DEMOGRAPHIC RESEARCH
A peer-reviewed, open-access journal of population sciences

DEMOGRAPHIC RESEARCH

VOLUME 51, ARTICLE 2, PAGES 17–48
PUBLISHED 16 JULY 2024
https://www.demographic-research.org/Volumes/Vol51/2
DOI: 10.4054/DemRes.2024.51.2

Research Article

Climate change and fertility desires: An experimental study among university students in Belgium and Italy

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Demographic Research: Volume 51, Article 2
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Abstract

BACKGROUND
As more people recognise the challenges of climate change, an increasing number are trying to reduce their ecological footprint. However, it remains uncertain whether this extends to decisions about having children. Despite public debate, scholarly research remains scarce.

OBJECTIVE
Our aim is to explore whether and how vignettes about climate change impact short-term fertility desires among young adults, and how this may be moderated by perceived personal responsibility and satisfaction with the government.

METHODS
We conducted an online experiment with university students from Belgium (N = 262) and Italy (N = 169). Respondents not in the control group were exposed to either a pessimistic or a more optimistic climate change vignette before being asked about their fertility desires. Multinomial regression was used for hypothesis testing.

RESULTS
The exposure to a pessimistic scenario increased the likelihood of low fertility desire in both Belgian and Italian respondents compared to their control groups. Following the optimistic scenario, Belgians reported a higher probability of high desire, while Italians experienced effects similar to those exposed to the pessimistic scenario. These differences were moderated by feelings of personal responsibility and satisfaction with government's actions.

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CONCLUSION
Respondents' fertility desires were negatively affected by the pessimistic climate change scenario regardless of their nationality, with notable variation according to perceived responsibility and satisfaction with government actions.

CONTRIBUTION
This paper addresses the current research gap in the literature on climate change concerns and fertility desires through the use of an experiment-based study.

1. Introduction

In the context of continuing world population growth and climate change, urgent concern regarding how humans impact the environment is becoming a crucial aspect of political debate and the everyday choices made by individuals (O'Neill et al. 2012). A growing number of people are striving to reduce their impact on the planet by modifying their lifestyles, such as adopting sustainable consumption practices (Fischer et al. 2017; Onel et al. 2018), changing their diet (Sanchez-Sabate, Badilla-Briones, and Sabaté 2019), and choosing environmentally friendly modes of transportation (Suchanek and Szmelter-Jarosz 2019). However, it remains uncertain whether this heightened environmental awareness also extends to decisions regarding parenthood and childbearing.

This research explores whether climate change scenarios affect fertility desires. Although this issue is emerging as a topic of scholarly research, it is still unclear whether and how individuals take climate change concerns into consideration in their family planning. Previous work has suggested that individuals approach concerns about climate change from two different perspectives: on the one hand they consider possible ways to reduce their personal impact (i.e., by having fewer children), and on the other hand they worry about the well-being of future generations, which prompts them to ponder whether the world is now a suitable place to raise children (Bodin and Björklund 2022).

In this paper we report on an online experiment-based study implemented among university students in Belgium and Italy. Experimental design is a useful tool in social research as it offers the opportunity to estimate the effects of explanatory factors and explore causal relationships, while reducing potential biases and uncertainties associated with unobserved confounders (Jackson and Cox 2013). Although studies on fertility attitudes have used experimental methods (notably Vignoli et al. 2022 and Guetto, Bazzani, and Vignoli 2022), to our knowledge this is the first experiment-based study on the topic of climate change and fertility desires.

The target population for the analysis is university students, who, compared to the general population, are expected to have a higher level of awareness of climate change,

which is positively associated with higher education (Jaoul-Grammare and Stenger 2022). University students typically do not plan to become parents in the very near future. Therefore, we consider more 'distant' fertility desires to be more appropriate for this population, rather than fertility intentions, which are more proximate and specific (see Miller 2011). Consequently, our objective is to explore the relationship between fertility desires and climate change among young adults in two different countries, Belgium and Italy. Do vignettes about climate change affect fertility desires in young adults? Are Belgian and Italian respondents' fertility desires differently affected by potential climate change scenarios?

Belgium and Italy offer intriguing points of comparison. They share similarities and experience common trends, including having similar consumption patterns as reflected in CO_2 emissions per capita (IEA-EDGAR CO_2 2022). However, they also exhibit relevant differences. First, they display diverging fertility rates, with a Belgian TFR slightly higher than the European average at 1.53 in 2022, and an Italian TFR considerably lower at 1.24 in the same year (Eurostat 2024). Second, there is an observable difference in the level of attention given to the issue in the political sphere. This is exemplified by the lower representation of 'Green' parties (e.g., *Groen* and *Ecolo* in Belgium, *Europa Verde* in Italy) in Italy, where in April 2024 only 5 out of 400 deputies were Green (Camera dei deputati n.d.), while in Belgium the number was 21 out of 150 deputies (De Kamerleden n.d.).

2. Background

We examine fertility desires through the Treatments-Desires-Intentions-Behaviour (T-D-I-B) perspective (Miller 2011). In this framework, fertility-related behaviours are conceptualised as components of a process ranging from unconscious predispositions to concrete and conscious actions. While intentions require some degree of planning and take into account personal circumstances like partnership situation, housing, and income (Bachrach and Morgan 2013), fertility desires capture antecedent levels of motivation with only minimal consideration of the practical implications of actually having children in the current personal conditions (Miller 2011).

Life-course sociologists have explored how fertility behaviour is intricately linked to the interplay between past, present, and future circumstances, incorporating both external socio-structural elements and internal conditions such as personal preferences and physiological factors (Huinink and Kohli 2014). In line with this perspective, a recent development in fertility studies introduced the Narrative Framework, which posits that fertility attitudes are influenced not only by past and present constraints but also by hypothetical 'narrative-of-the-future' scenarios embedded in socially shared

perspectives, regardless of their factual accuracy (Vignoli et al. 2020b). Consequently, fertility intentions not only reflect the subjective constraints individuals may face in the future but are also shaped by socially shared perceptions of what the future may hold (Vignoli et al. 2020a).

These narratives have been analytically employed to investigate fertility intentions (e.g., Vignoli et al. 2022; Guetto, Bazzani, and Vignoli 2022) in the context of economic and health uncertainties. Climate change and its associated uncertainties align with this framework and therefore warrant similar investigation. Employing this approach implies that (1) from a theoretical perspective, the examination of climate change's influence on fertility must acknowledge the pervasive uncertainty it generates, and (2) from a methodological standpoint, when analysing desires it is suitable to use experimental methods that present future scenarios, especially when analysing causal relationships (Vignoli et al. 2020b).

Quantitative scientific studies addressing fertility desires and climate change remain scarce in the published literature, with ongoing discussions circulating in non-academic forums, mostly in newspaper articles focusing on individual activists and their viewpoints. However, some existing studies have analysed the connection between climate change concern and fertility attitudes (mostly intentions), although only through observational research.

