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Six ways health psychology can contribute to climate change mitigation and adaptation

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Human activities over the last two centuries have resulted in increased greenhouse gases (GHG) emissions and ultimately the sharp warming of our planet (Steffen et al., 2015). Global surface temperature has increased by 1.09°C compared to the preindustrial period (1850–1900; Intergovernmental Panel on Climate Change, IPCC, 2018). Although many governments have considered climate change as a national safety and security threat, and a few have initiated some of the necessary transformations required to mitigate its impacts and adapt to it, even the most ambitious actions taken to date are insufficient to slow down global emissions. For any near term GHG emissions scenario possible under current structural, political, and economic conditions, global surface temperatures are expected to continue to increase until at least mid-century (IPCC, 2018). Current policies and actions are estimated to be taking us to +2.7 °C global warming by 2100 compared to the 1850–1900 baseline temperature (Climate Analytics and New Climate Institute, 2022).

This abovementioned scenario leads to dangerous Earth system trajectories and potential catastrophic consequences including mass mortality related to food and water shortages, state fragility and international and local conflicts (Kemp et al., 2022). Temperatures of more than 2 °C above preindustrial values have not been sustained on Earth's surface since before the Pleistocene Epoch (more than 2.6 million years ago). This is profoundly important because human civilization did not develop under the conditions that prevailed 3 million years ago, and whether our current civilizations can live and thrive in such a climate is unknown. Limiting the worst consequences of climate change requires quick radical behavioral, economic, and societal transformation simultaneously. We believe that health psychology can contribute to this challenge, beyond what has been done in other related disciplines such as environmental psychology.

Through this chapter, our aim is to motivate health psychology researchers and practitioners to redirect some of their research activities towards climate change related topics. Climate change is defined in the present chapter according to the IPCC definition "a change in the state of the climate that can be identified by changes in the mean and/or the variability of its properties and that persists for an extended period, typically decades or longer". The present chapter notably focuses on the problems caused by anthropogenic climate change, such as rising temperatures, increasing occurrence and intensity of extreme weather events, air pollution or again rising sea level. The COVID-19 pandemic shows that our scientific community can quickly generate vast amounts of new practical knowledge in record time on topics that are only partially familiar to us. Imagine what could be achieved in one year if, similar to COVID-19, our scientific community shifted to focus on climate mitigation and adaptation. To accelerate this transition, and as a starting point, this chapter proposes six research topics that the field of health psychology and behavioral medicine could take on from (1) behavioral adaptation to

climate change, (2) the behavioral aspects of climate change mitigation, (3) health equity, (4) rebound effects in behavioral sciences, (5) the interplay between behaviors, well-being and energy consumption and (6) mental health in context of climate change.

Fostering behavioral adaptation to climate change

We have summarized the impact of climate change on health behaviors in a previous literature review (Chevance et al., 2022). Here, we proposed that climate change is associated with health behaviors through at least two different pathways: (*i*) direct and indirect (or mediated) effects and (*ii*) in the form of behavioral shocks and secular trends. Example of direct effects includes the impact of heat extremes on the human physiology and subsequent consequences in terms of physical activity, while indirect effects include for instance the impact of hurricanes on sleep via mental health issues (e.g., post-traumatic stress disorders). Behavioral shocks and secular trends refer to the time scales at which climate change can impact behaviors, with extreme weather events leading to situations of emergency in the short-term (i.e., behavioral shocks), and slower secular changes in the climate impacting our behaviors on the long run such as progressive temperature increases and their behavioral effects over several years/decades (see Chevance et al., 2022 for a literature review).

Although relatively few studies have documented the effects of climate-related outcomes on health behaviors (Berrang-Ford et al., 2021), we argue here that it is too late to conduct more observational studies on this topic. In our opinion, the evidence of the disruptive effects of climate change on health and health behaviors are strong, or good-enough, to avoid wasting time on the (re)estimation of these effects. Instead, the urgent situation requires us to directly invest time and energy in scalable quasi-experimental or interventional studies that could help individuals and communities to cope with the negative consequences of climate change (Brown et al., 2022). To our knowledge, very few health behavior change interventions have been (*i*) specifically designed to help individuals cope with climate outcomes (e.g., how should we promote active transportation in the context of high levels of air pollution), or (*ii*) simply implemented in the context of environmental threats (e.g., how to prevent sleep disorders or dehydration in the context of extreme heat).

