Emotion and Fertility in Times of Disaster: Conceptualizing Fertility Responses to the COVID-19 Pandemic and Beyond

Natalie Nitsche l nitsche@demogr.mpg.de
D. Susie Lee

Emotion and Fertility in Times of Disaster: Conceptualizing Fertility Responses to the COVID-19 Pandemic and Beyond

Abstract

Fertility responses to disasters have been varied in direction, strength, and across time and place. First studies on the behavioral fertility response to the Covid-19 pandemic, a multi-faceted disaster, indeed report large regional and temporal variation. The underlying factors of fertility responses to disasters in general and the Covid-19 pandemic in particular remain, however, poorly understood. We propose a novel theoretical framework, which posits that emotion experienced during a disaster directly affects reproductive desires and behaviors and can be utilized to understand disaster-fertility responses. Leaning on terror management theory and the 'Narratives of the Future' framework, which theorizes the role of subjective economic uncertainty perceptions for family formation, we use data from the German Panel Analysis of Intimate Relationships and Family Dynamics (pairfam) of to test whether the level of negative emotion or worries experienced during the first months of the pandemic are associated with changes in the number of desired children from prior years. Indeed, our results demonstrate increases in the number of desired children at higher experienced levels of anxiety and anger, while economic and health-related worries don't show significant associations with fertility desire change. We conclude that further conceptualizations and empirical studies of the role of emotion for fertility motivations during crises and beyond hold much promise.

Natalie Nitsche[1] **and D. Susie Lee**[1]

[1]Max Planck Institute for Demographic Research, Germany

Corresponding author:

Natalie Nitsche, MPIDR, Konrad-Zuse Str. 2, 18055 Rostock, nitsche@demogr.mpg.de

Introduction

It is well known that the fertility response to disasters varies. It has been found to be contingent on the type of disaster, the affected region, contextual factors and individual characteristics (Skirbekk 2022). Two years into the Covid-19 pandemic, which combines a worldwide health crisis, economic crisis, and unprecedented shifts in social life, first studies on its fertility response indeed indicate wide variation across time and space (Sobotka et al. 2021, Aassve et. al 2021, Nitsche et al. 2022). While the literature on the trends of observed fertility behaviors in the aftermath of the Covid-19 pandemic is evolving, very little is yet known on the underlying factors which cause this variation in fertility behaviors and their underlying motivations.

The present study addresses this question. We examine the role of psychological factors for changes in fertility desires during the first phase of the Covid-19 pandemic in Germany, using data from the German Panel Analysis of Intimate Relationships and Family Dynamics (pairfam). The mechanism for fertility-desire-change we propose and examine departs from the usual toolbox used in demographic studies on the fertility response to disasters. These often center on socio-economic factors, access to partners and contraception, or linkages between mortality and fertility. In other words, most of the prior studies focused on the *cues* that potentially trigger the fertility response, leaving *how* these cues are actually *perceived* and translated into behavior by individuals largely unaddressed (Cohan and Cole 2002; Cohan, Cole, and Schoen 2009; Rodgers, John, and Coleman 2005). We theorize that cues or events that occur, for example disasters, affect fertility preferences and behaviors systematically via being *channeled* through *how people feel in response to them*, rather than, or in addition to, their pragmatic or materialistic impacts on the human experience.

A large array of studies have theorized on potential driving forces of fertility responses to crises and disasters, some of which make references to subjective perceptions and psychological factors. For instance, demographers have argued that the mortality of an own child or expectations of future child mortality trigger the desire for childbearing to replace lost children (Lloyd and Ivanov 1988; Nobles, Frankenberg, and Thomas 2015). Others argue that general and economic uncertainty are key drivers of fertility behaviors, in particular in times of economic recessions, and that unemployment and job insecurity lead to the postponement of pregnancies and fertility decline (Ayllón 2019; Kreyenfeld 2016; Sobotka, Skirbekk, and Philipov 2011; Vignoli, Mencarini, and Alderotti 2020). Culturally focused concepts theorize that disasters cause rapid attitudinal and cultural shifts and may lead to more traditional family values becoming prominent, which may then lead to fertility increases (Conrad, Lechner, and Werner 1996; Rodgers et al. 2005). While these approaches implicitly build upon the relevance of subjective perceptions and psychological factors for explaining change in fertility preferences and behaviors during times of crises, they do not discuss or test these psychological mechanisms explicitly.

In the present study, we integrate psychological approaches that theorize on the role of emotion and subjective perceptions for decision-making with the analysis of changes in fertility desire in times of disaster. Building on terror management theory andthe "Narratives of the Future" approach, we argue that negative emotions (fear, anger, loneliness) and worries related to health and economic prospects are of particular relevance to changes in fertility desires in times of disaster. We test whether negative emotions and worries experienced during the first Covid-19 lockdown in Germany are associated with changes in fertility desires from before the after this salient moment of crisis.

Emotional constructs, disasters, and fertility

Psychologists have long established that emotions are crucial for humans as a motivational force for survival, in adapting to the environment, and in all social communication (Niedenthal and Ric 2017). Affective scientists agree that emotions profoundly guide human decision-making and behavior (Huntsinger and Ray 2016), likely rendering the rational-choice approach (and the duality of emotion versus cognition in general) obsolete (Lerner et al. 2015). The inquiry of emotion in decision-making is, however, a young and emerging field, with no unified framework as yet existing. In extension, conceptual integration of emotion, emotional constructs, or mental-health aspects into fertility research are yet to be developed. Nonetheless, the social-demographic, epidemiological and bio-medical literatures suggest a significant association between emotional well-being and fertility (Kohler and Mencarini 2016; Lynch et al. 2014; Margolis and Myrskylä 2011; Myrskylä and Margolis 2014; Palomba et al. 2018; Rooney and Domar 2018). The directionality and mechanisms of the link between emotional well-being and fertility remain empirically unclear and poorly specified theoretically.

The COVID-19 pandemic is making a significant impact on population mental health in a negative way (Ayers et al. 2020; Pierce et al. 2020). Young adults appear to be particularly affected by COVID-19 in terms of decline in mental well-being (Leavey, Eastaugh, and Kane 2020; Li et al. 2020; Rossi et al. 2020). Young adults are also the prime age group to contribute to fertility in the coming years, studying the link between emotion experience during the Covid-19 pandemic and changes in their fertility desires thus holds particular relevance. In addition to being an integral ingredient for decision-making, emotions and emotion regulation are essential modules of mental health and well-being (Berking and Wupperman 2012; Lerner et al. 2015). Uncertainty has been shown to increase the reliance on

affect in decision-making (Faraji-Rad and Pham 2017). Disasters and crises are times of
heightened uncertainty, which underscores that emotion likely has heightened relevance for
reproductive planning and decision making amidst pandemics and other disasters. Hence,
psychological factors and emotion likely constitute not only an important driver of
childbearing preferences and behavior in general, but may actually play a key role in fertility
responses to disasters.

Negative impacts of disasters on mental health have often been documented (Norris,
Friedman, and Watson 2002). The Covid-19 pandemic triggered a spike in google searches
for anxiety related inquiries across the US (Ayers et al. 2020; Hoerger et al. 2020). Significant
emotional 'change' from pre-disaster times is thus rather likely to occur in the realm of
negative valence emotion than emotion of positive valence (Shannon et al. 1994).
Furthermore, exposure to a disaster can have detrimental effects on immediate and future
mental health by posing a threat to basic human emotional needs fulfillment (Weems et al.
2016). Studies indicate that social distancing during the pandemic has been associated with a
decreased sense of belongingness and higher levels of loneliness (Benke et al. 2020;
Graupmann and Pfundmair 2022). In the present study, we therefore focus on the experience
of *negative emotion*, such as anxiety, anger, loneliness, worries about one's own health and
economic future, as well as worries about the health of loved ones.

