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Interactions between concerns for the environment and other sources of concern in 31 European countries

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Abstract

Understanding how different sources of concern interact in people's mind is a question that has entertained generations of scholars. The finite-pool-of-worry (FPW) hypothesis states that humans have limited resources to worry, thus when they are worried about one issue they become less worried about other issues. Instead, the affect generalization theory (AGT) posits that an increased level of worry about one threat increases concerns about related threats. To this end, we adopt a Lotka–Volterra model to detect instances of AGT and FPW among worries for the environment, economy, safety, social issues and immigration in 31 European countries between 2012 and 2019 (Eurobarometer data). Consistently with AGT, we find that an increase in the concern for the environment often favors the growth of concerns for the economy. Meanwhile, consistently with FPW, an increase in the concerns for the economy and for other sources of worry, often pushes down concerns for the environment. Building on our results, we hypothesize the existence of a pyramid of worries. At the bottom of the pyramid lie worries like concerns for the economy, which generally predate other worries. Concerns for the environment lie at the very top of the pyramid as they are generally predated by other worries. Last, we find that AGT and FPW can coexist not only over time and across countries, but also as a result of an asymmetric interaction.

1. Introduction

Worries are closely tied to behaviors and personal preferences (Loewenstein *et al* 2001, Leiserowitz *et al* 2007, van der Linden *et al* 2019). How much people worry about the environment influences whether they adopt pro-environmental behaviors and their support for policies aimed at climate change mitigation (Leiserowitz 2006, Bouman *et al* 2020). In turn, how worried people are about the environment is likely to depend on how worried they are about other issues, like the state of the economy (Whitmarsh 2011, Scruggs and Bengal 2012). Thus, it is important to understand how concerns for the environment interact with other sources of concerns.

There are two main theories that aim to explain the interaction among different sources of worries: the 'finite-pool-of-worry' (FPW) hypothesis (Weber 1997, Hansen 2004), and the affect generalization theory (AGT) (Johnson and Tversky 1983). The FPW hypothesis moves from the observation that humans face cognitive resources constraints (Simon 1957), and hence they can only have a FPWs (Shome and Marx 2009). Directly testing the existence of a FPWs would require measuring the overall level of worry across all possible sources of concern over time. This is unlikely to be feasible, so the empirical literature operationalizes the FPW theory somewhat differently, and equates it with the idea that if people become more worried about one issue they will be less

Table 1. The possible interactions between pairs of worries

Interaction	Description of the interaction	AGT & FPW
Pure competition	The competing worries A and B suffer from each other's existence	FPW from A to B and from B to A
Predator–prey	Predator-worry (A) benefits from prey-worry (B). Prey-worry suffers from predator-worry	FPW from A to B. AGT from B to A
Mutualism	Symbiosis or a win-win situation between worries	AGT from A to B and from B to A
Commensalism	One worry (B) is positively affected by the other (A), while the other (A) is not affected by the first worry (B)	AGT from A to B
Amensalism	One worry (B) is negatively affected by the other (A), while the other (A) is not affected by the first worry (B)	FPW from A to B
Neutralism	No interaction	No AGT or FPW

concerned about something else (Hansen *et al* 2004, Sisco 2020, Evensen *et al* 2021). Instead, the AGT posits that concerns over one potential threat can be transferred to other worries via associative networks. Consequently, an increased level of worry about one potential threat would induce a person to worry more about related threats.

Studying how concerns for the environment interact with other sources of concern is complicated by three factors. First, the relationships are mediated by exogenous and endogenous factors, and hence are likely to change over time. Second, directly asking about the relationship among sources of worries is unlikely to produce reliable answers, as people might not be aware of how sources of concern interact in their mind. Third, interactions can be asymmetric. For instance, a growth in the worry for the environment might favor the growth of concerns for the economy, whereas an increase in the concerns for the economy might push down concerns for the environment. Against this background, it is unsurprising that, despite the obvious practical relevance of the research question, there are only a few studies analyzing how different concerns interact over time (Sisco 2020, Evensen *et al* 2021).

To fill this gap, we collect data on personal worries in 31 countries between 2012 and 2019 from the *Eurobarometer* (2021), the polling instrument of the European Union. We account for all possible answers, and aggregate them in the following categories of concerns: environment, safety, economy, immigration, and social issues (see table 2).

To identify the dynamic interactions among these categories of concerns, and—hence to detect instances of AGT and FPW—we adopt the competition model introduced in Marasco *et al* (2016). This Lotka–Volterra type model presents three fundamental advantages. First, it can capture all the possible kinds of interactions among an arbitrarily large number of worries (see table 1) and thus detect instances of AGT and FPW. Second, the model can identify how the kind and the intensity of these interactions evolves over time. Third, since the analytic

solutions of the model are known, the interaction coefficients—and hence the existing interactions among worries—can be determined using a limited number of observations.

In our framework, three kinds of interactions fit within the FPW: pure competition, predator–prey (the effect of the predator-worry on the prey-worry), and amensalism. When two sources of worry are in pure competition an increase in one worry pushes down the other. Similarly, when the concerns for the predator-worry increase, the concerns for the prey-worry are pushed down. The same interaction exists in amensalism from one worry to the other. These dynamics are consistent with how the empirical literature operationalizes the FPW hypothesis (Sisco 2020, Evensen *et al* 2021), and therefore we label them 'FPW interactions'.

Similarly, three kinds of interactions fit within the AGT: mutualism, predator–prey (the effect of the prey-worry on the predator-worry), and commensalism. When two sources of worry are in a mutualistic relationship an increase in one worry favors the growth of the other. Similarly, an increase in the concern for the prey-worry favors the growth of the predator-worry. The same interaction exists in commensalism from one worry to the other. These dynamics are consistent with how the empirical literature operationalizes the AGT, and therefore we label them 'AGT interactions'.

