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ABSTRACT

Climate Change Salience, Economic Insecurity, and Support for Mitigation Policies*

Many people remain opposed to climate change mitigation policies. This opposition is an obstacle to policy action and, therefore, important to understand. We explore how unusually high temperatures (heat waves), which observably increase the salience of climate change-related issues, affect people's support for policies to reduce emissions. We additionally test whether this relationship is moderated by economic status and employment conditions. By linking local temperature observations to attitudes collected in large U.K. surveys, we find that unusually hot weather caused significant reductions in support in 2012-2013, a high-unemployment period, but not in 2018-2019, a low-unemployment period. The negative effects in 2012-2013 were driven by people working in carbon-intensive industries and people who felt economically insecure. Overall, these findings suggest that economically vulnerable groups can respond negatively to the promotion of climate change mitigation policies, but that this negativity is mutable.

JEL Classification: D83, H23, Q54, Q58

Keywords: climate change, attitudes, economic insecurity, employment

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1. INTRODUCTION

There is substantial scientific evidence supporting anthropogenic climate change and the need for mitigation policies, but apathy and scepticism persist (Hornsey et al., 2016; Egan and Mullin, 2017; Nowakowski and Oswald, 2020). Results from a 2022 survey highlight that 24% of Americans believe that human activity does not contribute to global climate change, 28% oppose steps to become carbon neutral by 2050, and 35% believe that mitigation policies will hurt the economy (Tyson et al., 2022).[1] A key concern about mitigation policies, such as taxes on fossil fuels, is that they lead to layoffs and the shutdown of firms (Fairbrother et al, 2019; Vona, 2019).[2] Some empirical evidence supports this viewpoint, with the U.S. 1990 Clean Air Act reducing employment in polluting industries (Walker, 2011) and British Columbia's carbon tax policy reducing employment in carbon-intensive and trade-sensitive industries (Yamazaki, 2017), particularly among less-educated workers (Yip, 2018). On the other hand, research demonstrates that people substantially over-estimate the personal economic impacts of mitigation policies, especially people with pessimistic policy beliefs (Douenne and Fabre, 2022).

Understanding the formation of viewpoints regarding climate change and the environment is important because these viewpoints influence public support for proposed mitigation interventions. Examples of public opposition preventing climate change-related policies include the 2016 and 2018 rejection of carbon tax initiatives in America's Washington State, and the 2018 French' yellow vests' (gilets jaunes) movement against rising fuel taxes (Douenne and Fabre, 2022). Similarly, the 2017 exit of the U.S. from the Paris Agreement is an example of a political choice justified by the need to defend the jobs of blue-collar workers in energy-intensive sectors (Vona, 2019). It is also important to understanding climate change-related attitudes because they are associated with individual pro-environmental behaviours, such as switching off lights in rooms that aren't being used (Alcock et al., 2017) and reusing and recycling behaviours (Escario et al., 2020).

This study uses large nationally-representative surveys of U.K. residents to explore how an increase in the salience of climate change issues – brought on by abnormally hot weather –

[1] In addition, a large 2016 survey found that Europeans view climate change as a less important problem than economic issues, such as living costs and unemployment (Nowakowski and Oswald, 2020).

[2] Douenne and Fabre (2022) surveyed 3,002 French households regarding their views on a hypothetical policy to increase the carbon tax, with revenue redistributed uniformly, and found that 70 percent of respondents disapproved of the policy (10 percent approved and the remainder did not express a view).

impacts people's attitudes towards private and public mitigation action. We also analyse whether attitudinal impacts vary by respondent's economic situation, such as their income, views regarding future financial wellbeing, and employment status in a carbon-intensive industry. Regressions are estimated across two distinct time periods; each had significant heat events but very different economic conditions.

Unusual weather events attract attention from the public and generate discussion about the causes and consequences of climate change and the need for mitigation policies (Aykut et al., 2012; Bloodheart et al., 2015; Herrnstadt and Muehlegger, 2014; Lang, 2014; Moore et al 2019; Painter et al., 2021; Schafer et al., 2014; Schmidt et al., 2012). For instance, Herrnstadt and Muehlegger (2014) show that unusual weather increases climate change salience and that these effects extend to action on environmental issues in the U.S. Congress. Similarly, Choi et al. (2020) show that attention to climate change issues increases following abnormally high temperatures and that this harms the stock market returns of carbon-intensive firms. We also demonstrate in this paper that a 2013 U.K. heatwave was associated with significantly more newspaper articles regarding climate change and global warming. Given the literature and our own empirical results, we use the recent experience of unusually hot temperatures to proxy the increased salience of climate change-related issues.

Our approach compares attitudinal differences between people surveyed in the same calendar month and living in the same geographical area (month-area fixed-effects) who experienced a different number of abnormally hot days in the week before their interview. We additionally estimate the effects of a U.K. heatwave on attitudes using an event-study design. Data is sourced from the U.K. Household Longitudinal Study, which has a large sample size (approximately 40,000 observations in our main analysis sample), substantial information on respondent characteristics, and year-round surveying (enabling the event-study approach).

Our results show that people express significantly less support for climate change mitigation action after abnormally hot weather. Interestingly, the negative effects occur only during the period with high national unemployment (2012-2013) and not during the period with low national unemployment (2018-2019). In addition, the negative effects are most prominent for people who are more financially insecure and who work in carbon-intensive industries. It is likely that these people feel economically threatened by climate change mitigation policies and become more negative in their attitudes towards them when they are debated after unusual weather events.

The study contributes to a multidisciplinary literature focused on the climatic and environmental factors influencing people's attitudes towards climate change. Most of this research is focused on people's awareness and knowledge about climate change, whether they believe it is occurring, and their concerns about it. In a review of this literature, Egan and Mullin (2017) conclude that "results consistently show a positive relationship between exposure to warmer temperatures and higher levels of warming belief" (p.216). Li et al. (2011) using samples of 582 Americans and 290 Australians, and Egan and Mullin (2012) using a sample of 6,726 Americans, find that unusually warm weather is associated with increased belief in global warming. Relatedly, Dai et al. (2015) analyse a sample of 1,054 Chinese adults and find that reported heatwave exposure is positively associated with belief in global climate change. In contrast to these studies and most of the literature, our analysis is focused on people's level of support for climate change mitigation policies. As noted by Egan and Mullin (2017), "what the public thinks about policy response is probably the aspect of climate change opinion about which we know the least" (p.213).

