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ORIGINAL ARTICLE

Exposure to heat wave risks across time and places: Seasonal variations and predictors of feelings of threat across heat wave geographical susceptibility locations

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Abstract
Vulnerability to heat waves and their negative effects on health vary not only due to individual factors but also due to situational factors, such as time and geography. Hence, we explored seasonal variations and predictors of heat wave feelings of threat across different heat wave geographical susceptibility locations in Portugal. A total of 238 Portuguese residents responded to a web-based longitudinal survey: before the summer, during a heat wave in the summer, during the summer, and after the summer. Geographical location was used as an indicator of risk exposure, operationalized as heat wave occurrence susceptibility (low, moderate, high). Heat wave demands and resources perceptions were assessed to compute an indicator of heat wave feelings of threat. During the heat wave, feelings of threat were higher among participants in high-susceptibility locations, with demands outweighing resources perceptions, suggesting greater distress and coping difficulty. Regression analysis suggested that older participants and female participants living in moderate–high-susceptibility locations had greater difficulty in recovering. Heat wave risk perception and positive affect about heat were identified as the most consistent predictors of heat wave feelings of threat, with risk perception increasing and positive affect decreasing such feelings. Participants with (individual and geographical) vulnerability profiles, who had greater difficulty in coping and recovering from heat waves, could benefit from resource-building/enhancing interventions. In a climatic crisis context, monitoring psychological responses to heat waves (e.g., threat) may enable anticipated action to build resilience before, rather than after, the effects become damaging to physical and psychological health.

KEYWORDS
adaptation and resilience, feelings of threat, geographical susceptibility, heat waves

1 | INTRODUCTION

Excessive exposure to extreme hot weather events can bring significant complications to individuals, affecting their health and wellbeing (Agüero, 2014; Charlson et al., 2021; Kovats & Hajat, 2008; Ma et al., 2015; World Health Organization [WHO], 2015). These negative effects can range from minor symptoms, such as headache, nausea, sweating, weakness, impaired cognition, experience of negative emotions, and loss of productivity, to severe physical and mental complications, such as heat exhaustion, heat stroke, dehydration, distress, anxiety, depression, and even death (Clayton et al., 2021; Gasparrini & Armstrong, 2011; Hajat et al., 2010, 2014; Laurent, 2021; Liu et al., 2021; Luber & McGeehin, 2008; McGregor et al., 2007; Oray et al., 2018; Thompson et al., 2018). Yet, the negative effects of extreme heat on health and wellbeing vary across time, individuals, communities, populations, and geographical locations (Esplin et al., 2019; Hass et al., 2021; Howe et al., 2019; Koppe et al., 2004; Mayrhuber et al., 2018). This variation may be due not only to individual factors such as sociodemographic characteristics (e.g., age; gender; education level) but also to situational factors such as geographical (e.g., intensity and frequency of exposure) and acclimation and adaptation processes (e.g., physiological adaptation; familiarization; habituation). For example, when compared to individuals living in geographical locations less susceptible to the occurrence of heat waves and thus less exposed to their risks, individuals in more susceptible locations may be more accustomed and familiarized with those events. Such experience may have enabled them to mobilize not only procedural knowledge and material resources, but also physical, psychological, and social resources to help counter the effects of extreme heat (Arbuthnott et al., 2016; Esplin et al., 2019; Stocker et al., 2013; Valois et al., 2017). Other factors, such as having healthy lifestyles (e.g., healthy eating habits; regular physical activity), good health condition (e.g., absence of comorbidities), social support networks (e.g., living with others; being integrated in the community), adequate living conditions (e.g., thermal insulation), available protective equipment (e.g., air conditioning units), economic safety (e.g., having employment), and local interventions and support facilities (e.g., public health interventions; community cooling centers) have also been shown to mitigate the negative impacts of extreme heat on health and wellbeing (Arbuthnott et al., 2016; Bakhsh et al., 2018; Bose-O'Reilly et al., 2021; Hancock & Vasmatzidis, 2003; Hass & Ellis, 2019; Hass et al., 2021; Marinucci et al., 2014; Mayrhuber et al., 2018; Rodrigues et al., 2020; Widerynski et al., 2017).

However, more frequent and intense exposure to extreme heat, coupled with other factors such as age or belonging to a risk group, can also deplete individuals physical, psychological, and social resources (Hajat et al., 2014; Hancock & Vasmatzidis, 2003; Kovats & Hajat, 2008). This can be further aggravated when the geographical locations more susceptible to the occurrence of heat waves also correspond to more isolated and low-income areas, with older or more vulnerable populations, and greater inequalities in the access to physical and psychological healthcare, as is the case in Portugal (Di Meglio et al., 2018; Mauritti et al., 2019; Moreira, 2011; Ordem dos Psicólogos Portugueses [OPP], 2020; Rego et al., 2013; Rodrigues, 2019; Rodrigues et al., 2020, 2021; Silva, 2012). For example, these regions are typically located in the interior of the country and are characterized by small villages and towns with lower demographic density, having higher aging and elderly dependency indexes, lower per capita purchasing power, fewer job opportunities, scarcity of commercial and business centers, and greater barriers in the access to emergency, primary, and specialized healthcare units (e.g., greater travel distance and/or uneven terrain depending on the region). In that regard, how heat waves and hot weather impact individuals living in different heat wave geographical susceptibility locations, and their psychological responses to such events over time (e.g., threat and stress), is still understudied in research.

1.1 | Demands and resources perceptions as an indicator of threat and stress

Psychological responses of threat and stress as well as subjacent adaptation and coping behaviors can be understood as a function of individuals subjective evaluation of (1) demands (i.e., perceived demands—danger; effort; uncertainty) posed by heat waves and other extreme hot weather events and (2) personal and social resources (i.e., perceived resources—knowledge and capabilities; dispositions; external support) available to cope with such demands (Blascovich, 2007; Blascovich & Mendes, 2000, 2010; Domingos et al., 2020; Fredrickson, 2004; Gaspar et al., 2015, 2023; Gonzalez-Mulé & Cockburn, 2017; Gonzalez-Mulé et al., 2021; Jenny et al., 2019; Li et al., 2013; Skinner et al., 2003; Skinner & Zimmer-Gembeck, 2007, 2015). Particularly, the ratio (D/R) between demands (D) and resources (R) perceptions has been systematically associated to specific psychological, physiological, and behavioral outcomes (for a review, see Blascovich & Mendes, 2000, 2010; Tomaka et al., 1993, 1997). According to the authors, higher values of this ratio (i.e., when perceived demands are significantly higher than resources; $D/R > 1$) have been associated to higher distress, worry, exhaustion, avoidance rather than approach behaviors (e.g., withdrawal; freeze), and more pernicious cardiovascular response patterns (e.g., greater total peripheral resistance). Lower values of this ratio (i.e., when perceived demands are significantly lower than resources; $D/R < 1$) have been associated to lower stress (i.e., distress and eustress), worry, exhaustion, and less pernicious cardiovascular response patterns, but also lower motivation for protection (e.g., unawareness; underestimation). Balanced values of this ratio (i.e., when perceived demands and resources are not significantly different; $D/R \approx 1$) have been associated to higher eustress, protective response, and approach rather than avoidance behaviors (e.g., prevention; planning) while maintaining less pernicious cardiovascular response patterns, making this an "optimal motivational state". This motivational state happens when feelings of threat (D/R) are high enough to promote protective action without inducing damaging levels of stress or withdrawal/freeze behaviors (i.e., challenge). Moreover, there is evidence that this type of operationalization (i.e., D/R) represents a type of canonical cortical operation[1] that provides explanation and context for the neural mechanisms behind the formation of these feelings, that is, for example, the feelings and the creation of meaning resulting from the comparison between two perceptions (Aqil et al., 2021; Carandini & Heeger, 2012; Louie et al., 2013).

Feelings of threat (D/R) can be influenced by multiple individual and sociodemographic factors and are typically context-dependent (Blascovich & Mendes, 2000; Theorell & Karasek, 1996), being unclear if or how they vary in the con-

[1] Canonical cortical operations are mathematical operations applied by the brain in a wide variety of contexts and capable of explaining and unifying seemingly unrelated neural and perceptual phenomena (Aqil et al., 2021).

text of heat waves as well as across different seasons and heat wave geographical susceptibility locations. This understanding can be particularly important, as it may provide an evidence-based indicator about how different populations, in different geographical locations and at different times of the year, are feeling about heat waves (i.e., an indicator of threat posed by heat waves) and how they are coping with and recovering from heat waves and hot weather (i.e., an indicator of stress associated with heat waves and hot weather). Because feelings of threat (D/R) are operationalized from demands (D) and resources (R) perceptions, it has the advantage of also providing decision makers with additional information about the prevalence of such perceptions. Additionally, better knowledge about predictors of feelings of threat (D/R) can provide decision makers with evidence for targeted interventions to promote protective action without inducing damaging levels of stress. Due to their predictive role, feelings of threat (D/R) can be further used as an indicator of change in such interventions (Blascovich & Mendes, 2010).

In the context of heat waves, research suggests that factors, such as heat wave risk perception, positive affect about heat, need for cognition, temperature feeling, temperature interference in daily life, and awareness of heat protection recommendations, may play an important role in shaping feelings of threat, although their role is still unclear (Beckmann & Hiete, 2020; Bruine de Bruin et al., 2016; Hajat et al., 2010; Hass et al., 2021; Lefevre et al., 2015). The current study aims to contribute to this by providing a better understanding of such role.

1.2 | Current study

We conducted a web-based survey with a longitudinal research design to explore feelings of threat (D/R), as an indicator of how participants living in different geographical locations of Portugal, varying in heat wave occurrence susceptibility (i.e., heat wave geographical susceptibility), felt about heat waves. This was assessed across different seasons of the year (i.e., an indicator of threat posed by heat waves), reflecting an overall longitudinal indicator of how participants coped with and recovered from heat waves and hot weather (i.e., an indicator of stress associated with heat waves and hot weather).

For that, we focused on three research questions: (RQ1) Are there seasonal variations in heat wave feelings of threat (D/R) within the groups of participants living in the different heat wave geographical susceptibility locations of Portugal? (RQ2) Are there seasonal variations in heat wave feelings of threat (D/R) between the groups of participants living in the different heat wave geographical susceptibility locations of Portugal? and (RQ3) What factors predicted heat wave feelings of threat (D/R) across different seasons and different heat wave geographical susceptibility locations of Portugal?

2 | METHODS

2.1 | Sample

The web-based longitudinal survey was completed by a sample of 238 Portuguese residents that participated in all 4 waves: (1) in the spring before the summer; (2) during a heat wave in the summer; (3) during the summer; and (4) in the autumn after the summer. The sample was recruited following nonrandom sampling procedures, namely, through convenience and snowball sampling, resorting to institutions that served as informants in the community (e.g., parish councils; elderly associations; universities) and other participants for reference to potential participants. In that regard, we requested these institutions collaboration for disseminating the survey among their users. Additionally, survey instructions also requested that participants share the survey within their social network.

Participants were between 17 and 89 years old ($M = 39.13$; $SD = 17.14$), with 70.2% ($n = 167$) female, 68.9% ($n = 164$) reporting at least level 3 professional/vocational or higher education level, 15.1% ($n = 36$) reporting living alone, 52.9% ($n = 126$) reporting doing regular physical activity, 62.6% reporting being employed ($n = 149$), and 0.4% ($n = 1$) reporting having a health condition that could condition exposure to hot weather (asthma).[2] It should be noted that this is not a representative sample of the Portuguese population, presenting a higher proportion of female participants, higher education level, and higher employment rates than what is found in the Portuguese population.

2.2 | Procedure and measures

Data was collected between June 2018 and November 2018. The first survey wave (SW1) took place in June 2018, during the last month of spring, before a heat wave. The second survey wave (SW2) took place in August 2018, just after the beginning of the summer and during a heat wave with maximum average temperatures above 40°C and minimum average temperatures above 20°C (Instituto Português do Mar e da Atmosfera [IPMA], 2018a). The third survey wave (SW3) took place outside of a heat wave during the summer in September 2018, which was characterized as the hottest September since 1931 (IPMA, 2018b). The fourth wave (SW4) took place in November 2018 outside of a heat wave during the autumn, after the "summerlike" temperatures that characterized the beginning of autumn 2018 in the

[2] Considering this participant's heat wave geographical susceptibility group (high susceptibility), it was observed that, for this participant and across survey waves, feelings of threat (D/R) were below average, suggesting that, in this case, reporting a condition did not contribute for an overestimation of feelings of threat.

country started decreasing[3] (IPMA, 2018b). In the first survey wave, participants received an email invitation to an online survey about climate change and natural hazards, with the following instruction: “the aim of this study is to investigate how people cope with climate change and natural hazards, such has extreme temperature, throughout the different seasons of the year.” This also included information about follow-up survey waves, research contact procedures, and informed consent, including the right to withdraw from the study at any moment if they wished so. No additional information regarding the survey was provided. On subsequent survey waves, participants received an email with the same background information and a request for continuing their participation. Periodic reminders were also sent to participants who had not yet given their responses. Collected measures are described below.

2.2.1 | Geographical susceptibility to the occurrence of heat waves (heat wave geographical susceptibility[4])

This variable was assessed by asking participants the location where they lived (e.g., town, village, hamlet name) and consulting the geographical susceptibility level to the occurrence of heat waves in that location, as issued in the Portuguese National Civil Protection Commission Platform for Disaster Risk Reduction (Plataforma Nacional para a Redução do Risco de Catástrofes—PNRRC) “InfoRiscos”[5] web tool. Figure 1 shows the heat wave geographical susceptibility map for Portugal. Depending on participants living location, heat wave geographical susceptibility level was coded as low, moderate, high, or very high. Because the four survey waves were completed by only four participants who reported living in very high heat wave geographical susceptibility locations, we decided to merge this sample with the sample of participants in the high-susceptibility category.[6] As such, the indicator of heat wave geographical susceptibility used in the analysis is comprised by three levels: (1) low susceptibility; (2) moderate susceptibility; (3) high susceptibility.

[3] The beginning of autumn 2018 in Portugal was characterized by very high values of air temperature, having been exceeded (or equaled) the values of the maximum temperature for the month of September (IPMA, 2018b).

[4] Heat wave geographical susceptibility is defined as the annual probability of occurrence of heat waves in such locations, with the following classification: low susceptibility—probability ≤30%; moderate susceptibility—probability 31%–50%; high susceptibility—probability 51%–70%; very high susceptibility—probability ≥70%. In Portugal, the Institute for Sea and Atmosphere defines heat waves as 6 or more consecutive days with maximum daily temperatures 5°C above the average value for the reference period, or 3 consecutive days with maximum daily temperatures 10°C above the average value for the reference period.