One scientific study using 2011 Eurobarometer data finds that concern for climate change is positively associated with fertility intentions, contrary to its initial hypothesis (De Rose and Testa 2015). Conversely, a study conducted in Canada in 2012 finds a negative relationship between reproductive intentions and concern about climate change (Arnocky, Dupuis, and Stroink 2012). The results indicate that in the specific context examined, young adults who express concern about the impact of humans on the environment and who worry about the consequences of pollution on their health are less inclined to have children. This finding aligns with a more recent study among Canadian undergraduate students, suggesting that an eco-conscious mindset and valuing the environment are associated with a lower desire to have children (Davis, Arnocky, and Stroink 2019). Additionally, a Polish study has found that individuals who express a desire to have biological children are less concerned about climate change than those who do not wish to have biological children (Bielawska-Batorowicz, Zagaj, and Kossakowska 2022).

Several factors can influence an individual's decision to contemplate not having children and to ultimately opt for childlessness due to concerns about climate change. If this decision is a way to mitigate climate change and its consequences, the individual's sense of responsibility is playing a crucial role in shaping decisions (Schneider-Mayerson and Leong 2020). When individuals feel accountable for the climate crisis, they may

proactively modify their behaviours and actions, including their decisions regarding reproduction.

But who should bear responsibility for the climate crisis – individuals, governments, or private companies? The level of trust regarding government initiatives on the environment and the corresponding optimism or pessimism can also be a pivotal factor when it comes to fertility decisions. The perceived impact of government action may influence individuals' perspectives on the future, with those who trust such initiatives tending to be more optimistic (Fairbrother et al. 2021). The connection between trust and fertility becomes particularly evident in times of increased uncertainty, when a decrease in trust is associated with lower fertility rates. Conversely, an elevated level of trust has the potential to alleviate the adverse effects of uncertainty on individuals' intentions to have children (Aassve, Le Moglie, and Mencarini 2021).

The factors influencing these opinions are closely tied to individual contexts, emphasising the need to understand prevailing attitudes across countries. Looking at Belgium and Italy, differences emerge in climate change awareness and responsibility. While according to ESS data both countries show very similar percentages acknowledging climate change, attributing it to human activity, and foreseeing negative impacts (Poortinga et al. 2018), Eurobarometer data (European Commission 2021) reveal that Belgians are more likely to consider climate change the most serious global problem (25% vs. 7% of Italians). Another relevant finding concerns who, according to respondents, should be responsible for taking action against climate change. Both countries align with the European average in assigning responsibility to national governments, businesses, and the European Union. However, there is a noticeable contrast regarding those who believe individuals should take responsibility. Belgium is consistent with other countries at 41%, while Italy is lower at 28%.

These findings suggest that despite often being aware of climate change and its associated risks, Italians, compared to Belgians, tend to see themselves less as responsible agents in addressing climate change, preferring to delegate responsibility to others. The differences persist when examining fertility and overall attitudes towards parenthood. Despite lower fertility rates in Italy than Belgium, studies indicate a reverse situation regarding fertility desires. Belgians view those who choose not to have children more favourably and both Belgian men and women express more frequently than their Italian counterparts that they do not wish to become parents (Sobotka and Testa 2008). However, in Italy contextual constraints and limitations, rather than intentional choices, are likely responsible for the low fertility rates. For instance, Régnier-Loilier and Vignoli (2011), in their investigation of the French and Italian contexts, propose that fertility intentions are often overestimated in Italy, influenced by various factors, including traditional familism.

3. Hypotheses

Our primary hypothesis posits that respondents, when exposed to a pessimistic climate change vignette, will show a lower desire to have children compared to the control group (Hypothesis 1a). Conversely, when confronted with an optimistic scenario, they will express a higher desire (Hypothesis 1b).

Second, we expect that individuals reporting a high sense of personal responsibility will be more affected by the scenarios than those reporting relatively low responsibility (Hypothesis 2). Note that earlier studies about the attribution of responsibility for climate change found a higher percentage of Belgians viewing themselves as responsible actors compared to Italians. So, the implication of Hypothesis 2, if true, would be that Belgians are more strongly affected by the climate scenarios than Italians.

Third, given earlier findings about the importance of trust for fertility, we also investigate the role of trust in government action. A pessimistic climate change scenario's potential adverse effect on fertility desires might be mitigated by a belief in active government intervention, while the impact could be exacerbated in instances of low trust in government procedures. We hypothesise that individuals who are more dissatisfied with the government will be more affected by exposure to a climate change vignette than those who have greater trust in the government's actions (Hypothesis 3).

4. Data and methods

4.1 Sample

Data was collected in May 2023, using the online survey platform Qualtrics. While there is a growing trend of using online experimental methods (also within fertility studies; e.g., Guetto, Bazzani, and Vignoli 2022), the decision to use online surveys significantly limited our control over respondents. For instance, we did not gather detailed geographical information about respondents beyond nationality. However, it is noteworthy that the initial distribution primarily targeted northern regions of Italy (especially between Piedmont and Tuscany) and Flanders (Flemish-Brabant).

Most respondents were recruited through Italian and Belgian university professors, who agreed to send links to the questionnaire on their respective student platforms. Professors distributed the survey in classes of various disciplines, including geography, communication, chemical engineering, social sciences, education sciences, and social work. Students were invited to forward the link to their peers. In the survey, respondents were asked to specify their field of study, revealing diverse academic backgrounds, with notable distinctions between Belgians and Italians. Among Belgians, the largest

proportion of respondents came from political and social sciences (45.5%), followed by engineering and computer science (16.1%), and mathematics and natural sciences (10.2%). Conversely, among Italians the predominant fields of study were medical sciences (21.5%), mathematics and natural sciences (17.2%), and legal studies (11.0%).

Given this recruitment strategy, our sample cannot be considered random, as procedures employing snowball sampling are inherently non-random (Parker, Scott, and Geddes 2019). The survey remained accessible to anybody who had the link, given respondents the flexibility to open the questionnaire and return to it later. Consequently, the average completion time does not precisely reflect the duration of the survey. However, the majority of respondents completed the survey within 4 to 5 minutes (with a median time of 276 seconds).

As our target population consisted of Italian and Belgian university students, we did not collect information from individuals who did not consent, were not university students, or were studying in countries other than Belgium or Italy. This exclusion was predetermined in the survey design, terminating data collection upon selection of these specific options. Furthermore, we actively excluded individuals from the sample who indicated having children (N = 8) and those who either did not specify their nationality or identified with nationalities other than Belgian and Italian (N = 8). After this data cleaning process the sample consists of 431 respondents, with 39.2% being Italians and 60.8% Belgians.

Upon following the link, respondents were randomly assigned to 1 of 3 questionnaires, one containing the optimistic vignette, one with no vignette, and one with the pessimistic vignette. To ensure randomisation we created a single link from the existing questionnaire links using the Allocate Monster platform (Fergusson 2016). Table 1 presents the distribution of respondents across the scenarios.

Table 1: Distribution of scenarios across nationalities

Nationality	Optimistic	Control group	Pessimistic	Total
Belgians	93	84	85	262
Italians	59	65	45	169
Total	152	149	130	431

The questionnaire was targeted at all university students pursuing Bachelor's, Master's, or PhD degrees in their respective home countries, Belgium or Italy. The majority of respondents were either Bachelor's students (48.3%) or Master's students (43.6%). Specifically, among Belgian respondents 52.3% were pursuing a Bachelor's degree and 40.8% were enrolled in a Master's programme. By contrast, among Italian respondents 42.0% were enrolled in Bachelor's degree programmes, and 47.9% were pursuing Master's degrees. 3.4% of Belgian indicated pursuing other degrees, such as

being enrolled in bridging programmes. A larger proportion of Italian respondents (8.3%) selected this response, often reporting being enrolled in single-cycle degree programmes such as law or medicine. Although it could be argued that the category PhD (N = 11) comprises a significantly different group than Bachelor's and Master's students, we decided to keep it, as the age was rather similar to that of the others (mean = 25.7) and they did not already have children.