In our modeling framework, FPW interactions from worry A to B emerge when the interaction coefficient g_B of B is positive or when $g_B = 0$ and $g_A > 0$. On the contrary, AGT interactions occur when g_B is negative or when $g_B = 0$ and $g_A < 0$ (see table 3). Then, in contrast of the established literature, identifying the emergence of the FPW and AGT interactions is extremely easy.

The FPW hypothesis and the AGT have previously been portrayed as mutually exclusive (Sisco 2020), but our modeling framework suggests that they can coexist in three instances. First, when two sources of worry are in a predator–prey relationship the dynamic that emerges is consistent with the

FPW hypothesis from the predator-worry to the prey-worry, and simultaneously consistent with the AGT from the prey-worry to the predator-worry. This is because predator–prey is an *asymmetric interaction*, in which the effect of the predator-worry on the prey-worry is of the opposite sign to the effect of the prey-worry on the predator-worry (Dominioni *et al* 2020).

Second, the kind of interactions among worries changes over time and across countries. Thus, it is possible that a pair of worries is in FPW interactions for a period (and/or a country) and in AGT interactions for another. Third, for a given time interval if there are multiple worries it is possible that some worries stand in FPW interaction, whereas other stand in AGT interactions.

2. Methods

2.1. Data collection and aggregation, the logit model

The analysis is based on the public opinion data on personal worries collected by the *Eurobarometer* between 2012 and 2019. We consider all the 31 countries for which complete data is available. Each European Barometer survey consisted of approximately 1000 face-to-face interviews per country. As we are interested in personal worries, we focus on the question '*Personally, what are the two most important issues you are facing at the moment? (max. 2 answers)*'. The data is reported in terms of percentages of people who indicated a given worry.

The possible answers to the question were: (a) crime, (b) the economic situation, (c) rising prices/inflation/cost of living, (d) taxation, (e) unemployment, (f) terrorism, (g) housing, (h) the financial situation of your household, (i) immigration, (j) health and social security, (k) the education system, (l) the environment, climate and energy issues, (m) pensions, (n) working conditions, (o) living conditions, (p) defence/foreign affairs, (q) other, (r) none, and (s) do not know. We consider all possible answers that were included in the years considered (see SI). We aggregate all worries in five categories, and consider the answers *other, none and do not know* as a residual category (see table 2). To statistically support our grouping into categories we carried out a factor analysis both exploratory (to identify the hidden factors) and confirmatory (to validate the proposed clusterization). However, all the tests we carried out confirmed that the data matrix is not factorizable. For instance, the Kaiser–Meyer–Olkin value for the data aggregated at EU level is 0.393, which is much below the acceptable level (Watkins 2018). Similarly, the dataset fails also the Haitovsky multicollinearity test. This was not surprising as the data from the Eurobarometer gives us only aggregated data, making

the number of observations lower than the parameters that need to be estimated.

Let $W_{i,j}(t)$ be the total number of respondents in the jth country that at time t indicated a worry included in the ith category, i.e.:

$$W_{i,j}(t) = \sum_{h_i=1}^{n_i} w_{h_i,j}(t), \quad i = 0, \ldots, 5, \quad j = 1, \ldots, 31,$$

(1)

where $w_{h_i,j}$ is the number of respondents indicating the worry h_i belonging to the ith category, and n_i is the number of worries of the ith category for the jth country.

Then, the shares $P_{i,j}(t)$ at time t for the categories environment ($i = 1$), safety ($i = 2$), economy ($i = 3$), immigration ($i = 4$), social issues ($i = 5$), and outside option ($i = 0$) for the jth country are determined as follows:

$$P_{i,j}(t) = \frac{W_{i,j}(t)}{\sum_{h=0}^{5} W_{h,j}(t)}, \quad i = 0, \ldots, 5, \quad j = 1, \ldots, 31.$$

(2)

We identify the shares $P_{i,j}(t)$ with the probability of choosing the category i from all possible categories via the *logit model*, i.e.:

$$P_{i,j}(t) = \frac{\exp(f_{i,j}(t))}{\sum_{h=0}^{5} \exp(f_{h,j}(t))}, \quad i = 0, \ldots, 5, \quad j = 1, \ldots, 31,$$

(3)

where $f_{i,j}(t)$ is the *utility function* for a respondent of jth country to choose a worry in the ith category at time t. In particular, each utility function $f_{i,j}(t)$ is defined as a (linear or nonlinear) function of all aspects and attributes impacting the choice among alternative worries. Furthermore, since the category *Outside option* ($i = 0$) plays the role of the *outside good*, then equation (3) becomes:

Table 2. Aggregation of worries in categories.

Category	Issues
Environment	Environment, climate and energy issues
Safety	Crime, terrorism
Economy	Economic situation, rising prices/inflation/cost of living, taxation, unemployment, the financial situation of your household, pensions, working conditions
Immigration	Immigration
Social issues	Health and social security, the education system, living conditions, housing
Outside option	Other, none, do not know

$$P_{i,j}(t) = \frac{\exp(f_{i,j}(t))}{1 + \sum\limits_{h=1}^{5} \exp(f_{h,j}(t))},$$

$$i = 1, \ldots, 5, \quad j = 1, \ldots, 31$$

$$P_{0,j}(t) = \frac{1}{1 + \sum\limits_{h=1}^{5} \exp(f_{h,j}(t))}, \qquad (4)$$

where $P_{0,j}(t) = 1 - \sum\limits_{i=1}^{5} P_{i,j}(t)$ at any time t.

2.2. Dynamical competition model of Lotka–Volterra type

Assuming that all the utility functions $f_{i,j}(t)$ are of class $C^2([t_0, +\infty))$, it can be proved that equation $(4)_1$ are the unique (global) solution of the following Cauchy problem:

$$\begin{cases} \dfrac{dP_{i,j}(t)}{dt} = g_{i,j}(t) P_{i,j}(t) \left[1 - P_{i,j}(t)\right] - \sum\limits_{h=1, h \neq i}^{5} g_{h,j}(t) P_{h,j}(t) P_{i,j}(t), \quad i = 1, \ldots, 5, \\[4mm] P_{i,j}(t_0) = \dfrac{\exp(f_{i,j}(t_0))}{1 + \sum\limits_{h=1}^{5} \exp(f_{h,j}(t_0))} \qquad\qquad t \in [t_0, +\infty), \end{cases} \qquad (5)$$

where $g_{i,j} = df_{i,j}/dt$ and $j = 1, \ldots, 31$.