Health psychologists are potential key actors in the design, implementation and evaluation of such interventions. Using our traditional toolboxes (e.g., the experimental medicine approach to health behavior change; Sheeran et al., 2017), interventions could focus on individuals, as we are used to, but also on communities (Okvat & Zautra, 2011), or even at larger scales (e.g., evaluating and refining the impact of national plans on behavioral outcomes in the context of climate change; Chaloupka et al., 2012). To foster this transition, seeking new collaborations with colleagues skilled in climate and health sciences, planetary health or environmental health and epidemiology will be key. Our experience is that many researchers with a background in these disciplines are keen to transition to more human-centered and interventional initiatives, and have few skills compared with us health psychologists when it comes to conducting this type of interventional research. Behavioral and mental adaptation to climate change is in its infancy and people with a background in health psychology could have a key impact in this domain.

Accelerating mitigation efforts

The Intergovernmental Panel on Climate Change suggests the classification of human behaviors in two categories: adaptation and mitigation behaviors (IPCC, 2018). The latter is defined as pro-active efforts '*to reduce emissions or enhance the sinks* of *greenhouse gases*'. However, in a consequentialist perspective, all mitigation behaviors are not equal in terms of

carbon footprint reduction. For instance, recycling and less frequent car use are considered as low and high impact behaviors, respectively. Unfortunately, a large part of previous research (notably in environmental psychology) has focused on low-impact behaviors such as recycling (Nielsen et al., 2021), instead of highly impactful ones, such as eating fewer animal products, reducing car use, lowering residential energy use, having fewer children, and decreasing flying frequency (Akenji et al., 2019).

Three main behaviors can be considered as high win-win behaviors for health psychologists interested in health and environmental co-benefits (Bernard, 2019; see also Inauen et al., 2021). First, a meat- and fish-free diet is associated with an individual carbon footprint reduction of 35% and a reduced total and cause-specific mortality (Fresán & Sabaté, 2019). Second, car driving is a major determinant of GHG emissions and local air pollution, and in parallel, high frequency of car use is related to higher risk of cardiovascular disease (Patterson et al., 2020). Shifting from car to active transport is also a protective factor of depressive disorders and enhanced well-being. Third, housing energy use is the second larger carbon footprint source of households behind transports (see Akenji et al.,2019), and is increasingly vital for maintaining a good health via adequate temperatures and humidity management (particularly for individuals with scarce economical resources; Jessel et al., 2019). For instance, improved home insulation has shown to be associated with reduced hospital admissions, incidence and severity of chronic respiratory disease, and improved quality of life (Fyfe et al., 2020).

Mitigation efforts could also be designed to reorganize health systems practices. Indeed, the international healthcare sector had a climate footprint equivalent to almost 5% of global net emissions (Health Care Without Harm, 2019). In other words, if health systems were treated as a country, it would be the fifth largest emitter on the planet. Healthcare carbon footprint represents a sizable percentage of high-income countries' footprints (7.6 % US, 6.7 % Switzerland, 6.4 % Japan, 6 % United Kingdom; Health Care Without Harm, 2019). Thus, the healthcare supply chain, infrastructure and healthcare delivery have to be decarbonized. It implies major cultural changes for healthcare, by focusing more on prevention of non-communicable diseases than carbon-intensive care and hospitalization (Hensher & Zywert, 2020). In practice, health psychologists could contribute to decreasing patients' emissions related to transportation (i.e., for example via tele-consultations, health monitoring at home), and strengthen their efforts to prevent unplanned hospitalizations or complications among patients with chronic diseases (i.e., primary prevention). By doing this, the community would contribute to healthcare decarbonization.

Finally, evidence-based psychological and behavioral interventions should be re-designed with regards to their carbon footprints and not only their clinical effectiveness. Traditionally, clinical outcomes and cost-effectiveness are the key indicators to develop guidelines and organize healthcare practices. We argue here that carbon-effectiveness (i.e., the carbon emissions per health gain produced) should also now be considered before scaling-up an intervention. For instance, a study showed that smoking cessation delivery modes have different carbon footprints (Smith et al., 2013). They range from high for group or individual counseling (>16 tons of CO_2 for 1000 smokers) to low for short messages or phone calls (<8 tons of CO_2 for 1000 smokers, here the text message support was the most carbon-effective strategy; Smith et al., 2013). From a planetary health perspective, text message support or telemedicine could be more frequently implemented while less carbon-effective strategies (i.e., individual counselling) could be delivered to non-responsive smokers only via, for example, Sequential Multiple Assignment Randomized Trials (Collins, Murphy and Strecher, 2007). Health psychologists should now balance clinical effectiveness and carbon-effectiveness before scaling-up interventions.

