ,  $p < 0.001$ ) to high ( $b = 0.41$ , 95%CI [0.31, 0.51],  $t = 8.25$ ,  $p < 0.001$ ), the strength of the relationship between overall perceived risk and mitigation behavior became increasingly less evident. In other words, it was among participants with low (high) self-efficacy that the positive relationship between perceived risk and mitigation behavior was most (least) evident. Furthermore, we also found that the relationship between overall perceived risk and mitigation behavior was moderated by worldviews ( $t = 3.79$ ,  $p < 0.001$ ). As egalitarian-communitarian worldviews increased from low ( $b = 0.51$ , 95%CI [0.44, 0.58],  $t = 14.77$ ,  $p < 0.001$ ), to medium ( $b = 0.43$ , 95%CI

<sup>1</sup> For exploratory purposes, we repeated all three of our regression analyses using only the data from the UK residents and then using only the data from the US residents. The results of these separate analyses are reported in Supplementary Tables S.I., S.II., and S.III in the Appendix. The results replicated those found in the UK-US combined analysis, except that temporal distance did not predict the willingness to support precautionary controls among US residents.

[0.36, 0.49],  $t = 13.26$ ,  $p < 0.001$ ) to high ( $b = 0.35$ , 95%CI [0.26, 0.43],  $t = 8.18$ ,  $p < 0.001$ ), the strength of the relationship between overall perceived risk and mitigation behavior became increasingly less evident. In other words, it was among participants with strong individualism-hierarchical (egalitarian-communitarian) worldviews that the positive relationship between perceived risk and mitigation behavior was most (least) evident.

## 4 | GENERAL DISCUSSION

We found that our UK and US samples perceived GPG to present a moderate-to-high risk and that these risk perceptions had a strong positive relationship with the willingness to adopt mitigation behaviors and support preventative measures. Our participants' risk perceptions were primarily characterized by negative affective concerns about environmental degradation and resources shortages. The sample believed that the worst effects of GPG were yet to come and perceived the adverse outcomes of GPG to be geographically and socially remote, with the world's poorest people being worst affected. Despite their willingness to engage in risk management actions, our participants reported low self-efficacy and that governments, rather than individuals and communities, have the greatest capacity to influence GPG.

In addition to corroborating the findings from previous research on risk perceptions of GPG (e.g., Dawson & Johnson, 2017), our results also provide several new and important insights into this phenomenon. First, by conducting a cross-cultural comparison, we identified that the perceived risk of GPG was higher among UK residents than among US residents, indicating that GPG risk perceptions can vary between countries. Compared to their US counterparts, more UK residents (i) reported directly observing more evidence of GPG in their community/country and (ii) believed that the worst impacts of GPG were more temporarily proximate. However, the UK participants were no more/less willing than the US participants to engage in GPG risk management actions.

Second, we identified that worldviews are strongly related to both GPG risk perceptions and the willingness to engage in mitigation behaviors and support preventative controls. Furthermore, we found that worldviews moderated the identified relationship between risk perceptions and country of residence. Specifically, worldviews were associated with much greater variance in overall perceived risk among the US (cf. UK) participants, with perceived risk being highest for US participants with egalitarian-communitarian worldviews and lowest for US participants with individualism-hierarchists worldviews. This finding indicates that public concerns about GPG are more strongly associated with cultural values, beliefs, and cognitions in the United States (cf. the United Kingdom), which may correspond with a higher level of polarization that is often observed in US public opinion on social, environmental, and political issues (Fiorina & Abrams, 2008; Heltzel & Laurin, 2020; Rubaltelli et al., 2023). Our finding that risk perceptions were highest among

participants with egalitarian-communitarian worldviews may have been because such individuals are typically more concerned about the plight of others and recognized, consistent with the literature, that people in the world's poorest regions are more likely to experience the greatest adverse effects from GPG (Cleland, 2013; Dake, 1991, 1992; Ezeh et al., 2012; Lacroix & Gifford, 2018).

Third, our sample had low benefit perceptions for GPG. Hence, while some scholars and commentators have argued that GPG provides many advantages and that the associated risks are often exaggerated, similar views were not evident among our participants. Relatedly, a study by Dawson (2018) found that there was no difference in the perceived risk of GPG between a control group and individuals who had been exposed to information about the potential benefits of GPG, but they did find heightened risk perceptions among the individuals who had been exposed to information about the potential risks of GPG. Hence, consistent with our findings, this suggests that individuals may be relatively resistant to forming positive perceptions of GPG.

Finally, by conducting our study 3 weeks after the 8 billion milestone, we obtained evidence that suggests the level of exposure to GPG media coverage at this moment in time was not related to GPG risk perceptions. While this finding is inconsistent with the literature that shows risk perceptions can be heightened by recent exposure to information about potential adverse events or outcomes (Johnson & Tversky, 1983; Keller et al., 2006; Visschers et al., 2009), it does suggest that our samples' perceptions may have been relatively stable and resistant to salient external influences. Indeed, our participants mean score on our overall perceived risk scale was 6.9, which is identical to the mean observed in Dawson and Johnson's (2017) study that was conducted 3 years after the 7 billion milestone. Hence, the collective evidence suggests the public perception that GPG presents a moderate-to-high risk is relatively steadfast.