4.2 Analytic strategy

Participants were randomly assigned to 1 of 3 conditions: one in which they were confronted with a rather pessimistic text about climate change, one with a more optimistic outlook, and a control group with no exposure to such text. They were then questioned them about their fertility desires: "Imagine yourself a few years from now and try to answer the following question: on a scale of 1 to 7, how strong is your desire to have biological children in your life, where 1 is no desire and 7 is a very strong desire?"

For formal hypothesis testing we used multinomial logistic regression models predicting high or low fertility desire as compared to the intermediate baseline. Fertility desires, serving as the dependent variable, were recoded into three categories: no/low desire (comprising responses 'no desire', 'very low desire', and 'moderately low desire'), neither high nor low desire, and high desire (comprising responses 'moderately high desire', 'high desire', and 'very high desire').

All analyses were performed in R (v4.2.2; R Core Team 2022). The models were estimated using the 'multinom' function from the 'nnet' package (Venables and Ripley 2002). The 'ggemmeans' function from the 'ggeffects' package (Lüdecke 2018) was used for predicting probabilities.

4.3 Questionnaire

As the eligible respondents were from Belgium or Italy, the questionnaire was translated into Dutch, French, and Italian. Whenever possible the survey presented official translations from international surveys (e.g., ESS and Eurobarometer).

At the beginning of the survey, respondents were presented with a short description of the purpose of the data collection. The same description was reiterated by professors who distributed the survey to their students. The description emphasised that the data collected would contribute to a thesis exploring participants' views on climate change and their preferences regarding having children. This implies three key points: (1) the self-selection of participants, (2) participants' awareness of the survey's content, climate

change and fertility desires, (although the direct connection between the two was not explicitly stated), and (3) participants' lack of awareness regarding the presence of climate change scenarios and the experimental design.

The online questionnaire was structured as follows. First, we asked participants about their views on climate change, their sense of responsibility, and their opinion of their government. Next, we inquired about their desires regarding having children. Some participants received only this question, while those in the experimental groups were first exposed to the vignettes describing different climate change scenarios. Finally, we collected sociodemographic information.

It is important to emphasise the potential role of the order in which these questions were asked. By posing questions about climate change at the beginning, no group was entirely free from being triggered to think about climate change. Respondents may have already made the connection between the topics, potentially affecting their responses. However, some of them were randomly exposed to one of the following vignettes, while others were not.

4.3.1 The vignettes[3]

The scenarios were inspired by the observations of the report of the Intergovernmental Panel on Climate Change (IPCC 2022). Our aim here was to construct two evidence-based texts that provided respondents with a simplified but plausible view of the future, one with a hopeful view of the future, highlighting the advances that have been made so far, and the other pessimistic in tone, highlighting the shortcomings. The IPCC report (2022) indicates that climate change has a significant negative impact on both nature and people: it is contributing to an increase in extreme weather conditions such as heat waves, heavy rainfall, droughts, and fires. This has severe repercussions on production, water security, and several sectors of the economy, which can in turn affect economic stability, leading to labour force displacement, migration, heightened community violence, and civil conflict (Palinkas and Wong 2020). The report suggests that climate change is also affecting human mortality and is damaging individuals' physical (e.g., exacerbated risk of contracting certain diseases) and mental health (e.g., stress).

The optimistic scenario highlights relevant improvements in addressing the climate issue, including increased public awareness and political debate, as well as a growing

[3] Throughout the text, we have referred to the climate change scenarios as 'vignettes'. While they are commonly used in factorial survey experiments, they are not limited to this context and can also be applied in in-between subjects designs. We have adopted the definition outlined by Atzmüller and Steiner (2010), where a vignette is described as a "short, carefully constructed description of a person, object, or situation, representing a systematic combination of characteristics" (p. 128).

emphasis on scientific research. The Eurobarometer's special report on climate change (European Commission 2021) indicates increases between 2011 and 2021 in the number of people considering climate change a serious problem (from 68% to 78%) and in those taking action to address it (from 53% to 64%). Another positive development is the growth of political debate, fuelled in part by the prominence of young climate activists (Han and Ahn 2020). This has led to an increase in international policies and agreements to tackle climate change, such as the 2015 Paris Agreement, the first global climate agreement imposing legally binding emission reduction obligations on all participating countries (Luomi 2020). Furthermore, scientific research on climate change exploring technological (Nylund, Brem, and Agarwal 2022; Breyer et al. 2019) and biological (Guilyardi et al. 2018) means to remove CO_2 from the atmosphere has also increased. Moreover, adaptation efforts to manage climate risks and opportunities have progressed in various sectors and regions, with at least 170 countries incorporating such efforts into their policies and planning, although geographical disparities still exist (IPCC 2022).

The pessimistic scenario explores the potential – but plausible – consequences of reaching 1.5°C and 2°C increases in global warming, widely recognised as significant threats to the planet (Sanderson, O'Neill, and Tebaldi 2016). According to the IPCC report (2022), these increases pose manifold and unavoidable repercussions for both humans and the ecosystem. For instance, a 1.5°C increase would put 3% to 14% of existing species at very high risk of extinction, with percentages escalating with higher temperatures. Additionally, water availability would be impacted, and ecosystems such as forests, coral reefs, and coastal wetlands would suffer devastation (IPCC 2022). Sea-level rise would threaten coastal settlements and infrastructure, potentially submerging low-lying coastal ecosystems (IPCC 2022). Rising temperatures and extreme heat contribute to stress and mortality, exacerbating hazards to health and food security through contamination of crops and seafood. In addition, marine and terrestrial ecosystems would be destroyed, with irreversible impacts on less resilient ecosystems (IPCC 2022).

Based on this, the following two vignettes were constructed. The underlined part of the text indicates the sections that differ between the two scenarios.

Optimistic scenario	**Pessimistic scenario**
The issue of climate change is widely recognised as urgent by scientists, who identify human activities as its main cause. The effects of climate change, such as the increase in extreme weather events like heatwaves and heavy rainfalls, have a negative impact on the natural world and society, damaging ecosystems and posing challenges to food security, water availability, and physical and mental health. However, there are encouraging signs for the future of the environment. A growing number of people are aware of the impact of climate change and are willing to change their habits to a more sustainable lifestyle. Additionally, climate change has become a topic of discussion in local and international politics, with the development of policies and agreements to address the situation. Research efforts, including those related to CO_2 removal from the environment, are on the rise and offer innovative solutions to tackle the problem. In conclusion, while climate change remains an urgent problem, positive actions and efforts towards sustainability offer hope for a better future for the planet.	The issue of climate change is widely recognised as urgent by scientists, who identify human activities as its main cause. The effects of climate change, such as the increase in extreme weather events like heatwaves and heavy rainfalls, have a negative impact on the natural world and society, damaging ecosystems and posing challenges to food security, water availability, and physical and mental health. Despite efforts to address climate change, current actions and goals seem inadequate to prevent its devastating consequences. Predictions indicate that temperatures will continue to rise with serious consequences, and many researchers suggest an inevitable increase of at least 2°C by the end of the century. Risks associated with rising temperatures include a high risk of extinction for tens of thousands of species, reduced water availability, destruction of marine and terrestrial ecosystems, and increased stress and mortality. In conclusion, the situation is serious and alarming: the projected temperature increase carries multiple devastating risks for both the environment and humanity.