Theoretical considerations and hypotheses
Terror management theory argues that during times of crises, feelings of existential terror &
death awareness are aroused, deeply impacting 'human thought, emotion, motivation, and
behavior' (Pyszczynski, Solomon, and Greenberg 2015). How people manage this potential
for and the resulting anxiety, the various pathways via which this management occurs are

specified in the terror managed theory (ibid.). Relevant for motivations and behaviors related to childbearing are the anxiety-buffering pathways which lie in the relational realm, e.g. seeking closeness to others, and by pursuing (first or continued) parenthood to create a sense of comfort and immortality (Solomon 2019). Solomon (2019) argues that close relationships serve to buffer anxiety. Moreover, making the transition to parenthood, or having an additional child, may provide psychological benefits, such as quenching existential anxieties, or fulfilling the need to belong.

One implication of the terror management theory is that the desire for having a baby should increase during times of disaster, in particular among those who are affected by feelings of anxiety or death awareness. Some existing experimental studies indeed suggest that the desire have children becomes more salient when individuals are faced with an intervention that arouses existential fears of death, compared to control groups receiving an intervention that aroused pain, or that received no interventions (Fritsche et al. 2007; Mathews and Sear 2008). To the best of our knowledge, no study has tested this argument during a 'real' disaster event, nor using representative survey data.

Based on the terror management theory, we expect that anxious emotions and other negative emotions such anger and loneliness experienced during or after the onset of will trigger increases in fertility desires. Worries which are related to one's own health should also trigger an increase in the desired number of children, while worries related to economic concerns should not. Our first hypotheses is therefore as follow:

H1: Higher levels of anxiety, anger, loneliness, and worries regarding one's own health experienced during the onset of the Covid-19 pandemic are associated with increases in the number of desired children compared with pre-pandemic desires.

Conversely, a the potentially detrimental role of economic uncertainty for family formation processes has long been theorized in the social sciences (Ayllón 2019; Kreyenfeld 2010, 2016; Kreyenfeld, Andersson, and Pailhé 2012; Sobotka et al. 2011). Accordingly, the economic uncertainty hypothesis posits that unemployment, increased job insecurity, and reduced income since the spread of globalization in general and during recessions in particular could affect childbearing decisions (Vignoli, Guetto, et al. 2020a). Recession induced fertility declines due to the postponement of childbearing have been observed across different ages and regions (Matysiak, Sobotka, and Vignoli 2021; Schneider 2015) and are expected especially among young adults (Ranjan 1999), who have lower employment stability and more time left in their fertile life courses. Some degree of fertility increase is also expected, if the opportunity costs of raising children become lower during recessions, and women trade in lower prospect in the labor market for having more children (Butz and Ward 1979). The direction of fertility responses to recessions is thus likely to depend on the characteristics of both the specific individual as well as a society where the recession occurs, such as labor market flexibility and gender equality. The economic uncertainty hypothesis assumes that rising uncertainty in ones future economic stability is the main aspect causing fertility postponement, but it may affect in particular those who have the strongest prospects of creating greater economic stability in the foreseeable future, such as the highly educated (Sobotka et al. 2011). Indeed, while rising unemployment has been the economic indicator most consistently linked to falling birth rates in macro level studies, its effect has been shown to vary by socio-economic resources. Women with high education postponed childbirth in the

face of unemployment, but those with the lowest education levels displayed increases in first birth rates when facing unemployment and economic worries, potentially due to the need to reduce future life uncertainty via childbirth (Kreyenfeld 2005, 2010). Similarly, Vignoli et al.(2020) report that the effect of job uncertainty on fertility plans is contingent on subjective well-being (Vignoli, Mencarini, et al. 2020). Only those with low well-being scores adjusted their fertility intentions downward when faced with uncertain working conditions (Vignoli, Mencarini, et al. 2020). Similarly, an expected income loss was not linked to pregnancy planning postponement or abandonment during COVID-19 lockdowns except in the UK (Luppi, Arpino, and Rosina 2020), further corroborating that not the cue of economic loss, but perhaps rather the perception of a threat channel economic insecurity into downward adjustment of fertility desires and plans. Hence, expected economic instability, and in extension falling GDPs or rising unemployment levels, do not appear to be good predictors to forecast the COVID-19 pandemic fertility response. The effect of economic instability on the fertility response during disasters and recessions may thus rather link to the subjective perception of threat (economic threat, but also threats to health, life, social connection) and the subjective perception of how this threat may most efficiently be remedied.

This salient importance of subjective perceptions of future economic uncertainty has recently been explicitly theorized in the 'narratives of the future' framework (Vignoli, Bazzani, et al. 2020; Vignoli, Guetto, et al. 2020b). The narratives framework posits that "expectations, imaginaries and narratives of the future determine fertility decisions together with structural constraints and past experiences" (Vignoli et al 2020b, p.8). While the narratives framework is geared toward theorizing fertility intentions and fertility decision-making, we argue that it can be extended to the desired number of children.

Thus, based on the economic uncertainty hypothesis in general and the 'narratives of the future' framework in particular, we expect that worries related to economic *conditions* will lead to a *decline* in fertility desires. Worries about one's own or relatives' health may also predict declines in fertility desires in the uncertainly framework, while general negative emotions such as anxiety, anger or loneliness should not.

H2: Higher levels economic and health-related worries experienced during the onset of the Covid-19 pandemic are associated with decreases in the number of desired children compared with pre-pandemic desires.

Data and Sample

The data for our empirical analyses come from the German Panel Analysis of Intimate Relationships and Family Dynamics (pairfam). This panel study was collected in yearly waves since 2008 in Germany. The panel started with 12,000 respondents, representing three birth cohorts (1971-73, 1981-83, 1991-93). It focuses on family processes, and incorporates many measures on family formation, as well as social psychological elements (union and fertility histories, division of work, social norms, attitudes, personality, emotion, mental health etc.). Each wave includes measures on mental health and emotional processes, and surveys fertility intentions and desires, and partnership related aspects.

Wave 12 went into the field, conducting face to face interviews, in the first months of 2020. By mid-march, 6285 interviews had been conducted, when data collection was halted due to the first Covid-19 lockdown. The collection of data for wave 12 was finalized between May and July 2020, and yielded additional 3403 respondents. In addition, all panel respondents were invited to participate in an add-on web-based survey, the now called pairfam Covid-wave. This was an extra 'Covid' wave unrelated to wave 12. This Covid-wave was collected during the

second half of the first lockdown in Germany, between May and July 2020. 3108 respondents responded to this extra-wave online survey between May and July 2020 (Hank and Steinbach 2021)). The collection of the Covid wave and wave 12 largely overlap during the months of May to July 2020. Regular waves (i.e. wave 12) collect measures on fertility desires. The extra Covid wave was a short survey, which collected data on the quality of life during the lockdown, amongst other measures on how people felt and worried about.

Our analytic sample includes only individuals who answered both the add-on Covid wave (which yields emotion measures), and participated in the second collection phase of wave 12 in May-July 2020 (which yields the post-covid fertility desire measure). Moreover, individuals were only included when they had answered either wave 11 or wave 10, which provides the measures for pre-pandemic fertility desires. This resulted in an analytic sample size of 746 individuals. Please see figure 1 for a schematic outline of sampling times of each measure.

Figure 1 about here

After listwise deletion of cases with missing variables, our final analytical sample consists of 691 to 733, depending on the choice of covariates. We estimate stepwise models and have retained all available cases without missing data points. This results in slightly larger sample sizes for models with fewer variables. While it is not ideal to compare models with different numbers of cases, we gave precedent to retention of cases in at the expense of exact sample comparability due to the small overall sample size.