### 4.1 | Limitations and future directions

There are some limitations to our study that could be addressed in future research. While we have conducted the first cross-national comparison of GPG risk perceptions, there remains much scope to examine how these perceptions vary across the world. For example, it would be beneficial to obtain insights into GPG perceptions in some of the world's less developed and less industrialized countries and in regions where the population is declining or where governments implement more coercive policies to control population levels. Indeed, it could be argued that future studies should focus on assessing GPG knowledge and perceptions in the regions of the world where fertility rates are highest. Such studies could aim to determine the extent to which individuals, communities, and governments are aware of GPG-related challenges and are empowered or motivated to address such issues. Clearly, these studies would need to be conducted with sensitivity and due consideration given to the cultural values,

customs, and socioeconomic conditions of the countries and communities sampled (Bongaarts, 2016). Similarly, because we recruited our sample from the online platform *Prolific*, there might be value in conducting studies that obtain data from samples that have lower levels of access to technology.

We recognize that the items we used to measure concepts such as the willingness to employ mitigation behaviors and to support precautionary actions were relatively broad in scope. This lack of specificity may have allowed each participant to interpret the items in different ways, thus leading them to provide responses to differing imagined scenarios or to even see some merit in providing generalized socially desirable responses. To address this potential issue, future studies could ask participants to respond to scenarios that are much more detailed and concrete or could conduct interviews that explore the exact details of what participants are or are not willing to do in response to the challenges associated with GPG.

To assess information exposure, we elected to measure the quantity of GPG-related items that our participants had engaged with. However, it is possible that this measurement provides a relatively crude assessment of the extent to which people pay attention to and fully engage with information on GPG. Therefore, there could be some value in future research that examines the extent of engagement with, rather than the frequency of exposures to, GPG-related information. Relatedly, our results indicated that risk perceptions were not related to recent GPG information exposure. However, we acknowledge the possibility that media coverage of the 8 billion milestone may not have reached and/or impacted the public in a meaningful way. Indeed, our results showed that only 47% of our sample reported having seen at least one GPG-related article in the last month, and our study design did not enable us to gain any insights into the extent to which the participants who had seen such articles engaged with and/or understood the article's content. Thus, we suggest that future studies should aim to provide more detailed analyses of the impact of GPG media coverage on public knowledge, perceptions, and behaviors. Such studies might be best conducted under controlled conditions, where the influence of specific variables (e.g., format, narrative style, imagery, competing news stories, etc.) can be closely monitored and manipulated.

We elected to use a questionnaire to obtain data on our target phenomena so that we could perform inferential statistical analyses, and thus, obtain epistemic insights into our focal phenomena at the population level. However, because questionnaires restrict the participants' capacity to provide data beyond the options on the response scales, it can be argued that the data we obtained only provide a limited window of insight into public understanding and perceptions of GPG. Epistemic limitations are inevitable in any field of research that is in its infancy, and therefore, we advocate the use of alternative methodologies to enhance and extend current knowledge of this topic. For example, researchers might use the mental models methodology to understand how public knowledge and perceptions of GPG differ from that of experts and, in doing so, could identify inaccuracies or shortcom-

ings in public knowledge that could then become the focus of educational interventions (Atman et al., 1994). Similarly, Q-Methodology could be employed to gain more detailed insights into the diverse range of subjectively constructed views of GPG and how these might each operate in unique ways to influence mitigation behaviors and support for precautionary measures (McKeown & Thomas, 2013). Indeed, the insights gained from our study could be further extended by research that examines the role of GPG risk perceptions in influencing actual behaviors in naturalistic contexts and not just the professed willingness to engage in such behaviors.

Our participants demonstrated a limited appreciation for the central role that equal rights and opportunities for women can play population growth rates. Hence, future studies could assess the efficacy of different risk communications that aim to improve public understanding of the relationship between women's rights/opportunities, population growth, and the associated risks. We also identified that individuals with strong individualist-hierarchical worldviews had the lowest GPG risk perceptions. If it were assumed that such perceptions are inaccurate and that there is benefit in trying to remedy this situation, then there could be some merit in assessing the efficacy of risk communications that encourage people with individualist-hierarchical worldviews to understand better how GPG issues might directly affect them even when the population growth predominantly occurs in other regions of the world (e.g., via mass migrations, geopolitical conflicts, economic instabilities). Furthermore, because the variables included in our study only accounted for 45% of the variance in perceived risk, future studies should attempt to identify other key predictors of perceived risk.

## 5 | CONCLUSION

Throughout the 21st century, the global population will continue to grow to unprecedented levels. A large body of the literature indicates that this growth will present humanity with a wide range of challenges that could contribute to major systemic problems in social, political, economic, and environmental contexts. Hence, it has been argued that managing these challenges should be a key international priority so that GPG supports rather than arrests humanity's progress and prospects. To address these challenges, it seems that humans will need to have accurate knowledge of GPG and the associated risks and have the motivation to engage in mitigation behaviors and/or to support preventative controls. Our study provides important and novel insights into the extent to which such knowledge and motivation currently exists and identifies some of the key factors that can influence public willingness to address the challenges of GPG. We hope that these findings can be utilized to help avert the adverse and potentially catastrophic effects of GPG.

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## SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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