[5] The “InfoRiscos” web tool is part of the Portuguese National Platform for Disaster Risk Reduction (Plataforma Nacional para a Redução do Risco de Catástrofes) and managed by the Portuguese National Civil Protection Commission. This web tool can be accessed at https://www.pnrrc.pt/index.php/geovisualizador/.

[6] For these four participants and across survey waves, feelings of threat (D/R) were below average, suggesting that the inclusion on the high susceptibility group did not contribute for an overestimation of feelings of threat.

2.2.2 | Heat wave feelings of threat

This variable was computed by dividing the reported averaged value of demands perceptions by the reported averaged value of resources perceptions (D/R) in line with the threat appraisal operationalization proposed by Tomaka et al. (1993, 1997). Besides providing an indicator of the magnitude of heat wave feelings of threat, the computed measure also provides information on when perceived demands exceed perceived resources and vice versa (i.e., when perceived demands are greater than perceived resources feelings of threat indicator will be greater than 1, and lower otherwise). To enable the computation of this indicator, heat wave demands and resources perceptions were assessed using two separate scales derived from the work developed by Domingos et al. (2020). Items for these scales were redacted following the categories and themes identified in the interviews conducted by Domingos et al. (2020), which enabled the identification of public expressions of heat wave demands and available coping resources. Prior to this study, we conducted a pretest with a small sample of participants residing in different geographical locations of Portugal to check if there were any issues with the wording used in the items redaction and assess if the items were understood by respondents as reflecting heat wave demands and available coping resources. The demands scale is comprised by 13 items representing danger, effort, and uncertainty, and the resources scale is comprised by 18 items representing knowledge, abilities, skills, and also individual dispositions, and external support (Appendix A). Both use a response scale anchored from 1 (strongly disagree) to 5 (strongly agree). On each survey wave, the demands scale was first presented to the participants with the instruction, “The following statements represent possible demands posed by heat waves, please rate how much you agree or disagree with each one”, followed by the 13 items presented in randomized order. Next, for the resources scale, participants received the instruction: “The following statements represent possible resources to cope with the demands posed by heat waves, please rate how much you agree or disagree with each one”, which was followed by the 18 items presented in randomized order. Reliability, observed for each survey wave, across the 13 demands scale items (Cronbach’s α: SW1 = 0.88; SW2 = 0.89; SW3 = 0.89; SW4 = 0.89) and the 18 resources scale items (Cronbach’s α: SW1 = 0.86; SW2 = 0.85; SW3 = 0.86; SW4 = 0.85) was good and sufficient to warrant computing each participant’s mean rating. No item had to be dropped (see Appendix B). As these are new scales, and to provide additional evidence on their validity, we also present a test–retest reliability correlation matrix (see Appendix C) and an exploratory factor analysis (see Appendix D). Results from the test–retest reliability correlation matrix show moderate-to-strong positive correlations between the repeated measures of demands and resources, respectively. Correlations were strongest between the Second Survey Wave (during a heat wave in the summer) and the Third Survey Wave (during the summer). Results

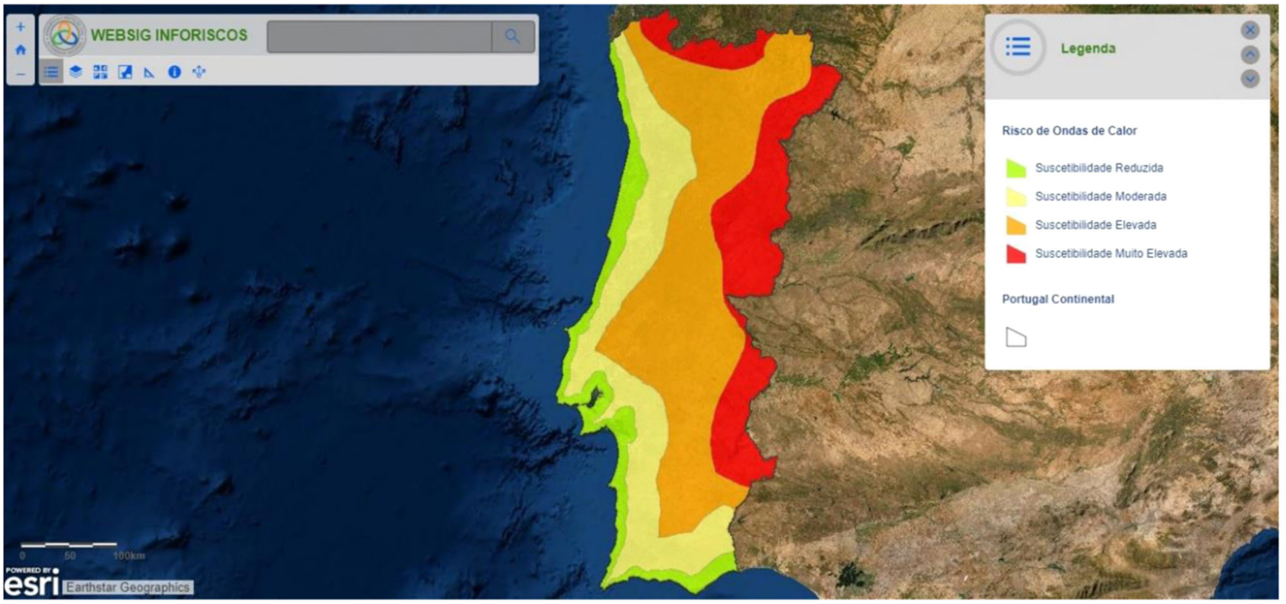

FIGURE 1 Portuguese National Civil Protection Commission Platform for Disaster Risk Reduction "InfoRiscos" Web Tool: with the heat wave geographical susceptibility layer and respective heat wave susceptibility levels for mainland Portugal. *Note*: green, low susceptibility; yellow, moderate susceptibility; orange, high susceptibility; red, very high susceptibility. *Source*: https://www.pnrrc.pt/index.php/geovisualizador/.

from the exploratory factor analysis explain more than 50% of the variance of the demands and resources scales and suggest differences between how items were grouped theoretically and how items were factored together. Nevertheless, the emerging factors' content and themes are concurrent with the theoretical categories that guided the creation of the demands and resources scales, with some logical adjustments such as danger and effort factoring together, and external support being divided into different subcategories (see Appendix D). It should be noted that as these are new measures being developed, more work is needed to better understand the construct of demands and resources perceptions, their dimensions, and factorial structure. Overall, the scales present good indicators of internal consistency, test–retest reliability, and the items factored together in a coherent factorial structure. These scales reflect participants overall perception of demands posed by heat waves and of available resources to cope with them, and they were used to compute the feelings of threat indicator (D/R).

2.2.3 | Heat wave risk perception

This variable was operationalized as a composite measure of the perceived risk of heat waves to oneself and others. This measure was comprised by three items using a response scale anchored from 1 (extremely low) to 5 (extremely high). On each survey wave, participants were asked, "How do you rate the level of risk that heat waves have or may have?" considering the following items: (1) "For you"; (2) "For your family"; (3) "For the Portuguese population". Reliability, observed for each survey wave, was good and sufficient to warrant computing each participant's mean rating of heat wave risk perception (Cronbach's α: SW1 = 0.83; SW2 = 0.83; SW3 = 0.86; SW4 = 0.85).

2.2.4 | Temperature feeling

This variable was operationalized as a measure of how hot or cold participants perceived the temperature to be during the 5 days prior to participating in each survey wave, considering the season. This was measured with a single item using a response scale anchored from 1 (a lot colder than average for the season) to 5 (a lot hotter than average for the season). In each survey wave, participants were asked, "Considering the current season, how do you classify the temperature you felt in the last five days?".

2.2.5 | Temperature interference in daily life

This variable was operationalized as a measure of the perceived interference of high temperatures in regular daily life or routine. This measure included individual and social components and was comprised by three items using a response scale anchored from 1 (nothing at all) to 5 (extremely). On each survey wave, participants were instructed, "How much did the temperatures felt in the last five days interfered with?" and considered the following items: (1) "Your daily life or routine"; (2) "The daily life or routine of your family"; (3) "The daily life or routine of the Portuguese population". Reliability, observed for each survey wave, was good and sufficient to warrant computing each participant's mean rating of perceived temperature interference in daily life (Cronbach's α: SW1 = 0.86; SW2 = 0.88; SW3 = 0.88; SW4 = 0.89).

2.2.6 | Positive affect about heat

This variable was assessed based on the translated version[7] of the scale proposed by Lefevre et al. (2015). Participants rated their positive affect about hot weather, on four items, using a response scale anchored from 1 (strongly disagree) to 5 (strongly agree). In each survey wave, participants were instructed to "Read the following statements and rate how much you agree or disagree with each one, considering the meaning that hot weather has for you". They considered the following items, presented in randomized order: (1) "I love hot weather"; (2) "I want to get tanned"; (3) "I spend time in the sun when I can"; and (4) "I go on holiday to seek out warm or hot weather". Reliability, observed for each survey wave, was good and sufficient to warrant computing each participant's mean rating, as reflecting overall positive affect about heat (Cronbach's α: SW1 = 0.80; SW2 = 0.81; SW3 = 0.83; SW4 = 0.82).

2.2.7 | Need for cognition

This variable was measured using the short version proposed by Epstein et al. (1996) included in the Rational-Experiential Inventory short scale (REI-10), which was translated to Portuguese.[8] This scale is comprised by five items, using a response scale anchored from 1 (completely false) to 5 (completely true). On each survey wave, participants were instructed to "Read the following statements and rate how much you agree or disagree with each one". They considered the following items, presented in randomized order: (1) "I don't like to have to do a lot of thinking" (reverse coded); (2) "I try to avoid situations that require thinking in depth about something" (reverse coded); (3) "I prefer to do something that challenges my thinking abilities rather than something that requires little thought"; (4) "I prefer complex to simple problems"; and (5) "Thinking hard and for a long time about something gives me little satisfaction" (reverse coded). Reliability across the five items, observed for each survey wave, was good and sufficient to warrant computing each participant's mean rating, as reflecting a measure of participants overall need for cognition (Cronbach's α: SW1 = 0.82; SW2 = 0.82; SW3 = 0.85; SW4 = 0.87).

2.2.8 | Reports of having heard heat protection recommendations

From the second survey wave onward, and in line with Lefevre et al. (2015), this variable was assessed based on participants reports of whether they had heard specific public recommendations about how to protect themselves from heat in the 5 days prior to their participation in the study. For that, we asked participants, "in the last week did you hear or read any news, information, or recommendation about what to do or how to protect yourself from heat?" Possible answers were "yes" and "no".

2.2.9 | Demographic variables

Participants reported their age, gender, highest level of education completed, whether they lived alone or with others, whether they did regular physical activity or not, if they had (in their opinion) any health condition that could prevent or make inadvisable the exposure to hot weather, and employment status. Comprehensive descriptive statistics can be seen in Appendix E.

2.3 | Analysis plan

Seasonal variations in heat wave feelings of threat (D/R) within the groups of participants living in the different heat wave geographical susceptibility locations of Portugal were assessed using within-subjects ANOVAs (RQ1). Between-subjects ANOVAs were used to further assess seasonal variations in heat wave feelings of threat (D/R) between the groups of participants living in the different heat wave geographical susceptibility locations of Portugal (RQ2). Predictors of heat wave feelings of threat across different seasons and different heat wave geographical susceptibility locations of Portugal were assessed using multiple linear regressions (RQ3). All analyses were conducted in IBM SPSS 20, and the verification of assumptions (e.g., normality; absence of multivariate outliers) for the used statistical tests and bias corrections was performed in line with Marôco (2014) and Tabachnick and Fidell (2007). For all analyses, we set $\alpha = 0.05$ (two-sided).

3 | RESULTS

3.1 | Seasonal and geographical variations in heat wave feelings of threat (RQ1/RQ2)

Figure 2 consolidates the results of seasonal variations in heat wave feelings of threat (D/R) within and between participants

[7] The original version in English (Lefevre et al., 2015) was translated to Portuguese and reverse translated to English by two independent translators fluent in both English and Portuguese, and then screened by a third independent translator fluent in both languages. The final version of the scale, in Portuguese, was then reviewed by the researchers and pre-tested on a sample of Portuguese participants before being included in the study. Two items from the original scale were previously excluded due to low internal consistency. The Portuguese version can be made available upon request to the authors.

[8] The original version in English (Epstein et al., 1996) was translated to Portuguese and reverse translated to English by two independent translators fluent in both English and Portuguese, and then screened by a third independent translator fluent in both languages. The final version of the scale, in Portuguese, was then reviewed by the researchers and pre-tested on a sample of Portuguese participants before being included in the study. The Portuguese version can be made available upon request to the authors.

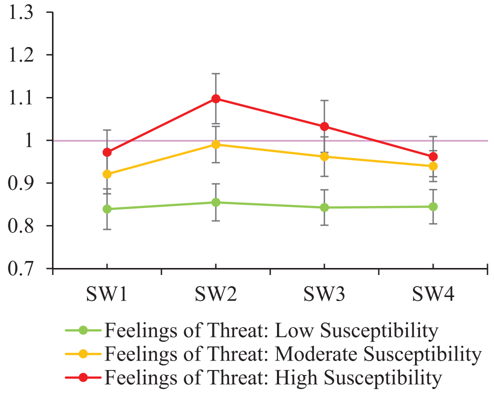

FIGURE 2 Seasonal variations in heat wave feelings of threat within and between participants living in the different heat wave geographical susceptibility locations. *Note*: SW1, First Survey Wave (before the summer); SW2, Second Survey Wave (during a heat wave in the summer); SW3, Third Survey Wave (during the summer); SW4, Fourth Survey Wave (after the summer). Scale ranging from 0.2 to 5. Versions of the figure separated by heat wave geographical susceptibility location can be seen, respectively, in Appendix F (Figure F1–F3). Details on differences between demands and resources perceptions, highlighting when D/R > 1, D/R < 1, and D/R ≈ 1, can be seen in Appendix G.

living in the different heat wave geographical susceptibility locations of Portugal, showing that (RQ1) Seasonal variations in heat wave feelings of threat were only significant within participants living in high (F(3, 246) = 12.271; $p < 0.001$; $\eta^2_p = 0.130$; $\pi = 0.998$) and moderate (F(3, 144) = 5.445; $p < 0.01$; $\eta^2_p = 0.102$; $\pi = 0.904$) heat wave geographical susceptibility locations, and nonsignificant (F(3, 315) = 0.431; $p = 0.690$; $\eta^2_p = 0.004$; $\pi = 0.127$) within participants living in low heat wave geographical susceptibility locations; and that (RQ2) in each survey wave were observed examples of significant differences in heat wave feelings of threat between participants living in the different heat wave geographical susceptibility locations (F(8, 466) = 6.298; $p < 0.001$; $\eta^2_p = 0.102$; $\pi = 1.000$). Details on means and standard deviations can be seen in Appendix E.