Table 1 about here

Table 1 depicts basic sample characteristics of these individuals included in our analytic sample (right column) and individuals who responded to wave Covid *after* answering wave 12 (2038 individuals). Our analytical sample is on average younger, and therefore more often still

childless, living without a partner, and lower educated. This difference is due to the pairfam sampling strategy. Wave 11 included a refresher sample of young adults. These individuals were scheduled to be interviewed for wave 12 last, meaning they constitute most of the late 12-interviewees who received the wave 12 questionnaire at the end of the first Covid-19 lockdown. Only these individuals had the chance to complete the Covid-wave survey before wave 12 (Bozoyan et al. 2021), and thus enter our analytic sample. Roughly 80% of our analytic sample consist of wave 11 refresher sample participants, of which 70% are under age 30. Selectivity into late wave 12 interview was hence to a large extent driven by pairfam's data collection schedule and membership in the refresher sample. In other words, self-selection is less of a concern with our sample, although it contains only roughly 10% of the overall panel sample.

Measures

Dependent process

We use a measure for fertility desires as our central dependent outcome. It reflects the total number of desired children in ones' lifetime, under ideal circumstance ("Disregarding constraints, how many kids would you ideally like to have"). This item has been collected in every pairfam wave (apart from the Covid-19 add-on wave). We use the change in fertility desires from wave 11 (or 10 in cases with missing values on wave 11) in 2019 (2018 resp.) to wave 12 in 2020 as our dependent outcome of interest. The difference in desired number of children between wave 12 and wave 10 created a linear variable. Our final measure is a categorical variable which indicates whether individuals desired the same number of children in wave 12 (N=548 / 74.8% of sample), more children (N=85 / 11.6% of sample), or fewer children (N=99 / 13.5%) than pre-pandemic.

Emotion measures and control variables

The Covid wave featured a variety of questions on respondents' emotional states and worries during the first pandemic wave. We use two of those items as our main predictors:

1) A question on how the respondent felt during the last four weeks, including a variety of sub-answers on the respondents emotions of *negative* valence ("how did you feel/what was your prevailing feeling most of the time during the last four weeks … angry/anxious/lonely and other emotions"). Answer options ranges from 1 (does not apply at all) to 5 (applies completely). The emotion measure, hence, represents the prevailing emotion of the respondents during the 4 weeks prior to the interview.

2) A question on whether and how much the respondent is currently worried about their own health, their economic situation and prospects, and the health of close others. There were three answer options: 1=no worries, 2=some worries, 3=major worries. Answer choices of 'don't know' and 'don't want to answer' were coded as missing for both measures.

Figures 2a and 2b show the distribution of these items. Feeling angry and lonely was more common than feeling anxious, nonetheless, the majority of respondents had not felt either of these three emotions as prevailing emotion. The large majority of respondents was at least somewhat worried about the health of relatives, while worries about own health or financial worries were less common. Using principal component analysis, we tested whether the emotion and worry items measured distinct or overlapping concepts. As they did not, we retained the original individual emotion and worry variables.

Method

We use a first differences regression approach to estimate the association between the level of certain emotional states and worries felt during May-July 2020 and the change in fertility

12

desires from wave 11 (2019) to wave 12 (mid-2020). The first differenced estimator is an econometric approach used to address unobserved heterogeneity in panels (Liker, Augustyniak, and Duncan 1985)(Liker et al. 1985). The estimator requires data for both the dependent and the independent measures from two time points. While our analytic sample provides observations from two time points for the dependent measure, the emotion variables of interest are only available during the Covid wave for the large majority of the analytic sample. The worry variables were new items specifically designed for the Covid-wave and are not available in prior waves. Measures for feeling anxious, angry and lonely were sampled previously. They are, however, not surveyed every year. This item had last been collected in wave 5 in 2014. A prior measure for this feeling question was therefore only available for only about 20% of the sample. This is in large part due to the large proportion of wave 11 refresher sample participants in our analytic sample, a wave that did not include this specific feeling question. We therefore dismissed the first different estimator, and estimate first differences in the dependent process predicted by the level of each emotion and worry felt during May-July 2020.

We control for basic socio-economic factors (age, education, parenthood, sex), and a 5-item indicator for personality ('big 5') (Gosling, Rentfrow, and Swann Jr 2003). This consists of one measure each for neuroticism, openness, extraversion, conscientiousness, and agreeableness. This item was measured in wave 11 for the refresher sample, but not the regular sample. We used wave 10 personality measures for regular sample, and wave 6 personality measures when wave 10 variables had missing values. Personality has been linked to the range, intensity, and valence (quality) of emotion (Revelle and Scherer 2009), it is, however, just a rough control measure for emotional dispositions within individuals.

Nonetheless, it likely provides some control for unobserved heterogeneity in baseline emotional dispositions of the individuals.

We estimate separate models for each emotion and worry indicator (anxious, angry, lonely, economic worry, own health worry, others' health worry). We estimate three models per indicator. The first models estimates the association between the predictor of interest and fertility desire change, the second adds basic controls, the third model controls for the big 5 personality measures. In all models, the group of those who desire the same number of children pre-and post-first-Covid-19 lockdown constitute the references category. The models indicate the log odds of being in the groups of those who either decrease or increase their number of desired children.

Results

Models 1-9 (table 2) tests H1 related to the terror management approach. They show results for the associations of feeling anxious, angry, and lonely with fertility desire change. Figure 3 plots the coefficients of our main model (without control variables) of each emotion indicator. A one unit increase in feeling anxious most of the time (models 1) increases the log odds of desiring more children than prior to the pandemic by .22. (p=.033), relative to those who desire the same number of children. Adding socio-economic controls reduces the coefficient to .19 (p=.072) (model 2), while controlling for personality does not cause any changes to coefficient size or p-value (.23, p=.029) (model 3). There is no significant association between feeling anxious and decreases in fertility desires, relative to those who desire the same number of children throughout.

The association between levels of anger and fertility desire change is very similar. A one unit increase in feeling angry most of the time (model 4) increases the log odds of desiring more children than prior to the pandemic by .26. (p=.009), relative to those wanting the same number of children. This association is robust to adding socio-economic controls (.22 (p=.035), model 5) or controls for personality (.27 (p=.014), model 6), respectively. Again, level differences in feeling angry during the first lockdown are not associated with decreases in the desired number of children. Note that the correlation between feeling anxious and feeling angry is .38, in other words, while varying, they appear to measure two different concepts.

Feeling lonely (models 7-9) does not show any significant associations with either increases or decreases in the desired number of children. Coefficients are close to zero for all models. Taken together, these results indicate support for the terror management hypothesis, even though only for feeling anxious and angry, not for feeling lonely.

Table 3 and figure 4 shows the models for the three worry-related variables, and test the uncertainty hypothesis. Effect sizes of worrying about one's economic prospects (models 10-12) and about one's own health (models 13-15) are around .2, indicating a slight positive association between an increase in worry and the log odds of expressing the desire for more children in the summer of 2020 compared with 2019. However, all coefficients fail to reach standard or marginal levels of statistical significance. All corresponding p-values lie beyond the.10 mark (not shown). In addition, a one unit increase in worrying about one's own economic prospects increases the log odds to fall in the group of those who express a desire for fewer children compared with the year prior to the pandemic by .24-.28. But again, p-values fail to reach standard or marginal levels of significance for either model. No association is present between worries about loved one's health and change in fertility desires.

These results offer some weak support for the uncertainty hypotheses in the realm of economic worries, as those with higher worry levels have slightly higher changes of being among those who decrease their desired number of children. However, worrying about one's finances or own health has non-significant yet positive associations with expressing the desire for more children, which can be interpreted as further evidence in support of the terror management hypothesis.

Discussion

The aim of our study was to offer a new conceptual lens on how emotions and threat perceptions experienced during times of crises may impact fertility desires, and in extension reproductive behaviors. Natural and human-made large-scale crises commonly elicit threat perceptions and negative emotion, such as anxiety, worries, or anger, a pattern also present during the Covid-19 pandemic (Huang et al. 2020; Kabir and Madria 2021; Su et al. 2021). Negative emotion thus deserve special attention for studying reproductive motivations and behaviors in times of crises.