Our study also contributes to a separate strand of literature that analyses how economic factors influence attitudes towards climate change. This literature generally shows that worsening economic conditions are associated with less concern about the environment and that the success of green-agenda policies is likely to be higher under favourable economic conditions (Kahn and Kotchen 2011; Kachi et al., 2015; Scruggs and Benegal, 2012; Benegal, 2018; Cafferata et al, 2021). Most recently, Meyer (2022) analyses U.S. data and estimates that a one percentage point increase in the county-level unemployment rate reduces by 3-5 percentage points the likelihood that the survey respondent believes in and wants action on climate change. We contribute to this literature by documenting that the impacts of abnormally high temperatures on support for climate change action are most strongly negative for economically insecure subgroups.

2. DATA

Our data are from the U.K. Household Longitudinal Study (UKHLS). UKHLS surveyed approximately 40,000 households living in the United Kingdom in wave one, and included questions on social, economic and behavioural issues. Data collection started in 2009-2010 for wave 1 and eleven waves of data are currently available (University of Essex, 2022).

In wave 4 (conducted throughout 2012 and 2013) and wave 10 (conducted throughout 2018 and 2019), UKHLS asked individuals about their level of agreement with statements related to climate change mitigation:

- It's not worth the U.K. trying to combat climate change, because other countries will just cancel out what we do
- It's not worth me doing things to help the environment if others don't do the same
- Any changes I make to help the environment need to fit in with my lifestyle

Respondents are asked to state their level of agreement on a five-point scale from 'strongly agree' (1) to 'strongly disagree' (5).

For our main outcome measure, we average responses to generate a 'pro-climate change action' index (ranging from 1 to 5), measuring people's degree of support for policy action to combat climate change (higher values implying greater support). Figure 1 presents the distribution of the index separately by questionnaire wave. In both waves, more respondents supported climate change action than not, but it is clear that there was a rightward shift of density between waves 4 and 10. The sample means equal 3.2 and 3.4 in waves 4 and 10, respectively.

Notably, the two survey waves occurred in time periods with vastly different economic conditions. Unusually high unemployment characterised the first period (2012-2013), while unusually low unemployment characterised the second period (2018-2019); see Appendix Figure A1 for a time-series of the U.K. unemployment rate and our sampling periods. The political environment also differed between periods. For instance, public attention was focused on Brexit during 2018-2019, and concerns were raised that climate ambitions could be scaled back in favour of trade agreements and less stringent regulations (Burns et al, 2018). These differences in the economic and political climates may have affected population attention and concerns about climate change mitigation.

We link UKHLS responses to station-level temperature data from the Centre for Environmental Data Analysis (CEDA) Archive, which stores daily weather observations from all Met Office weather stations across the U.K. (Met Office, 2012). We focus our analysis on 168 stations that recorded observations for at least 95% of days during our sample. We assign each local authority district (LAD) to its closest five weather stations and calculate daily average temperature readings, weighted by the inverse squared Euclidian distance from LAD centroids to stations. Daily temperature measures at the Government Office Region (GOR) level are derived by calculating the population-weighted average of LAD temperatures.

The main temperature variables are the number of days in the week before the interview that maximum temperature deviations exceeded various thresholds. Maximum temperature deviations equal the difference between daily maximum temperatures and 'usual' temperatures for that time of year, which we define as the 20-year average in maximum temperatures for the week surrounding the interview date from 1992 to 2011. Predictably, days >3°C above normal are much more common than days >6°C above normal. Nevertheless, the large sample size of the UKHLS means that there are a nontrivial number of respondents who experienced extreme conditions before their survey. For example, 857, 649, 361, 119 and 50 surveys were completed following 3, 4, 5, 6 and 7 days of temperatures >6°C above normal (see Appendix Figure A2).

3. METHODS

We apply two approaches to estimate the effects of abnormally hot temperatures on attitudes. First, we estimate a regression that includes area-time fixed-effects:

$$attitude_{iat} = \beta hot\_days_{at} + \gamma X_{iat} + \theta_{at} + \varepsilon_{iat} \qquad (1)$$

where $attitude_{iat}$ is the attitude index of individual i in location a in month-year t, and hot_days_{at} is the number of abnormally hot days experienced in the week before the interview. X_{iat} is a vector of individual characteristics, including age and age squared, sex, and highest educational qualification. The coefficient of interest β measures how attitudes are impacted by recent abnormally hot weather. There were several such periods during our sample windows. March 2012, May 2012, July and August 2013, June to August 2018, and July 2019 all recorded unusually high temperatures.

The Government Office Region (GOR)-month-year fixed-effects (θ_{at}) control for: (i) differences between geographical areas in climate and attitudes (e.g. northern England has different climate and political attitudes than southern England); (ii) positive trends in maximum temperatures and climate change beliefs over time; and (iii) differences across months within a year in the occurrence of abnormally hot temperatures and the salience of climate change issues. The inclusion of these fixed-effects implies that identification of β comes from variation in attitudes between people surveyed in the same calendar month and living in the same geographical area, but who experienced a different number of hot days in the week before their interview.

Note that equation (1) is not a standard Two-Way Fixed Effects (TWFE) specification in which all observations in group (GOR) j are treated at time (month-year) t. Instead, our treatment is determined by temperature measurements during the seven days before the individual's interview date. Therefore, our specification does not lend itself to the recent advances in the difference-in-differences literature that explore treatment heterogeneity in TWFE models (e.g. Goodman-Bacon 2021).

Importantly, UKHLS does not randomly assign respondents' interview dates; therefore, within GOR-month-year variation in temperatures is not guaranteed to be exogenously determined. The risk is that respondents chose or altered interview dates based on weather forecasts or recent weather and that the propensity to do so is associated with individual characteristics. To test the exogeneity of within GOR-month-year variation in temperatures, we separately regress respondent characteristics (sex, age, marital status, income, children, education, employment) on the number of abnormally hot days (≥6°C above normal) in the past week and GOR-month-year fixed-effects. The results are presented in Table 1. The coefficient estimates are all small and statistically insignificant, indicating that recent hot weather is unrelated to the types of people interviewed.

Our second approach to estimate the effects of abnormally hot temperatures is an event-study design. It compares changes in attitudes between people surveyed in the weeks surrounding a significant national heat wave in 2013 and people surveyed at other times in 2012 and 2013. The 2013 U.K. heat wave included unusually high temperatures for most of July, with maximum temperatures greater than 30°C for seven consecutive days, greater than 28°C on nineteen consecutive days, and a maximum temperature of 33.5°C recorded on July 22nd (Lefevre et al., 2015).[3] After a brief respite in late July, temperatures rose again, with a maximum of 34.1°C recorded on August 1st. Green et al. (2016) estimate that the heat wave caused 195 deaths in people aged ≥ 65 years and 106 deaths in people aged <65 years.