For each country, the share $P_{i,j}(t)$ of the ith category increases when its utility function $f_{i,j}(t)$ increases, whereas it decreases when the utility function $f_{h,j}(t)$ of any other category increases. Thus, owing to equation (5), the evolution of the share $P_{i,j}(t)$ of the ith category for the jth country is mathematically determined by the intrinsic growth rate function $g_{i,j}(t)$ and the competition functions $g_{h,j}(t)$ between the ith and hth categories. Then, at any time and for any given country, the competitive interactions between any pair of categories—and therefore the presence of AGT and FPW interactions, or both—are determined by the signs of the functions $g_{i,j}(t)$ according to table 3.

Furthermore, owing to table 3, except for when amensalism or commensalism may occur, the AGT and FPW interactions between all worry categories $P_{i,j}$ and a fixed category $P_{h,j}$, for all $i \neq h$, only depend on sign of the interaction coefficient $g_{h,j}$ (see SI).

To determine the utility functions—and hence the interactions coefficients—from the historical data of the categories of worry we first determine a discrete set of values for each of them as follows:

$$f_{i,j}(t) = \ln P_{i,j}(t) - \ln P_{0,j}(t), \quad \forall i, j, \qquad (6)$$

then we use a *Fourier series of order n* to obtain an approximate analytical form of these functions.

In figures 1–3, as an example, we present the results of our model for Germany. The results for all the countries can be found in the appendix.

Figure 1 right panel shows the simultaneous interactions among all sources of worries, whereas figure 2

highlights how the category environment interacts with each of the other categories.

In figure 3 we show AGT and FPW interactions of Environment versus Safety and Economy and vice versa for the Germany in the time interval 2012–2019. We assess the accuracy of our model using the *mean square error (MSE)* and we found that for all countries and categories, the order of magnitude of the MSE is between 10^{-6} and 10^{-4} (see appendix table 1).
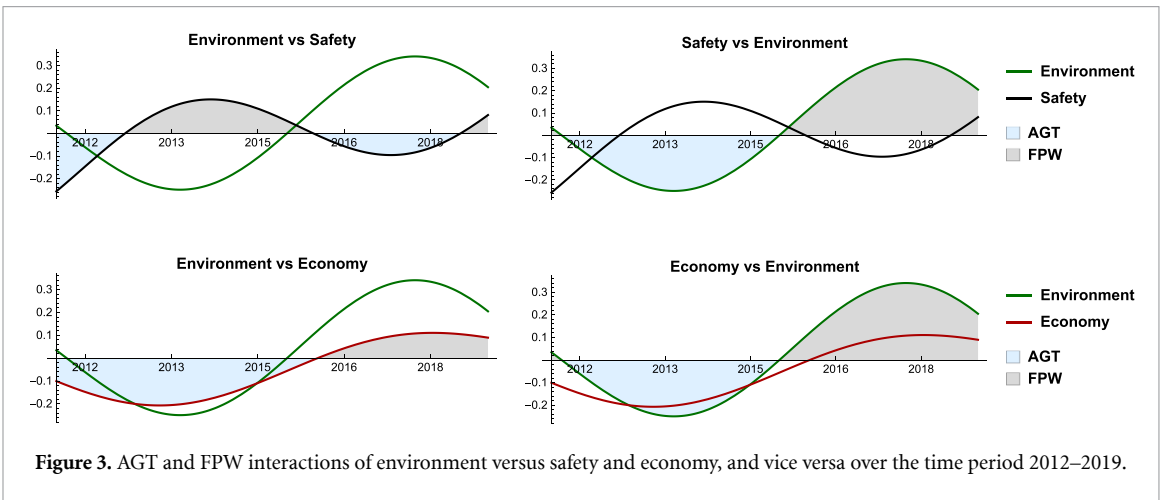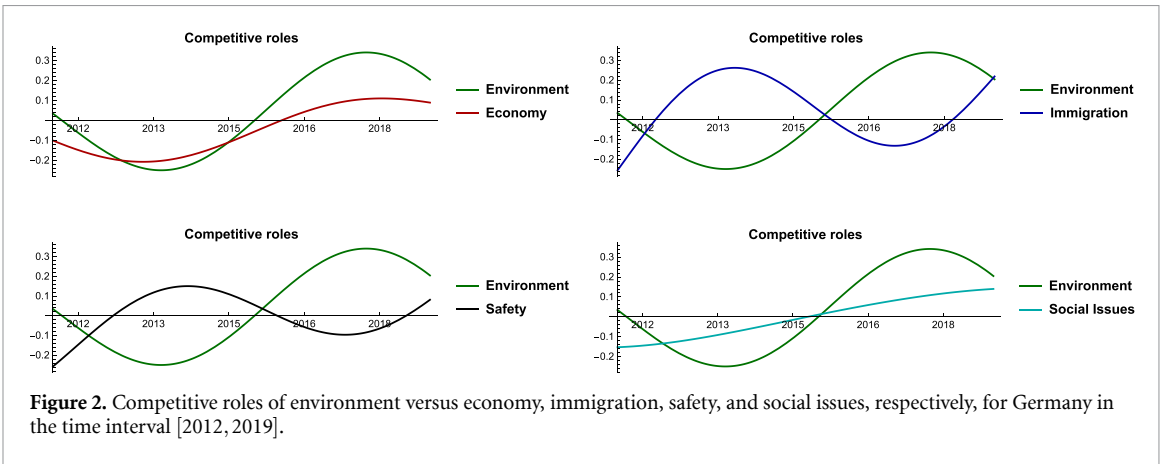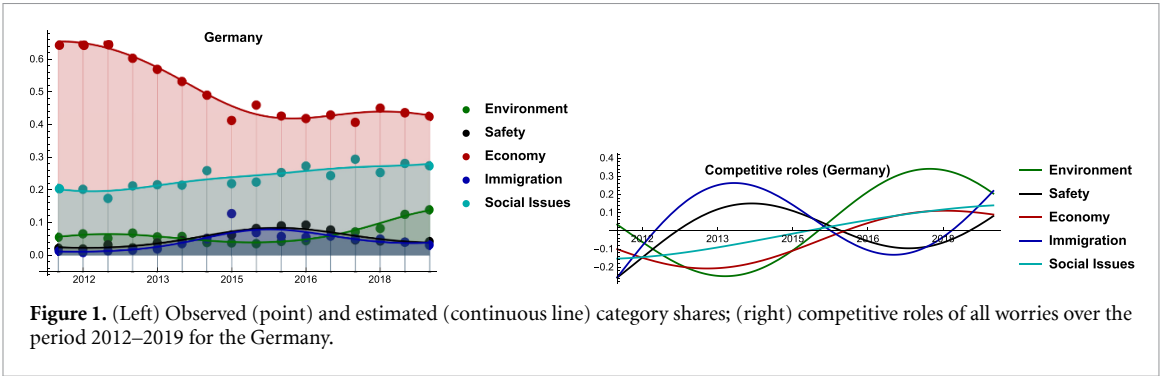
2.3. Statistical test