Leaning on terror management theory and belongingness research, we hypothesized that mortality salience, and threats to safety, health, and social connectedness experienced during disasters may result in heightened desires for reproduction, as an anxiety management strategy. Indeed, our results indicate that higher levels of fear, anger and worries about own health experienced during the first lockdown (April to June 2020) in a German sample of young adults are associated with an increase in the desired number of children, compared to 2019. These findings lend support to our H1.

Conversely, we found only very weak evidence for our second hypothesis, which was derived from the the economic uncertainty hypothesis and the 'narratives of the future' framwork and stated that worries related to one's economic situation or health (or that of loves ones) should lead to a decrease in fertility desires. While higher levels of economic worries were indeed linked with higher log odds of decreasing the desired number of children, this finding was statistically not significant. Also, higher levels in uncertainty additionally associated with higher log odds of increasing one's desired number of children, further muddling the picture on the worry-fertility desires connection.

Prior studies have conceptualized on and tested the subjective uncertainty perception concept (Vignoli et al. 2020). Available empirical studies indeed indicate a reduction in fertility desires under economic threat and uncertainty perceptions, however, they are based on experimental data collections and have not yet been tested with panel survey data collected in times of actual disasters (Lappegård et al. 2022; Vignoli et al. 2022). Our results cast a less clear picture and don't indicate a clear pattern between worry perception-fertility desire change, although the lack of statistical significance may be related low lack of statistical power.

The most central contribution of our study lies in providing evidence for a salient link between higher levels of feeling anxious or angry most of the time with increases in the desired number of children from before to during the pandemic. Not only does this finding align with terror management theory and our reasoning on belongingness needs, but it could also help to explain heterogeneity in the fertility response to disaster. If certain types of disaster (natural disasters such as earthquakes or manmade catastrophes such as terror attacks) trigger sudden strong upticks of fear, anxiety or anger, they may lead to a (perhaps temporary) rise in the average desired number of children and stimulate conceptions and the birth rate.

This could also explain why crises such as recessions, which may not lead to the same sudden increase in mortality salience or anxiety may rather have dampening effects on birth rates (Matysiak et al. 2021). Deeper investigations of emotional landscapes and changes therein to events, both collectively on the population level as well as among individuals or social groups, may therefore hold much promise in further examining and understanding fertility motivations and behaviors.

Doing so seems of particular relevance in the aftermath of the Covid-19 pandemic, which has triggered a mental health crisis among adolescence and young adults (O'Connor et al. 2021; Panchal et al. 2021). If and whether short term fluctuation of emotional experiences link in the same way to fertility motivations as longer lasting mental health distress remains unknown, a question which future research may address. Mental health among young adults was already deteriorating before the onset of the Covid-19 pandemic (Breslau et al. 2021; Patel et al. 2022)(Breslau et al 2021, Patel et al. 2022), making this question all the more socially relevant.

While innovative, our study is not without limitations. First, we work with a small sample, and while it stems from a large nationally representative panel study in Germany, it is not representative of the overall sample. Sampling schedules by the pairfam team drive a large part of the selectivity into our analytic sample, which is somewhat reassuring. Nonetheless, great care is needed in the interpretation of these results for the larger population of Germany, as external validity may be compromised. Currently the data is the only available source for testing the link between emotion and worries experienced during the disaster and within-individual change in fertility desires relative to the year(s) prior to the pandemic. Worldwide, there exist less than a handful of panel studies which allow for such a research design, others

of which have not yet been released. Our study thus uses the best possible data currently available.

Second, our estimates may be subject to unobserved heterogeneity bias and selectivity, as we cannot estimate fixed effects or complete first differenced estimator models. Further analyses indicate that the fear and anger effects may be stronger among the childless compared with parents (Appendix figure A). Future research is needed to replicate our findings in larger samples, which models that allow for purging stable characteristics among individuals, or estimate stratified models by social groups. Finally, we cannot know whether our findings apply to disaster moments only or are generalizable to 'normal' times. The number of individuals changing desires in our analytic sample from 2019 to 2020 is 25%. While it is well known that fertility desires change over the life course (Heiland, Prskawetz, and Sanderson 2008), no study has yet estimated what percentage of the sample changes the desired number of children from year to year. More research is needed to understand whether this constitutes a sizeable fertility desire change that goes beyond the average 'year to year change' of fertility desires in panel studies, or is comparable to year-to year changes in fertility changes across other time periods.

References

Ayers, John W., Eric C. Leas, Derek C. Johnson, Adam Poliak, Benjamin M. Althouse, Mark Dredze, and Alicia L. Nobles. 2020. "Internet Searches for Acute Anxiety During the Early Stages of the COVID-19 Pandemic." *JAMA Internal Medicine*.

Ayllón, Sara. 2019. "Job Insecurity and Fertility in Europe." *Review of Economics of the Household* 17(4):1321–47. doi: 10.1007/s11150-019-09450-5.

Benke, Christoph, Lara K. Autenrieth, Eva Asselmann, and Christiane A. Pané-Farré. 2020. "Lockdown, Quarantine Measures, and Social Distancing: Associations with Depression, Anxiety and Distress at the Beginning of the COVID-19 Pandemic among Adults from Germany." *Psychiatry Research* 293:113462.

Berking, Matthias, and Peggilee Wupperman. 2012. "Emotion Regulation and Mental Health: Recent Findings, Current Challenges, and Future Directions." *Current Opinion in Psychiatry* 25(2):128–34.

Breslau, Joshua, Melissa L. Finucane, Alicia R. Locker, Matthew D. Baird, Elizabeth A. Roth, and Rebecca L. Collins. 2021. "A Longitudinal Study of Psychological Distress in the United States before and during the COVID-19 Pandemic." *Preventive Medicine* 143:106362.

Butz, William P., and Michael P. Ward. 1979. "Will US Fertility Remain Low? A New Economic Interpretation." *Population and Development Review* 663–88.

Cohan, Catherine L., and Steve W. Cole. 2002. "Life Course Transitions and Natural Disaster: Marriage, Birth, and Divorce Following Hurricane Hugo." *Journal of Family Psychology* 16(1):14–25. doi: 10.1037/0893-3200.16.1.14.

Cohan, Catherine L., Steve W. Cole, and Robert Schoen. 2009. "Divorce Following the September 11 Terrorist Attacks." *Journal of Social and Personal Relationships* 26(4):512–30. doi: 10.1177/0265407509351043.

Conrad, Christoph, Michael Lechner, and Welf Werner. 1996. "East German Fertility after Unification: Crisis or Adaptation?" *Population and Development Review* 331–58.

Faraji-Rad, Ali, and Michel Tuan Pham. 2017. "Uncertainty Increases the Reliance on Affect in Decisions." *Journal of Consumer Research* 44(1):1–21.

Fritsche, Immo, Eva Jonas, Peter Fischer, Nicolas Koranyi, Nicole Berger, and Beatrice Fleischmann. 2007. "Mortality Salience and the Desire for Offspring." *Journal of Experimental Social Psychology* 43(5):753–62. doi: 10.1016/j.jesp.2006.10.003.

Gosling, Samuel D., Peter J. Rentfrow, and William B. Swann Jr. 2003. "A Very Brief Measure of the Big-Five Personality Domains." *Journal of Research in Personality* 37(6):504–28.

Graupmann, Verena, and Michaela Pfundmair. 2022. "When Ostracism Is Mandated: COVID-19, Social Distancing, and Psychological Needs." *The Journal of Social Psychology* 1–13.

Hank, Karsten, and Anja Steinbach. 2021. "The Virus Changed Everything, Didn't It? Couples' Division of Housework and Childcare before and during the Corona Crisis." *Journal of Family Research* 33(1):99–114. doi: 10.20377/jfr-488.

Heiland, Frank, Alexia Prskawetz, and Warren C. Sanderson. 2008. "Are Individuals' Desired Family Sizes Stable? Evidence from West German Panel Data." *European Journal of Population/Revue Européenne de Démographie* 24(2):129–56.