3.1.1 | Higher feelings of threat during a heat wave within participants living in high heat wave geographical susceptibility locations

For participants living within high-susceptibility locations, feelings of threat were significantly higher during a heat wave in the summer (SW2; $M = 1.10$; $SD = 0.27$) than before the summer (SW1; $M = 0.97$; $SD = 0.24$; $p < 0.001$; 95% CI[0.06; 0.19]), during the summer (SW3; $M = 1.03$; $SD = 0.28$; $p < 0.01$; 95% CI[0.02; 0.11]), and after the summer (SW4; $M = 0.96$; $SD = 0.22$; $p < 0.001$; 95% CI[0.07; 0.21]). No other significant differences were observed among survey waves for these participants.

3.1.2 | Higher feelings of threat during a heat wave within participants living in moderate heat wave geographical susceptibility locations

For participants living within moderate-susceptibility locations, feelings of threat were significantly higher during a heat wave in the summer (SW2; $M = 0.99$; $SD = 0.15$) than before the summer (SW1; $M = 0.92$; $SD = 0.16$; $p < 0.05$; 95% CI[0.01; 0.13]) and after the summer (SW4; $M = 0.94$; $SD = 0.13$; $p < 0.05$; 95% CI[0.01; 0.09]). No other significant differences were observed between survey waves for these participants.

3.1.3 | Higher feelings of threat in high heat wave geographical susceptibility locations before the summer

Feelings of threat were significantly higher among participants living in high-susceptibility locations ($M = 0.97$; $SD = 0.24$) than among participants living in low-susceptibility locations ($M = 0.84$; $SD = 0.25$; $p < 0.001$; 95% CI[0.05; 0.21]). Differences between participants living in moderate-susceptibility locations ($M = 0.92$; $SD = 0.16$) and participants living in low-susceptibility locations ($M = 0.84$; $SD = 0.25$) were marginally significant ($p < 0.10$; 95% CI[−0.01; 0.18]). Differences between participants living in high-susceptibility locations ($M = 0.97$; $SD = 0.24$) and participants living in moderate-susceptibility locations ($M = 0.92$; $SD = 0.16$) were nonsignificant ($p = 0.431$; 95% CI[−0.05; 0.15]).

3.1.4 | Higher feelings of threat in high heat wave geographical susceptibility locations during a heat wave in the summer

Feelings of threat were significantly higher among participants living in high-susceptibility locations ($M = 1.10$; $SD = 0.27$) than among participants living in moderate ($M = 0.99$; $SD = 0.15$; $p < 0.05$; 95% CI[0.01; 20]) and low-susceptibility locations ($M = 0.86$; $SD = 0.23$; $p < 0.001$; 95% CI[0.16; 0.32]). These were also significantly higher among participants living in moderate-susceptibility locations ($M = 0.99$; $SD = 0.15$) than among participants living in low-susceptibility locations ($M = 0.86$; $SD = 0.23$; $p < 0.01$; 95% CI[0.04; 0.23]).

3.1.5 | Higher feelings of threat in high and moderate heat wave geographical susceptibility locations during the summer

Feelings of threat were significantly higher among participants living in high-susceptibility locations ($M = 1.03$; $SD = 0.28$) than among participants living in low-susceptibility locations ($M = 0.84$; $SD = 0.22$; $p < 0.001$; 95% CI[0.11; 0.27]). These were also significantly higher among participants living in moderate-susceptibility locations ($M = 0.96$; $SD = 0.16$) than among participants living in low-susceptibility locations ($M = 0.84$; $SD = 0.22$; $p < 0.01$; 95% CI[0.03; 0.21]). Differences between participants living high-susceptibility locations ($M = 1.03$; $SD = 0.28$) and participants living in moderate-susceptibility locations ($M = 0.96$; $SD = 0.16$) were nonsignificant ($p = 0.206$; 95% CI[−0.03; 0.17]).

3.1.6 | Higher feelings of threat in high and moderate heat wave geographical susceptibility locations after the summer

Feelings of threat were significantly higher among participants living in high-susceptibility locations ($M = 0.96$; $SD = 0.22$) than among participants living in low-susceptibility locations ($M = 0.85$; $SD = 0.21$; $p < 0.001$; 95% CI[0.05; 0.19]). These were also significantly higher among participants living in moderate-susceptibility locations ($M = 0.94$; $SD = 0.13$) than among participants living in low-susceptibility locations ($M = 0.85$; $SD = 0.21$; $p < 0.05$; 95% CI[0.02; 0.18]). Differences between participants living in high-susceptibility locations ($M = 0.96$; $SD = 0.22$) and participants living in moderate-susceptibility locations ($M = 0.94$; $SD = 0.13$) were nonsignificant ($p = 0.805$; 95% CI[−0.06; 0.11]).

3.2 | Seasonal and geographical predictors of heat wave feelings of threat (RQ3)

Regarding RQ3, in the overall and across survey waves and heat wave geographical susceptibility locations, heat wave risk perception was identified as the most consistent positive predictor, increasing heat wave feelings of threat. Positive affect about heat was identified as the most consistent negative predictor, decreasing heat wave feelings of threat. Yet, situations were identified across heat wave geographical susceptibility locations where only one or none of the two was found to be a significant predictor. Temperature interference in daily life was found to be a positive predictor, increasing heat wave feelings of threat during a heat wave (SW2) in high and low heat wave geographical susceptibility locations, and during the summer (SW3) in high heat wave geographical susceptibility locations. Need for cognition was found to be a negative predictor, decreasing heat wave feelings of threat during a heat wave (SW2) in high heat wave geographical susceptibility locations. Being employed was also found to be a negative predictor, decreasing heat wave feelings of threat before the summer (SW1) in high heat wave geographical susceptibility locations, as well as during a heat wave (SW2) and during the summer (SW3) in low heat wave geographical susceptibility locations. Factors such as age and being female were found to be positive predictors, increasing heat wave feelings of threat after a heat wave (SW3 & SW4), particularly in high (age; being female) and moderate (being female) heat wave geographical susceptibility locations. As such, the analysis identified two classes of predictors: (1) predictors that increased heat wave feelings of threat, such as heat wave risk perception, temperature interference in daily life, being female, and age; and (2) predictors that decreased heat wave feelings of threat, such as positive affect about heat, need for cognition, and employment status. Detailed results of regression analyses can be seen in Appendix H.

3.2.1 | Significant predictors of heat wave feelings of threat before the summer (SW1) in the different heat wave geographical susceptibility locations

In low-susceptibility locations, heat wave risk perception increased ($\beta = 0.41$; $p < 0.001$; 95% CI[0.07; 0.18]), and positive affect about heat decreased ($\beta = -0.29$; $p < 0.01$; 95% CI[−0.13; −0.03]) feelings of threat. In moderate-susceptibility locations, positive affect about heat decreased ($\beta = -0.45$; $p < 0.01$; 95% CI[−0.20; −0.03]) feelings of threat. In high-susceptibility locations, positive affect about heat ($\beta = -0.30$; $p < 0.01$; 95% CI[−0.14; −0.02]) and being employed ($\beta = -0.28$; $p < 0.05$; 95% CI[−0.26; −0.01]) decreased feelings of threat, whereas heat wave risk perception increased them ($\beta = 0.27$; $p < 0.01$; 95% CI[0.02; 0.16]).

3.2.2 | Significant predictors of heat wave feelings of threat during a heat wave in the summer (SW2) in the different heat wave geographical susceptibility locations

In low-susceptibility locations, positive affect about heat ($\beta = -0.29$; $p < 0.01$; 95% CI[−0.11; −0.03]) and being employed ($\beta = -0.17$; $p < 0.05$; 95% CI[−0.16; 0.000]) decreased feelings of threat. Heat wave risk perception ($\beta = 0.28$; $p < 0.01$; 95% CI[0.02; 0.14]) and temperature interference in daily life ($\beta = 0.28$; $p < 0.01$; 95% CI[0.02; 0.12]) increased feelings of threat. In moderate-susceptibility locations, heat wave risk perception increased ($\beta = 0.45$; $p < 0.01$; 95% CI[0.03; 0.17]) and positive affect about heat decreased ($\beta = -0.35$; $p < 0.05$; 95% CI[−0.12; −0.01]) feelings of threat. In high-susceptibility locations, need for cognition ($\beta = -0.29$; $p < 0.01$; 95% CI[−0.18; −0.03]) and positive affect about heat ($\beta = -0.22$; $p < 0.05$; 95% CI[−0.12; −0.01]) decreased feelings of threat, whereas temperature interference in daily life increased them ($\beta = 0.23$; $p < 0.05$; 95% CI[0.01; 0.14]).

3.2.3 | Significant predictors of heat wave feelings of threat during the summer (SW3) in the different heat wave geographical susceptibility locations

In low-susceptibility locations, positive affect about heat ($\beta = -0.18$; $p < 0.05$; 95% CI[−0.08; −0.001]) and being employed ($\beta = -0.17$; $p < 0.05$; 95% CI[−0.16; −0.001]) decreased feelings of threat, whereas heat wave risk perception increased them ($\beta = 0.50$; $p < 0.001$; 95% CI[0.07; 0.19]). In moderate-susceptibility locations, positive affect about heat decreased ($\beta = -0.40$; $p < 0.05$; 95% CI[−0.15; −0.02]) and being female increased ($\beta = 0.44$; $p < 0.05$; 95% CI[0.04; 0.27]) feelings of threat. In high-susceptibility locations, temperature interference in daily life ($\beta = 0.48$; $p < 0.001$; 95% CI[0.08; 0.25]), age ($\beta = 0.43$; $p < 0.05$; 95% CI[0.001; 0.01]), and being female ($\beta = 0.32$; $p < 0.01$; 95% CI[0.07; 0.34]) increased feelings of threat.

3.2.4 | Significant predictors of heat wave feelings of threat after the summer (SW4) in the different heat wave geographical susceptibility locations

In low-susceptibility locations, heat wave risk perception increased ($\beta = 0.39$; $p < 0.001$; 95% CI[0.05; 0.16]) and positive affect about heat decreased ($\beta = -0.28$; $p < 0.01$; 95% CI[−0.10; −0.02]) feelings of threat. In moderate-susceptibility locations, heat wave risk perception increased feelings of threat ($\beta = 0.49$; $p < 0.01$; 95% CI[0.03; 0.16]). In high-susceptibility locations, heat wave risk perception ($\beta = 0.27$; $p < 0.05$; 95% CI[0.02; 0.16]) and being female ($\beta = 0.25$; $p < 0.05$; 95% CI[0.01; 0.24]) increased feelings of threat.

4 | DISCUSSION

Extreme hot weather events such as heat waves have serious impacts on health and wellbeing. Yet, how heat waves and hot weather impact individuals living in different heat wave geographical susceptibility locations of Portugal, as well as their psychological responses (e.g., threat and stress) to such events over time is still unclear (Esplin et al., 2019). Here, we explored seasonal variations (before the summer; during a heat wave in the summer; during the summer; after the summer) and predictors of heat wave feelings of threat (indicators computed from perceived demands and resources) across different heat wave geographical susceptibility locations in Portugal. We found evidence of seasonal and geographical variations in heat wave feelings of threat, suggesting that the heat wave was more threatening for participants in high heat wave geographical susceptibility locations, compared to participants in other locations. Moreover, we identified heat wave risk perception as the most consistent positive predictor of heat wave feelings of threat, and positive affect about heat as the most consistent negative predictor. This suggests that positive affect about heat may work as a protective resource in some situations, that is, by reducing feelings of threat and distress when these are high and other resources may be lacking. However, it may also reduce feelings of threat in situations where these probably would need to be promoted for motivating protective behavior, that is, when the potentially risky situation is appraised as safe rather than challenging.

During the heat wave, we found that heat wave feelings of threat were higher among participants in high heat wave geographical susceptibility locations, when compared to participants in moderate- and low-susceptibility locations. Heat wave feelings of threat were also higher among participants in moderate heat wave geographical susceptibility locations, when compared to participants in low-susceptibility locations. Yet, differently from participants in moderate heat wave geographical susceptibility locations where perceived demands and available coping resources did not differ significantly (D/R $\approx$ 1), participants in high susceptibility locations perceived significantly more demands than available coping resources (D/R > 1). This suggests that participants in high heat wave geographical susceptibility locations may have experienced not only greater threat but also greater distress and difficulty in coping with the heat wave. Differently, participants in moderate heat wave geographical susceptibility locations may have experienced a situation where heat wave perceived demands were concerning, but resources were perceived as enough to enable coping without inducing damaging levels of stress or withdrawal/freeze behaviors (Blascovich, 2007; Blascovich & Mendes, 2000, 2010; Skinner et al., 2003; Skinner & Zimmer-Gembeck, 2007, 2015; Tomaka et al., 1993, 1997).

Before and after the heat wave, we found no significant differences in heat wave feelings of threat between participants in high and moderate heat wave geographical susceptibility locations, with such feelings progressively decreasing in both locations after the heat wave. Although the trend suggests that participants recovered after the heat wave (i.e., D/R $\approx$ 1 or D/R < 1), analysis of predictors of heat wave feelings of threat shows that older participants and female participants living in moderate–high-susceptibility locations had greater difficulty in recovering. For example, according to Hass et al. (2021), women typically express high heat risk perception as they often take on a larger caretaking role, which can potentially increase their levels of threat and distress after heat waves, when taking care of affected family members.