The event-study approach is represented by the following regression:

[3] See https://www.metoffice.gov.uk/weather/learn-about/weather/case-studies/heat-wave-july2013 for more details on the heat wave.

$$attitude_{it} = \sum_m \beta_m D_{it-m} + \delta Z_{it} + \varepsilon_{it} \quad (2)$$

where D_{it-m} is a vector of M treatment dummies equal to 1 if individual i experienced the heat wave in period $t-m$, and β_m quantify the extent to which attitudes are impacted by the heat wave occurring in the future (leads) and in the past (lags). Z_{it} includes the same individual characteristics as in equation (1), and also year fixed-effects and month fixed-effects. The β_m parameters are identified from a comparison of attitudes in June, July and August of 2013 (before and after the heat wave) with attitudes in June, July and August of 2012, relative to changes over time between the other months of 2012 and 2013. Importantly, there were no heat waves in 2012. We cannot repeat this event study approach using data from wave 10 (2018-2019) because there were summer heatwaves in both 2018 and 2019, and therefore no control period.[4]

4. RESULTS

4.1. Impacts of a national heat wave on the salience of climate change

Before discussing our main results, we present a brief analysis of the association between abnormally high temperatures and the salience of climate change and global warming issues. Salience is measured using monthly counts of articles covering climate change or global warming from U.K. newspapers (Guardian, Observer, Daily Mail, Mail on Sunday, Telegraph, Sunday Telegraph, Times, and Sunday Times). These data are from the Boykoff et al. (2022) database and include 36 months of article counts from 2012-2014.

Methodologically, we use an event study design similar to that described in equation (2). The key differences are that the data are monthly and cover a more extended period. I.e. years before and after the 2013 summer heat wave are used as controls. The regression specification includes indicators for July and August 2013 (corresponding to the UK 2013 heatwave), year fixed effects, and month fixed effects. Given that the newspapers are national, we could not exploit temperature differences across regions of the UK.

[4] For summaries of these heat wave events, see https://en.wikipedia.org/wiki/2018_British_Isles_heat_wave and https://en.wikipedia.org/wiki/2019_European_heat_waves. Also see Appendix Figure A3 which presents U.K. Google search interest in heatwaves (from Google Trends) during 2012-2013 and 2018-2019. This figure clearly highlights the summer heatwaves in 2013, 2018 and 2019.

Regression results suggest that the 2013 heatwave substantially increased the total number of articles in August 2013. Specifically, the estimated effect for August equals 190.6 additional articles (t-statistic = 4.69), relative to a sample mean of 406.9 (a 47% increase). The August effect was driven by significant increases in articles in the Telegraph and the Times, which are often described as right-wing or pro-conservative newspapers. The estimated effect for July 2013 was small and not statistically significant (t-statistic = 0.72).[5]

In summary, the analysis suggests that discussion of issues related to climate change and global warming increased with abnormally hot temperatures during our sample period. This aligns with results from prior studies (e.g. Herrnstadt and Muehlegger, 2014; Painter et al., 2021; Schmidt et al., 2012) and supports our assumption that abnormally hot weather increases the salience of climate change and global warming issues, which may in-turn affect reported attitudes towards mitigation policies.

4.2. Impacts of abnormally hot temperatures on pro-action attitudes

To explore the impacts of abnormally hot days on pro-climate change action attitudes, we begin by estimating regression equation (1). Figure 2 presents the estimated coefficient for 'number of abnormally hot days in the past week' from five separate regressions, each using a different temperature threshold to measure 'hot'. We follow this approach because we were *a priori* agnostic about the heat level sufficient to generate a measurable change in attitudes.

The results indicate that the number of hot days is associated with lower scores on the index in wave 4, implying less support for action to combat climate change. The estimated effects (and confidence intervals) increase in magnitude with increases in the temperature threshold. The number of days ≥3°C above normal is not estimated to significantly affect pro-climate change action attitudes. The estimated impact is largest for the variable representing the number of days in the past week that are ≥6°C above normal. This level of abnormality corresponds to ≥29°C in London during July, which has a long-term average of approximately 23°C. The coefficient of -0.020 (p-value = 0.006) indicates that every additional day ≥6°C in the past week reduces the pro-action index by 0.02 units.

[5] Importantly, August 2013 did not contain any internationally important climate change meetings. The United Nations Climate Change Conference – the nineteenth session of the Conference of the Parties (COP 19) - took place from 11 to 22 November 2013 in Warsaw, Poland.

To aid interpretation of the 'days ≥6°C above normal' effect, consider experiencing five abnormally hot days in the past week (pragmatically a heat wave). This extreme weather event is estimated to increase the index by 0.10, which is a moderate-sized effect. It is equivalent to 13% of one standard deviation in the index, greater in magnitude than having children (2 children compared with none reduces index by 0.04) or being married (marriage compared with being single reduces index by 0.04), is slightly smaller than the gender gap (males score 0.14 less than females), and is much smaller than the education gap (individuals with GCSE-only score 0.28 lower than degree-holders). See Appendix Table A1 for the complete set of coefficient estimates.

The estimated associations in Figure 2 are confirmed in Table 2. Experiencing abnormally hot weather leads to greater agreement with all three statements supporting inaction. For example, it is estimated that five additional days ≥6°C above normal in 2012-2013 leads to a 0.11 unit (5*0.022) increase in agreement with the statement that "it's not worth the U.K. trying to combat climate change" (see row (a) in Table 2).

In contrast to the significant negative wave 4 effects, the wave 10 estimated effects in Figure 2 are small, positive, and statistically insignificant. Similarly, abnormally hot weather is not strongly associated with the three individual attitude variables (Table 2). However, there is a weak positive effect (significant at the 10% level) on level of disagreement with the statement that "any changes I make to help the environment need to fit in with my lifestyle" (see row (c) in Table 2).[6]

To support our causal interpretation of the estimates in Figure 2 and Table 2, we additionally estimated placebo regressions using the regression specification shown in equation (1). Our placebo outcome is the attitude towards traditional gender roles. Specifically, we calculate the mean response to five statements, such as "family life suffers when the woman has a full-time mob" and "a husband's job is to earn money, a wife's job is to look after the home and family". There are no clear causal mechanisms between short-term temperature shocks and gender role attitudes, and so if our regression is well-specified, we should find that the number of abnormally hot days in 2012/13 is a statistically insignificant predictor of attitudes. Appendix

[6] We have additionally estimated the effects of the number of abnormally hot days in the past week on agreement with climate change 'belief' statements, such as: "the so-called 'environmental crisis' facing humanity has been greatly exaggerated". For both wave 4 and wave 10, estimated effects are small and statistically insignificant. That is, people's views on the existence and consequence of climate change (global warming) are unaffected by recent abnormally hot weather.