4.3.2 Other questions

The first part of the questionnaire included several questions aimed at assessing participants' views on climate change, agency, and responsibility. Respondents were asked if they believed that the climate is changing ("You may have heard the idea that the world's climate is changing due to increases in temperature over the past 100 years. Do you think the world's climate is changing?"). Furthermore, we asked about their personal concern: "How worried are you about climate change?" Their sense of personal

responsibility was addressed by the question: "To what extent do you feel personal responsibility to try to reduce climate change?" Their opinions on government action were measured through the statement "Indicate your level of agreement with the following statement. Governments are not doing enough to tackle climate change".

These questions were presented before the experimental section; therefore, as previously mentioned, climate change had already been introduced to respondents, potentially establishing an association between the topics and triggering the control group as well. Thus, while it could be argued that the inclusion of these questions itself acted as a treatment, this paper focuses on examining the effects of the additional treatment involving vignettes, which differentiated between groups and included a control group.

At the end of the questionnaire, respondents were asked about sociodemographic characteristics; namely their gender identity, age, nationality, sexual orientation, relationship status, and if they had children or were currently expecting a child.

5. Results

Table 2 presents the characteristics of the sample in terms of opinions on climate change, fertility desires, and sociodemographics. By design, our sample consists of young individuals, with a slight overrepresentation of female students. Almost everyone believed in climate change and was at least moderately worried about it, without relevant differences by nationality. Our sample is consistent with previous surveys that have found that Belgians more frequently consider themselves personally responsible for tackling climate change compared to Italians. When it comes to opinions on their governments' actions in this regard, the overall sentiment leaned toward dissatisfaction, with a notably higher level of dissatisfaction among Italian respondents.

Table 2: Descriptive statistics of the sample by nationality

	Belgium		Italy	
	%	N	%	N
Climate change is…				
1.…*definitely not changing*	0.4	1	0.6	1
2.…*probably not changing*	0.0	0	0.0	0
3.…*probably changing*	7.3	19	7.1	12
4.…*definitely changing*	92.4	242	92.3	156
Climate change concern				
1. *Not worried at all*	1.5	4	0.6	1
2. *Slightly worried*	1.5	4	4.1	7
3. *Moderately worried*	30.5	80	24.3	41
4. *Very worried*	44.3	116	44.4	75
5. *Extremely worried*	22.1	58	26.6	45
Sense of personal responsibility				
1. *No responsibility*	1.1	3	1.8	3
2. A small amount	14.1	37	18.6	31
3. A moderate amount	42.0	110	44.3	74
4. *A high amount*	37.0	97	31.1	52
5. *A very high amount*	5.7	15	4.2	7
Governments are not doing enough (A/D)				
1. *Strongly disagree*	1.5	4	0.6	1
2. *Somewhat disagree*	3.4	9	3.6	6
3. *Neither agree nor disagree*	8.0	21	3.6	6
4. *Somewhat agree*	38.3	100	24.8	41
5. *Strongly agree*	48.7	127	67.3	111
Fertility desires				
1. *No desire at all*	9.4	24	13.5	22
2. *Low desire*	14.1	36	9.2	15
3. *Moderately low desire*	9.8	25	8.6	14
4. *Neither high nor low desire*	10.2	26	20.2	33
5. *Moderately high desire*	18.8	48	16.6	27
6. *High desire*	21.2	54	19.6	32
7. Very high desire	16.5	42	12.3	20
Gender (ref. male)				
Female	59.2	155	62.1	105
Sexual orientation (ref. non-heterosexual)				
Heterosexual	80.2	210	77.5	131
Relationship status (ref. unpartnered)				
Partnered	40.5	106	61.5	104

	Min-Max	Mean	SD	Min-Max	Mean	SD
Age	17–38	21.5	2.9	19–38	22.9	2.7

5.1 Experiment

Table 3 presents descriptive statistics of the stated fertility desires for the three experimental conditions and the two countries. There are notable differences between the countries.

Table 3: Mean fertility desires and standard deviation by country

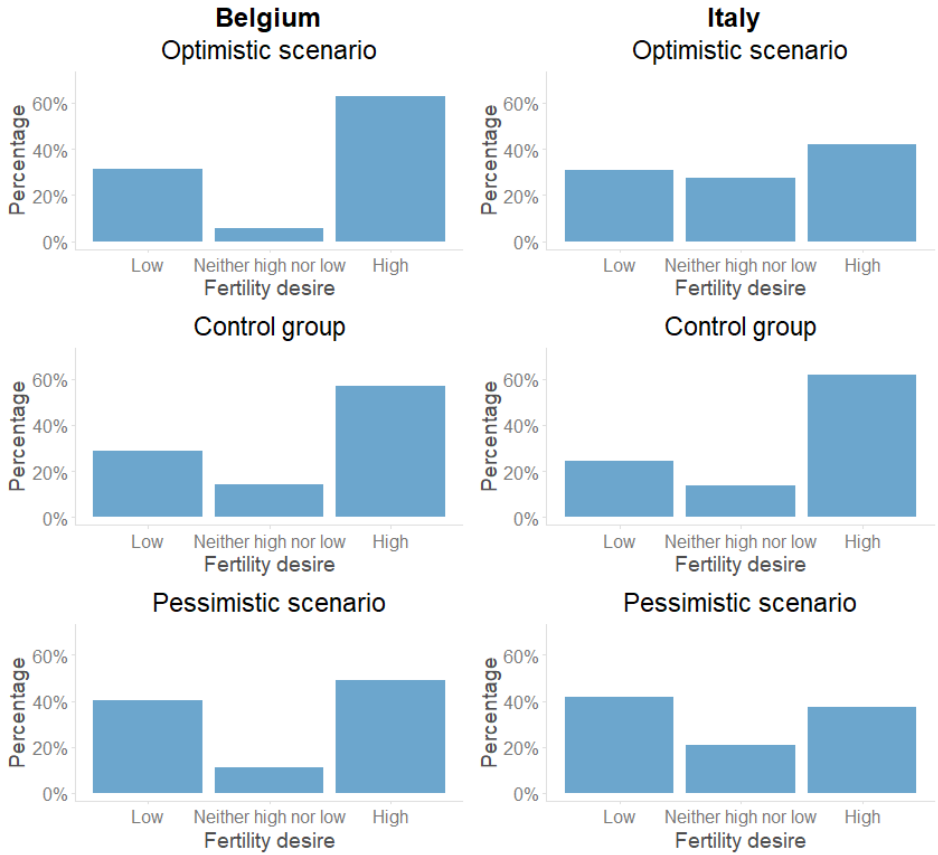
	Belgium			Italy		
	Mean	SD	N	Mean	SD	N
Optimistic	4.60	1.92	89	4.20	1.94	55
Control	4.51	1.77	84	4.69	1.90	65
Pessimistic	4.21	2.18	82	3.65	1.80	43
Total	4.44	1.96	255	4.25	1.92	163

The differences in mean fertility desires are smaller among Belgians than among Italians, with the optimistic questionnaire showing slightly higher average desires than the control group, and slightly lower average desires in the pessimistic group. These findings are consistent with the hypothesis that the more optimistic climate vignette increases fertility desires (from 4.51 in the control group to 4.60 in the optimistic group), while the pessimistic climate vignette decreases them (4.21). However, the Analysis of Variance conducted in the Belgian sample shows a p-value of 0.40, suggesting that there is no significant difference between the groups. On the other hand, in Italy both the optimistic and the pessimistic questionnaires exhibit lower scores than the neutral condition (4.69), with the pessimistic climate vignette showing a particularly pronounced decrease (3.65) and the optimistic vignette showing a smaller decrease (4.20). These findings therefore suggest that among Italians the optimistic stimulus did not work as expected. The Analysis of Variance conducted on the Italian sample shows a p-value of 0.02, suggesting there is a significant difference in the means between the groups.