Hoerger, Michael, Sarah Alonzi, Laura M. Perry, Hallie M. Voss, Sanjana Easwar, and James I. Gerhart. 2020. "Impact of the COVID-19 Pandemic on Mental Health: Real-Time Surveillance Using Google Trends." *Psychological Trauma: Theory, Research, Practice, and Policy* 12(6):567.

Huang, Long, Wansheng Lei, Fuming Xu, Hairong Liu, and Liang Yu. 2020. "Emotional Responses and Coping Strategies in Nurses and Nursing Students during Covid-19 Outbreak: A Comparative Study." *PloS One* 15(8):e0237303.

Huntsinger, Jeffrey R., and Cara Ray. 2016. "A Flexible Influence of Affective Feelings on Creative and Analytic Performance." *Emotion* 16(6):826.

Kabir, Md Yasin, and Sanjay Madria. 2021. "EMOCOV: Machine Learning for Emotion Detection, Analysis and Visualization Using COVID-19 Tweets." *Online Social Networks and Media* 23:100135.

Kohler, Hans-Peter, and Letizia Mencarini. 2016. "The Parenthood Happiness Puzzle: An Introduction to Special Issue." *European Journal of Population* 32(3):327–38.

Kreyenfeld, Michaela. 2005. "Economic Uncertainty and Fertility Postponement: Evidence from German Panel Data." Pp. 34–67 in *Presentation Prepared for the Meeting of the Verein für Socialpolitik*. Citeseer.

Kreyenfeld, Michaela. 2010. "Uncertainties in Female Employment Careers and the Postponement of Parenthood in Germany." *European Sociological Review* 26(3):351–66.

Kreyenfeld, Michaela. 2016. "Economic Uncertainty and Fertility." Pp. 59–80 in *Social Demography Forschung an der Schnittstelle von Soziologie und Demografie*, *Kölner Zeitschrift für Soziologie und Sozialpsychologie*, edited by K. Hank and M. Kreyenfeld. Wiesbaden: Springer Fachmedien.

Kreyenfeld, Michaela, Gunnar Andersson, and Ariane Pailhé. 2012. "Economic Uncertainty and Family Dynamics in Europe: Introduction." *Demographic Research* 27:835–52.

Lappegård, Trude, Axel Peter Kristensen, Lars Dommermuth, Alessandra Minello, and Daniele Vignoli. 2022. "The Impact of Narratives of the Future on Fertility Intentions in Norway." *Journal of Marriage and Family* 84(2):476–93.

Leavey, Cara, Alexandra Eastaugh, and Martina Kane. 2020. *Generation COVID-19*. The Health Foundation.

Lerner, Jennifer S., Ye Li, Piercarlo Valdesolo, and Karim S. Kassam. 2015. "Emotion and Decision Making." *Annual Review of Psychology* 66(1):799–823. doi: 10.1146/annurev-psych-010213-115043.

Li, Guanjian, Dongdong Tang, Bing Song, Chao Wang, Shen Qunshan, Chuan Xu, Hao Geng, Huan Wu, Xiaojin He, and Yunxia Cao. 2020. "Impact of the COVID-19 Pandemic on Partner Relationships and Sexual and Reproductive Health: Cross-Sectional, Online Survey Study." *Journal of Medical Internet Research* 22(8):e20961.

Liker, Jeffrey K., Sue Augustyniak, and Greg J. Duncan. 1985. "Panel Data and Models of Change: A Comparison of First Difference and Conventional Two-Wave Models." *Social Science Research* 14(1):80–101.

Lloyd, Cynthia B., and Serguey Ivanov. 1988. "The Effects of Improved Child Survival on Family Planning Practice and Fertility." *Studies in Family Planning* 19(3):141–61. doi: 10.2307/1966750.

Luppi, Francesca, Bruno Arpino, and Alessandro Rosina. 2020. *The Impact of COVID-19 on Fertility Plans in Italy, Germany, France, Spain and UK. preprint.* SocArXiv. doi: 10.31235/osf.io/wr9jb.

Lynch, C. D., R. Sundaram, J. M. Maisog, A. M. Sweeney, and G. M. Buck Louis. 2014. "Preconception Stress Increases the Risk of Infertility: Results from a Couple-Based Prospective Cohort Study—the LIFE Study." *Human Reproduction* 29(5):1067–75.

Margolis, Rachel, and Mikko Myrskylä. 2011. "A Global Perspective on Happiness and Fertility." *Population and Development Review* 37(1):29–56.

Mathews, Paul, and Rebecca Sear. 2008. "Life after Death: An Investigation into How Mortality Perceptions Influence Fertility Preferences Using Evidence from an Internet-Based Experiment." *Journal of Evolutionary Psychology* 6(3):155–72. doi: 10.1556/jep.6.2008.3.1.

Matysiak, Anna, Tomáš Sobotka, and Daniele Vignoli. 2021. "The Great Recession and Fertility in Europe: A Sub-National Analysis." *European Journal of Population* 37:29–64. doi: 10.1007/s10680-020-09556-y.

Myrskylä, Mikko, and Rachel Margolis. 2014. "Happiness: Before and after the Kids." *Demography* 51(5):1843–66.

Niedenthal, Paula M., and François Ric. 2017. *Psychology of Emotion.* Psychology Press.

Nobles, Jenna, Elizabeth Frankenberg, and Duncan Thomas. 2015. "The Effects of Mortality on Fertility: Population Dynamics after a Natural Disaster." *Demography* 52(1):15–38.

Norris, Fran H., Matthew J. Friedman, and Patricia J. Watson. 2002. "60,000 Disaster Victims Speak: Part II. Summary and Implications of the Disaster Mental Health Research." *Psychiatry: Interpersonal and Biological Processes* 65(3):240–60.

O'Connor, Rory C., Karen Wetherall, Seonaid Cleare, Heather McClelland, Ambrose J. Melson, Claire L. Niedzwiedz, Ronan E. O'Carroll, Daryl B. O'Connor, Steve Platt, and Elizabeth Scowcroft. 2021. "Mental Health and Well-Being during the COVID-19 Pandemic: Longitudinal Analyses of Adults in the UK COVID-19 Mental Health & Wellbeing Study." *The British Journal of Psychiatry* 218(6):326–33.

Palomba, Stefano, Jessica Daolio, Sara Romeo, Francesco Antonino Battaglia, Roberto Marci, and Giovanni Battista La Sala. 2018. "Lifestyle and Fertility: The Influence of Stress and Quality of Life on Female Fertility." *Reproductive Biology and Endocrinology* 16(1):113.

Panchal, Urvashi, Gonzalo Salazar de Pablo, Macarena Franco, Carmen Moreno, Mara Parellada, Celso Arango, and Paolo Fusar-Poli. 2021. "The Impact of COVID-19 Lockdown on Child and Adolescent Mental Health: Systematic Review." *European Child & Adolescent Psychiatry* 1–27.

Patel, Kishan, Elaine Robertson, Alex SF Kwong, Gareth J. Griffith, Kathryn Willan, Michael J. Green, Giorgio Di Gessa, Charlotte F. Huggins, Eoin McElroy, and Ellen J. Thompson. 2022. "Psychological Distress Before and During the COVID-19 Pandemic Among Adults in the United Kingdom Based on Coordinated Analyses of 11 Longitudinal Studies." *JAMA Network Open* 5(4):e227629–e227629.

Pierce, Matthias, Holly Hope, Tamsin Ford, Stephani Hatch, Matthew Hotopf, Ann John, Evangelos Kontopantelis, Roger Webb, Simon Wessely, and Sally McManus. 2020. "Mental Health before and during the COVID-19 Pandemic: A Longitudinal Probability Sample Survey of the UK Population." *The Lancet Psychiatry*.

Pyszczynski, Tom, Sheldon Solomon, and Jeff Greenberg. 2015. "Thirty Years of Terror Management Theory: From Genesis to Revelation." Pp. 1–70 in *Advances in experimental social psychology*. Vol. 52. Elsevier.