Figure A4 demonstrates that this is indeed the case. For each temperature threshold (from ≥3°C to ≥7°C above normal), the estimated effect is statistically insignificant at the 10% level.

Finally, we have tested whether changes in a person's mood may be driving our results. People's mood may worsen on abnormally hot days, causing them to answer survey questions differently than they may otherwise have (e.g. more pessimistically). For instance, Connolly (2012) concludes that "Low temperatures increase happiness and reduce tiredness and stress, raising net affect, and high temperatures reduce happiness." Though, in contrast, Frijters et al. (2020) fail to find a clear effect of temperature on wellbeing, with the estimate changing from significantly positive to significantly negative depending upon the regression specification used. Similar to the gender attitude results reported above and with the inconsistent findings in Frijters et al. (2020), we find that number of abnormally not days in the past week is not associated with recently feeling unhappy or depressed ($p = 0.879$) or feeling reasonably happy ($p = 0.787$).

4.3. Impacts of a national heat wave on pro-action attitudes

The second approach used to explore the impacts of abnormally hot days on pro-action attitudes is an event study of the U.K. heat wave in 2013 (see discussion in Section 3). The regression includes nine indicator variables representing that the individual's survey occurred in the beginning, middle or end of June, July or August 2013, individual-level controls, and month and year fixed-effects. The estimated coefficients (and confidence intervals) for the nine indicators are presented in Figure 3. There is a clear drop in pro-action attitudes in June and early August, corresponding to the heat wave. The estimated effects for June 11-20, June 21-30, and August 1-10 equal -0.124 ($p = 0.008$), -0.094 ($p = 0.020$) and -0.129 ($p = 0.036$), respectively. These effects are moderate in size, equivalent to around 15% of a standard deviation, and roughly similar to the gender gap in attitudes. All other coefficients are smaller, and none are statistically significant at the 10% level.

Another important finding from Figure 3 is that the reduction in pro-action attitudes (i.e. increase in opposition to climate change action) is short-lived, with coefficient estimates for mid- and late-August close to zero. That is, attitudes towards climate change action returned to normal one or two weeks after the hot weather subsided. This result can be replicated by including lag variables in regression equation (1). Table 3 presents coefficients on variables representing the number of days ≥6°C above normal in three 4-week blocks spanning three months before the respondent's interview (1-28, 29-56, and 57-84 days). The estimates show that only abnormally hot days experienced in the four weeks before the interview impact attitudes: every additional day ≥ 6°C in the past four weeks is estimated to reduce the index by 0.016 (compared to the 0.020 estimated effect for the past seven days, shown in Figure 2). Abnormally hot days 5-8 weeks and 9-12 weeks before the interview are estimated to have small negative effects (-0.005 and -0.002) on the pro-action attitude index.

4.4. Which sub-populations are most strongly impacted?

This final sub-section explores whether specific population groups drive the results discussed in Section 4.2. We hypothesize that the estimated effects will be larger (more negative) for groups who feel more threatened by enhanced policy action, such as those working in carbon polluting industries. Specifically, we estimate the effect of the number of days ≥6°C on the attitude index separately for different subsamples, defined by income, educational attainment, employment status, industry, and financial security.

The results of the heterogeneity analysis for the 2012-2013 survey years are shown in Figure 4. The estimated coefficient estimates are similar for people above and below median household income (-0.021 and -0.022), but more negative for people with fewer years of formal education (-0.028), people who are not working (-0.033), people who work in carbon-intensive industries (-0.035), and people who expect their future financial situation to be fair or poor (-0.030). [7] In other words, the estimates are larger (more negative) for subgroups that are more economically vulnerable and who have more to lose with new mitigation policies. The increased private and public discussion of issues related to climate change following extreme heat – for example, proposals for new taxes on fossil fuels – is a likely mechanism for these effects. For instance, those who work in carbon-intensive industries (e.g. fossil fuel energy generation) may feel threatened by unemployment if their sector is specifically discussed following heat waves.

In contrast to the estimates in Figure 4, the estimated relationships between abnormal temperatures in 2018-2019 and support for action against climate change are near zero for all

[7] The extent to which an industry is carbon intensive is defined by the usage of carbon-based fuels such as coal, natural gas and petrol. Data come from the Office for National Statistics' dataset on Energy use by industry, source and fuel, see: https://www.ons.gov.uk/economy/environmentalaccounts/datasets/ukenvironmentalaccountsenergyusebyindustrysourceandfuel

sub-groups (see Figure 5). The most likely explanation for this difference across years is that during 2018-2019 (relative to 2012-2013), economic growth was high, unemployment was low, and government policy debate was comparatively less focused on climate change. The improved job opportunities and greater financial security may have reduced the number of people feeling threatened by enhanced policy action. Another possible explanation is that there is a positive trend across time in the proportion of people who support climate change mitigation activities (perhaps as the necessity for such measures become clearer).

5. CONCLUSION

Empirical studies have demonstrated that belief in anthropometric climate change significantly increases following warmer temperatures (Egan and Mullin, 2017). Short-term temperature shocks provide little evidence of the true extent of global warming, but it is common for people to associate unusual weather with global warming and for people to update their attitudes based on readily available information. Moreover, it has been shown that unusual weather increases the salience of issues related to global warming through commentary and debate in traditional and social media and through informal discussions with friends and family, which may result in people becoming better informed about its causes (Goldberg et al., 2019).

Using two empirical approaches applied to a large sample of survey responses from 2012-2013, we find that support for public policy action and private behaviour aimed at combating climate change reduces – rather than increases – following days with abnormally high temperatures. For example, results from an event-study analysis show that in the weeks immediately following a 2013 heatwave, our pro-action attitude index reduced by 15% of a standard deviation, a similar magnitude to the difference in attitudes between men and women.