Figure 1 presents the distribution of this recoded variable by nationality (Belgian on the right and Italian on the left) and by sample group.

From this Figure it appears that in the control group, Italians and Belgians present overall similar distributions of desires, with the majority reporting high desire, followed by low desire, and neither high nor low desire. However, the situation in the experimental groups varies between the two country samples. In both groups, compared to the control groups, the percentage of high desire decreases among those exposed to a pessimistic scenario (slightly in the case of Belgium and markedly in the case of Italy), while the percentage of low desire increases. Conversely, when considering the groups exposed to the optimistic vignette, only among Belgians is there a slight increase in the percentage of high desire, while among Italians the percentage is noticeably lower.

Figure 1: Distribution of fertility desires by experimental group and nationality

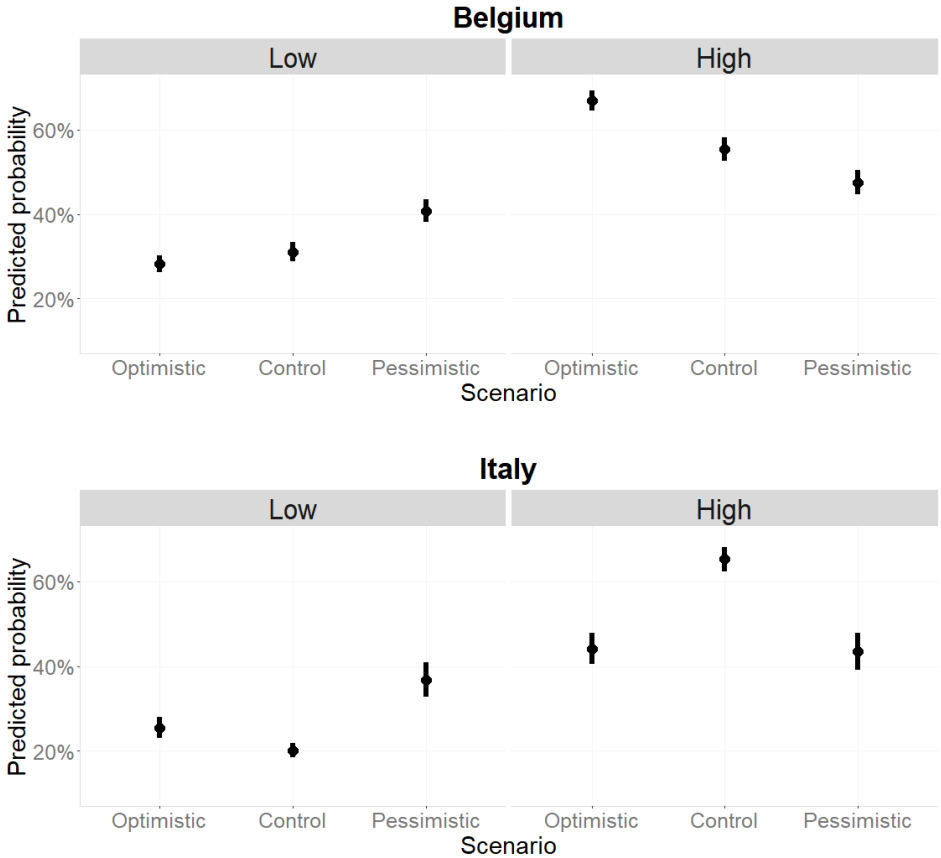


Note: Belgian sample on the left and Italian sample on the right.

5.2 Multinomial logistic regression

Our models include sociodemographic variables established as relevant in previous literature, including gender, sexual orientation (heterosexual or non-heterosexual), and relationship status (partnered or not). The logit coefficients of the full models are presented in the Appendix.

Figure 2: Predicted probabilities of low fertility desire (left) and high fertility desire (right) by climate change scenario (optimistic, pessimistic, and control group)



Note: explanatory variables set at the following mean values for gender (0 male; 1 female), age, sexual orientation (0 non-heterosexual; 1 heterosexual), relationship status (0 unpartnered; 1 partnered): (for the Belgian sample) gender (0.60), age (21.57), sexual orientation (0.80), and relationship status (0.40); (for the Italian sample) gender (0.62), age (22.91), sexual orientation (0.79), and relationship status (0.60).

Figure 2 shows the predicted values of fertility desires, calculated by taking the average of the level of the covariates using the 'ggemmeans' function implemented in R. We employed 83.5% confidence intervals to assess whether our model led to significant differences in predicted fertility desires depending on the presented climate scenario (Goldstein and Healy 1995; Knol, Pestman, and Grobbee 2011). Such confidence

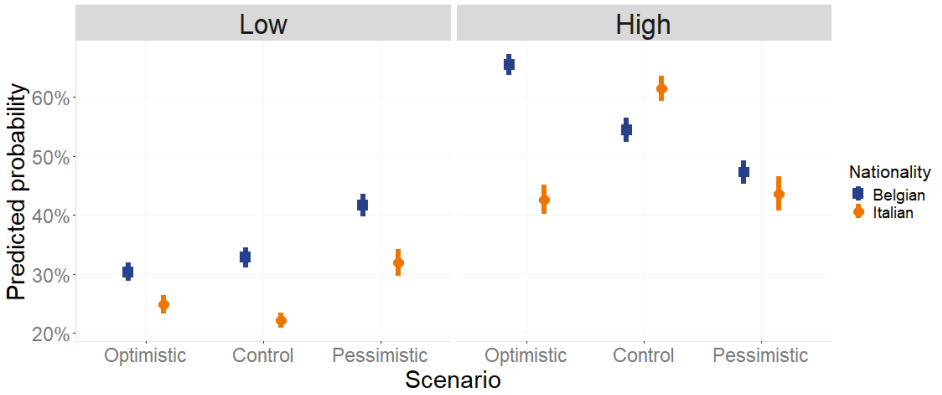
intervals for predictions align with the fact that when the p-value for distinguishing between statistically significant differences is set at 0.05, two means are considered significantly different if their confidence intervals at this level do not overlap (Austin and Hux 2002).