Ranjan, Priya. 1999. "Fertility Behaviour under Income Uncertainty." *European Journal of Population / Revue Européenne de Démographie* 15(1):25–43. doi: 10.1023/A:1006106527618.

Revelle, William, and Klaus R. Scherer. 2009. "Personality and Emotion." Pp. 304–6 in *Oxford companion to emotion and the affective sciences*. Vol. 1. Oxford University Press Oxford, UK.

Rodgers, Joseph Lee, Craig A. St. John, and Ronnie Coleman. 2005. "Did Fertility Go up after the Oklahoma City Bombing? An Analysis of Births in Metropolitan Counties in Oklahoma, 1990–1999." *Demography* 42(4):675–92. doi: 10.1353/dem.2005.0034.

Rooney, Kristin L., and Alice D. Domar. 2018. "The Relationship between Stress and Infertility." *Dialogues in Clinical Neuroscience* 20(1):41.

Rossi, Rodolfo, Valentina Socci, Dalila Talevi, Sonia Mensi, Cinzia Niolu, Francesca Pacitti, Antinisca Di Marco, Alessandro Rossi, Alberto Siracusano, and Giorgio Di Lorenzo. 2020. "COVID-19 Pandemic and Lockdown Measures Impact on Mental Health among the General Population in Italy." *Frontiers in Psychiatry* 11.

Schneider, Daniel. 2015. "The Great Recession, Fertility, and Uncertainty: Evidence From the United States." *Journal of Marriage and Family* 77(5):1144–56. doi: 10.1111/jomf.12212.

Shannon, Mitsuko P., Christopher J. Lonigan, A. J. Finch Jr, and Charlotte M. Taylor. 1994. "Children Exposed to Disaster: I. Epidemiology of Post-Traumatic Symptoms and Symptom Profiles." *Journal of the American Academy of Child & Adolescent Psychiatry* 33(1):80–93.

Sobotka, Tomáš, Vegard Skirbekk, and Dimiter Philipov. 2011. "Economic Recession and Fertility in the Developed World." *Population and Development Review* 37(2):267–306. doi: 10.1111/j.1728-4457.2011.00411.x.

Su, Yue, Peijing Wu, Sijia Li, Jia Xue, and Tingshao Zhu. 2021. "Public Emotion Responses during COVID-19 in China on Social Media: An Observational Study." *Human Behavior and Emerging Technologies* 3(1):127–36.

Vignoli, Daniele, Giacomo Bazzani, Raffaele Guetto, Alessandra Minello, and Elena Pirani. 2020. "Uncertainty and Narratives of the Future: A Theoretical Framework for Contemporary Fertility." Pp. 25–47 in *Analyzing Contemporary Fertility*, *The Springer*

Series on Demographic Methods and Population Analysis, edited by R. Schoen. Cham: Springer International Publishing.

Vignoli, Daniele, Raffaele Guetto, Giacomo Bazzani, Elena Pirani, and Alessandra Minello. 2020a. "A Reflection on Economic Uncertainty and Fertility in Europe: The Narrative Framework." *Genus* 76(1):28. doi: 10.1186/s41118-020-00094-3.

Vignoli, Daniele, Raffaele Guetto, Giacomo Bazzani, Elena Pirani, and Alessandra Minello. 2020b. "A Reflection on Economic Uncertainty and Fertility in Europe: The Narrative Framework." *Genus* 76(1):28. doi: 10.1186/s41118-020-00094-3.

Vignoli, Daniele, Letizia Mencarini, and Giammarco Alderotti. 2020. "Is the Effect of Job Uncertainty on Fertility Intentions Channeled by Subjective Well-Being?" *Advances in Life Course Research* 100343.

Vignoli, Daniele, Alessandra Minello, Giacomo Bazzani, Camilla Matera, and Chiara Rapallini. 2022. "Narratives of the Future Affect Fertility: Evidence from a Laboratory Experiment." *European Journal of Population* 38(1):93–124. doi: 10.1007/s10680-021-09602-3.

Weems, Carl F., Justin D. Russell, Erin L. Neill, Steven L. Berman, and Brandon G. Scott. 2016. "Existential Anxiety among Adolescents Exposed to Disaster: Linkages among Level of Exposure, PTSD, and Depression Symptoms." *Journal of Traumatic Stress* 29(5):466–73.

Tables and Figures

Figure 1: Pairfam waves and study design

Figure 2a: Distribution of emotion variables
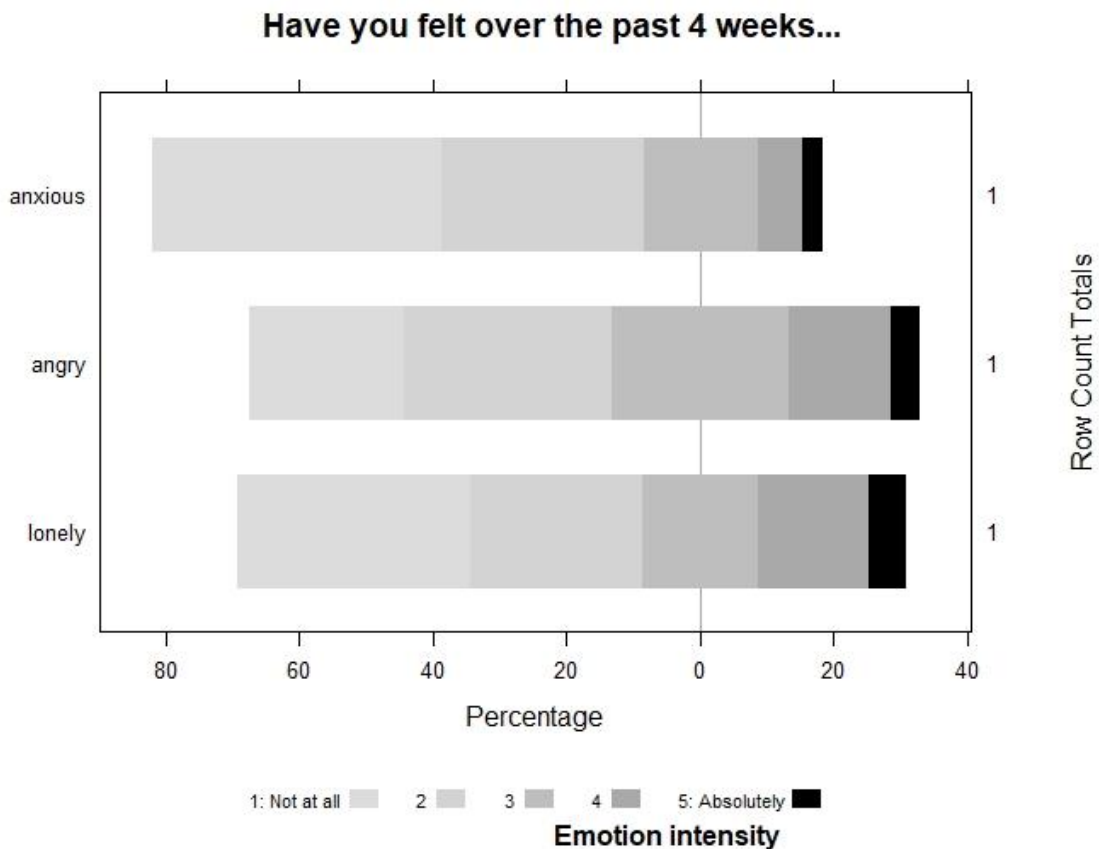
Figure 2b: Distribution of worry variables