Interestingly, we found that heat wave feelings of threat did not vary significantly, over time, among participants in low heat wave geographical susceptibility locations. For these participants, perceived heat wave demands were always significantly lower than perceived resources (D/R < 1). Moreover, the indicator of heat wave feelings of threat (D/R) tended to be significantly lower for participants in low heat wave geographical susceptibility locations, when compared to participants in high and moderate heat wave geographical susceptibility locations, except before the heat wave, when it did not differ significantly from participants in moderate heat wave geographical susceptibility locations. On the one hand, this suggests that, at the time, and considering potential differences in the magnitude of the heat wave in low heat wave geographical susceptibility locations, participants perceived enough resources to cope with the perceived demands posed by the heat wave. This was also supported by predictor analysis, which identified being employed, a factor typically associated to heat protection and adaptive response (Hass et al., 2021), as contributing to lower heat wave feelings of threat among these participants during and right after the heat wave. This could possibly be due to the fact that those being employed could, on average, be wealthier than those unemployed and have greater resources to cope with the heat wave. Yet, this interpretation should be taken with care, as we did not collect data about participant's socioeconomic status in this study. On the other hand, considering that low feelings of threat (i.e., when resources significantly outweigh demands) are also associated to lower motivation for protection (Blascovich, 2007; Blascovich & Mendes, 2000, 2010), it is possible that participants living in these geographical locations were maybe still lacking awareness of the demands and the risk posed by heat waves. For example, as suggested by Hass et al. (2021, p. 5), "when a person believes they are acclimatized to heat or believe they already know what measures to take, they are less likely to take protective measures." The latter can be exacerbated by positive affect about heat, as suggested by the predictor analysis and research showing that positive affect about heat tends to reduce heat protection intentions and behaviors (Bruine de Bruin et al., 2016; Lefevre et al., 2015). In fact, it was more consistent in lowering heat wave feelings of threat than predictors typically associated with the mobilization of resources and generation of alternatives for protection (e.g., ideas on how to protect themselves), such as need for cognition and employment status (Bakker, 1999; Bruine de Bruin et al., 2015; Hass et al., 2021; Hittner, 2004; Ruiter et al., 2004; Williams-Piehota et al., 2003), representing a potential affective bias with implications for health and wellbeing (i.e., "a threat that evokes positive affect"; Bruine de Bruin et al., 2016), but also a protective factor when resources are lacking (Skinner et al., 2003; Skinner & Zimmer-Gembeck, 2007, 2015; Swim et al., 2009).

Although studies suggest that greater heat wave risk perception can increase heat protection intentions and behaviors (Ban et al., 2019; Bruine de Bruin et al., 2016; Esplin et al., 2019; Hajat et al., 2010; Hass et al., 2021; Kalkstein & Sheridan, 2007; Lefevre et al., 2015; Sheridan, 2007), these findings, in accordance with Esplin et al. (2019), also highlight that increasing heat wave risk perception without providing resources, can have a detrimental effect as it may result in greater threat, distress, and further depletion of physical and psychological resources (Clayton et al., 2021; Swim et al., 2009). Furthermore, research suggests that following the communication of heat warnings, coping resources are not always immediately available (Esplin et al., 2019), the effectiveness of various heat protection measures is often unknown, and protective behaviors are still misunderstood (Hass et al., 2021; Kalkstein & Sheridan, 2007; Sheridan, 2007). Considering this context, results further indicate that people living in high heat wave geographical susceptibility locations of Portugal and potentially vulnerable groups (e.g., elderly; females) living in both high- and medium-susceptibility locations, could greatly benefit from resource-building interventions to help them cope with and recover from the demands posed by these extreme hot weather events.

Results also suggest that closer monitoring of people's awareness of demands and availability of resources (e.g., ability) to cope with these events across different heat wave geographical susceptibility locations is needed and can be useful for policy planning. Such monitoring may enable, for example, the timely delivery of resource-building interventions, that is, before rather than after the effects of extreme heat become damaging to health and wellbeing (Kim et al., 2014). This capability may be particularly important considering the vulnerability of Portugal to climate change (Naumann et al., 2020; Rocha et al., 2020; Rodrigues et al., 2021; Schleussner et al., 2019) and the fact that extreme hot weather events are expected to become more intense, frequent, and long-lasting (Clayton et al., 2015; Hajat et al., 2014; Howe et al., 2019; Intergovernmental Panel on Climate Change [IPCC], 2014; Lefevre et al., 2015; World Economic Forum [WEF], 2017). The institutional capability to monitor, identify emerging threats, and implement measures before such threats escalate gains further importance considering that some of the locations most susceptible to heat waves in Portugal also correspond to locations characterized by an older and more vulnerable population, with lower formal education levels, lower income, poorer housing conditions, and greater inequalities in the access to physical and psychological healthcare, that is, with less resources (Di Meglio et al., 2018; Mauritti et al., 2019; Moreira, 2011; OPP, 2020; Rego et al., 2013; Rodrigues, 2019; Rodrigues et al., 2020, 2021; Silva, 2012). In that regard, the survey-based methodology used in this study provides a practical example of an evidence-based and theory-driven, easy-to-implement, and relatively low-cost way for assessing indicators of psychological responses of threat and stress associated with heat waves and hot weather, with the potential to be adapted and applied in the assessment of other "real world risky situations." Because feelings of threat (D/R) are operationalized from demands (D) and resources (R) perceptions, it has the advantage, if needed, of also providing decision makers with additional information about the prevalence of such perceptions.

Although providing preliminary evidence that monitoring heat wave demands and resources perceptions over time enables better understanding about peoples' psychological responses of threat and stress associated with such extreme weather events, the current study presents some limitations. The sample was collected following non-random sampling procedures and is not representative of the Portuguese population or of the populations living in the different heat wave geographical susceptibility locations. As such, results are indicative, and generalizations should be parsimonious. Yet, the sample captures the heterogeneity of some sociodemographic characteristics of those populations, and robust statistical procedures were used to reduce the potential impact of sample limitations. Moreover, when collecting the sample, procedures were implemented for limiting biasing effects of convenience samples, namely, through the diversification of the geographical locations where the sample was recruited. As such, the sample was comprised by participants from multiple locations within the same heat wave geographical susceptibility level (i.e., living in different geographical locations with the same level of heat wave occurrence susceptibility), from the north to south, and from littoral to inland. Lastly, it should be noted that although presenting good indicators of internal consistency, test–retest reliability, and items factoring together in a coherent factorial structure, the demands and resources perception scales correspond to new instruments that are still being improved. Nevertheless, we believe that this work also provides a much needed contribution to understanding the nature and dimensions of these constructs, promoting further developments.

Despite its limitations, the current study provides a much needed exploratory longitudinal analysis, whose absence was previously recognized as a limitation in the field of human responses to extreme hot weather events (see Hass et al., 2021). Future studies can explore more comprehensive samples, consider additional predictors, and include behavioral and physiological indicators of threat and stress. Such studies can also include measures of magnitude of heat waves in different heat wave geographical susceptibility locations (e.g., daily or average temperature during the heat wave) and individual acclimation to heat (e.g., habituation). In line with Hass et al. (2021), the current longitudinal study also highlights the importance of greater integration between research and intervention to provide citizens with the individual and social resources they still need to cope with, adapt, and build resilience to the demands posed by extreme hot weather events and other emerging risks in a context of climate crisis. For example, it provides practical evidence indicative that people living in high heat wave geographical susceptibility locations of Portugal may still be needing protective resources, while highlighting the need to monitor threat and stress responses in moderate and low geographical susceptibility locations. By doing this, resources can be provided before, rather than after, these individuals start experiencing damaging levels of distress due to heat waves.

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CONFLICT OF INTEREST STATEMENT

The authors declare no conflicts of interest.

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REFERENCES

Agüero, J. (2014). Long-term effect of climate change on health: Evidence from heat waves in Mexico. *SSRN IDB Working Paper Series*, *481*. https://doi.org/10.2139/ssrn.2391679

Aqil, M., Knapen, T., & Dumoulin, S. O. (2021). Divisive normalization unifies disparate response signatures throughout the human visual hierarchy. *Proceedings of the National Academy of Sciences*, *118*(46), e2108713118. https://doi.org/10.1073/pnas.2108713118

Arbuthnott, K., Hajat, S., Heaviside, C., & Vardoulakis, S. (2016). Changes in population susceptibility to heat and cold over time: Assessing adaptation to climate change. *Environmental Health*, *15*(1), 33. https://doi.org/10.1186/s12940-016-0102-7

Bakhsh, K., Rauf, S., & Zulfiqar, F. (2018). Adaptation strategies for minimizing heat wave induced morbidity and its determinants. *Sustainable Cities and Society*, *41*, 95–103. https://doi.org/10.1016/j.scs.2018.05.021

Bakker, A. B. (1999). Persuasive communication about AIDS prevention: Need for cognition determinates the impact of message format. *AIDS Education and Prevention*, *11*, 150–162.

Ban, J., Shi, W., Cui, L., Liu, X., Jiang, C., Han, L., Wang, R., & Li, T. (2019). Health-risk perception and its mediating effect on protective behavioral adaptation to heat waves. *Environmental Research*, *172*, 27–33. https://doi.org/10.1016/j.envres.2019.01.006

Beckmann, S., & Hiete, M. (2020). Predictors associated with health-related heat risk perception of urban citizens in Germany. *International Journal of Environmental Research and Public Health*, *17*(3), 874. https://doi.org/10.3390/ijerph17030874

Blascovich, J. (2007). Challenge, threat, and health. In J. Y. Shah & W. L. Gardener (Eds.), *Handbook of motivation science* (pp. 481–493). Guilford Press.

Blascovich, J., & Mendes, W. B. (2000). Challenge and threat appraisals: The role of affective cues. In J. Forgas (Ed.), *Studies in emotion and social interaction, second series. Feeling and thinking: The role of affect in social cognition* (pp. 59–82). Cambridge University Press.

Blascovich, J., & Mendes, W. B. (2010). Social psychophysiology and embodiment. In S. T. Fiske, D. T. Gilbert, & G. Lindzey (Eds.), *The handbook of social psychology* (pp. 194–227). John Wiley & Sons Inc.

Bose-O'Reilly, S., Daanen, H., Deering, K., Gerrett, N., Huynen, M. M., Lee, J., Karrasch, S., Matthies-Wiesler, F., Mertes, H., Schoierer, J., Shumake-Guillemot, J., van denHazel, P., van Loenhout, J. A., & Nowak, D. (2021).

COVID-19 and heat waves: New challenges for healthcare systems. *Environmental Research*, *198*, 111153. https://doi.org/10.1016/j.envres.2021.111153

Bruine de Bruin, W., Lefevre, C. E., Taylor, A. L., Dessai, S., Fischhoff, B., & Kovats, S. (2016). Promoting protection against a threat that evokes positive affect: The case of heat waves in the United Kingdom. *Journal of Experimental Psychology: Applied*, *22*(3), 261–271. https://doi.org/10.1037/xap0000083

Bruine de Bruin, W., McNair, S. J., Taylor, A. L., Summers, B., & Strough, J. (2015). "Thinking about numbers is not my idea of fun": Need for cognition mediates age differences in numeracy performance. *Medical Decision Making*, *35*(1), 22–26. https://doi.org/10.1177/0272989X14542485

Carandini, M., & Heeger, D. J. (2012). Normalization as a canonical neural computation. *Nature Reviews Neuroscience*, *13*(1), 51–62. https://doi.org/10.1038/nrn3136

Charlson, F., Ali, S., Benmarhnia, T., Pearl, M., Massazza, A., Augustinavicius, J., & Scott, J. G. (2021). Climate change and mental health: A scoping review. *International Journal of Environmental Research and Public Health*, *18*(9), 4486. https://doi.org/10.3390/ijerph18094486

Clayton, S., Devine-Wright, P., Stern, P. C., Whitmarsh, L., Carrico, A., Steg, L., Swim, J., & Bonnes, M. (2015). Psychological research and global climate change. *Nature Climate Change*, *5*, 640–646. https://doi.org/10.1038/nclimate2622

Clayton, S., Manning, C., Speiser, M., & Hill, A. N. (2021). *Mental health and our changing climate: Impacts, inequities, responses*. American Psychological Association and ecoAmerica. https://www.apa.org/news/press/releases/mental-health-climate-change.pdf

Di Meglio, E., Kaczmarek-Firth, A., Litwinska, A., & Cristian, R. (2018). *Living conditions in Europe –2018 edition*. Publications Office of the European Union. https://doi.org/10.2785/39876

Domingos, S., Gaspar, R., Fonseca, H., & Marôco, J. (2020). DeCodeR framework: Data collection and coding for demands and resources appraisal in extreme weather events. *PsyEcology*, *11*, 90–103. https://doi.org/10.1080/21711976.2019.1643988

Epstein, S., Pacini, R., Denes-Raj, V., & Heier, H. (1996). Individual differences in intuitive-experiential and analytical-rational thinking styles. *Journal of Personality and Social Psychology*, *71*(2), 390–405. https://doi.org/10.1037/0022-3514.71.2.390

Esplin, E. D., Marlon, J. R., Leiserowitz, A., & Howe, P. D. (2019). "Can you take the heat?" Heat-induced health symptoms are associated with protective behaviors. *Weather, Climate, and Society*, *11*(2), 401–417. https://doi.org/10.1175/WCAS-D-18-0035.1

Fredrickson, B. L. (2004). The broaden-and-build theory of positive emotions. *Philosophical Transactions of the Royal Society of London, Series B, Biological Sciences*, *359*(1449), 1367–1378. https://doi.org/10.1098/rstb.2004.1512

Gaspar, R., Barnett, J., & Seibt, B. (2015). Crisis as seen by the individual: The norm deviation approach. *PsyEcology*, *6*, 103–135. https://doi.org/10.1080/21711976.2014.1002205

Gaspar, R., Domingos, S., Toscano, H., Filipe, J., Leiras, G., Raposo, B., Pereira, C., Godinho, C., Francisco, R., Silva, C., & Arriaga, M. T. (2023). Crises social sensing: Longitudinal monitoring of social perceptions of systemic risk during public health crisis. *Journal of Risk Research*, *26*(4), 345–366. https://doi.org/10.1080/13669877.2023.2170450

Gasparrini, A., & Armstrong, B. (2011). The impact of heat waves on mortality. *Epidemiology*, *22*, 68–73. https://doi.org/10.1097/EDE.0b013e3181fdcd99

Gonzalez-Mulé, E., & Cockburn, B. (2017). Worked to death: The relationships of job demands and job control with mortality. *Personnel Psychology*, *70*, 73–112. https://doi.org/10.1111/peps.12206

Gonzalez-Mulé, E., Kim, M. M., & Ryu, J. W. (2021). A meta-analytic test of multiplicative and additive models of job demands, resources, and stress. *Journal of Applied Psychology*, *106*(9), 1391–1411. https://doi.org/10.1037/apl0000840

Hajat, S., O'Connor, M., & Kosatsky, T. (2010). Health effects of hot weather: From awareness of risk factors to effective health protection. *The Lancet*, *375*, 856–863. https://doi.org/10.1016/S0140-6736(09)61711-6

Hajat, S., Vardoulakis, S., Heaviside, C., & Eggen, B. (2014). Climate change effects on human health: Projections of temperature-related mortality for the UK during the 2020s, 2050s and 2080s. *Journal of Epidemiology & Community Health*, *68*, 641–648. https://doi.org/10.1136/jech-2013-202449

Hancock, P. A., & Vasmatzidis, I. (2003). Effects of heat stress on cognitive performance: The current state of knowledge. *International Journal of Hyperthermia*, *19*(3), 355–372. https://doi.org/10.1080/0265673021000054630

Hass, A. L., & Ellis, K. N. (2019). Using wearable sensors to assess how a heatwave affects individual heat exposure, perceptions, and adaption methods. *International Journal of Biometeorology*, *63*, 1585–1595. https://doi.org/10.1007/s00484-019-01770-6

Hass, A. L., Runkle, J. D., & Sugg, M. M. (2021). The driving influences of human perception to extreme heat: A scoping review. *Environmental Research*, *197*, 111173. https://doi.org/10.1016/j.envres.2021.111173

Hittner, J. B. (2004). Alcohol use among American college students in relation to need for cognition and expectations of alcohol's effects on cognition. *Current Psychology*, *23*, 173–187. https://doi.org/10.1007/BF02903077

Howe, P. D., Marlon, J. R., Wang, X., & Leiserowitz, A. (2019). Public perceptions of the health risks of extreme heat across US states, counties, and neighborhoods. *PNAS Proceedings of the National Academy of Sciences of the United States of America*, *116*(14), 6743–6748. https://doi.org/10.1073/pnas.1813145116

Instituto Português do Mar e da Atmosfera. (2018a). *Resumo Climatológico—Agosto de 2018*. Instituto Português do Mar e da Atmosfera, I.P.