We use the paired t-test to assess whether (a) the averages of the relative frequency distributions of AGT and FPW among the concerns differ; (b) the averages of the relative frequency distributions of AGT between any pairs of concerns, e.g. environment vs economy and environment vs safety, differ.

Let $data_1$ and $data_2$ be a paired samples of equal length $n = 31$. After verifying that the differences distribution $data_1 - data_2$ forms a sample from a normal population, we test whether the mean of $data_1 - data_2$ is zero using the Student paired t-test. In detail, we test the null hypothesis $H_0 : \mu_{12} = \mu_0$ against the alternative hypothesis $H_0 : \mu_{12} \neq \mu_0$, where μ_{12} is the mean of the paired differences of the two data sets $data_1 - data_2$ and $\mu_0 = 0$. The test statistic is assumed to follow a Student distribution, and the null hypothesis H_0 is rejected only if $p < \alpha$, where the significance level α is set to 0.05.

We find that the null hypothesis H_0 is rejected in all cases except for the averages of the relative frequency distributions of AGT and FPW for environment vs safety (see appendix table 2–4).

Table 3. The competitive roles between any pair of categories $P_{i,j}(t)$ and $P_{h,j}(t)$ for the jth country and their relationships with FPW and AGT interactions.

$g_{i,j}$	$g_{h,j}$	Type of interaction	$P_{i,j} \longrightarrow P_{h,j}$	$P_{h,j} \longrightarrow P_{i,j}$
$+$	$+$	Pure competition	FPW	FPW
$-$	$+$	Predator–prey	FPW	AGT
$+$	0	Amensalism	FPW	$\diagup$
$-$	$-$	Mutualism	AGT	AGT
$+$	$-$	Prey–predator	AGT	FPW
$-$	0	Commensalism	AGT	$\diagup$
0	0	Neutralism	$\diagup$	$\diagup$

Figure 1. (Left) Observed (point) and estimated (continuous line) category shares; (right) competitive roles of all worries over the period 2012–2019 for the Germany.

Figure 2. Competitive roles of environment versus economy, immigration, safety, and social issues, respectively, for Germany in the time interval $[2012, 2019]$.

Figure 3. AGT and FPW interactions of environment versus safety and economy, and vice versa over the time period 2012–2019.

3. Results

3.1. Finite-pool-of-worry and affect generalization theory coexist

First, we investigate whether FPW and AGT can simultaneously coexist within a given pair of worries. In our framework, this condition is realized when two worries are in a predator–prey interaction, i.e. when the interaction coefficients have opposite signs. In fact—consistently with the FPW hypothesis—an increase in the worry-predator pushes down the worry-prey, while—consistently with the AGT—an increase in the worry-prey favors the growth of the worry-predator.

Figure 4 indicates how often predator–prey relationships emerge between the various categories of worries on average across all countries. We observe that predator–prey interactions represent on average about 36% of the total interactions across all countries in all time periods. Moreover, we note that for all pairs of worries there are at least some instances in which AGT and FPW simultaneously coexist.

Second, we analyze whether the FPW hypothesis and the AGT alternate over time for a given pair of worries. To put it differently, we study if the kind of interaction among worries changes over time. As an example, in figure 5 we show how interactions consistent with FPW and AGT alternate over time in Denmark, Finland, France, Germany and United Kingdom. We observe that in all countries considered AGT and FPW interactions alternate for all pairs of worries. Third, figure 5 also shows that at a given moment there can be a pair of worries standing in an interaction that is consistent with one theory (e.g. AGT), while another pair stands in an interaction that is consistent with the other theory (e.g. FPW).

These results suggests that AGT and FPW cannot be portrayed as mutually exclusive when there are multiple sources of worries interacting in people's mind, and the way in which these worries interact changes over time.