Interestingly, this significant decrease in support is not replicated using survey responses from 2018-2019. A possible explanation for this difference is that economic conditions were poor during the former period (2012-2013) and good during the latter period (2018-2019). For instance, the unemployment rate had dropped from 8.3% in January 2012 to 4.2% in January 2018 and 3.9% in January 2019. A common concern about climate change mitigation policies is that they can lead to the shutdown of firms and layoffs of blue-collar workers. This fear may be more common and intense during periods of high unemployment.

Supporting this interpretation are additional estimates from heterogeneity analyses. The negative effects from the 2012-2013 sample period are most prominent for economically vulnerable people: the less educated, non-employed, and financially insecure. The negative effect was also large for people who work in carbon-intensive industries. More economically vulnerable groups are generally less supportive of climate change mitigation policies (Umit and Schaffer, 2020), and our results suggest they become even more negative in their attitudes towards them when they are debated after abnormally high temperatures.

An explanation for the findings is that increased exposure to policy discussions in traditional and social media – following abnormally hot weather – strengthens anti-mitigation attitudes among people who are worried that climate change policies will negatively affect their economic situation. A related explanation is that people with pre-existing anti-mitigation attitudes become more zealous when exposed to calls for policy action. For example, in a recent experimental study, Bail et al. find that exposing Republicans to liberal ideas on social media strengthens conservative attitudes (Bail et al., 2018).

Regarding policy conclusions, our results suggest that policy makers can reduce public opposition to climate change-related policies if proposed when macroeconomic conditions are good and if they can lessen the fears of vulnerable groups through positive economic messaging.[8] These conclusions align with those in Cafferata et al. (2021).They develop an agent-based model to explore how employment conditions affect environmental attitudes under confirmation bias, and conclude that policy makers should act when employment is increasing and should emphasise the gains of climate change mitigation.

[8] Ho et al. (2022) conduct a field experiment linked to actual environmental behaviour and find that environmental information campaigns can affect environmental attitudes, but that environmental behaviour is only affected when information campaigns are coupled with celebrity endorsements.

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FIGURES

Figure 1: Histograms of 'pro-climate change action' index by wave

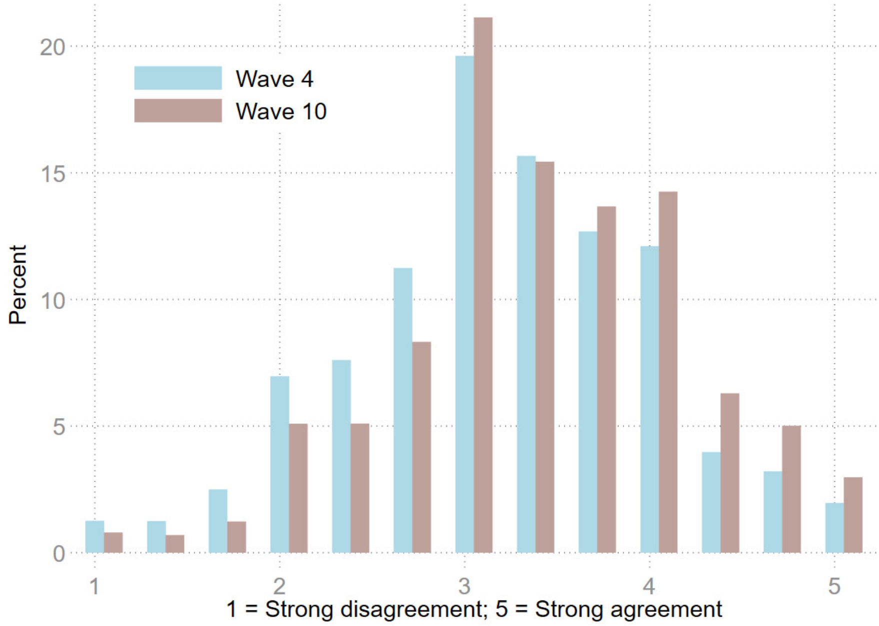
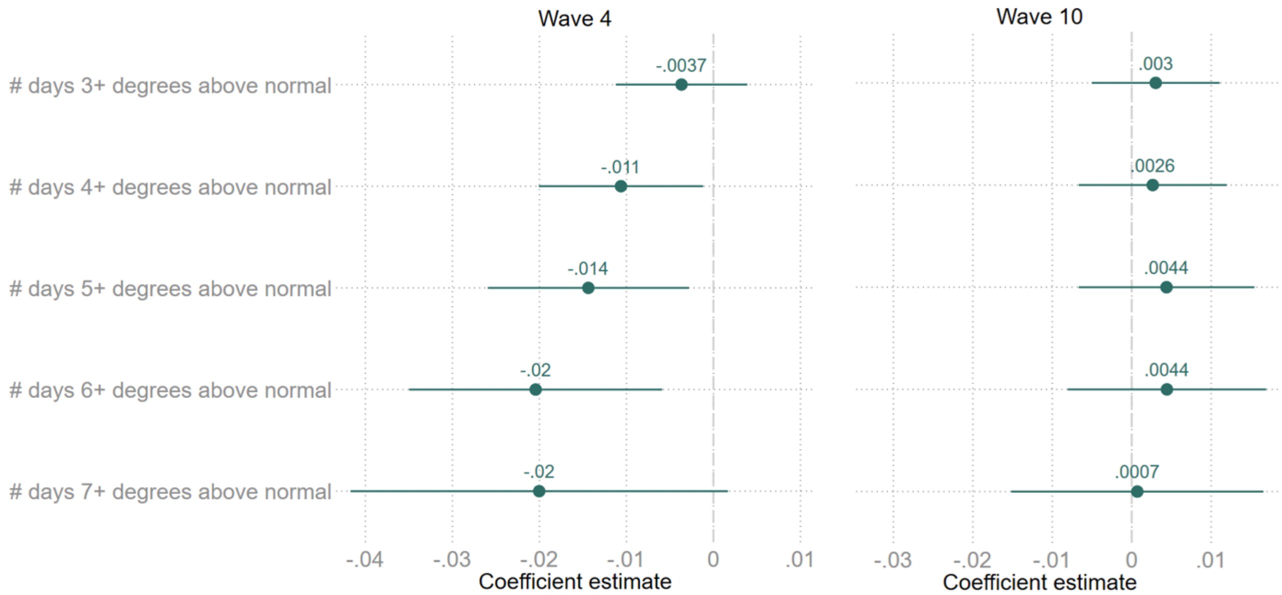
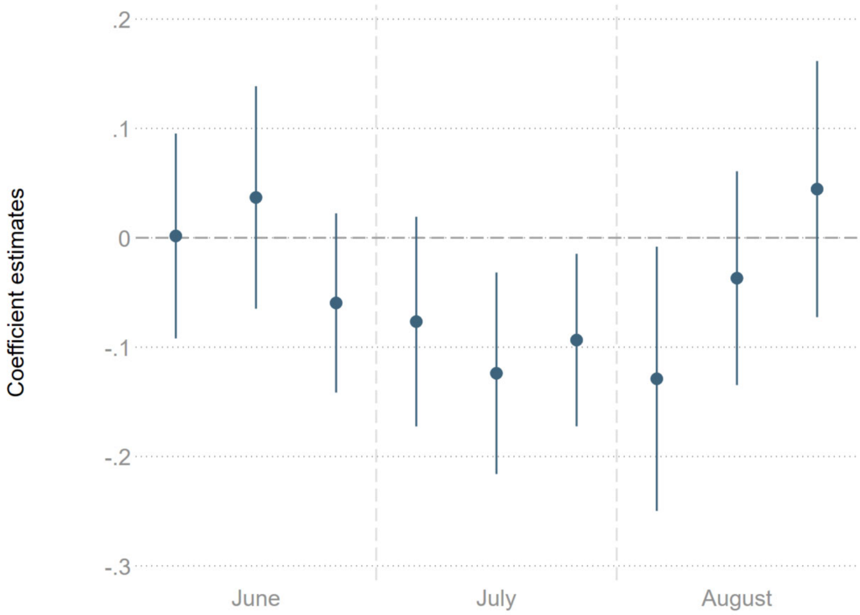