Figure 3: Association of feeling anxious, angry and lonely during March to May with increases and decreases in the number of desired children (relative to desiring the same number of children) from pre- to post-first Covid-19 lockdown.
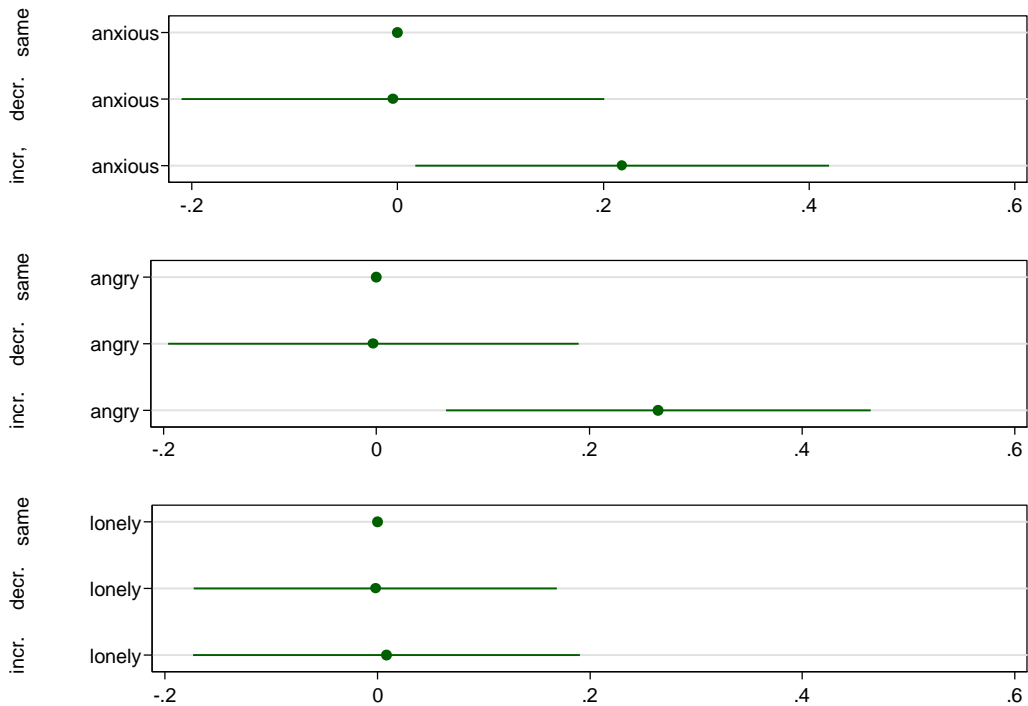
Note: Plotted coefficients, multinomial logit models, three separate models (one for each emotion variable). No additional covariates included in model.

Figure 4: Association of feeling worried about one's own economic situation, one's own health, and relatives' health during March to May 2020 with increases and decreases i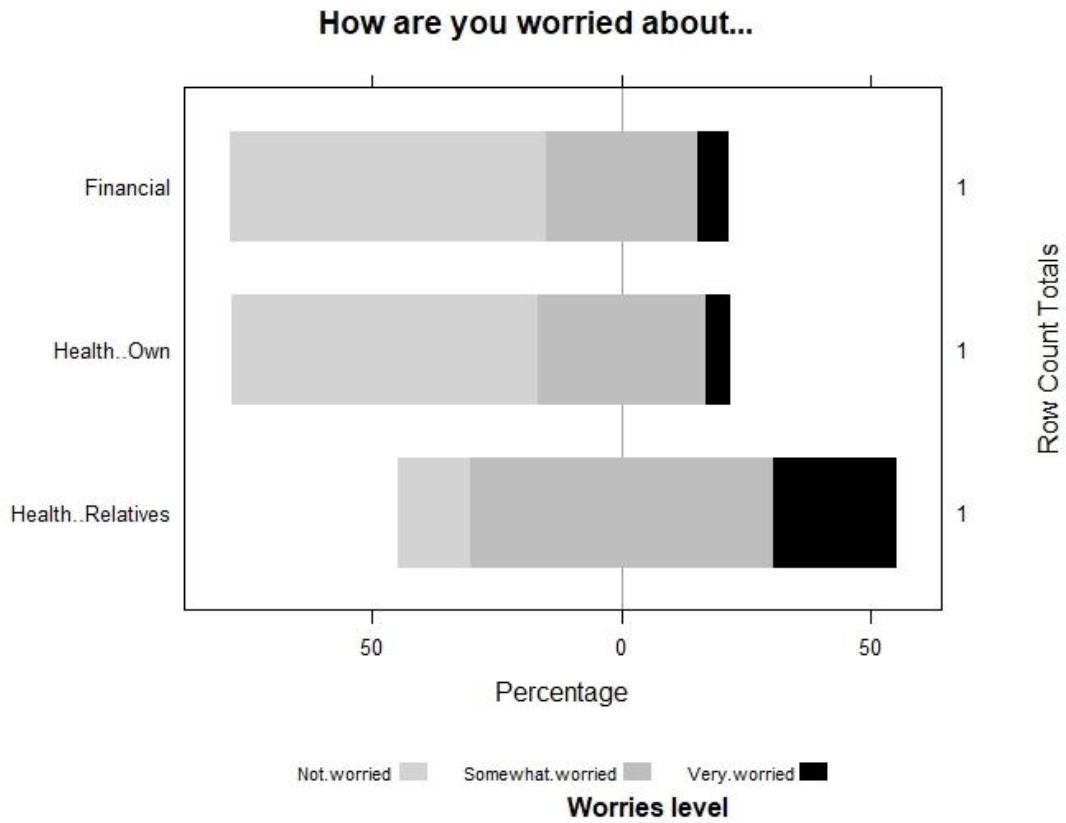n the number of desired children (relative to desiring the same number of children) from pre- to post-first Covid-19 lockdown.
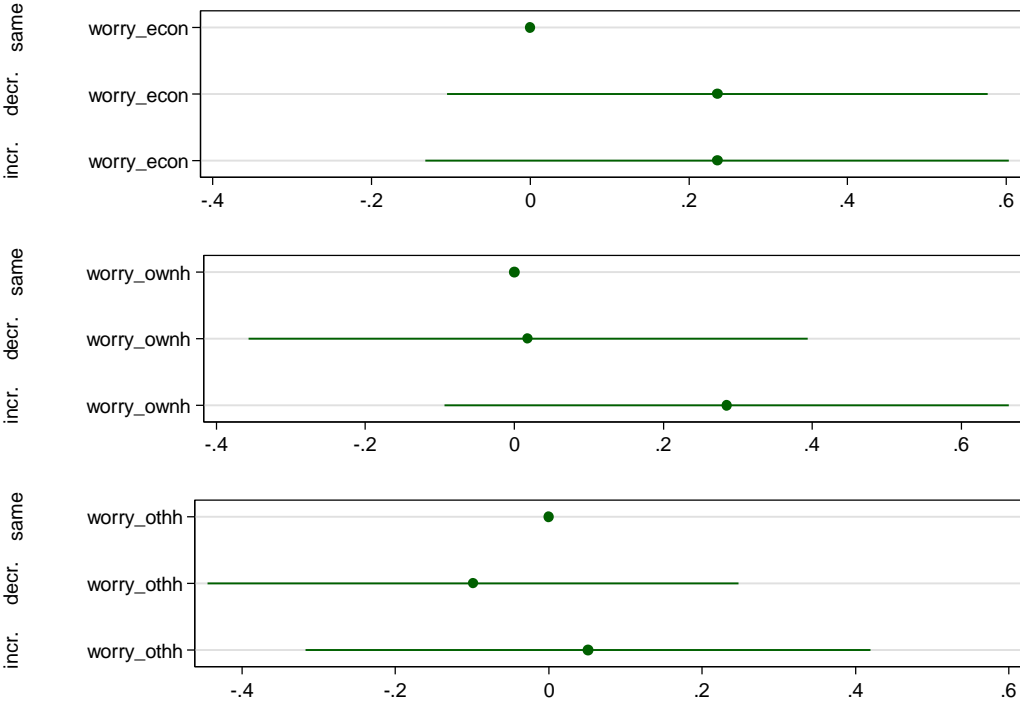
Note: Plotted coefficients, multinomial logit models, three separate models (one for each emotion variable). No additional covariates included in model.