Putting health equity at the heart of any initiatives

The current climate situation is unfair: (*i*) our current generation and the previous one are responsible for the uncontrolled emissions, but the worst effects of climate change will be experienced by today's children that do not have control over those situations; (*ii*) the bottom 50% of low-income countries are responsible for only 15% of global emissions but are also those that are already suffering more from climate change and have fewer resources to cope with; (*iii*) within-countries, a similar pattern is observed, a strong correlation exists between incomes and per capita emissions (i.e., the higher emitters are the high-income social groups), and people living in socially disadvantaged areas, or with less financial resources, are expected to experience more difficulties coping with the health consequences of climate change (e.g., lower rate of access to air conditioning or effective home insulation; see Chevance et al., 2022).

These forms of inequity should be at the heart of any interventions and initiatives led by health psychologists. We argue that mitigation efforts should first target wealthy individuals that have the most resource-intensive lifestyle, within- and between- countries. The question of inter-generational inequity is difficult to approach. The most consequential decisions today are almost certainly being influenced by intergenerational delay discounting (i.e., countries' focus on short-term vs long-term gains). The field of health psychology could play a role by developing interventions manipulating this construct of delay discounting, which has been relevant for understanding health behaviors in the past (Daugherty & Brase, 2010). Studying and monitoring adolescents and childrens' health, in this specific context of climate change, is also crucial.

Finally, climate change is also expected to impact the health of women and men differently, particularly in low- and middle-income countries (Chevance et al., 2022). For example, rising temperatures could substantially worsen the health impacts of menopause, notably hot flashes. Men could experience other risks, like suicide due to extreme weather events impacting their occupational activities (e.g., droughts in Indian's farmers). In parallel, it has been argued that the promotion of climate friendly policies was associated with a reduction in gender inequality at a worldwide scale (Andrijevic et al., 2020). Based on this, the field of health psychology should consciously monitor and seek to understand and address any disparities that might manifest in relation to sex or gender when developing projects in the domains of climate change and health.

Accounting for rebound effects when promoting behavior change

The adoption of new behaviors (e.g., meat consumption reduction) or technologies (e.g., electric car use) in health or climatic perspectives can sequentially produce new behaviors in individuals. For example, an increase in electricity consumption has been observed in recent adopters of solar panels. This phenomenon is called rebound (Santarius & Soland, 2018) or spillover effects (Geiger et al., 2021). It can be positive (i.e., adoption of other healthy or climate friendly behaviors) or negative (i.e., adoption of other unhealthy or carbon-intensive behaviors). Indeed, new behaviors or technologies can produce some gains in terms of financial, psychological and temporal resources. For instance, shifting from car to bike use for daily commuting can be associated with money saving. However, if this money is then spent on long distance vacation and air travels, a negative rebound effect has occurred (from an environmental perspective). Also, doing shopping in plastic-free grocery stores can improve the shopper green self-identity. However, this new identity, developed by adopting low-impact behaviors, can license more carbon-intensive behaviors such as long-distance trips and negatively impact the person's overall environmental footprint. In contrast, as an example of an attempt to encourage

positive rebound effects in behavioral interventions through incentivization, new shared electric bike adopters have been offered a 12-month discount for vegetarian meals (York et al., 2022).

Several individual factors are associated with positive or negative rebound effects in behaviour change interventions (Santarius & Soland, 2018). Improved self-efficacy after the adoption of a first behavior is associated with higher occurrence of positive rebound effect. Low-incomes, moral licensing and compensatory beliefs phenomena are related to negative rebound effects (Santarius & Soland, 2018). In the longer term, rebound effects are also driven by organizational and economic factors such as energy price, production processes, ancillary applications, and tax credit or exemption.

Possible negative rebound effects should be anticipated in health behavior change interventions targeting environmental co-benefits. For instance, shifting from car to active transport for daily commuting can be associated with an increase of individual food-related greenhouse gas emissions due to increased energy expenditure (Mizdrak et al., 2020) or a reduction of leisure related physical activities (Brondeel et al., 2019). Conversely, health behavioral change interventions can also be designed to foster positive rebound effects. A positive behavioral rebound effect occurred more frequently when interventions are autonomy-supportive, provide a strong rationale, do not use financial (dis)incentives, and address normative and personal gain goals (Geiger et al., 2021). For example, an intervention promoting cycling for daily commuting to work could include booster sessions or a second phase designed to include bicycle travel in other life domains.