3.2. The relationship between concerns about the economy and the environment
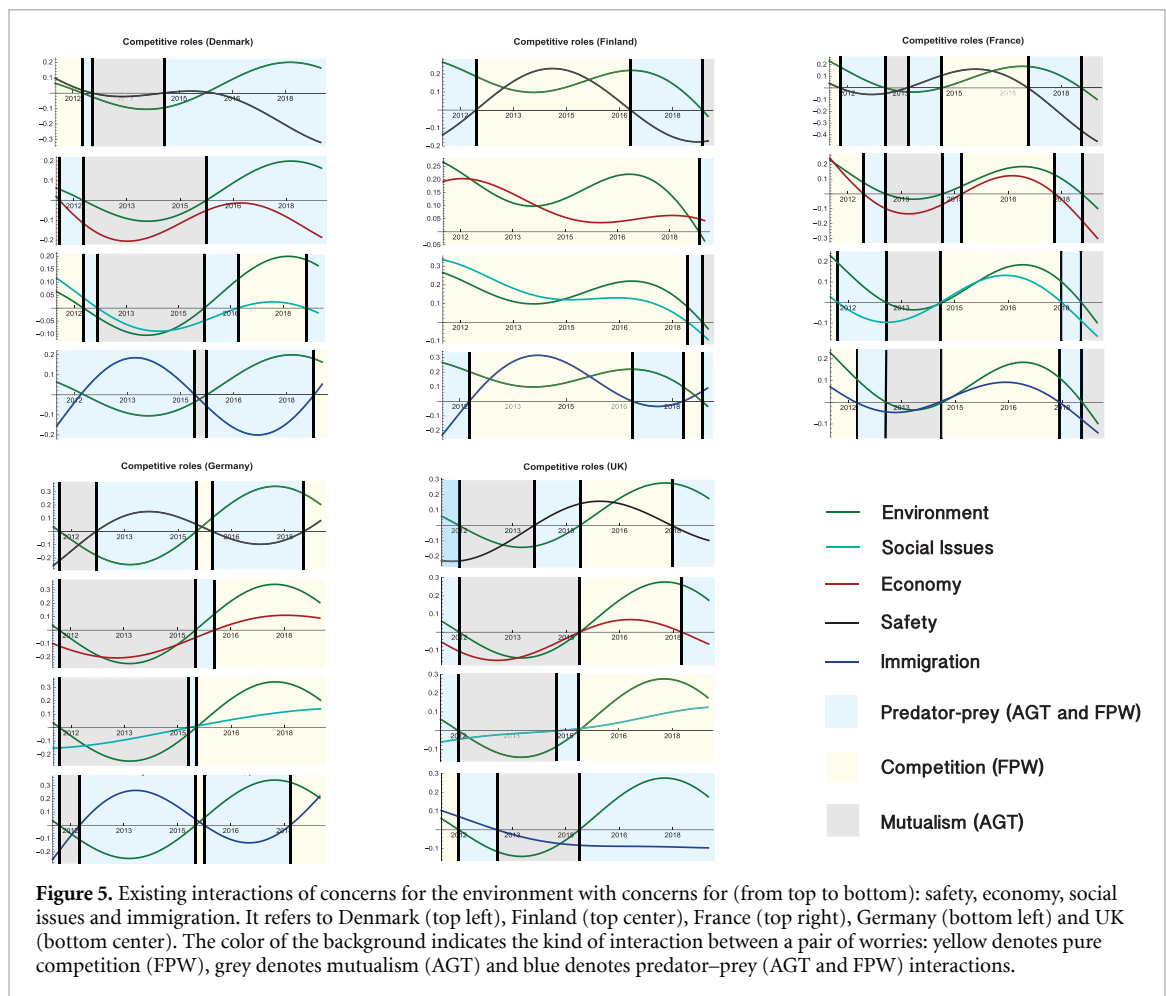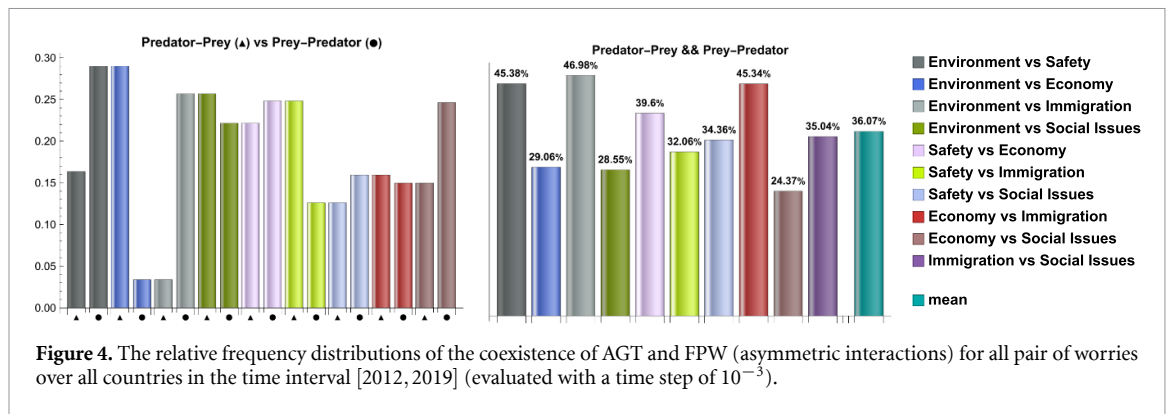
A large body of literature has investigated the relationship between the economy and the environment (Tiba and Omri 2017). For instance, an influential strand of literature emphasizes that—among other things—ecological limits place inescapable constrains on future economic growth, and therefore that countries should aim at managing economic degrowth (Kallis *et al* 2012). This literature reinforces the idea that there is a crucial relationship between the economy and the environment, which is why we focus our attention mostly on this relationship. However,

fewer studies investigate how people *perceive* this relationship. And yet this question is extremely relevant. First, concerns for the environment influence private actions (Bouman *et al* 2020), which in turn can have a significant impact on climate change (Dietz *et al* 2009). One key problem is that the effect on pro-environmental behaviors of extrinsic incentives is generally short-lived (Van Der Linden 2015). Instead, if people internalize that being concerned about the environment and acting accordingly is the right thing to do, then pro-environmental behaviors are more likely to be sustained over time (Van Der Linden 2015). Second, it is harder to implement policies to protect the environment and mitigate climate change if people are not concerned about global warming or the environment in general. 'To put it differently, it is people who are the drivers of, are affected by, and have the capacity to respond to global change' (Weaver *et al* 2014).