Table 1: Sample Descriptives of Analytic Sample (right column) compared with wave 12 May-July respondents who answered wave Covid after answering wave 12

Characteristic	Covid Wave later, N = 2,038[T]	Covid Wave sim/before, N = 746[T]
Age Category		
10s	478 (23%)	295 (40%)
20s	438 (21%)	168 (23%)
30s	611 (30%)	225 (30%)
40+	511 (25%)	58 (7.8%)
sex		
Female	1,182 (58%)	431 (58%)
Male	856 (42%)	315 (42%)
Number of Children		
0	1,181 (58%)	528 (71%)
1	251 (12%)	80 (11%)
2	434 (21%)	92 (12%)
3	130 (6.4%)	40 (5.4%)
4+	42 (2.1%)	6 (0.8%)
Education attainment		
1/Basic education	578 (28%)	324 (43%)
2/Secondary education	417 (20%)	119 (16%)
3/Post-secondary education	1,043 (51%)	303 (41%)
Income changed		
0/Decreased	495 (24%)	184 (25%)
1/Stayed the same	1,337 (66%)	445 (60%)
2/Increased	42 (2.1%)	12 (1.6%)
Do not know / No answer	164 (8.0%)	105 (14%)
Employment situation changed		
0/No	470 (23%)	146 (20%)
1/Yes	1,157 (57%)	375 (50%)
Do not know / No answer	21 (1.0%)	13 (1.7%)
Not applicable	390 (19%)	212 (28%)
Currently living with a partner		
0/No	897 (44%)	428 (57%)
1/Yes	1,136 (56%)	316 (42%)
Do not know / No answer	5 (0.2%)	2 (0.3%)
Employment situation of partner changed		
0/No	356 (17%)	95 (13%)
1/Yes	731 (36%)	205 (27%)
Do not know / No answer	16 (0.8%)	6 (0.8%)
Not applicable	935 (46%)	440 (59%)

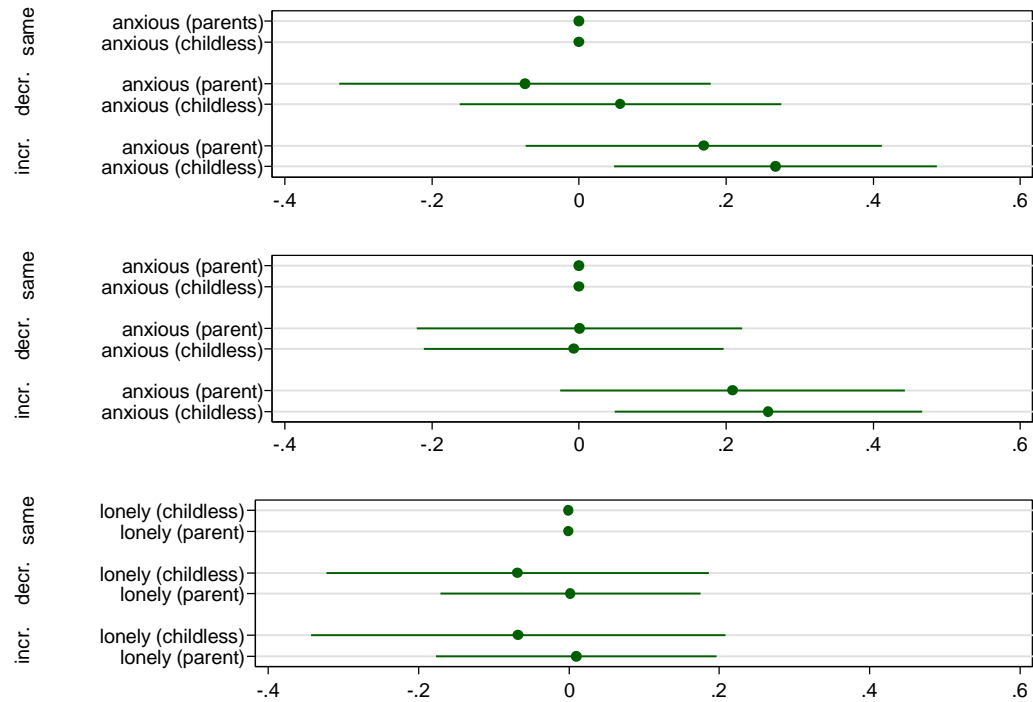[T] n (%)

Table 2: Emotion Models

Variable	m1	m2	m3	m4	m5	m6	m7	m8	m9
same	*reference*								
decrease									
anxious	0.00	0.02	0.02						
angry				0.00	-0.02	0.03			
lonely							0.00	0.00	0.01
age		0.19			0.19			0.19	0.00
sex		-0.09			-0.08			-0.08	
education		-0.07			-0.07			-0.07	
childless		0.37			0.37	0.17		0.37	
neuroticism			-0.04			-0.06			-0.04
extraversion			-0.15			-0.17			-0.15
agreeable			0.10			0.08			0.09
conscient.			-0.10			-0.05			-0.10
open			0.32*			0.33*			0.31*
_cons	-1.70***	-2.15**	-2.37*	-1.70***	-2.08**	-2.59**	-1.71***	-2.13**	-2.31*
increase									
anxious	0.22*	0.19	0.23*						
angry				0.26**	0.22*	0.27*			
lonely							0.01	-0.03	0.02
age		0.24			0.22			0.26	0.06
sex		0.31			0.37			0.42	
educ		-0.13			-0.12			-0.14	
childless		0.46			0.46	0.13		0.48	
neuroticism			-0.11			-0.12			-0.07
extraversion			0.21			0.18			0.23
agreeable			0.05			0.06			0.05
conscient.			-0.10			-0.01			-0.08
open			-0.06			-0.08			-0.10
_cons	-2.31***	-3.35***	-2.26*	-2.54***	-3.58***	-2.72**	-1.88***	-3.10***	-2.08*
N	732	711	714	733	712	702	732	711	715

Table 3: Worry Models

Variable	m10	m11	m12	m13	m14	m15	m16	m17	m18
same									
decrease									
worry econ.	0.24	0.27	0.28						
worry ownh.				0.02	0.08	0.06			
worry othh.							-0.10	-0.06	-0.11
age_cat		0.14			0.17			0.18	
sex		-0.17			-0.10			-0.08	
educ		-0.03			-0.06			-0.07	
childless		0.35			0.35			0.35	
neuroticism			-0.06			-0.05			-0.03
extraversion			-0.09			-0.14			-0.15
agreeable			0.07			0.09			0.10
conscient.			-0.12			-0.10			-0.10
open			0.32*			0.31*			0.31*
_cons	-2.06***	-2.37***	-2.69**	-1.73***	-2.18**	-2.35*	-1.50***	-1.95**	-2.08*
increase									
worry_econ.	0.24	0.14	0.29						
Worry ownh				0.29	0.27	0.34			
Worry othh							0.05	0.07	0.03
aget		0.27			0.20			0.26	
sex		0.35			0.39			0.42	
educ		-0.09			-0.10			-0.15	
childless		0.46			0.43			0.46	
worry1			0.29						
neuroticism			-0.14			-0.12			-0.07
extraversion			0.24			0.24			0.22
agreeable			0.03			0.03			0.06
conscient.			-0.08			-0.09			-0.07
open			-0.15			-0.11			-0.11
_cons	-2.24***	-3.39***	-1.87	-2.28***	-3.41***	-2.11*	-1.95***	-3.26***	-2.00
N	712	691	696	729	708	711	729	708	711

Appendix

Figure A: Association of feeling anxious, angry and lonely during March to May with increases and decreases in the number of desired children (relative to desiring the same number of children) from pre- to post-first Covid-19 lockdown among parents and the childless.

Note: Plotted coefficients, multinomial logit models, three separate models (one for each emotion variable). No additional covariates included in model.