There are clear differences between the patterns observed for Belgians and Italians. In the Belgian sample, exposure to the optimistic vignette leads to an increased likelihood of high desire compared to the control group, while the pessimistic vignette is associated with a lower likelihood of people reporting a high desire compared to the control group. In the Italian sample the control group displays a notably high probability of expressing a high fertility desire, in contrast to both other groups. In both the optimistic and pessimistic scenario groups, our model predicts a significantly lower proportion of people expressing a high fertility desire. It is crucial to emphasise that while a difference exists between the two experimental groups in Belgium, the corresponding groups in Italy exhibit similar probabilities. This suggests that immediate exposure to a climate vignette, regardless of its optimism or pessimism, negatively influences fertility desires among the Italian students. This pattern just described for high fertility desires is mirrored in the pattern of the responses reporting low fertility desire. In Belgium, the pessimistic vignette negatively affects desire, resulting in a rise in the probability of selecting low desire compared to the control group. Conversely, the optimistic scenario leads to a slight, though insignificant, decrease in this probability. In Italy, both scenarios increase the likelihood of selecting low desire compared to the control group, with the optimistic vignette showing a small but significant effect and the pessimistic demonstrating a more pronounced impact.

Figure 3 allows a better comparison between the samples by nationality by jointly analysing the full sample, while also considering the interaction between the vignette received and nationality (see M4 in the Appendix).

Belgian and Italian respondents exhibit notable differences. When examining high desire, we observe distinct patterns. In response to the pessimistic scenario, both groups show similar probabilities of reporting high desire. However, exposure to an optimistic scenario reveals a significant gap between the two samples. While Belgians are positively stimulated and thus exhibit a higher probability of reporting high desire compared to their control group, Italians display a notably lower probability compared to both the Belgians exposed to an optimistic vignette and the Italian control group. On the other hand, Belgian respondents consistently show higher probabilities of selecting low desire than Italians. Although the differences are not as pronounced as those observed for high desire, common patterns emerge. The pessimistic vignette leads to an increased probability of reporting low desire compared to the respective control groups, while the optimistic scenario generally yields percentages similar to the control group for both nationalities.

Figure 3: Predicted probabilities of low and high fertility desire by climate change scenario (optimistic, pessimistic, and control group), considering nationality (Belgian and Italian)

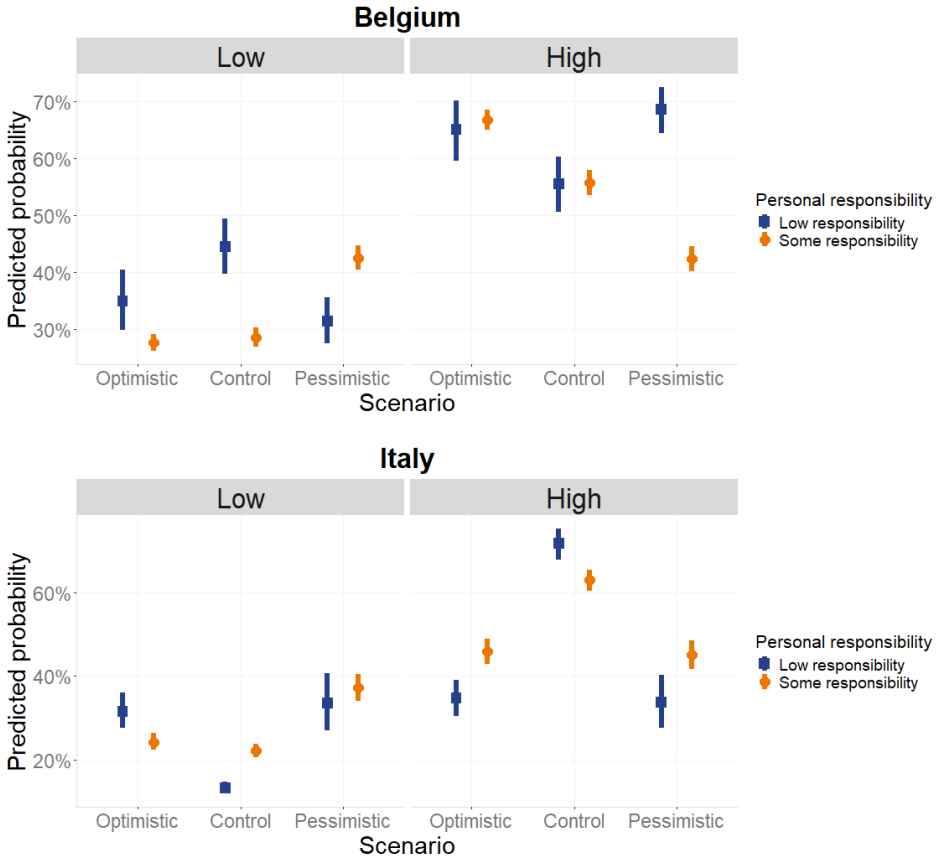


Note: explanatory variables set at the following mean values for gender (0 male; 1 female), age, sexual orientation (0 non-heterosexual; 1 heterosexual), relationship status (0 unpartnered; 1 partnered): gender (0.61), age (22.08), sexual orientation (0.80), and relationship status (0.48).

5.3 Role of personal responsibility

We next investigate the role of feelings of personal responsibility, by estimating how they interact with the climate vignettes. Due to the extremely low percentage of individuals feeling no responsibility (see Table 2), it was dummy coded as (no or) 'low responsibility' (i.e., categories 1, 2) versus at least 'some responsibility' (i.e., categories 3, 4, 5). Figure 4 depicts the variation in predicted desires across the groups, considering exposure to the scenarios and taking into account the interaction between receiving a scenario and perceived responsibility (see M5 and M6 in the Appendix).

Figure 4: Predicted probabilities of low and high fertility desire by climate change scenario (optimistic, pessimistic, and control group), considering level of personal responsibility (low and some)



Note: explanatory variables set at the following mean values for gender (0 male; 1 female), age, sexual orientation (0 non-heterosexual; 1 heterosexual), relationship status (0 unpartnered; 1 partnered): (for the Belgian sample) gender (0.60), age (21.57), sexual orientation (0.80), and relationship status (0.40); (for the Italian sample) gender (0.62), age (22.90), sexual orientation (0.79), and relationship status (0.60).

In Belgium a distinct difference emerges, specifically in the case of the pessimistic scenario. The results align with expectations, indicating that individuals who receive a pessimistic scenario are significantly and differently affected depending on their sense of personal responsibility. When considering Belgians exposed to a pessimistic vignette, those who report low or non-existent responsibility have a similar predicted probability

of high desire (or even slightly higher) compared to those exposed to the optimistic vignette. Conversely, individuals with some level of responsibility exhibit a significantly lower likelihood of reporting high desire when confronted with the pessimistic scenario. Similarly, those who report low responsibility are less likely to report low desire when exposed to a pessimistic scenario, while they are more likely to do so when exposed to an optimistic scenario.

Among Italians, when considering the predicted probabilities of reporting high desire, the effects of the vignettes are relatively similar, with higher percentages for those with some responsibility and lower percentages for those with low responsibility. Regarding low desire, there is a small difference when exposed to the optimistic scenario, revealing higher percentages among those with a lower sense of responsibility.