Decoupling energy use, health and well-being

Many mainstream "solutions" to climate change emphasize the role of technological innovations for climate change mitigation without really questioning our energy-intensive lifestyles and daily behaviors (Akenji et al., 2019). Although we have seen fantastic improvements in energy efficiency over the last years, technological promises have enabled rapid, effective and fair mitigation measures (McLaren & Markusson, 2020). The scale of the issue and the urgency is so important that efficiency improvements alone (i.e., replacing objects, like a car, with a less carbon-intensive ones but without changing the pattern of utilization) will not be sufficient in limiting global warming (IPCC, 2022). Two other options exist: (*i*) modal shift (e.g., using public transport instead of cars) and (*ii*) absolute reduction, what we refer to here as sufficiency (e.g., reducing physical consumption of goods and services, such as traveling less instead of traveling differently). In the following paragraphs, we address the challenge of staying healthy with less (energy) consumption and how health psychologists could contribute to this challenge, notably in high-income countries where the most efforts with regards to lifestyle changes need to be made.

It is crucial to have in mind that, at the global scale, 85% of our energy comes from fossil fuels (i.e., oil, coal, and gas; see the following graph: https://ourworldindata.org/global-energy-200-years); other major sources being biomass (e.g., wood), nuclear power and hydro-power, and then other renewables (e.g., wind, solar) representing only a tiny percentage of our global energetical mix (i.e., around 5%). Therefore, reducing drastically our utilization of fossil fuels, and thus limiting global warming, will very likely imply a decrease in the quantity and intensity of our daily activities (i.e., how we travel, eat and consume), again, especially in high-income countries where wealthy individuals have the most resource intensive lifestyles. To quantify this, a recent report concluded that current per-capita lifestyles' carbon footprint (i.e., the energy consumed at the scale of an individual, via their transports, housing, foods, goods and leisure) in high income countries should decrease by around 90% by 2050 (in a scenario where global warming is limited to + 1.5 °C by 2100 and without extensive use of carbon removal technologies; Akenji et al., 2019). We are not arguing here that the whole responsibility

for achieving this target (i.e., -90%) is on individuals, and, obviously, major structural and political changes will be needed to live within socio-economical contexts that allowed such lifestyles. But, still, radical behavior change towards more sufficiency are needed, if we want to safeguard our climate; in explicit terms, traveling less, buying and consuming less of anything, and in a way accepting that we need to cut back on our energy-intensive everyday lifestyles.

The health psychology community could contribute to this transition notably by addressing the challenge of decoupling energy consumption from health outcomes or in other words by studying how to stay healthy in societies where we would consume less of everything (Bernard, 2019; Büchs & Koch, 2019). Indeed, positive correlations between energy consumption (at the scale of an individual or a country) and well-being or life expectancy are well demonstrated in the literature (O'Neill et al., 2018). One emerging challenge is thus this decoupling of energy use and health. Especially in high income countries, well-being relies extensively on the (over)consumption of goods and services[1]. Consuming and traveling less, for example, could thus be seen as a loss of quality of life. Accompanying this transition and monitoring how a decrease in consumption is associated with health markers could be a new topic of research for health psychologists. To our opinion, preparing our societies towards more sufficiency would be both a mitigation measure (i.e., reducing our lifestyle carbon footprints) and, given the current geo-political context, also an adaptation strategy (i.e., as we are writing this chapter, at the autumn of the year 2022, the conflict in Ukraine poses serious threats to some European countries in regards of their energy supply, illustrating the fact that, within the current geo-political context, sufficiency should not only be seen as a democratically planned set of actions but also something that could be imposes by the context).

Designing mental health interventions relevant to climate change

From well-being to severe mental disorders, all mental health indicators are and will be severely worsened by climate change (Lawrance et al., 2021). The direct mental health consequences of climate change are related to extreme events, rising temperature, and air pollution. Exposure to climate-related events results in higher rates of mental disorders (Lawrance et al., 2021). Floods, droughts, and wildfires have been associated with higher risk of anxiety, stress, mood-related disorders. This is particularly concerning because negative psychological impacts from any form of natural disasters exceed physical injuries by a ratio of 40 to 1 (Lawrance et al., 2021). Heat waves exacerbate suicidal thoughts and suicide attempts rates in general population, and symptoms among people with pre-existing mental health disorders. It also increases demands and disruptions of mental healthcare services. Finally, short term exposure to air pollutants (e.g., fine particulate matter) has been associated with increased daily hospital admissions and emergency visits for mental disorders (Bernardini et al., 2020). Exposure to air pollution during childhood is associated with increased risk of developing psychotic and depressive disorders (Antonsen et al., 2020).

