HUMAN **TRANSILIENCE**
IN THE FACE OF ADVERSITIES

Embracing Global Challenges
as Stepping Stones,
rather than Stumbling Blocks

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Human Transilience in the Face of Adversities

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To each and every one of those who try to turn adversity into opportunity.

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1

General Introduction

1.1. INTRODUCTION

Our time is plagued by global crises. As humans living in the 21st century, we face a seemingly unending succession of challenges, which are not limited to a few isolated incidents: from natural disasters (e.g., Hurricane Katrina in 2005, earthquake in Haiti in 2010, earthquake in Turkey in 2023) and pandemics (e.g., the COVID-19 pandemic), to financial crises (e.g., the real estate market collapse in 2008) and political upheavals (e.g., the Arab Spring in 2010). Some of these events are likely to become more frequent and severe in the years to come. For example, scientists predict that natural hazards will increase due to global warming (IPCC, 2014a; 2022), and, partially because of this, there is a high threat of more pandemics in the future (Kretzschmar et al., 2022). The fact that we are vulnerable to large-scale crises, and we will remain so in the future, highlights the urgency of understanding how humans can adapt to such crises, namely how they can protect themselves and their communities whilst maintaining good mental health and quality of life.

While humanity has faced crises and risks throughout history, contemporary challenges are unprecedented in their scale, scope, and complexity (Lagadec, 2009; Lagadec & Topper, 2012). As an overarching feature, these large-scale crises are characterised by great uncertainty. First, the probability, magnitude, and geographic impact of natural disasters induced by climate change, as well as the timing and location of potential future pandemics, is highly uncertain. Second, many present-time crises are characterised by a lack of clear cause-and-effect relationships (e.g., the effect of global warming on specific weather patterns is ambiguous; Trenberth et al., 2015), and crises often are sudden and unexpected in nature, such as the outbreak of the COVID-19 pandemic. Third, contemporary crises have multiple environmental, social and economic causes and impacts, which makes them much harder to predict and manage. As such, the 21st century calls for a better understanding, not only of crisis and risk management (Lagadec & Topper, 2012), but also of how humans can adapt and maintain their well-being in the face of these unprecedented challenges.

Importantly, large-scale crises may have another, less obvious, consequence: they may serve as catalysts for positive change and growth. Historically, there is some evidence for this claim. For example, studies have shown that people were able to not only persist, but also flexibly adapt, and even thrive in the face of climate change in the past (Degroot et al., 2021). For instance, during the Late Antique Little Ice Age (sixth century AD) and the Little Ice Age (thirteenth to nineteenth century AD), humans adapted to climate change by introducing novel agriculture activities and water management strategies which allowed for economic expansion (Izdebski et al., 2016). Also, people shifted to new sources of energy, developed new trading methods, and

invented new practices and languages by migrating to different areas (Degroot et al., 2021). As another example, during the Black Death in Europe in the 14th century, the surviving population experienced significant social and economic beneficial changes that ultimately led to the end of the feudal system and the rise of the middle class (Herlihy, 1997). Additionally, medical advances were made during this time, such as the development of quarantine measures and the use of herbal remedies (Benedictow, 2004); such developments provided better awareness about preventive measures, valuable knowledge regarding disease prevention and treatment and a reduction in health risks. Thus, it seems that individuals and communities have been capable of adapting to large-scale crises in the past by doing more than 'bouncing back', namely doing more than merely maintaining and recovering what they had (cf. Bonanno et al., 2011; cf. Fletcher & Sarkar, 2013; cf. Galli & Vealey, 2008). Remarkably, they have been able to change for the better, by exploiting new opportunities and shifting to new, better ways of life.