Turning to studies investigating the relationship between concerns for the environment and the economy, Whitmarsh (2011) observed that between 2003 and 2008 the perceived severity of climate change sharply declined. She attributed this effect to the looming financial crisis, thus suggesting that increased concerns about the economic situation might have decreased the concerns about climate change. Similarly, Scruggs and Benegal (2012) found that short term economic concerns—and especially unemployment—have a strong chilling effect on climate concerns.

Given the importance of this relationship, and the limited number of studies on the issue, we start by analyzing the impact of changes in concerns for the economy on concerns for the environment. We find that across all countries FPW interactions emerge 60.6% of the time, whereas AGT interactions only emerge 39.4% of the time. Thus, FPW interactions are almost 54% more frequent than AGT interactions (figure 6, right panel). This difference is statistically significant ($t = -3.3977$, $p = 0.0019$).

On the contrary, when focusing on the impact of changes in concerns for the environment on concerns for the economy we observe a prevalence of AGT interactions. On average, across the 31 countries considered AGT interactions emerge 61.7% of the times, whereas evidence for the FPW interactions emerge 38.3% of the times. Thus AGT interactions are approximately 61% more frequent (figure 6, left panel). This difference is statistically significant (paired *t*-test: $t = 3.4392$, $p = 0.0017$). We then turn to the single countries. We observe that when looking at the effect of concerns for the economy on concerns for the environment FPW interactions are more common in 21 countries (approximately 68%) (figure 6, right panel). Vice versa, in 27 out of 31 countries (approximately 87%) AGT interactions are more

Figure 4. The relative frequency distributions of the coexistence of AGT and FPW (asymmetric interactions) for all pair of worries over all countries in the time interval [2012, 2019] (evaluated with a time step of 10^{-3}).

Figure 5. Existing interactions of concerns for the environment with concerns for (from top to bottom): safety, economy, social issues and immigration. It refers to Denmark (top left), Finland (top center), France (top right), Germany (bottom left) and UK (bottom center). The color of the background indicates the kind of interaction between a pair of worries: yellow denotes pure competition (FPW), grey denotes mutualism (AGT) and blue denotes predator–prey (AGT and FPW) interactions.

common than FPW interactions when considering the effect of concerns for the environment on concerns for the economy (figure 6, left panel).

Taken together, these results suggest that the AGT is predominant when focusing on the effect of concerns for the environment on concerns for the economy. Therefore, it seems that people have internalized the economic consequences of environmental issues, and consequently concerns for the environment often favor the growth of concerns for the economy. However, our results also suggest that an increase in concerns for the economy pushes down a less immediate concern like the one for the

environment. This result is consistent with the findings of Whitmarsh (2011) and Scruggs and Benegal (2012).