Instituto Português do Mar e da Atmosfera. (2018b). *Boletim Climatológico Sazonal—Outono de 2018*. Instituto Português do Mar e da Atmosfera, I.P.

Intergovernmental Panel on Climate Change. (2014). Climate change 2014: Synthesis report. In R. K. Pachauri & L. A. Meyer (Eds.), *Contribution of working groups I, II and III to the fifth assessment report of the Intergovernmental Panel on Climate Change*. IPCC.

Jenny, G. J., Bauer, G. F., Füllemann, D., Broetje, S., & Brauchli, R. (2019). "Resources–demands ratio": Translating the JD-R-Model for company stakeholders. *Journal of Occupational Health*, *62*, e12101. https://doi.org/10.1002/1348-9585.12101

Kalkstein, A. J., & Sheridan, S. C. (2007). The social impacts of the heat-health watch/warning system in Phoenix, Arizona: Assessing the perceived risk and response of the public. *International Journal of Biometeorology*, *52*, 43–55. https://doi.org/10.1007/s00484-006-0073-4

Kim, M., Kim, H., & You, M. (2014). The role of public awareness in health-protective behaviours to reduce heat wave risk. *Meteorological Applications*, *21*, 867–872. https://doi.org/10.1002/met.1422

Koppe, C., Kovats, S., Jendritzky, G., & Menne, B. (2004). *Heat-waves: Risks and responses*. World Health Organization, Regional Office for Europe.

Kovats, R. S., & Hajat, S. (2008). Heat stress and public health: A critical review. *Annual Review of Public Health*, *29*, 41–55. https://doi.org/10.1146/annurev.publhealth.29.020907.090843

Laurent, J. G. (2021). The impact of heat waves on cognitive function among young adults. In J. W. Dash (Ed.), *World scientific encyclopedia of climate change: Case studies of climate risk, action, and opportunity* (Vol. 3, pp. 165–170). World Scientific Publishing Co Pte Ltd. https://doi.org/10.1142/9789811213960_0023

Lefevre, C. E., Bruine de Bruin, W., Taylor, A. L., Dessai, S., Kovats, S., & Fischhoff, B. (2015). Heat protection behaviors and positive affect about heat during the 2013 heat wave in the United Kingdom. *Social Science & Medicine*, *128*, 282–289. https://doi.org/10.1016/j.socscimed.2015.01.029

Li, F., Jiang, L., Yao, X., & Li, Y. (2013). Job demands, job resources and safety outcomes: The roles of emotional exhaustion and safety compliance. *Accident Analysis and Prevention*, *51*, 243–251. https://doi.org/10.1016/j.aap.2012.11.029

Liu, J., Varghese, B. M., Hansen, A., Xiang, J., Zhang, Y., Dear, K., Gourley, M., Driscoll, T., Morgan, G., Capon, A., & Bi, P. (2021). Is there an association between hot weather and poor mental health outcomes? A systematic review and meta-analysis. *Environment International*, *153*, 106533. https://doi.org/10.1016/j.envint.2021.106533

Louie, K., Khaw, M. W., & Glimcher, P. W. (2013). Normalization is a general neural mechanism for context-dependent decision making. *PNAS Proceedings of the National Academy of Sciences of the United States of America*, *110*(15), 6139–6144. https://doi.org/10.1073/pnas.1217854110

Luber, G., & McGeehin, M. (2008). Climate change and extreme heat events. *American Journal of Preventive Medicine*, *35*(5), 429–435. https://doi.org/10.1016/j.amepre.2008.08.021

Ma, W., Zeng, W., Zhou, M., Wang, L., Rutherford, S., Lin, H., Liu, T., Zhang, Y., Xiao, J., Zhang, Y., Wang, X., Gu, X., & Chu, C. (2015). The short-term effect of heat waves on mortality and its modifiers in China: An analysis from 66 communities. *Environment International*, *75*, 103–109. https://doi.org/10.1016/j.envint.2014.11.004

Marinucci, G. D., Luber, G., Uejio, C. K., Saha, S., & Hess, J. J. (2014). Building resilience against climate effects: A novel framework to facilitate climate readiness in public health agencies. *International Journal of Environmental Research and Public Health*, *11*, 6433–6458. https://doi.org/10.3390/ijerph110606433

Marôco, J. (2014). *Análise estatística com o SPSS Statistics* (6ª ed.). Pêro Pinheiro.

Mauritti, R., Nunes, N., Alves, J. E., & Diogo, F. (2019). Social inequalities and development in Portugal a look at the regional scale and the low density territories. *Sociologia On Line*, *19*, 102–126. https://doi.org/10.30553/sociologiaonline.2019.19.5

Mayrhuber, E. A.-S., Dückers, M. L. A., Wallner, P., Arnberger, A., Allex, B., Wiesböck, L., Wanka, A., Kolland, F., Eder, R., Hutter, H. P., & Kutalek, R. (2018). Vulnerability to heatwaves and implications for public health interventions—A scoping review. *Environmental Research*, *166*, 42–54. https://doi.org/10.1016/j.envres.2018.05.021

McGregor, G. R., Pelling, M., Wolf, T., & Gosling, S. (2007). *The social impacts of heat waves*. Environment Agency.

Moreira, M. J. (2011). Portugal demographic—(dis)continuities in 2011—North and inner central regions. *Instituto Nacional De Estatistica, Revista De Estudos Demográficos*, *51–52*, 169–206.

Naumann, G., Russo, S., Formetta, G., Ibarreta Ruiz, D., Forzieri, G., Girardello, M., & Feyen, L. (2020). *Global warming and human impacts of heat and cold extremes in the EU*. Publications Office of the European Union.

Oray, N. C., Oray, D., Aksay, E., Atilla, R., & Bayram, B. (2018). The impact of a heat wave on mortality in the emergency department. *Medicine*, *97*, e13815. https://doi.org/10.1097/MD.0000000000013815

Ordem dos Psicólogos Portugueses. (2020). *Crise económica, pobreza e desigualdades—Relatório sobre impacto socioeconómico e saúde mental em Portugal*. Ordem dos Psicólogos Portugueses. https://www.ordemdospsicologos.pt/ficheiros/documentos/crise_econaomica_pobreza_e_desigualdades.pdf

Rego, C., Ramos, I., Lucas, M. R., & Baltazar, M. S. (2013). *Diferenças de desenvolvimento entre o interior e o litoral português?—Uma abordagem multivariada*. Universidade de Évora e Associação Portuguesa de Geógrafos.

Rocha, A., Pereira, S. C., Viceto, C., Silva, R., Neto, J., & Marta-Almeida, M. (2020). A consistent methodology to evaluate temperature and heat wave future projections for cities: A case study for Lisbon. *Applied Sciences*, *10*(3), 1149. https://doi.org/10.3390/app10031149

Rodrigues, C. F. (2019). Inequality and poverty in Portugal does location matter? *Sociologia On Line*, *19*, 15–32. https://doi.org/10.30553/sociologiaonline.2019.19.1

Rodrigues, M., Santana, P., & Rocha, A. (2020). Modelling climate change impacts on attributable-related deaths and demographic changes in the largest metropolitan area in Portugal: A time-series analysis. *Environmental Research*, *190*, 109998. https://doi.org/10.1016/j.envres.2020.109998

Rodrigues, M., Santana, P., & Rocha, A. (2021). Modelling of temperature-attributable mortality among the elderly in Lisbon metropolitan area, Portugal: A contribution to local strategy for effective prevention plans. *Journal of Urban Health*, *98*, 516–531. https://doi.org/10.1007/s11524-021-00536-z

Ruiter, R., Verplanken, B., De Cremer, D., & Kok, G. (2004). Danger and fear control in response to fear appeals: The role of need for cognition. *Basic and Applied Social Psychology*, *26*, 13–24. https://doi.org/10.1207/s15324834basp2601_2

Schleussner, C., Menke, I., Theokritoff, E., van Maanen, N., & Lanson, A. (2019). *Climate impacts in Portugal*. Climate Analytics. https://youth4climatejustice.org/wp-content/uploads/2021/01/Climate-Analytics-Climate-Impacts-in-Portugal-min.pdf

Sheridan, S. C. (2007). A survey of public perception and response to heat warnings across four North American cities: An evaluation of municipal effectiveness. *International Journal of Biometeorology*, *52*(1), 3–15. https://doi.org/10.1007/s00484-006-0052-9

Silva, J. M. (2012). *As assimetrias regionais em Portugal: Análise da convergência versus divergência ao nível dos municípios*. [Master's Thesis, Universidade do Minho, Escola de Economia e Gestão]. RepositóriUM. http://hdl.handle.net/1822/22795

Skinner, E. A., Edge, K., Altman, J., & Sherwood, H. (2003). Searching for the structure of coping: A review and critique of category systems for classifying ways of coping. *Psychological Bulletin*, *129*(2), 216–269. https://doi.org/10.1037/0033-2909.129.2.216

Skinner, E. A., & Zimmer-Gembeck, M. J. (2007). The development of coping. *Annual Review of Psychology*, *58*, 119–144. https://doi.org/10.1146/annurev.psych.58.110405.085705

Skinner, E. A., & Zimmer-Gembeck, M. J. (2015). Coping across the lifespan. In J. D. Wright (Ed.), *International encyclopedia of the social & behavioral sciences* (2nd ed., Vol. 4, pp. 887–894). Elsevier. https://doi.org/10.1016/B978-0-08-097086-8.26015-7

Stocker, T. F., Qin, D., Plattner, G.-K., Tignor, M., Allen, S. K., Boschung, J., Nauels, A., Xia, Y., Bex, V., & Midgley, P. M. (2013). *Climate change 2013: The physical science basis—Contribution of working group I to the fifth assessment report of the Intergovernmental Panel on Climate Change*. Cambridge University Press.

Swim, J. K., Clayton, S., Doherty, T., Gifford, R., Howard, G., Reser, J., Stern, P., & Weber, E. (2009). *Psychology and global climate change: Addressing a multi-faceted phenomenon and set of challenges—A report by the American Psychological Association's task force on the interface between psychology and global climate change*. American Psychological Association. https://www.apa.org/science/about/publications/climate-change-booklet.pdf

Tabachnick, B. G., & Fidell, L. S. (2007). *Using multivariate statistics* (5th ed.). Pearson Education, Inc.

Theorell, T., & Karasek, R. A. (1996). Current issues relating to psychosocial job strain and cardiovascular disease research. *Journal of Occupational Health Psychology*, *1*, 9–26. https://doi.org/10.1037/1076-8998.1.1.9

Thompson, R., Hornigold, R., Page, L., & Waite, T. (2018). Associations between high ambient temperatures and heat waves with mental health outcomes: A systematic review. *Public Health*, *161*, 171–191. https://doi.org/10.1016/j.puhe.2018.06.008

Tomaka, J., Blascovich, J., Kelsey, R. M., & Leitten, C. L. (1993). Subjective, physiological, and behavioral effects of threat and challenge appraisal. *Journal of Personality and Social Psychology*, *65*, 248–260. https://doi.org/10.1037/0022-3514.65.2.248

Tomaka, J., Blascovich, J., Kibler, J., & Ernst, J. M. (1997). Cognitive and physiological antecedents of threat and challenge appraisal. *Journal of Personality and Social Psychology*, *73*, 63–72. https://doi.org/10.1037/0022-3514.73.1.63

Valois, P., Talbot, D., Caron, M., Carrier, M.-P., Morin, A., Renaud, J.-S., Jacob, J., & Gosselin, P. (2017). Development and validation of a behavioural index for adaptation to high summer temperatures among urban dwellers. *International Journal of Environmental Research and Public Health*, *14*(7), 820. https://doi.org/10.3390/ijerph14070820

Widerynski, S., Schramm, P., Conlon, K., Noe, R., Grossman, E., Hawkins, M., Nayak, S., Roach, M., & Hilts, A. S. (2017). The use of cooling centers to prevent heat-related illness: Summary of evidence and strategies for implementation. Centers for Disease Control and Prevention. https://doi.org/10.13140/RG.2.2.32267.59688

Williams-Piehota, P., Schneider, T. R., Pizarro, J., Mowad, L., & Salovey, P. (2003). Matching health messages to information-processing styles: Need for cognition and mammography utilization. *Health Communication*, *15*, 375–392. https://doi.org/10.1207/S15327027HC1504_01

World Economic Forum. (2017). *The global risks report 2017 –12th edition*. World Economic Forum.

World Health Organization. (2015). *Heatwaves and health: Guidance on warning-system development*. Chair, Publications Board.