We propose that humans can adapt also to contemporary large-scale adversities through positive change. Adapting to climate change, for instance, may help people to develop new skills, deepen their relationships with one another, and work together to build a more sustainable future (see IPCC, 2014a; 2023). As an example, citizens who implement green infrastructure solutions, such as rain gardens and green roofs, not only reduce their vulnerability to climate change, but may also seize opportunities for community engagement and for education on the importance of sustainability and environmental stewardship (Kim & Song, 2019; Parker & de Baro, 2019). In a similar way, pandemics, such as COVID-19, may help people gain more awareness about health and prevention, as well as introduce better daily habits and develop innovative ways to carry on their normal activities. For instance, when dealing with the COVID-19 pandemic, many people have started to prioritise their physical and mental health by incorporating healthy habits (e.g., regular exercise, meditation) into their daily routines (Ogueji, 2022). Additionally, people report several beneficial opportunities associated with working from home (which became much more common during the pandemic), such as reduced commuting time and its associated costs, increased flexibility, and even boosted productivity (Charalampous et al., 2018; Ipsen et al., 2021). As such, recognising the possibility for positive change is key to understand how humans can adapt to contemporary adversities.

Interestingly, most research studies on adaptation to contemporary adversities, like climate change, do not seem to recognise the possibility of new opportunities and positive change resulting from dealing with such adversities. This is remarkable, considering that positive change and new opportunities deriving from the confrontation with an adversity have received wide recognition in the domains of trauma and chronic

illnesses (Bostock et al., 2009; Carver & Antoni, 2004; Meyerson et al., 2011; Tomich & Helgeson, 2004), and that a prominent definition of climate change adaptation refers to *both* minimizing harm *and* finding new opportunities (IPCC, 2014b). Instead, the academic literature on climate change adaptation predominantly focuses on the negative consequences that climate change has for people and on possible ways to minimise them (Fritze et al., 2008; Manning & Clayton, 2018; Doherty, 2018). Similarly, the literature on adaptation to the COVID-19 pandemic typically focuses on how people showed resilience by maintaining and recovering a certain psychological equilibrium (i.e., "bouncing back"; Bozdag & Ergun, 2021; Chen & Bonanno, 2020; Luceño-Moreno et al., 2020; Riehm et al., 2021). Although it is clear that contemporary adversities present a significant threat, and that resilience is an important component of adaptation, focusing exclusively on minimising harm and maintaining the status quo constitutes a limited perspective on human adaptation to these large-scale challenges.

In this PhD dissertation, we introduce the novel construct of *transilience*, which we define as the perceived capacity to persist, adapt flexibly, and positively transform when confronted with an adversity. As such, transilience provides a broad perspective on human adaptation in the face of adversities that acknowledges the possibility for positive change, hence that is not merely about 'bouncing back' to what we had.

In this dissertation, we aim to address two key overarching research questions. First, do people perceive they can be transilient, and thus perceive they can persist, adapt flexibly, and positively transform in the face of large-scale adversities, in particular climate change and the COVID-19 pandemic? Second, to what extent does higher transilience promote engagement in adaptation actions and mental health in the face of such adversities? Across the chapters presented in this dissertation, we address more specific questions related to these overarching research questions. Below we elaborate on our conceptualization of transilience and the specific research questions we aim to address.

1.2 PERCEIVING TRANSILIENCE IN THE FACE OF CONTEMPORARY ADVERSITIES

We theorise that transilience comprises three components. Specifically, it reflects people's perceived capacity to persist (*persistence*), adapt flexibly (*adaptability*), and positively transform (*transformability*) in the face of an adversity.

The first component of transilience indicates the *perceived capacity to persist* in the face of an adversity, thus it reflects whether people perceive they have the resources to cope and carry on in the face of it. Persistence is at the core of resilience, commonly

understood as the capacity to 'bounce back' from stressful events (Bonanno, 2004; Fletcher & Sarkar, 2013; Galli & Vealey, 2008; Tugade & Fredrickson, 2004). Yet, as mentioned above, we highlight that adapting to contemporary adversities may be about, not only preserving the status quo, but also challenging it, for example by finding alternative and better ways to live. As such, we propose that the (perceived) capacity to adapt to contemporary adversities is about more than persistence alone.