Figure 2: Estimated associations between the number of abnormally hot days in the past week and attitudes



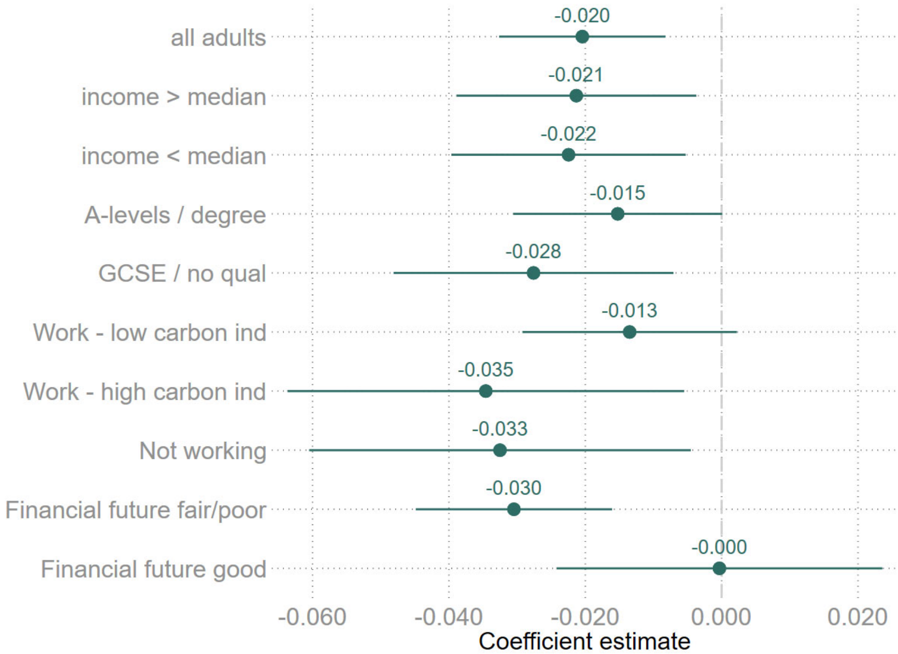
Note: Each point represents the coefficient estimate from a separate linear regression, where regressions also include 316 month-area fixed-effects, and covariates representing gender, age, marital status, income, educational attainment, and employment status. The bars represent 95% confidence intervals.

Figure 3: Estimated Effect of July 2013 Heat Wave on Attitude Index



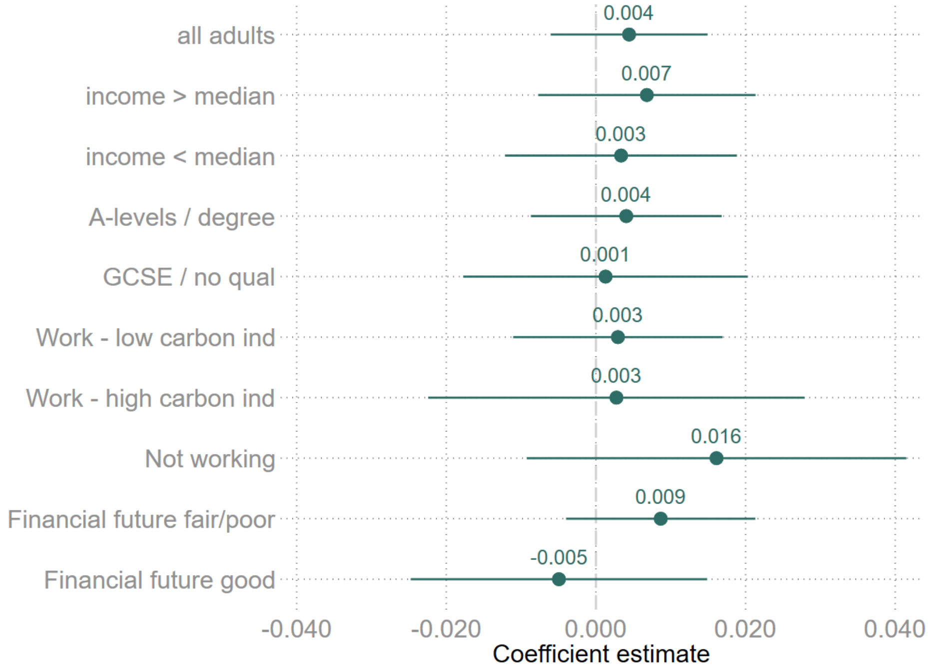
Note: The graph presents the estimated coefficients and 95% confidence intervals from an event study analysis of a U.K. wide heat wave that occurred in 2013. The regression includes covariates for area fixed effects, month fixed effects, year fixed effects, and covariates representing gender, age, marital status, income, educational attainment, and employment status.