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APPENDIX A: HEAT WAVE DEMANDS AND RESOURCES PERCEPTION SCALES

Scales of heat wave demands and resources perceptions, with items in their respective theoretical subcategories and instructions

Demands scale		
The following statements represent possible demands posed by heat waves; please rate how much you agree or disagree with each one. During a heat wave…		
Danger	*It1.*	*There is greater danger to my physical and bodily health (more headaches, colds, etc.)*
	It2.	*There is greater danger to my mental health (more stress, anxiety, discomfort, etc.)*
	It3.	*There is greater danger to my life (more likely to faint, lose consciousness, dying, etc.)*
	It4.	*There is greater danger to my social life (more likely to be isolated, away from others, miss on social events, etc.)*
	It5.	*There is greater danger for people typically seen as more "vulnerable" (children, elderly, etc.)*
	It6.	*There is greater danger to the environment (pets, plants, wildlife, etc.)*
Effort	*It7.*	*I have greater physiologic effort (more sweating, accelerated heartbeat, alterations in blood pressure, etc.)*
	It8.	*I have greater physical effort (more tiredness, fatigue, apathy, weakness, etc.)*
	It9.	*I have greater mental effort (more difficulty in thinking, concentrating, making decisions, etc.)*
	It10.	*I have greater emotional effort (more discomfort, irritability, difficulty in maintaining good mood, etc.)*
	It11.	*I have a greater financial effort (more expenses with air conditioning equipment, fans, and other climatization devices, electricity bills, etc.)*
Uncertainty	*It12.*	*I have greater doubts about what can happen to me (consequences, harms, risks, etc.)*
	It13.	*I have greater doubts about what to do to protect myself (available resources, protective behaviors, etc.)*
Resources scale		
The following statements represent possible resources to cope with the demands posed by heat waves; please rate how much you agree or disagree with each one. During a heat wave…		
Knowledge, abilities, and skills	*It1.*	*I have equipment that can help me deal with the heat (air conditioning, fans, chillers, etc.)*
	It2.	*I have clothing that can help me cope with the heat (fresh and transpirable clothes, hats, etc.)*
	It3.	*I have objects that can help me cope with the heat (hand fans, water sprayers, etc.)*
	It4.	*I have information and communication technologies that can help me cope with the heat (social networks, smart apps, etc.)*
	It5.	*I have financial resources that can help me cope with the heat (readily available money, savings, etc.)*
	It6.	*I have access to places that can help me cope with the heat (places with shades, cooled places, climatized places, etc.)*
	It7.	*I have physical capabilities that can help me cope with the heat (stamina, vitality, physical health, etc.)*
	It8.	*I have mental capabilities that can help me cope with the heat (ability to plan ahead, devise strategies, etc.)*
	It9.	*I have emotional capabilities that can help me cope with the heat (ability to control my emotions, to recognize and control what I'm feeling, etc.)*
	It10.	*I have avoidance behaviors that can help me cope with the heat (escape the heat, avoid going outside, etc.)*
	It11.	*I have approach behaviors that can help me cope with the heat (looking for protective places, hydrate myself, etc.)*
Dispositions	*It12.*	*I have personality tendencies that can help me cope with the heat (being calm, patient, understanding, interested, etc.)*
	It13.	*I have thinking and action tendencies that can help me cope with the heat (being proactive, preventive, thoughtful, etc.)*
External Support	*It14.*	*I have family and friends who can support and help me cope with the heat (relatives, neighbors, etc.)*
	It15.	*I have professionals who can give me recommendations and help me cope with the heat (health professionals, firefighters, etc.)*
	It16.	*I have available information that can help me cope with the heat (informative pamphlets, web pages, etc.)*
	It17.	*I have a belief that my faith in God, or in other spiritual beliefs, can help me cope with the heat*
	It18.	*I have institutions that can help me cope with the heat, if necessary (associations, community institutions, health authorities, etc.)*

Note: The Portuguese version can be made available upon request to the authors. The English version presented above is a simple translation from the Portuguese version used in the study. Before use in English or another language, the scales should be adapted and adjusted to the specific cultural background of the country and, if possible, validated. Each scale was presented separately (demands first), and the item presentation of each scale was randomized. Both scales used a response scale anchored from 1 (strongly disagree) to 5 (strongly agree).

APPENDIX B: CRONBACH'S ALPHA RELIABILITY STATISTICS FOR DEMANDS AND RESOURCES SCALES

Cronbach's alpha for demands and resources scales in each survey wave and average

	No. items	α SW1	α SW2	α SW3	α SW4	Average α
Demands	13	0.876	0.888	0.886	0.892	0.886
Resources	18	0.859	0.845	0.859	0.853	0.854

Note: SW1, First Survey Wave (before the summer); SW2, Second Survey Wave (during a heat wave in the summer); SW3, Third Survey Wave (during the summer); SW4, Fourth Survey Wave (after the summer).

Demands and resources scales Cronbach's alpha if item deleted

	Demands scale				Resources scale			
	α SW1	α SW2	α SW3	α SW4	α SW1	α SW2	α SW3	α SW4
Item 1	0.859	0.873	0.872	0.875	0.854	0.839	0.850	0.853
Item 2	0.858	0.871	0.869	0.875	0.852	0.837	0.854	0.845
Item 3	0.863	0.871	0.879	0.880	0.852	0.835	0.851	0.846
Item 4	0.868	0.879	0.875	0.884	0.849	0.831	0.848	0.844
Item 5	0.878	0.890	0.889	0.892	0.856	0.840	0.853	0.849
Item 6	0.875	0.891	0.887	0.893	0.849	0.833	0.849	0.845
Item 7	0.874	0.881	0.882	0.885	0.850	0.835	0.850	0.845
Item 8	0.864	0.879	0.876	0.883	0.848	0.830	0.847	0.844
Item 9	0.861	0.872	0.869	0.877	0.851	0.829	0.845	0.841
Item 10	0.861	0.874	0.869	0.875	0.858	0.850	0.858	0.849
Item 11	0.872	0.887	0.880	0.890	0.850	0.839	0.856	0.842
Item 12	0.865	0.879	0.879	0.884	0.851	0.835	0.850	0.845
Item 13	0.869	0.885	0.878	0.890	0.849	0.831	0.844	0.841
Item 14	–	–	–	–	0.852	0.841	0.852	0.844
Item 15	–	–	–	–	0.847	0.829	0.841	0.839
Item 16	–	–	–	–	0.843	0.829	0.846	0.838
Item 17	–	–	–	–	0.872	0.864	0.874	0.872
Item 18	–	–	–	–	0.855	0.841	0.854	0.849

Note: SW1, First Survey Wave (before the summer); SW2, Second Survey Wave (during a heat wave in the summer); SW3, Third Survey Wave (during the summer); SW4, Fourth Survey Wave (after the summer).

APPENDIX C: TEST–RETEST RELIABILITY CORRELATION MATRIX FOR DEMANDS AND RESOURCES SCALES

Correlations between the demands scale applied on each survey wave

Variable	Demands SW1	Demands SW2	Demands SW3	Demands SW4
Demands SW1	–			
Demands SW2	0.652***	–		
Demands SW3	0.683***	0.809***	–	
Demands SW4	0.686***	0.715***	0.750***	–

Note: SW1, First Survey Wave (before the summer); SW2, Second Survey Wave (during a heat wave in the summer); SW3, Third Survey Wave (during the summer); SW4, Fourth Survey Wave (after the summer).
*** $p < 0.001$.

Correlations between the resources scale applied on each survey wave

Variable	Resources SW1	Resources SW2	Resources SW3	Resources SW4
Resources SW1	–			
Resources SW2	0.679***	–		
Resources SW3	0.702***	0.816***	–	
Resources SW4	0.587***	0.653***	0.693***	–

Note: SW1, First Survey Wave (before the summer); SW2, Second Survey Wave (during a heat wave in the summer); SW3, Third Survey Wave (during the summer); SW4, Fourth Survey Wave (after the summer).
***$p < 0.001$.

APPENDIX D: DEMANDS AND RESOURCES SCALES EXPLORATORY FACTOR ANALYSIS

Demands scale exploratory factor analysis

	Factor 1	Factor 2	Factor 3
Demands item 10	0.700		
Demands item 9	0.626		
Demands item 8	0.619		
Demands item 2	0.603		
Demands item 1	0.574		
Demands item 7	0.533		
Demands item 3	0.492		
Demands item 12		0.852	
Demands item 13		0.634	
Demands item 4		0.605	
Demands item 11		0.438	
Demands item 5			0.743
Demands item 6			0.736

Note: Demands scale exploratory factor analysis considered the first application of the scale (i.e., first survey wave—before the summer). Kaiser–Meyer–Olkin (KMO) = 0.882. Applied factoring method is ordinary least squares. Applied rotation method is Varimax. Base analysis on Polychoric/tetrachoric correlation matrix. The three-factor solution, based on scree plot inflection point, explains 56.2% of variance.

Demands scale items grouped by factors retained in exploratory factor analysis	
Factor 1 ***(e.g., physical and psychological danger and effort)***	
Demands item 10	*I have greater emotional effort (more discomfort, irritability, difficulty in maintaining good mood, etc.)*
Demands item 9	*I have greater mental effort (more difficulty in thinking, concentrating, making decisions, etc.)*
Demands item 8	*I have greater physical effort (more tiredness, fatigue, apathy, weakness, etc.)*
Demands item 2	*There is greater danger to my mental health (more stress, anxiety, discomfort, etc.)*
Demands item 1	*There is greater danger to my physical and bodily health (more headaches, colds, etc.)*
Demands item 7	*I have greater physiologic effort (more sweating, accelerated heartbeat, alterations in blood pressure, etc.)*
Demands item 3	*There is greater danger to my life (more likely to faint, lose consciousness, dying, etc.)*
Factor 2 ***(e.g., general, social, and financial uncertainties)***	
Demands item 12	*I have greater doubts about what can happen to me (consequences, harms, risks, etc.)*
Demands item 13	*I have greater doubts about what to do to protect myself (available resources, protective behaviors, etc.)*
Demands item 4	*There is greater danger to my social life (more likely to be isolated, away from others, miss on social events, etc.)*
Demands item 11	*I have a greater financial effort (more expenses with air conditioning equipment, fans, and other climatization devices, electricity bills, etc.)*
Factor 3 ***(e.g., social and environmental dangers)***	
Demands item 5	*There is greater danger for people typically seen as more "vulnerable" (children, elderly, etc.)*
Demands item 6	*There is greater danger to the environment (pets, plants, wildlife, etc.)*

Resources scale exploratory factor analysis

	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
Resources item 11	0.810				
Resources item 10	0.639				
Resources item 2	0.607				
Resources item 6	0.586				
Resources item 3	0.394				
Resources item 13		0.576			
Resources item 12		0.753			
Resources item 9		0.720			
Resources item 7		0.643			
Resources item 8		0.593			
Resources item 18			0.719		
Resources item 15			0.578		
Resources item 17			0.564		
Resources item 5				0.766	
Resources item 1				0.442	
Resources item 14				0.437	
Resources item 4					0.611
Resources item 16					0.488

Note: Resources scale exploratory factor analysis considered the first application of the scale (i.e., first survey wave—before the summer). Kaiser–Meyer–Olkin (KMO) = 0.875. Applied factoring method is ordinary least squares. Applied rotation method is Varimax. Base analysis on Polychoric/tetrachoric correlation matrix. The five-factor solution, based on scree plot inflection point, explains 57.1% of variance.

Resources scale items grouped by factors retained in exploratory factor analysis	
Factor 1 ***(e.g., approach and avoidance coping behaviors)***	
Resources item 11	*I have approach behaviors that can help me cope with the heat (looking for protective places, hydrate myself, etc.)*
Resources item 10	*I have avoidance behaviors that can help me cope with the heat (escape the heat, avoid going outside, etc.)*
Resources item 2	*I have clothing that can help me cope with the heat (fresh and transpirable clothes, hats, etc.)*
Resources item 6	*I have access to places that can help me cope with the heat (places with shades, cooled places, climatized places, etc.)*
Resources item 3	*I have objects that can help me cope with the heat (hand fans, water sprayers, etc.)*
Factor 2 ***(e.g., physical and psychological coping capabilities)***	
Resources item 13	*I have thinking and action tendencies that can help me cope with the heat (being proactive, preventive, thoughtful, etc.)*
Resources item 12	*I have personality tendencies that can help me cope with the heat (being calm, patient, understanding, interested, etc.)*
Resources item 9	*I have emotional capabilities that can help me cope with the heat (ability to control my emotions, to recognize and control what I'm feeling, etc.)*
Resources item 7	*I have physical capabilities that can help me cope with the heat (stamina, vitality, physical health, etc.)*
Resources item 8	*I have mental capabilities that can help me cope with the heat (ability to plan ahead, devise strategies, etc.)*
Factor 3 ***(e.g., instrumental external support)***	
Resources item 18	*I have institutions that can help me cope with the heat, if necessary (associations, community institutions, health authorities, etc.)*
Resources item 15	*I have professionals who can give me recommendations and help me cope with the heat (health professionals, firefighters, etc.)*
Resources item 17	*I have a belief that my faith in God, or in other spiritual beliefs, can help me cope with the heat*
Factor 4 ***(e.g., proximity and material external support)***	
Resources item 5	*I have financial resources that can help me cope with the heat (readily available money, savings, etc.)*
Resources item 1	*I have equipment that can help me deal with the heat (air conditioning, fans, chillers, etc.)*
Resources item 14	*I have family and friends who can support and help me cope with the heat (relatives, neighbors, etc.)*
Factor 5 ***(e.g., informational and technological external support)***	
Resources item 4	*I have information and communication technologies that can help me cope with the heat (social networks, smart apps, etc.)*
Resources item 16	*I have available information that can help me cope with the heat (informative pamphlets, web pages, etc.)*