The second component of transilience indicates the *perceived capacity to adapt flexibly* to an adversity, hence it reflects the extent to which people perceive a broad range of options to adapt to an adversity. Adaptability allows people to revise and switch between adaptation strategies when needed. This flexible approach may favour long-term adaptation to contemporary large-scale adversities, which likely require a variety of responses (Adger et al., 2009; Berrang-Ford et al., 2021; Cinner et al., 2018; Coccia, 2021; Reser & Swim., 2011; Vij et al., 2017, Yan et al., 2020). Adaptability differs from people's perception of their ability to engage in certain adaptive behaviours (i.e., self-efficacy; Bandura, 1998; Rogers & Prentice-Dunn, 1997; Van Valkengoed & Steg, 2019b), as it reflects whether people perceive they have multiple options to adapt, rather than whether they think they can adapt at all.

The third component of transilience indicates *the perceived capacity to positively transform* by adapting to contemporary adversities, hence it reflects the extent to which people perceive they can positively evolve by dealing with such adversities, for instance by learning something new. To the best of our knowledge, transformability is typically not examined in studies aiming to understand adaptive responses to contemporary challenges. Yet, as mentioned above, historical evidence and studies in other domains suggest that experiencing adversity can have beneficial effects. For example, people indicate that their lives have positively changed by dealing with health problems and trauma (Carver & Antoni, 2004; Helgeson et al., 2006), and dealing with severe childhood adversity can enable the development of unique strengths (Ellis et al., 2017; Jay, 2018). Thus, it seems plausible that contemporary adversities may also have beneficial effects, such as an increase in innovation and creativity (Fritze et al., 2008; Doherty, 2018; Degroot et al., 2021; IPCC, 2023). Transformability differs from the extent to which people think adaptation actions are effective in reducing their vulnerability to the risks (i.e. outcome efficacy; Bandura, 1998; Rogers & Prentice-Dunn, 1997; van Valkengoed & Steg, 2019b), as transformability reflects whether people perceive the possibility for positive and transformative outcomes deriving from dealing with contemporary adversities.

In sum, higher transilience means that people more strongly perceive they can persist in the face of a certain adversity, can have a broad range of options to deal

with the adversity, and can change for the better by adapting to the adversity. This dissertation sets out, first, to develop and validate a reliable instrument to measure transilience (Chapter 2), which is needed to establish whether people perceive they can be transilient in the face of contemporary adversities (and to test whether higher transilience promotes adaptation actions and mental health). The transilience scale should capture well the three theorised components, yet it should also reflect that transilience is an overarching construct. We aim to test the validity of this transilience scale by examining whether transilience is positively related to existing constructs that are theoretically related (i.e., self-efficacy, outcome efficacy and resilience), while, at the same time, it does not overlap with these constructs. We also aim to establish that transilience does not imply that people deny or downplay the risks posed by contemporary adversities, as people would hardly see the need to adapt without acknowledging the adversity (see Van Valkengoed & Steg, 2019b). As elaborated upon below, in this dissertation we aim to examine whether people perceive transilience across different adversities and contexts, and whether they perceive they can be transilient as individuals as well as communities.

Do People Perceive Transilience across Different Adversities and Socio-Political Contexts?

While contemporary adversities share some common features (e.g., uncertainty), they are remarkably different. Pandemics, like COVID-19, can represent an immediate and direct threat to individual survival, whereas climate change consequences tend to be more gradual and cumulative (Poortinga et al., 2022; IPCC, 2014a). Additionally, the effects of a pandemic on personal health can be visible within days or weeks, while the severity of climate change risks may take longer periods to manifest, especially in Western countries (IPCC, 2014c). Besides, the type, impact and severity of the threat associated with contemporary adversities likely varies between different areas and countries. For instance, risks associated with climate change vary considerably across regions: in the United States, North-Eastern regions face increased rainfall and sea-level rise, whereas regions located in the in coastal South-West face risks of droughts and wildfires (Clayton et al., 2016); similarly, the severity of the impacts of the COVID-19 pandemic varied greatly across countries and regions, depending on factors such as the capacity of the healthcare system, the level of preparedness, and the effectiveness of measures taken to contain the virus. In Italy and Spain, for instance, the pandemic caused high infection and mortality rates, overwhelming healthcare systems and leading to shortages of equipment and staff, which worsened public panic (Amaro, 2020; Horowitz, 2020). In contrast, countries like Germany and The Netherlands had lower infection and mortality rates due to a stronger healthcare systems and early containment measures (Hoekman et al., 2020; Spahn, 2020). Therefore, we aim to examine whether people perceive transilience across different adversities (i.e., climate

change risks in Chapters 2 & 4 and the COVID-19 pandemic in Chapter 3), as well as across different contexts and regions in which the types and severity of the specific threat posed by such large scale adversities varies.