Figure 4: Heterogeneity in the estimated association for 2012-2013



Note: Each point represents the coefficient estimate on number of days ≥ 6°C above normal from a linear regression estimated using only the listed subsample. The bars represent 95% confidence intervals.

Figure 5: Heterogeneity in the estimated association for 2018-2019



Note: Each point represents the coefficient estimate on number of days ≥ 6°C above normal from a linear regression estimated using only the listed subsample. The bars represent 95% confidence intervals.

TABLES

Table 1: Estimated associations between number of abnormally hot days in the past week and individual characteristics

Outcome	Sample mean	Coef	
Male	0.429	-0.004	(0.004)
Age	43.07	0.014	(0.080)
Married	57.48	-0.000	(0.004)
Log household income	8.053	-0.008	(0.005)
Number of children in HH	0.463	0.004	(0.006)
University education	0.307	0.006	(0.004)
Employed	0.779	0.006	(0.003)

Note: Each row presents estimated coefficients from separate linear regressions with GOR-month-year fixed-effects. The outcomes are shown in column 1.

Table 2: Estimated effects of number of unusually hot days in the past week on individual statements

	Wave 4		Wave 10	
	Mean	Coef.	Mean	Coef.
(a) It's not worth the UK trying to combat climate change, because other countries will just cancel out what we do	3.34	-0.022** (0.010)	3.61	-0.002 (0.008)
(b) It's not worth me doing things to help the environment if others don't do the same	3.34	-0.022** (0.010)	3.51	0.002 (0.008)
(c) Any changes I make to help the environment need to fit in with my lifestyle	2.82	-0.017** (0.009)	2.94	0.014* (0.008)

Note: Figures are estimated coefficients from separate linear regressions, and the associated standard errors in parentheses. The outcomes all range from 1 (strongly agree) to 5 (strongly disagree). Each regression includes 316 month-area fixed-effects, and covariates representing gender, age, marital status, income, educational attainment, and employment status. *, ** and *** represent statistical significance at the 0.10, 0.05 and 0.01 levels, respectively.

Table 3: Estimated associations between the number of abnormally hot days in the past months and attitudes

Main temperature variables	Coef.	
# of days ≥ 6°C above normal in past 0-4 weeks	-0.016**	(0.007)
# of days ≥ 6°C above normal in past 5-8 weeks	-0.005	(0.008)
# of days ≥ 6°C above normal in past 9-12 weeks	-0.002	(0.006)

Note: Figures are estimated coefficients and the associated standard errors in parentheses. The dependent variable is the 'pro-climate change action' index (ranging from 1 to 5). Each regression includes 316 month-area fixed-effects, and covariates representing gender, age, marital status, income, educational attainment, and employment status. *, ** and *** represent statistical significance at the 0.10, 0.05 and 0.01 levels, respectively.

APPENDIX FIGURES

Figure A1: U.K. Unemployment Rate (aged 16 and over, seasonally adjusted)

Figure A2: Histograms of the number of days in the week before the interview that are more than 3, 4, 5 and 6 degrees above normal