3.3. The effect of concerns for the environment on other worries

Many studies have investigated the relationship between climate change and migratory dynamics. As the problems caused by climate change worsen, more people are displaced and migratory fluxes increase (Cattaneo *et al* 2020, Kaczan and Orgill-Meyer 2020). These dynamics suggest that AGT interactions should be predominant when analyzing the effect of concerns
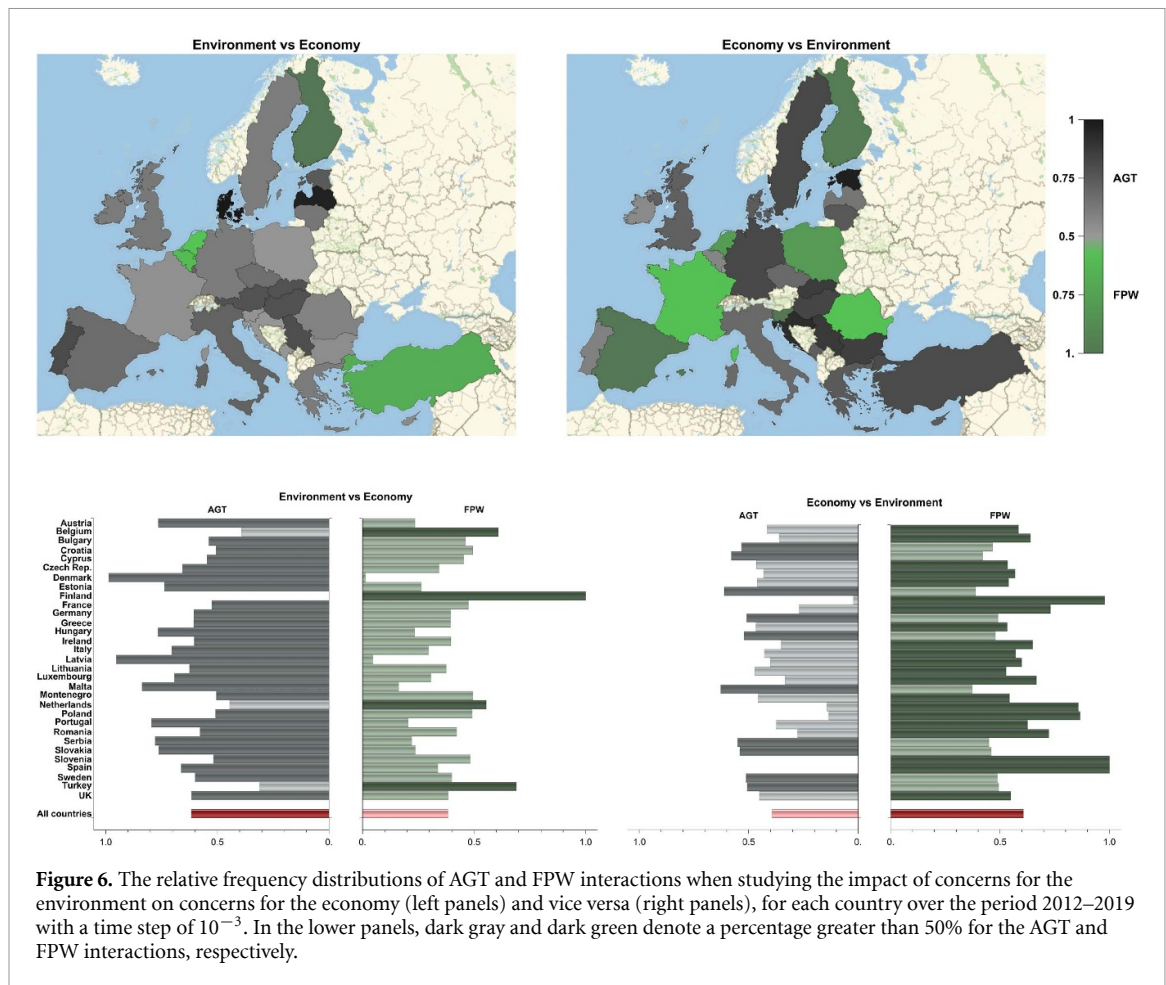
Figure 6. The relative frequency distributions of AGT and FPW interactions when studying the impact of concerns for the environment on concerns for the economy (left panels) and vice versa (right panels), for each country over the period 2012–2019 with a time step of 10^{-3}. In the lower panels, dark gray and dark green denote a percentage greater than 50% for the AGT and FPW interactions, respectively.
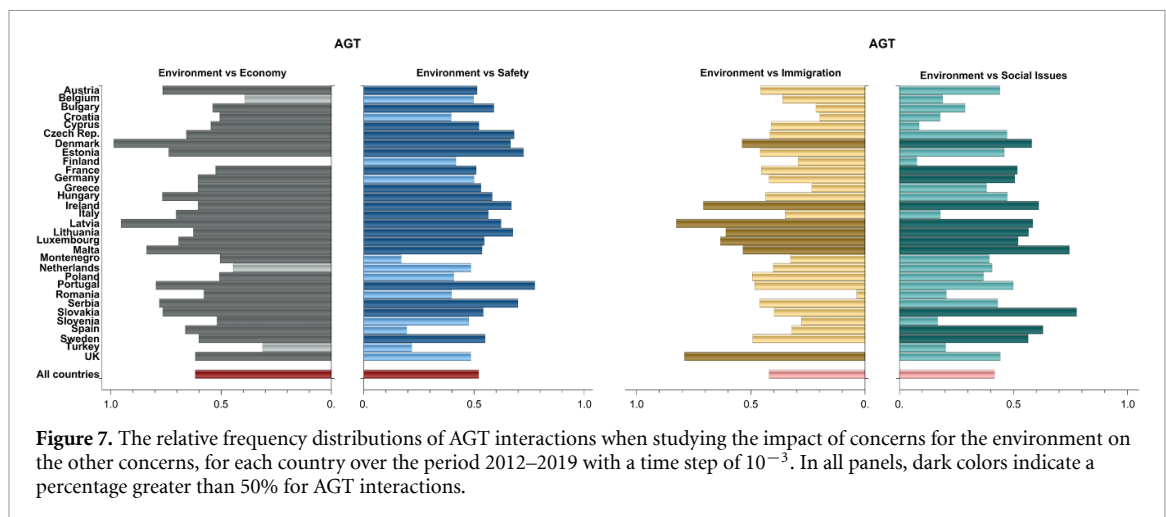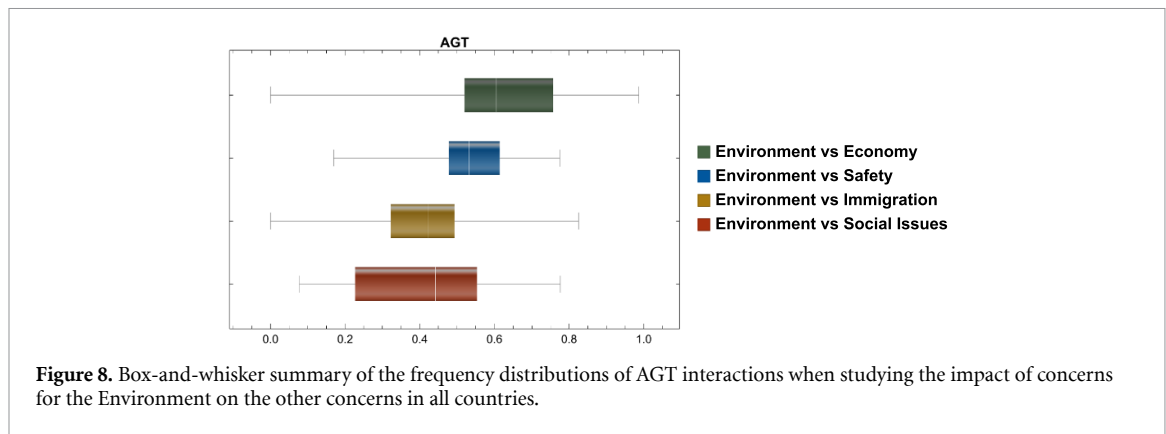

Figure 7. The relative frequency distributions of AGT interactions when studying the impact of concerns for the environment on the other concerns, for each country over the period 2012–2019 with a time step of 10^{-3}. In all panels, dark colors indicate a percentage greater than 50% for AGT interactions.

for the environment on concerns for immigration. However, we observe that AGT interactions from the environment to immigration are less common than FPW interactions (paired *t*-test: $t = -2.3917$, $p = 0.0232$). This pattern holds also when looking at single countries. Looking at the effect of concerns for the environment on concerns for immigration FPW interactions are more frequent in 24 countries (approximately 77%) (figure 7, center right panel).

Thus, despite the connection between climate change and migratory dynamics identified by the literature (Cattaneo *et al* 2020, Kaczan and Orgill-Meyer 2020), people do not perceive the existence of a linked faith between these issues.