Indirect effects of climate change can also deteriorate mental health, such as rising eco-anxiety and forced migration due to environmental degradation (e.g., sea rising) or social disruptions (e.g., food supply). Uncertainty about the future and a growing communication about climate change related risks are major sources of eco-anxiety. Eco-anxiety has increased worldwide during the last decade. Authors of a 10-country study concluded that 45% of included adolescents had major worries about future climate change consequences for their daily life (Hickman et al., 2021). Medium to strong associations between eco-anxiety and

[1] Of note, sufficiency involves intentional reduction of consumption and should not be confound with poverty where a reduction in consumption occurs, therefore most of the efforts here in terms of sufficiency concern wealthy individuals (see Akenji et al., 2019).

depression and stress have been previously found (Heeren & Asmundson, 2022). In parallel, a moderate level of eco-anxiety has also been associated with a greater likelihood of adoption of pro-environmental behaviors such as meat consumption reduction, active travel or natural park visits (Heeren & Asmundson, 2022). Thus, young people or adults with a moderate eco-anxiety level could be more receptive to health behavior change interventions targeting environmental co-benefits.

With regards to forced migration, the permanently or temporary relocation of people due to progressive environmental changes negatively affect their mental health. Studies carried out in high vulnerability to climate change countries (e.g., Philippines) showed that forced migration is a highly stressful experience exacerbated by a lack of social support, and limited access to housing, healthcare and education. Forced migration consequences were an increased incidence of psychotic, phobic, and mood disorders, and reduced self-esteem (Kelman et al., 2021). The (in)direct effects of climate change on public mental health and disadvantaged groups are well identified (Berry et al., 2018). Climate change disproportionately impacts mental health of children and youth, women and girls, adults with pre-existing mental disorders, and Indigenous people. For instance, adults with psychotic disorders have a two- or three-times higher risk of death during heat waves that people without mental disorders (Berry et al., 2018). Health psychologists should construct action plans as a community-policy-research endeavor, and produce scalable tool boxes incorporating evidence-based psychological interventions for mental disorders prevention and treatment in contexts relevant to climate change (Bernard, 2019). Their mode of delivery should be adapted to stable and crisis situations as well as culturally tailored.

Conclusion: Living well and healthy in a drastically decarbonized world

Health psychology, as a community, has little time left to meaningfully contribute to climate change mitigation and adaptation. The principal risk for our community is to act too little and too late (Bernard & Chevance, 2023). On the mitigation side, the challenge is to keep or enhance well-being and health while reducing GHG emissions at all levels (i.e., individuals, health institutions and countries). On the adaptation side, we need to accelerate our efforts to help individuals and communities to cope and being resilient to a changing climate, with a focus on vulnerable populations in the short term. Actions need to be coordinated at all levels simultaneously without opposing individual behavior changes with more systemic changes and health psychologists should push to be involved in all types of initiatives (i.e., from designing individual behavior change interventions to refining national plans that could have an impact on behavioral and/or psychological outcomes).

As a summary, the different sections of this chapter invite health psychologists to:

- Focus on behaviors with high health and environmental co-benefits such as meat reduction, active transportation, and behaviors relative to reducing household energy consumption;
- Put health equity at the heart of any initiative, keeping in mind that, most of the time, adaptation efforts should target vulnerable groups and mitigation efforts should target wealthy individuals;
- Invest time and energy in experimental and quasi-experimental research, given the urgency of the situation and the fact that previous evidence is good enough to develop interventional initiatives over observational ones that could be redundant;
- Account for potential rebound effects that could override all the results of an intervention because secondary effects have not been well anticipated;

- Seek multi-disciplinary collaborations with experts in planetary health, climate sciences or environmental epidemiology to develop win-win collaborations and bring together our skills in these fields of research.

We hope that this chapter will help motivate health psychologists to critically think about climate change and maybe, for some of them, reorient a part of their activities to contribute more directly to climate change mitigation and adaptation.

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