APPENDIX E: DESCRIPTIVE STATISTICS FOR ALL VARIABLES COLLECTED IN THE STUDY

Descriptive statistics

Variable	M; SD; n or % (n)
Heat wave geographical susceptibility	
Low susceptibility	44.5% (106)
Moderate susceptibility	20.6% (49)
High susceptibility	33.2% (79)
Very high susceptibility (merged with high)	1.7% (4)
Age global	$M = 39.13$; $SD = 17.14$; $n = 238$
16–25	24.8% (59)
26–60	58.8% (140)
61–75	13.9% (33)
+76	2.5% (6)
Age low susceptibility	$M = 34.29$; $SD = 12.65$; $n = 106$
16–25	28.3% (30)
26–60	66.0% (70)
61–75	5.7% (6)
+76	0.0% (0)
Age moderate susceptibility	$M = 38.29$; $SD = 17.47$; $n = 49$
16–25	32.7% (16)
26–60	51.0% (25)
61–75	14.3% (7)
+76	2.0% (1)
Age high susceptibility	$M = 45.86$; $SD = 19.72$; $n = 83$
16–25	15.7% (13)
26–60	54.2% (45)
61–75	24.1% (20)
+76	6.0% (5)
Gender global	
Male	29.8% (71)
Female	70.2% (167)
Gender low susceptibility	
Male	34.0% (36)
Female	66.0% (70)
Gender moderate susceptibility	
Male	28.6% (14)
Female	71.4% (35)
Gender high susceptibility	
Male	25.3% (21)
Female	74.7% (62)
Education level global	$M = 4.25$; $SD = 1.10$; $n = 238$
None (L1)	0% (0)
Primary education (L2)	10.1% (24)

(Continues)

Descriptive statistics

Variable	***M*; *SD; n* or % (*n*)**
Secondary education (L3)	21.0% (50)
Professional/vocational education (L4)	2.9% (7)
Higher education (L5)	66.0% (157)
Education level low susceptibility	$M = 4.66$; $SD = .80$; $n = 106$
None (L1)	0% (0)
Primary education (L2)	2.8% (3)
Secondary education (L3)	12.3% (13)
Professional/vocational education (L4)	.9% (1)
Higher education (L5)	84.0% (89)
Education level moderate susceptibility	$M = 4.22$; $SD = 1.05$; $n = 49$
None (L1)	0% (0)
Primary education (L2)	6.1% (3)
Secondary education (L3)	26.5% (13)
Professional/vocational education (L4)	6.1% (3)
Higher education (L5)	61.2% (30)
Education level high susceptibility	$M = 3.73$; $SD = 1.25$; $n = 83$
None (L1)	0% (0)
Primary education (L2)	21.7% (18)
Secondary education (L3)	28.9% (24)
Professional/vocational education (L4)	3.6% (3)
Higher education (L5)	45.8% (38)
Living alone global	
Yes	15.1% (36)
No	84.9% (202)
Living alone low susceptibility	
Yes	19.8% (21)
No	80.2% (85)
Living alone moderate susceptibility	
Yes	8.2% (4)
No	91.8% (45)
Living alone high susceptibility	
Yes	13.3% (11)
No	86.7% (72)
Physical activity global	
Yes	52.9% (126)
No	47.1% (112)
Physical activity low susceptibility	
Yes	59.4% (63)
No	40.6% (43)
Physical activity moderate susceptibility	
Yes	44.9% (22)
No	55.1% (27)
Doing physical activity high susceptibility	
Yes	49.4% (41)
No	50.6% (42)

(Continues)

Descriptive statistics	
Variable	***M*; *SD; n* or % (*n*)**
Health condition global	
Yes (asthma; high susceptibility)	0.4% (1)
No	99.6% (237)
Employ status global	
Employed	62.6% (149)
Unemployed/retired	37.4% (89)
Employ status low susceptibility	
Employed	69.8% (74)
Unemployed/retired	30.2% (32)
Employ status moderate susceptibility	
Employed	55.1% (27)
Unemployed/retired	44.9% (22)
Employ status high susceptibility	
Employed	57.8% (48)
Unemployed/retired	42.2% (35)
Heard heat protection recommendations	
Survey Wave 2 Global	
Yes	81.5% (194)
No	18.5% (44)
Survey Wave 3 Global	
Yes	78.2% (186)
No	21.8% (52)
Survey Wave 4 Global	
Yes	83.2% (198)
No	16.8.% (40)
Survey Wave 2 low susceptibility	
Yes	77.4% (82)
No	22.6% (24)
Survey Wave 2 moderate susceptibility	
Yes	81.6% (40)
No	18.4% (9)
Survey Wave 2 high susceptibility	
Yes	86.7% (72)
No	13.3% (11)
Survey Wave 3 low susceptibility	
Yes	73.6% (78)
No	26.4% (28)
Survey Wave 3 moderate susceptibility	
Yes	75.5% (37)
No	24.5% (12)
Survey Wave 3 high susceptibility	
Yes	85.5% (71)
No	14.5% (12)
Survey Wave 4 low susceptibility	
Yes	78.3% (83)
No	21.7% (23)

(Continues)

Descriptive statistics

Variable	M; SD; n or % (n)
Survey Wave 4 moderate susceptibility	
Yes	87.8% (43)
No	12.2% (6)
Survey Wave 4 high susceptibility	
Yes	86.7% (72)
No	13.3% (11)
Heat wave feelings of threat (D/R)	
Survey Wave 1 global	$M = 0.90$; $SD = 0.24$; $n = 238$
Survey Wave 2 global	$M = 0.96$; $SD = 0.25$; $n = 238$
Survey Wave 3 global	$M = 0.93$; $SD = 0.25$; $n = 238$
Survey Wave 4 global	$M = 0.91$; $SD = 0.20$; $n = 238$
Survey Wave 1 low susceptibility	$M = 0.84$; $SD = 0.25$; $n = 106$
Survey Wave 1 moderate susceptibility	$M = 0.92$; $SD = 0.16$; $n = 49$
Survey Wave 1 high susceptibility	$M = 0.97$; $SD = 0.24$; $n = 83$
Survey Wave 2 low susceptibility	$M = 0.86$; $SD = 0.23$; $n = 106$
Survey Wave 2 moderate susceptibility	$M = 0.99$; $SD = 0.15$; $n = 49$
Survey Wave 2 high susceptibility	$M = 1.10$; $SD = 0.27$; $n = 83$
Survey Wave 3 low susceptibility	$M = 0.84$; $SD = 0.22$; $n = 106$
Survey Wave 3 moderate susceptibility	$M = 0.96$; $SD = 0.16$; $n = 49$
Survey Wave 3 high susceptibility	$M = 1.03$; $SD = 0.28$; $n = 83$
Survey Wave 4 low susceptibility	$M = 0.85$; $SD = 0.21$; $n = 106$
Survey Wave 4 moderate susceptibility	$M = 0.94$; $SD = 0.13$; $n = 49$
Survey Wave 4 high susceptibility	$M = .96$; $SD = .22$; $n = 83$
Heat wave risk perception	
Survey Wave 1 global	$M = 3.30$; $SD = .74$; $n = 238$
Survey Wave 2 global	$M = 3.45$; $SD = .75$; $n = 238$
Survey Wave 3 global	$M = 3.31$; $SD = .78$; $n = 238$
Survey Wave 4 global	$M = 3.30$; $SD = .73$; $n = 238$
Survey Wave 1 low susceptibility	$M = 3.20$; $SD = .79$; $n = 106$
Survey Wave 1 moderate susceptibility	$M = 3.19$; $SD = .60$; $n = 49$
Survey Wave 1 high susceptibility	$M = 3.49$; $SD = .71$; $n = 83$
Survey Wave 2 low susceptibility	$M = 3.24$; $SD = .79$; $n = 106$
Survey Wave 2 moderate susceptibility	$M = 3.41$; $SD = .64$; $n = 49$
Survey Wave 2 high susceptibility	$M = 3.74$; $SD = 0.66$; $n = 83$
Survey Wave 3 low susceptibility	$M = 3.16$; $SD = 0.66$; $n = 106$
Survey Wave 3 moderate susceptibility	$M = 3.22$; $SD = 0.66$; $n = 49$
Survey Wave 3 high susceptibility	$M = 3.56$; $SD = 0.74$; $n = 83$
Survey Wave 4 low susceptibility	$M = 3.20$; $SD = 0.79$; $n = 106$
Survey Wave 4 moderate susceptibility	$M = 3.25$; $SD = 0.67$; $n = 49$
Survey Wave 4 high susceptibility	$M = 3.45$; $SD = 0.65$; $n = 83$
Temperature feeling	
Survey Wave 1 global	$M = 1.81$; $SD = 0.80$; $n = 238$
Survey Wave 2 global	$M = 4.36$; $SD = 0.75$; $n = 238$
Survey Wave 3 global	$M = 3.56$; $SD = 0.80$; $n = 238$
Survey Wave 4 global	$M = 3.22$; $SD = 1.03$; $n = 238$

(Continues)

Descriptive statistics	
Variable	***M*; *SD; n* or % (*n*)**
Survey Wave 1 low susceptibility	$M = 1.88$; $SD = 0.87$; $n = 106$
Survey Wave 1 moderate susceptibility	$M = 1.65$; $SD = 0.60$; $n = 49$
Survey Wave 1 high susceptibility	$M = 1.81$; $SD = 0.80$; $n = 83$
Survey Wave 2 low susceptibility	$M = 4.29$; $SD = 0.68$; $n = 106$
Survey Wave 2 moderate susceptibility	$M = 4.18$; $SD = 0.93$; $n = 49$
Survey Wave 2 high susceptibility	$M = 4.55$; $SD = 0.70$; $n = 83$
Survey Wave 3 low susceptibility	$M = 3.50$; $SD = 0.78$; $n = 106$
Survey Wave 3 moderate susceptibility	$M = 3.67$; $SD = 0.88$; $n = 49$
Survey Wave 3 high susceptibility	$M = 3.57$; $SD = 0.77$; $n = 83$
Survey Wave 4 low susceptibility	$M = 3.43$; $SD = 0.93$; $n = 106$
Survey Wave 4 moderate susceptibility	$M = 3.29$; $SD = 0.87$; $n = 49$
Survey Wave 4 high susceptibility	$M = 2.93$; $SD = 1.18$; $n = 83$
Temperature interference in daily life	
Survey Wave 1 global	$M = 2.44$; $SD = 0.83$; $n = 238$
Survey Wave 2 global	$M = 3.21$; $SD = 0.90$; $n = 238$
Survey Wave 3 global	$M = 2.38$; $SD = 0.80$; $n = 238$
Survey Wave 4 global	$M = 2.25$; $SD = 0.82$; $n = 238$
Survey Wave 1 low susceptibility	$M = 2.40$; $SD = 0.85$; $n = 106$
Survey Wave 1 moderate susceptibility	$M = 2.42$; $SD = 0.70$; $n = 49$
Survey Wave 1 high susceptibility	$M = 2.50$; $SD = 0.88$; $n = 83$
Survey Wave 2 low susceptibility	$M = 3.07$; $SD = 0.91$; $n = 106$
Survey Wave 2 moderate susceptibility	$M = 3.14$; $SD = 0.90$; $n = 49$
Survey Wave 2 high susceptibility	$M = 3.43$; $SD = 0.85$; $n = 83$
Survey Wave 3 low susceptibility	$M = 2.37$; $SD = 0.84$; $n = 106$
Survey Wave 3 moderate susceptibility	$M = 2.39$; $SD = 0.66$; $n = 49$
Survey Wave 3 high susceptibility	$M = 2.39$; $SD = 0.83$; $n = 83$
Survey Wave 4 low susceptibility	$M = 2.23$; $SD = 0.87$; $n = 106$
Survey Wave 4 moderate susceptibility	$M = 2.23$; $SD = 0.75$; $n = 49$
Survey Wave 4 high susceptibility	$M = 2.28$; $SD = 0.81$; $n = 83$
Positive affect about heat	
Survey Wave 1 global	$M = 3.27$; $SD = 0.87$; $n = 238$
Survey Wave 2 global	$M = 2.99$; $SD = 0.91$; $n = 238$
Survey Wave 3 global	$M = 3.08$; $SD = 0.93$; $n = 238$
Survey Wave 4 global	$M = 3.20$; $SD = 0.89$; $n = 238$
Survey Wave 1 low susceptibility	$M = 3.43$; $SD = 0.93$; $n = 106$
Survey Wave 1 moderate susceptibility	$M = 3.26$; $SD = 0.64$; $n = 49$
Survey Wave 1 high susceptibility	$M = 3.07$; $SD = 0.89$; $n = 83$
Survey Wave 2 low susceptibility	$M = 3.14$; $SD = 0.96$; $n = 106$
Survey Wave 2 moderate susceptibility	$M = 3.02$; $SD = 0.78$; $n = 49$
Survey Wave 2 high susceptibility	$M = 2.80$; $SD = 0.90$; $n = 83$
Survey Wave 3 low susceptibility	$M = 3.21$; $SD = 1.02$; $n = 106$
Survey Wave 3 moderate susceptibility	$M = 3.06$; $SD = 0.75$; $n = 49$
Survey Wave 3 high susceptibility	$M = 2.93$; $SD = 0.89$; $n = 83$
Survey Wave 4 low susceptibility	$M = 3.28$; $SD = 0.99$; $n = 106$
Survey Wave 4 moderate susceptibility	$M = 3.16$; $SD = 0.75$; $n = 49$
Survey Wave 4 high susceptibility	$M = 3.11$; $SD = 0.83$; $n = 83$

(Continues)

Descriptive statistics	
Variable	***M*; *SD; n* or % (*n*)**
Need for cognition	
Survey Wave 1 global	$M = 3.65$; $SD = 0.74$; $n = 238$
Survey Wave 2 global	$M = 3.58$; $SD = 0.73$; $n = 238$
Survey Wave 3 global	$M = 3.58$; $SD = 0.72$; $n = 238$
Survey Wave 4 global	$M = 3.59$; $SD = 0.78$; $n = 238$
Survey Wave 1 low susceptibility	$M = 3.80$; $SD = 0.74$; $n = 106$
Survey Wave 1 moderate susceptibility	$M = 3.59$; $SD = 0.66$; $n = 49$
Survey Wave 1 high susceptibility	$M = 3.49$; $SD = 0.75$; $n = 83$
Survey Wave 2 low susceptibility	$M = 3.77$; $SD = 0.67$; $n = 106$
Survey Wave 2 moderate susceptibility	$M = 3.43$; $SD = 0.73$; $n = 49$
Survey Wave 2 high susceptibility	$M = 3.43$; $SD = 0.76$; $n = 83$
Survey Wave 3 low susceptibility	$M = 3.82$; $SD = 0.68$; $n = 106$
Survey Wave 3 moderate susceptibility	$M = 3.41$; $SD = 0.72$; $n = 49$
Survey Wave 3 high susceptibility	$M = 3.38$; $SD = 0.70$; $n = 83$
Survey Wave 4 low susceptibility	$M = 3.79$; $SD = 0.71$; $n = 106$
Survey Wave 4 moderate susceptibility	$M = 3.43$; $SD = 0.78$; $n = 49$
Survey Wave 4 high susceptibility	$M = 3.44$; $SD = 0.80$; $n = 83$

APPENDIX F: SEASONAL VARIATIONS IN HEAT WAVE FEELINGS OF THREAT WITHIN PARTICIPANTS LIVING IN THE DIFFERENT HEAT WAVE GEOGRAPHICAL SUSCEPTIBILITY LOCATION

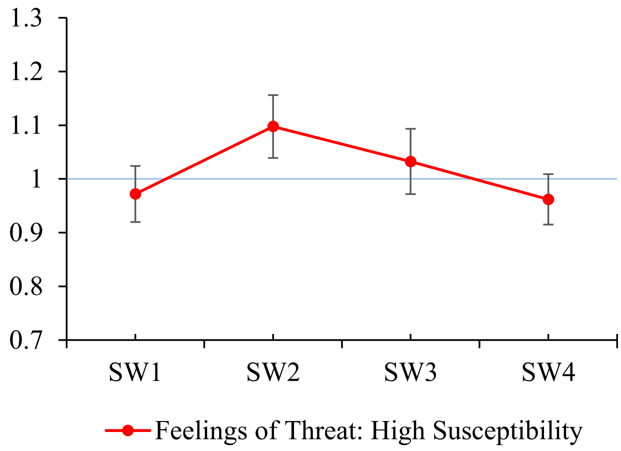

FIGURE F1 Seasonal variations in heat wave feelings of threat within participants living in high heat wave geographical susceptibility locations.