Moreover, many studies have identified a link between environmental factors and safety. In fact, there is robust evidence that warmer temperatures are associated with higher rates of offending and more

Figure 8. Box-and-whisker summary of the frequency distributions of AGT interactions when studying the impact of concerns for the Environment on the other concerns in all countries.

police calls for service (McDowall *et al* 2012, Mares and Moffett 2019), and that warming global temperatures are associated with a variety of crime measures (Hsiang *et al* 2013). Thus, also in this case it would be reasonable to expect a predominance of AGT interactions when considering the effect of concerns for the environment on concerns for safety. Indeed, we do observe a predominance of AGT interactions overall (52%) and in terms of countries (19% or 61.2% of the countries) (figure 7, center left panel). We note, however, that this difference in the type of interaction is not statistically significant (paired *t*-test: $t = 0.7844$, $p = 0.4389$).

Last, there could be a relationship between concerns for the environment and social issues because people might prefer investing public resources for social issues, instead of supporting climate-friendly policies. This might be especially true when investments in social issues generate immediate benefits (e.g. healthcare) (Andor *et al* 2018). Against this background, one would expect FPW interactions to be predominant. We observe that FPW interactions arise 58% of the times (figure 7, right panel), while AGT interactions only emerge 42% of the times (paired *t*-test: $t = -2.4904$ and $p = 0.0185$). FPW interactions are also predominant at the country level (20 countries, or 64.5%).

3.4. Comparing the environment–economy relationship with the relationship of environment with the other categories of worry
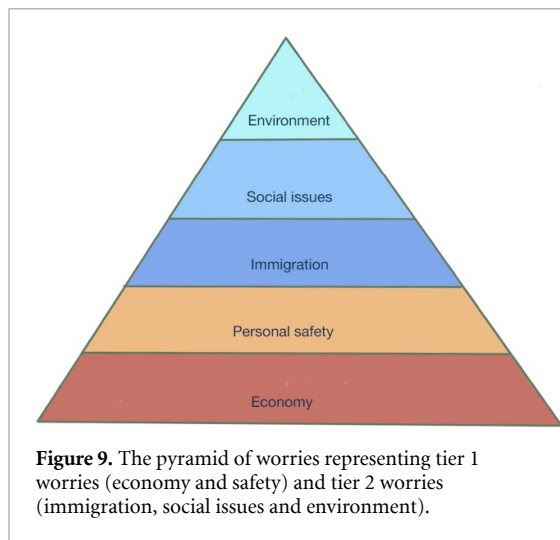
We test whether there is a significant difference in how often AGT interactions emerge from the environment to the economy and from the environment to the other categories of worry. We find that AGT interactions emerge more frequently when looking at the effect of the environment on the economy (61.7%), then when looking at the effect of the environment on immigration (paired *t*-test: $t = 5.8655$, $p = 2.0316 \times 10^{-6}$), safety concerns (paired *t*-test: $t = 3.2088$, $p = 0.0032$) and social issues (paired *t*-test: $t = 7.1664$, $p = 5.7 \times 10^{-8}$) (see figure 8 and appendix table 3).

3.5. The effect of other concerns on concerns for the environment and the economy

Last, we compare how the other categories of worry influence concerns for the environment and for the economy. We find that the influence of other worries on concerns for the economy is dominated by AGT interactions (61.7%), whereas the effect of other worries on the environment is dominated by FPW interactions (60.6%). Hence AGT is more frequent when focusing on the impact of other worries on concerns for the economy than on concerns for the environment (paired *t*-test: $t = 6.4521$, $p = 3.97 \times 10^{-7}$)

This finding is not surprising. It is reasonable that an increase in concerns like immigration or safety might make people more worried about their economic situation. Vice versa, a person concerned about safety might be less focused on concerns on the environment. Thus, this seems to suggest that economic concerns are a concern of a higher order than environmental concerns. This hypothesis is supported by the interactions that characterize other worries. In fact, the only other worry toward which interactions are dominated by AGT is safety (52.1%), while interactions toward social issues and immigration are dominated by FPW (58.2% and 57.9% respectively).

Building on Maslow's famous pyramid of needs (Maslow 1954), one could summarize visually our results using a pyramid a worries (figure 9 and supplementary figure 1). We build the pyramid as follows. At the bottom we place economy because it is the worry that is most often in FPW interactions with other worries. Thus, a growth in concerns for the economy often pushes down the other concerns. We place personal safety just above economy because after economy it is the worry that stands more often in FPW interactions with other worries. We then continue until we reach environment, which sits at the very top of the pyramid because it is the worry that is less often in FPW interactions with other worries. We consider economy and personal safety tier 1 worries, because they are more often in FPW interactions than in AGT interactions toward other worries. Therefore, an increase in the level of concern for these tier 1

Figure 9. The pyramid of worries representing tier 1 worries (economy and safety) and tier 2 worries (immigration, social issues and environment).

worries is likely to push down other concerns. To put it differently, tier 1 worries generally overtake other worries. Instead, at the top of the pyramid there are immigration, social issues and environment, which are worries that are more often in AGT interactions than in FPW interactions toward other worries (tier 2 worries). Thus, an increase in the level of concerns for a tier 2 worry is likely to increase the level of concern also for other worries.

Our results refer to the average respondent in the 31 countries considered, and hence it is possible that for subgroups of the population the hierarchy of worries is different. For instance, younger generations might consider environmental concerns a more pressing issue than older generations.

4. Conclusions

In this paper we show that the two leading theories explaining how worries are related can coexist. Specifically, we find that AGT dominates the interactions from the environment to the economic situation, suggesting that on average an increase in the concerns for the environment favors the growth of concerns for the economy. Instead, we find that the economic situation is more often in a FPW relationship with concerns for the environment, suggesting that an increase in concerns for the economy pushes down concerns for the environment. In the same vein, we find that immigration and social issues offer often push down concerns for the environment.

Data availability statement

The data that support the findings of this study are openly available at the following URL/DOI: https:// europa.eu/eurobarometer/about/other.

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