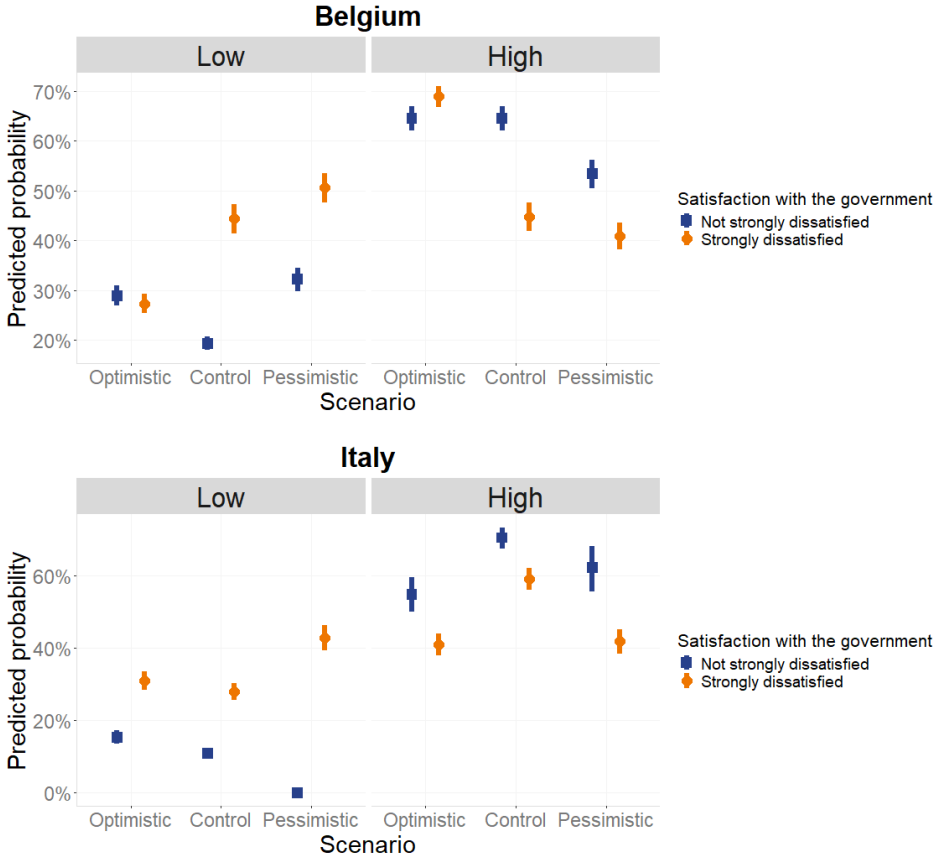
5.4 Role of trust in the government's actions

As shown in Table 2, the overall sentiment leans toward dissatisfaction with government. Notably, there is a higher percentage of strong dissatisfaction among Italian respondents, with 67.3% being strongly dissatisfied compared to 48.7% of Belgians. Given the distribution of this variable, we decided to dummy code this one as well. We distinguished between those strongly dissatisfied with government (category 5 in Table 2) and the rest (categories 1–2–3–4). Note that in some groups the sample size is very small, which undermines the stability of our estimate. In the Italian sample, only 32.7% of respondents did not report being strongly dissatisfied, which yields notably small sample sizes when crossed with the vignettes.

The plots in Figure 5 present predicted desire by country, considering exposure to the scenarios and taking into account the interaction between receiving a scenario and being dissatisfied with government (see M7 and M8 in the Appendix). The plots illustrate a difference in predicted desire based on the level of satisfaction.

Among Belgians, consistent and significant differences are found among respondents exposed to the pessimistic scenario. Those who report being strongly dissatisfied with the government's actions are less likely to report high desire and more likely to report low desire compared to those who are not strongly dissatisfied. In the Italian sample, consistent with previous findings, both experimental groups experience similar patterns. Those who are strongly dissatisfied are less likely to report high desire and more likely to report low desire, regardless of whether the vignette was optimistic or pessimistic.

Figure 5: Predicted probabilities of low and high fertility desire by climate change scenario (optimistic, pessimistic, and control group), considering the level of satisfaction with government's action to tackle climate change (strongly dissatisfied and not strongly dissatisfied)



Note: explanatory variables set at the following mean values for gender (0 male; 1 female), age, sexual orientation (0 non-heterosexual; 1 heterosexual), relationship status (0 unpartnered; 1 partnered): (for the Belgian sample) gender (0.60), age (21.56), sexual orientation (0.80), and relationship status (0.40); (for the Belgian sample) gender (0.62), age (22.90), sexual orientation (0.79), and relationship status (0.61).

6. Discussion and conclusion

The presented results provide some suggestive insights into the impact of climate change scenarios on fertility desires, revealing distinct effects in the Italian and the Belgian samples.

For Belgian students, our findings reveal a higher likelihood of reporting a high fertility desire when exposed to an optimistic climate vignette and a lower likelihood of high desire when exposed to the pessimistic scenario, compared to the control group. These effects are mirrored when examining the pattern of responses expressing low fertility desire. Conversely, Italians experience a negative impact from the experimental stimuli in both cases, suggesting that exposure to both optimistic and pessimistic climate change scenarios has a similar effect on fertility desires. Predicted desire is notably similar between the two experimental groups when considering high desire. However, when examining predicted low desire, the pessimistic vignette yields a higher probability of respondents selecting this option compared to the optimistic scenario, although both are higher than in the control group.

The visualisation of the differences by nationality allowed us to delve deeper into the previously identified results. Generally, the predictions differ consistently and significantly between the two countries, except for the pessimistic vignette in the outcome of high fertility. In this instance, both countries experienced a lower probability of reporting high desire compared to their respective control groups.

These findings are in line with Hypothesis 1a, as both Belgian and Italian respondents exposed to the pessimistic scenario show a lower probability of reporting high fertility desire compared to their control groups. However, for Hypothesis 1b we only find support in the Belgian context, where exposure to the optimistic scenario resulted in higher desire compared to the control group. Conversely, in the case of Italy, outcomes deviated from expectations, with the effect of the optimistic vignette being generally similar to that of the pessimistic vignette, leading to lower fertility desire compared to the control group. As a result, Hypothesis 1b is rejected in the Italian context.

To better comprehend the differences between the two countries, we analysed the role of two variables that may offer further insights. The first variable is the level of personal responsibility. Given that more Belgians report that they feel a high level of personal responsibility regarding climate change, differences in the distribution of this variable may explain variation in the responses. The analysis indeed reveals that personal responsibility plays a role in respondents' answers. Among Belgians, a significant difference is found among those reporting some responsibility and the others when exposed to a pessimistic scenario. Among Italians the effect is less evident, with similar differences between the two groups when looking at the probability of expressing a high desire (i.e., in both cases, those with high responsibility are more likely to report high

desire). Hence, Hypothesis 2 needs to be rejected in the Italian case, as the role of personal responsibility was found to be as expected only in the Belgian sample.

When considering the influence of personal satisfaction regarding government actions to address climate change, it appears that both Belgians and Italians exposed to a pessimistic scenario are less likely to express a high fertility desire and more inclined to report a low desire if they are highly dissatisfied with the government's actions. These results are in line with Hypothesis 3, as the satisfaction with environmental actions moderated the effects of the vignettes. However, consistent with the other findings, it is important to note that the Italian sample reacted similarly to the pessimistic and the optimistic scenarios.

Some limitations should be noted. First, our non-random sampling method prevents the generalisability of our results. We do not have information on the precise location of respondents. This is particularly significant, given the profound regional differences in both Belgium and Italy. Moreover, there are further limitations related to the implementation of the experiment design. Conducting experiments in a controlled physical setting is typically preferred in experimental research, as it ensures greater control over the procedures (Vignoli et al. 2022). Due to the online nature of this study, the level of control in this research is limited. Specifically, the absence of experimental control during the questionnaire administration introduces uncertainty as to whether respondents have thoroughly read the climate change texts. This is particularly relevant given that both scenarios commence with an identical brief depiction of the overall negative situation. This common introduction may partially account for the unexpected outcomes associated with the optimistic vignette, particularly evident in Italy.