Do People Perceive they can be Transilient also at the Collective Level?

Contemporary adversities, such as climate change, have significant and far-reaching impacts on communities, not just individuals. For instance, extreme weather events like floods and hurricanes can destroy entire neighbourhoods, displace residents, and disrupt local economies (IPCC, 2022). Adapting to present-day adversities may thus also require collective adaptation at the community level, in addition to individual adaptation efforts. For example, people may need to help others, share knowledge or join forces in order to address the threat posed by contemporary adversities, as individuals alone are likely unable to fully address such large-scale challenges (Chen, 2015; Van Zomeren & Iyer, 2009, 2010). Hence, the question is to what extent people perceive transilience, not only at the individual level, but also at the community level. In this dissertation, we therefore aim to develop and validate a collective transilience scale to capture whether people perceive they, as a community, can persist, adapt flexibly, and positively transform in the face of an adversity (and whether such higher collective transilience promotes adaptation actions). We will examine the relevance of collective transilience specifically in the context of climate change (Chapter 4).

1.3. TRANSILIENCE, ADAPTATION ACTIONS AND MENTAL HEALTH

In this dissertation we next aim to study to what extent transilience is associated with different types of adaptation actions, and with better mental health. We therefore aim to examine the relationship between transilience and a broad spectrum of adaptation intentions and behaviours, as well as different indicators of mental health.

To what extent does Transilience Predict Adaptation Actions?

Transilience and Individual Adaptation

Individual adaptation actions comprise a variety of actions that aim to protect the individual and their household from the risks posed by contemporary adversities, as well as showing support for policies aiming to foster adaptation (Van Valkengoed & Steg, 2019b; e.g. García de Jalón et al., 2013). Such adaptation actions can be *incremental*, which means they typically aim to preserve the status quo. For example, people can buy insurance or install wind shutters to adapt to climate change risks (Valkengoed & Steg, 2019a, 2019b). Similarly, people can keep 1.5m distance and wash their hands regularly to limit the spread of a virus during a pandemic (Perra, 2021). Individual adaptation actions can also be *transformative*, which means they

aim to challenge the status quo by doing things in a different way than before and by seeking new beneficial opportunities. For example, people can shift their diet to incorporate foods that are better suited for the changing climate in the local area, or set up a relocation plan to adapt to climate change risks. Similarly, people can decide to shift their lifestyle to establish different priorities (e.g., exercise, mental health, time spent with family) in response to a pandemic like COVID-19 (Ogueji, 2022).

In this dissertation, we aim examine to what extent higher transilience increases the likelihood that people (intend to) engage in a wide range of individual adaptation actions. We test this proposition both in the context of climate change (Chapter 2) and in the context of the COVID-19 pandemic (Chapter 3). Notably, in doing so we examine whether transilience can be a 'general antecedent' of adaptation actions (cf. van Valkengoed, 2022), namely a relevant predictor of different types of adaptation behaviours, in the face of different risks and across different contexts.

Transilience and Community-Based Adaptation

While the importance of studying climate change adaptation at the community level has been acknowledged (McNamara & Buggy, 2017), research has predominantly focused on behaviours at the level of individuals and their households (van Valkengoed & Steg, 2019a, 2019b). In this regard, little is known about what motivates people to engage in community-based adaptation actions, namely actions that help their community as a whole adapt to climate change risks. Like individual adaptation behaviours, these behaviours can be incremental (e.g. buying sandbags together with others to protect the local area from floods) or transformative (e.g., joining a community initiative to reshape the local neighbourhood by replacing concrete with trees and bushes, to protect the community against heatwaves and floods). Therefore, in this dissertation we aim to test whether community-based adaptation, which implies that people act within and in the interest of their community, is more likely to happen when people perceive higher transilience. Importantly, we assume that perceiving transilience at the individual level may not be enough to increase the likelihood that people engage in behaviours to protect their community from climate change risks. Instead, we propose that particularly collective transilience is likely to promote community-based adaptation, as this last comprises more than the individual interests and efforts. Our proposal, besides building on existing literature on what motivates action at the community level (e.g., Thaker et al., 2016), is in line with the compatibility principle (Ajzen, 2020), which states that constructs are more strongly related when they are assessed at the same level of specificity. Again, we examine whether higher collective transilience is related to different types of community-based adaptation across different contexts, thus examining whether collective transilience can also be a 'general antecedent' of community-based adaptation (cf. van Valkengoed, 2022).