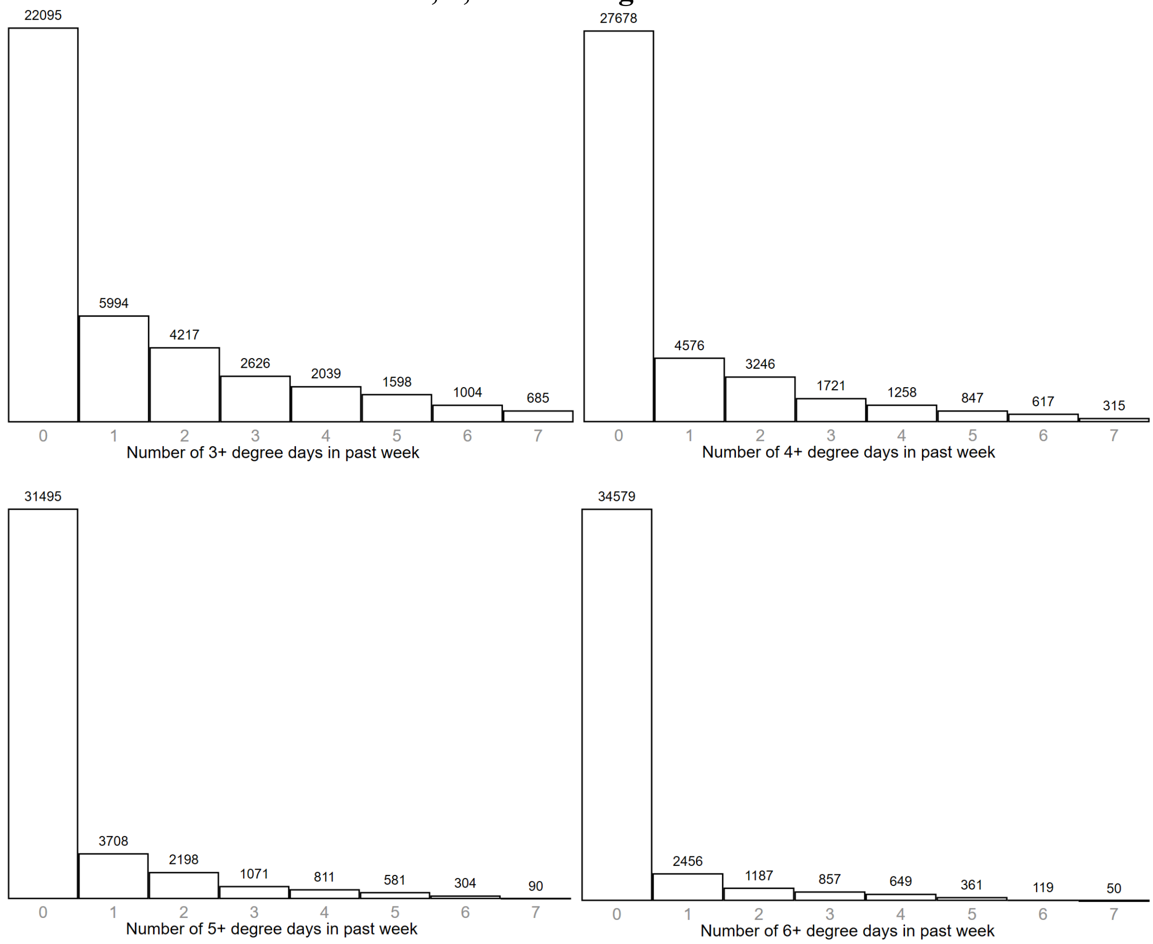
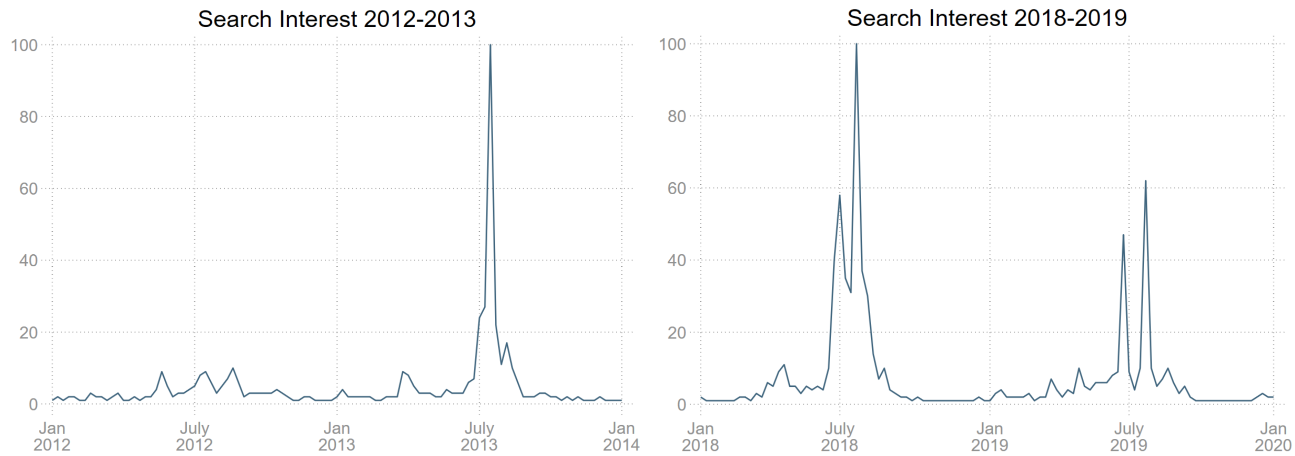
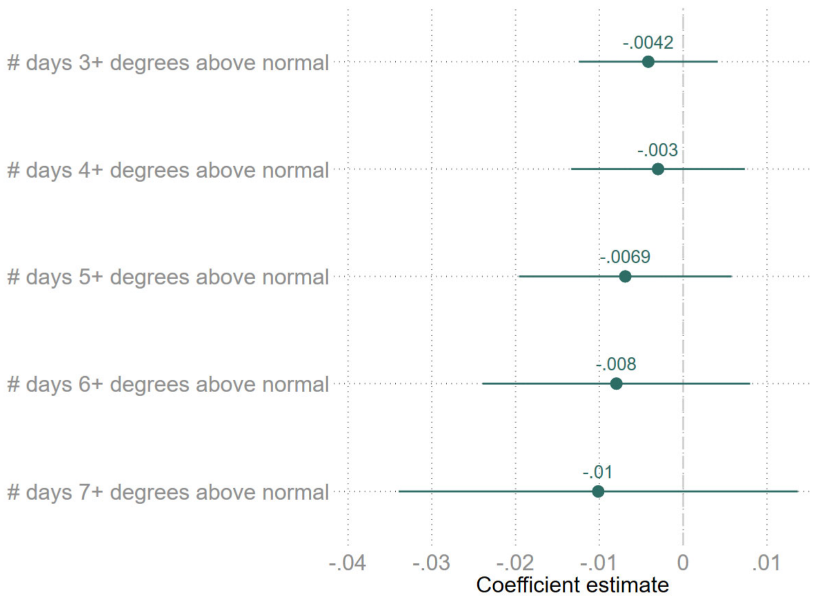


Figure A3: Google Search Interest in Heatwaves during the Two Survey Time Periods



Appendix Figure A4: Placebo test estimates - associations between number of unusually hot days in the past week and gender role attitudes



APPENDIX TABLES

Appendix Table A1: Attitude index regressions by wave

	Wave 4		Wave 10	
Number of days 6+ degrees above normal	-0.020***	(0.007)	0.004	(0.006)
Male	-0.141***	(0.013)	-0.129***	(0.014)
Age	0.116***	(0.034)	-0.027	(0.038)
Age/100 squared	-0.245***	(0.082)	0.086	(0.090)
Age/10000 cubed	0.171***	(0.064)	-0.070	(0.070)
Lives with spouse in HH	-0.036***	(0.014)	-0.054***	(0.016)
Lives with cohabitee in HH	-0.003	(0.017)	-0.009	(0.019)
Log household income	0.025***	(0.009)	0.047***	(0.009)
One child in HH	-0.038**	(0.019)	-0.011	(0.022)
Two children in HH	-0.043**	(0.020)	0.008	(0.023)
Three children in HH	-0.036	(0.032)	-0.076*	(0.040)
Four children in HH	-0.027	(0.065)	-0.144*	(0.081)
Five children in HH	-0.309**	(0.151)	-0.082	(0.189)
Six children in HH	-0.487	(0.355)	0.050	(0.346)
Seven children in HH	-0.125	(0.792)	-1.222	(0.771)
Education: Non-bachelor higher degree	-0.153***	(0.018)	-0.195***	(0.019)
Education: A-levels	-0.198***	(0.015)	-0.220***	(0.017)
Education: GCSE	-0.277***	(0.015)	-0.312***	(0.017)
Education: Other qualification	-0.353***	(0.022)	-0.388***	(0.026)
Education: No qualification	-0.508***	(0.024)	-0.488***	(0.033)
Activity: Paid employment	-0.024	(0.018)	-0.068***	(0.020)
Activity: Unemployed	0.006	(0.029)	-0.135***	(0.035)
Activity: Retired	-0.006	(0.042)	-0.023	(0.043)
Activity: On maternity leave	0.031	(0.061)	-0.102	(0.062)
Activity: Family care	-0.066**	(0.027)	-0.069**	(0.032)
Activity: Full-time student	0.241***	(0.059)	0.155**	(0.072)
Activity: Long-term sick or disabled	-0.092***	(0.030)	-0.096***	(0.034)
Activity: Government training scheme	-0.258	(0.199)	0.176	(0.387)
Activity: Unpaid work	-0.231	(0.212)	0.339*	(0.200)
Activity: On apprenticeship	-0.020	(0.457)	-0.242	(0.245)
Activity: Something else	-0.050	(0.075)	-0.095	(0.072)
Number of observations	23076		17182	