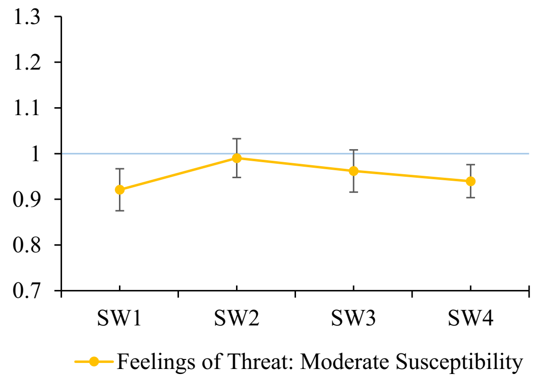

FIGURE F2 Seasonal variations in heat wave feelings of threat within participants living in moderate heat wave geographical susceptibility locations.

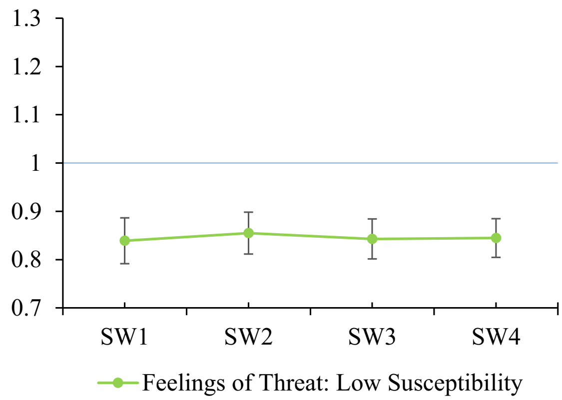

FIGURE F3 Seasonal variations in heat wave feelings of threat within participants living in low heat wave geographical susceptibility locations.
Note: For all figures—SW1, First Survey Wave (before the summer); SW2, Second Survey Wave (during a heat wave in the summer); SW3, Third Survey Wave (during the summer); SW4, Fourth Survey Wave (after the summer). Scale ranging from 0.2 to 5. Details on differences between demands and resources perceptions highlighting when D/R > 1, D/R < 1, and D/R ≈ 1 can be seen in Appendix G.

APPENDIX G: DIFFERENCES BETWEEN DEMANDS AND RESOURCES PERCEPTIONS IN THE DIFFERENT HEAT WAVE GEOGRAPHICAL SUSCEPTIBILITY LOCATIONS ACROSS SURVEY WAVES

Paired sample t-tests for differences between demands and resources perceptions in the different heat wave geographical susceptibility locations across survey waves, showing when demands perceptions are statistically higher, lower, or equal to resources perceptions

	Paired differences			
	Mean (SD)	**95% CI**	***t*(df)**	***p***
Low susceptibility				
SW1: demands–resources	−0.66(.90)	[−0.83; −0.48]	$t(105) = -7.52$	0.000
SW2: demands–resources	−0.59(0.83)	[−0.75; −0.43]	$t(105) = -7.37$	0.000
SW3: demands–resources	−0.64(0.83)	[−0.80; −0.48]	$t(105) = -7.98$	0.000
SW4: demands–resources	−0.63(0.77)	[−0.78; −0.48]	$t(105) = -8.44$	0.000
Moderate susceptibility				
SW1: demands–resources	−0.32(0.56)	[−0.48; −0.16]	$t(48) = -4.04$	0.000
SW2: demands–resources	−0.06(0.53)	[−0.21; 0.10]	$t(48) = -0.73$	0.469
SW3: demands–resources	−0.17(0.57)	[−0.33; −0.01]	$t(48) = -2.08$	0.043
SW4: demands–resources	−0.23(0.45)	[−0.36; −0.10]	$t(48) = -3.51$	0.001
High susceptibility				
SW1: demands–resources	−0.18(0.83)	[−0.36: 0.001]	$t(82) = -1.98$	0.052
SW2: demands–resources	0.24(0.85)	[0.05; 0.42]	$t(82) = -2.56$	0.012
SW3: demands–resources	0.01(0.83)	[−0.17; 0.19]	$t(82) = 0.13$	0.894
SW4: demands–resources	−0.20(0.74)	[−0.36; −0.04]	$t(82) = -2.46$	0.016

Note: SW1, First Survey Wave (before the summer); SW2, Second Survey Wave (during a heat wave in the summer); SW3, Third Survey Wave (during the summer); SW4, Fourth Survey Wave (after the summer). When perceived demands are significantly higher than resources, then $D/R > 1$; when perceived demands are significantly lower than resources, then $D/R < 1$; when perceived demands and resources are not significantly different, then $D/R \approx 1$.

APPENDIX H: REGRESSION ANALYSES (STANDARDIZED Β) SHOWING FACTORS PREDICTING HEAT WAVE FEELINGS OF THREAT ACROSS HEAT WAVE GEOGRAPHICAL SUSCEPTIBILITY LOCATIONS AND SURVEY WAVES

	Low susceptibility β 95% CI	Moderate susceptibility β 95% CI	High susceptibility β 95% CI
Predictors first survey wave			
Before the summer			
Age	0.08	−0.11	−0.08
	[−0.002; 0.01]	[−0.004; 0.002]	[−0.01; 0.003]
Female	−0.01	0.29†	0.10
	[−0.10; 0.09]	[−0.006; 0.21]	[−0.06; 0.17]
Education level	0.04	0.13	−0.16
	[−0.05; 0.07]	[−0.02; 0.07]	[−0.09; 0.03]
Living alone	−0.03	−0.13	0.02
	[−0.12; 0.09]	[−.25; 0.10]	[−.13; 0.16]
Physical activity	−0.12	−0.01	−0.11
	[−0.14; 0.03]	[−0.10; 0.10]	[−0.15; 0.05]
Being employed	−0.14†	−0.11	−0.28*
	[−0.17; 0.01]	[−0.12; 0.06]	[−0.26; −0.01]
Heard recommendations	–	–	–
Positive affect about heat	−0.29**	−0.45**	−0.30**
	[−0.13; −0.03]	[−0.20; −0.03]	[−0.14; −0.02]
Need for cognition	−0.09	0.13	−0.19
	[−0.09; 0.04]	[−0.04; 0.10]	[−0.13; 0.01]
Heat wave risk perception	0.41***	0.08	0.27**
	[0.07; 0.18]	[−0.06; 0.10]	[0.02; 0.16]
Temperature interference	0.13	0.19	0.09
	[−0.02; 0.09]	[−0.03; 0.11]	[−0.04; 0.09]
Temperature feeling	−0.04	0.26	0.03
	[−0.07; 0.05]	[−0.02; 0.16]	[−0.05; 0.07]
R^2	0.37	0.41	0.37
Model F	$F(11, 94) =$ 5.012***	$F(11, 37) =$ 2.373*	$F(11, 71) =$ 3.716***

	Low susceptibility β 95% CI	Moderate susceptibility β 95% CI	High susceptibility β 95% CI
Predictors second survey wave			
Heat wave in the summer			
Age	0.01	−0.16	0.22
	[−0.003; 003]	[−0.004; 0.001]	[−0.001; 0.01]
Female	−0.05	0.19	0.09
	[−0.11; 0.06]	[−0.04; 0.16]	[−0.07; 0.17]
Education level	0.16†	0.08	0.002
	[−0.004; 0.10]	[−0.03; .05]	[−0.06; 0.06]

(Continues)

	Low susceptibility β 95% CI	Moderate susceptibility β 95% CI	High susceptibility β 95% CI
Living alone	−0.01	0.10	−0.01
	[−0.10; 0.09]	[−0.10; 0.21]	[−0.15; 0.14]
Physical activity	0.04	0.16	−0.02
	[−0.06; 0.09]	[−0.04; 0.14]	[−0.11; 0.09]
Being employed	−0.17*	−0.07	−0.08
	[−0.16; 0.000]	[−0.10; 0.06]	[−0.17; 0.08]
Heard recommendations	−0.07	0.06	−0.08
	[−0.13; 0.05]	[−0.09; 0.14]	[−0.12; 0.08]
Positive affect about heat	−0.29**	−0.35*	−0.22*
	[−0.11; −0.03]	[−0.12; −0.01]	[−0.12; −0.01]
Need for cognition	−0.12	−0.22	−0.29**
	[−0.10; 0.02]	[−0.10; 0.01]	[−0.18; −0.03]
Heat wave risk perception	0.28**	0.45**	0.20†
	[0.02; 0.14]	[0.03; 0.17]	[−0.001; 0.16]
Temperature interference	0.28**	0.14	0.23*
	[0.02; 0.12]	[−0.03; 0.08]	[0.01; 0.14]
Temperature feeling	−0.05	0.03	0.03
	[−0.07; 0.04]	[−0.05; 0.05]	[−0.07; 0.09]
R^2	0.41	0.45	0.48
Model *F*	$F(12, 93) = 5.419$***	$F(12, 36) = 2.424$*	$F(12, 70) = 5.416$***

	Low susceptibility β 95% CI	Moderate susceptibility β 95% CI	High susceptibility β 95% CI
Predictors third survey wave			
During the summer			
Age	0.07	−0.07	0.43*
	[−0.002; 0.004]	[−0.004; 0.002]	[0.001; .01]
Female	−0.08	0.44*	0.32**
	[−0.11; 0.04]	[0.04; 0.27]	[0.07; 0.34]
Education level	0.09	0.13	0.01
	[−0.02; 0.07]	[−0.02; 0.07]	[−0.07; 0.07]
Living alone	−0.04	0.14	−0.07
	[−0.11; 0.07]	[−0.10; 0.26]	[−0.23; 0.11]
Physical activity	−0.05	−0.13	0.01
	[−0.09; 0.05]	[−0.14; 0.06]	[−11; 0.12]
Being employed	−0.17*	0.04	−0.09
	[−0.16; −0.001]	[−0.08; 0.10]	[−0.19; 0.09]
Heard recommendations	−0.02	0.06	0.07
	[−0.09; 0.07]	[−0.09; 0.14]	[−0.10; 0.21]
Positive affect about heat	−0.18*	−0.40*	−0.08
	[−0.08; −0.001]	[−0.15; −0.02]	[−0.09; 0.04]
Need for cognition	0.04	0.19	−0.05
	[−0.05; 0.07]	[−0.02; 0.11]	[−0.11; 0.07]

(Continues)

	Low susceptibility β 95% CI	Moderate susceptibility β 95% CI	High susceptibility β 95% CI
Heat wave risk perception	0.50***	0.29†	0.13
	[0.07; 0.19]	[0.000; 0.14]	[−0.03; 0.13]
Temperature interference	0.11	0.18	0.48***
	[−0.03; 0.09]	[−0.03; 0.12]	[0.08; 0.25]
Temperature feeling	0.004	−0.12	−0.06
	[−0.05; 0.05]	[−0.08; 0.04]	[−0.10; 0.06]
R^2	0.43	0.43	0.36
Model *F*	$F(12, 93) = 5.731$***	$F(12, 36) = 2.220$*	$F(12, 70) = 3.323$**
	Low susceptibility β 95% CI	**Moderate susceptibility β 95% CI**	**High susceptibility β 95% CI**
Predictors fourth survey wave			
After the summer			
Age	0.04	−0.03	−0.27
	[−0.002; 0.004]	[−0.003; 0.002]	[−0.01; 0.001]
Female	0.02	0.25	0.25*
	[−0.08; 0.10]	[−0.02; 0.16]	[0.01; 0.24]
Education level	0.09	−0.05	−0.25
	[−0.03; 0.07]	[−0.04; 0.03]	[−0.10; 0.01]
Living alone	0.002	−0.07	0.08
	[−0.10; 0.10]	[−0.16; 0.10]	[−0.09; 0.19]
Physical activity	−0.04	0.15	−0.13
	[−0.09; 0.06]	[−0.04; 0.11]	[−0.15; 0.04]
Being employed	−0.17†	−0.06	−0.12
	[−0.16; 0.01]	[−0.09; 0.05]	[−0.17; 0.06]
Heard recommendations	−0.12	−0.13	0.16
	[−0.15; 0.03]	[−0.17; 0.08]	[−0.04; 0.24]
Positive affect about heat	−0.28**	−0.20	−0.08
	[−0.10; −0.02]	[−0.09; 0.02]	[−0.08; 0.04]
Need for cognition	−0.01	0.12	−0.03
	[−0.06; 0.05]	[−0.03; 0.07]	[−0.07; 0.06]
Heat wave risk perception	0.39***	0.49**	0.27*
	[0.05; 0.16]	[0.03; 0.16]	[0.02; 0.16]
Temperature interference	0.02	−0.04	−0.12
	[−0.05; 0.06]	[−0.06; 0.05]	[−0.09; 0.03]
Temperature feeling	0.01	−0.24	−0.06
	[−0.04; 0.04]	[−0.08; 0.01]	[−0.06; 0.03]
R^2	0.29	0.42	0.27
Model *F*	$F(12, 93) = 3.218$**	$F(12, 36) = 2.135$*	$F(12, 70) = 2.185$*

Note: Standardized regression coefficients.
†$p < 0.10$.
*$p < 0.05$.
**$p < 0.01$.
***$p < 0.001$.