To what extent does Transilience Enhance Mental Health?

Contemporary adversities, such as climate change and the COVID-19 pandemic, can undeniably have serious negative impacts on individuals' mental and physical health (Fritze et al., 2008; Manning & Clayton, 2018; Pfefferbaum & North, 2020). However, transilience offers a positive perspective on human adaptation to these adversities, as it reflects individuals' perception of their capacity to carry on, to find multiple options to adapt, and to change for the better by adapting to a certain adversity. Consequently, it seems plausible that transilience may help people to maintain good mental health, even in the face of large-scale contemporary adversities.

Research has shown that psychological resilience is typically associated with higher levels of subjective well-being, and with better mental health in different domains (Hu et al., 2015), including the COVID-19 pandemic (Kavčič et al., 2021; Huffman et al., 2021). In this dissertation, we aim to expand upon these studies by examining whether transilience, which captures more than resilience alone, increases the likelihood that people show good mental health in the face of threats with varying levels of severity, including different adversities and contexts. Specifically, we test whether higher transilience is related to displaying higher levels of general subjective well-being and a higher degree of personal positive change (e.g., learning to better handle difficulties) due to the confrontation with an adversity. We study this both in the domain of climate change risks (Chapter 2) and in the domain of the COVID-19 pandemic (Chapter 3).

1.4 OVERVIEW OF CHAPTERS

In sum, in this PhD dissertation we aim to empirically test whether people perceive they can be transilient in the face of contemporary large-scale adversities, both as individuals and as a community. Furthermore, we want to assess the extent to which higher transilience can promote a wide range of adaptive responses, including individual and community-based adaptation actions. Next, we want to test whether higher transilience is related to higher subjective well-being and positive personal change, as indicators of good mental health and quality of life. We test our rationale across three empirical chapters.