The presence of outliers in the survey completion duration raises further concerns. On one hand, there are individuals who completed the survey remarkably quickly, within around a minute, prompting questions about the thoroughness of their engagement with the content and stimuli provided. On the other hand, some respondents took an unusually long time to complete the survey. Since we lack information on the time taken for respondents to answer each question, we cannot determine if and when they paused. Therefore, it is possible that they read the text on climate change and then answered about their desires days later.

Moreover, the order of questions plays a crucial role. While the inclusion of questions related to climate change aids obtaining a clearer understanding of the sample composition, it may also exert influence on the responses to the presented vignettes. The comparison lacks a totally unstimulated group, as even the control group received questions related to climate change. Consequently, their opinions may have already been influenced by them thinking about this topic. Furthermore, even the exposure to an optimistic climate scenario might trigger respondents to weigh the impact of having children on climate change, just like exposure to a pessimistic scenario rather than no

scenario exposure. This could explain the negative effect of both the optimistic and the pessimistic vignettes on the fertility desires of the Italian students. Remarkably, however, the effect of the optimistic scenario runs in a different direction in the Belgian case than in the Italian case: among Belgian students, exposure to the optimistic scenario leads to the expression of higher fertility desires as opposed to the negative effect of exposure to the pessimistic scenario.

Lastly, it is important to consider the context in which the data were collected. The collection took place only a few months after the political elections in Italy (September 2022). Therefore, it is plausible to assume that in this context the potential dissatisfaction with the election results prompted respondents to express greater dissatisfaction than they would have in other circumstances.

Nevertheless, these findings underscore the pivotal role of integrating climate change considerations into fertility-related research. The use of randomly assigned vignettes in our study allows us to evaluate the short-term impact of exposure to climate change scenarios on fertility desires in the two student groups. Furthermore, our research has shown substantial disparities between Belgium and Italy, underscoring the context-dependent nature of both climate change concern and the desire to have children. Future research should delve deeper into contextual factors, investigating whether the differences identified in this analysis extend to a more comprehensive sample.

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Appendix

Table A-1: Estimates (logit coefficients) of multinomial logit models on fertility desires

	M1 Belgian sample (N = 251)				M2 Italian sample (N = 153)			
	High Desire		Low desire		High Desire		Low desire	
	Coeff.	P-value	Coeff.	P-value	Coeff.	P-value	Coeff.	P-value
Scenario Control group (ref.)								
Optimistic	1.207	0.050	0.923	0.150	–1.127	0.031	–0.499	0.407
Pessimistic	–0.000	1.000	0.426	0.428	–0.718	0.219	0.291	0.655
Male (ref.)								
Female	0.002	0.996	0.814	0.096	–0.580	0.243	–1.046	0.066
Age	0.085	0.375	0.148	0.131	0.168	0.167	0.287	0.022
Non-heterosexual (ref.)								
Heterosexual	1.247	0.022	0.037	0.944	1.531	0.011	–0.775	0.158
Unpartnered (ref.)								
Partnered	0.301	0.540	–0.075	0.884	0.220	0.630	1.409	0.012
	M3 Entire dataset (N = 404)				**M4 Entire dataset** (N = 404)			
	High desire		Low desire		High desire		Low desire	
	Coeff.	P-value	Coeff	P-value	Coeff.	P-value	Coeff	P-value
Scenario Control group (ref.)								
Optimistic	–0.007	0.985	0.020	0.961	1.310	0.029	1.047	0.096
Pessimistic	–0.411	0.285	0.112	0.783	–0.003	0.995	0.378	0.480
Male (ref.)								
Female	–0.181	0.571	0.224	0.519	–0.315	0.338	0.125	0.724
Age	0.085	0.222	0.160	0.026	0.113	0.127	0.184	0.015
Non-heterosexual (ref.)								
Heterosexual	1.132	0.003	–0.403	0.268	1.264	0.002	–0.310	0.400
Unpartnered (ref.)								
Partnered	0.393	0.226	0.425	0.221	0.324	0.327	0.388	0.268
Belgian (ref.)								
Italian	–1.107	0.001	–1.278	0.000	–0.131	0.806	–0.644	0.269
Optimistic scenario x Italian					–2.367	0.003	– 1.626	0.057
Pessimistic scenario x Italian					–0.748	0.331	–0.423	0.603

Table A-1: (Continued)

	M5: Belgian sample (N = 251)				M6: Italian sample (N = 151)			
	High Desire		Low desire		High Desire		Low desire	
	Coeff.	P-value	Coeff.	P-value	Coeff.	P-value	Coeff.	P-value
Scenario Control group (ref.)								
Optimistic	2.734	0.000	2.333	0.000	–1.529	0.167	0.065	0.959
Pessimistic	4.918	0.000	4.356	0.000	–1.531	0.253	1.148	0.923
Male (ref.)								
Female	0.325	0.491	1.045	0.037	–0.618	0.229	–1.131	0.055
Age	0.101	0.302	0.156	0.120	0.160	0.191	0.287	0.022
Non-heterosexual (ref.)								
Heterosexual	1.176	0.033	–0.083	0.876	1.560	0.011	–0.789	0.156
Unpartnered (ref.)								
Partnered	0.128	0.799	–0.225	0.667	0.241	0.602	1.476	0.010
Low responsibility (ref.)								
Some personal responsibility	–14.172	0.000	–14.621	0.000	–0.118	0.903	0.525	0.640
Optimistic scenario x High responsibility	–1.531	0.008	–1.346	0.024	0.521	0.677	–0.665	0.642
Pessimistic scenario x High responsibility	–5.163	0.000	–3.927	0.000	1.022	0.491	0.197	0.906

	M7: Belgian sample (N = 250)				M8: Italian sample (N = 149)			
	High Desire		Low desire		High Desire		Low desire	
	Coeff.	P-value	Coeff.	P-value	Coeff.	P-value	Coeff.	P-value
Scenario Control group (ref.)								
Optimistic	0.899	0.246	1.302	0.125	–0.722	0.398	–0.136	0.911
Pessimistic	–0.082	0.899	0.617	0.397	–0.836	0.403	–13.151	0.000
Male (ref.)								
Female	0.006	0.990	0.780	0.115	–0.721	0.171	–1.218	0.043
Age	0.069	0.470	0.121	0.219	0.177	0.164	0.279	0.034
Non-heterosexual (ref.)								
Heterosexual	1.231	0.025	0.016	0.976	1.548	0.011	–0.623	0.281
Unpartnered (ref.)								
Partnered	0.246	0.619	–0.217	0.678	0.259	0.579	1.340	0.020
Not strongly dissatisfied (ref.)								
Strongly dissatisfied	0.023	0.975	1.219	0.116	1.178	0.822	1.292	0.191
Optimistic scenario x Strong dissatisfaction	0.585	0.626	–0.733	0.563	–0.417	0.702	–0.532	0.707
Pessimistic scenario x Strong dissatisfaction	0.234	0.826	–0.244	0.828	0.330	0.791	13.419	0.000