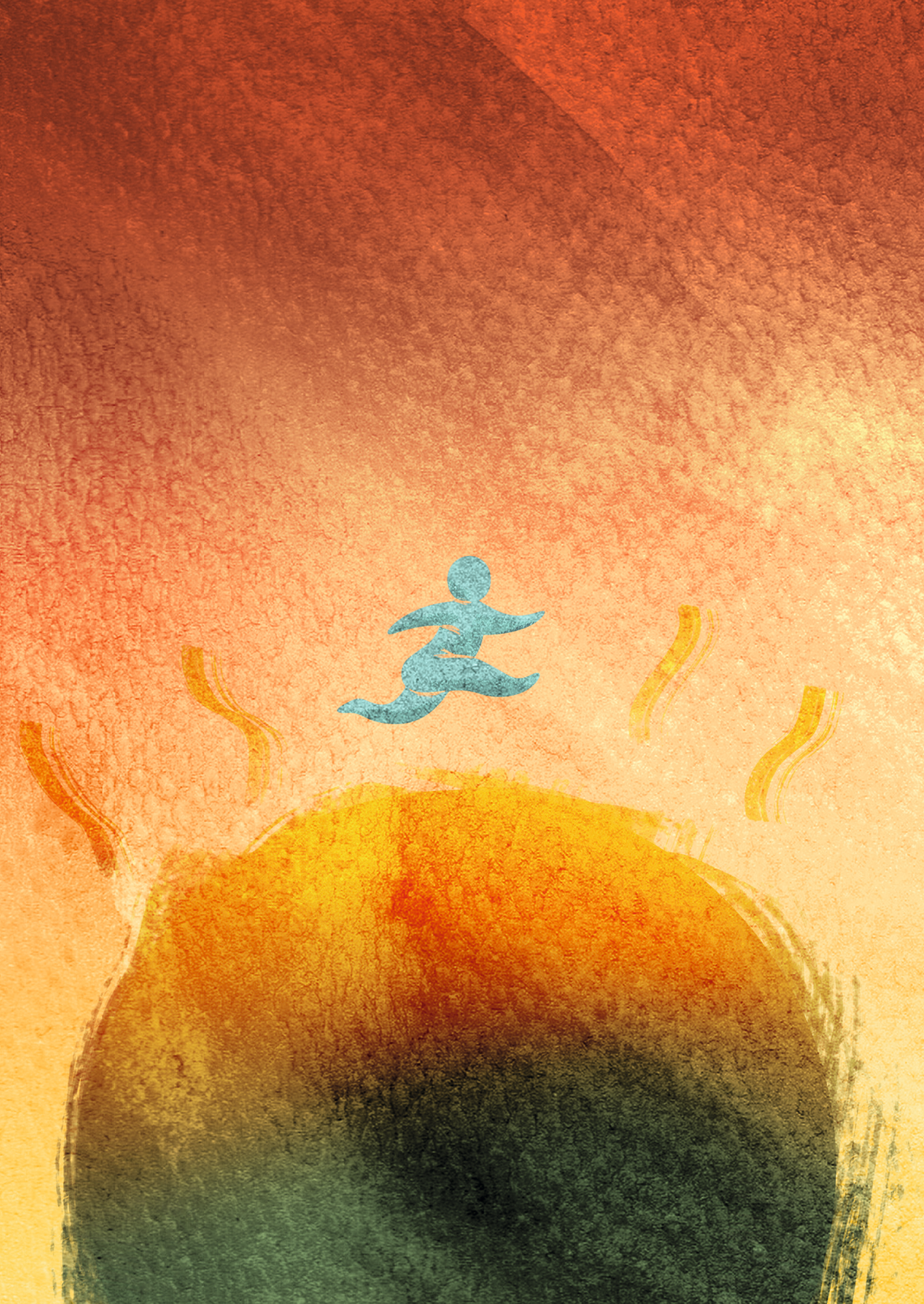
In Chapter 2, we develop and validate a scale to measure individual transilience in the face of climate change. Across four empirical studies conducted in three different countries (US, The Netherlands, UK), we assess the content, concurrent, discriminant, incremental and predictive validity of the climate change transilience scale. In doing so, we aim to verify that transilience is positively related, yet does not overlap with existing related constructs, namely self-efficacy, outcome efficacy and resilience. We also aim to verify that transilience does not imply that people perceive the risks of climate change

to a lesser extent. We examine whether people, on average, perceive they can be transilient in the face of climate change risks, across different countries. Furthermore, we examine to what extent climate change transilience is positively associated with different types of adaptation actions, such as individual adaptation intentions and behaviours (both incremental and transformative), collective adaptation intentions and behaviours, support for adaptation policies (both incremental and transformative) and political collective action. Next, we examine the extent to which higher transilience is associated with higher subjective well-being and positive change derived from the confrontation with climate change risks.

In Chapter 3, we aim to replicate the findings of Chapter 2 in the context of a different adversity, namely the COVID-19 pandemic. We aim to examine whether individuals perceive transilience in the face of the pandemic, reflecting a more urgent and acute threat compared to climate change. Notably, we aim to investigate the extent to which transilience is perceived across contexts in which the severity of the pandemic differed substantially, and in which different measures were implemented by national governments in response to it. Thus, we test our rationale across two studies conducted in different countries (i.e., Italy and The Netherlands); we also employ a longitudinal design in the study in The Netherlands to examine perceived transilience across different time points, in which the severity of the local threat varied. We aim to investigate the relationship between transilience and various adaptive responses to the pandemic, namely individual and collective adaptation behaviours and positive coping, as well as subjective well-being and positive personal change. We hypothesise that higher transilience increases the likelihood of adaptive actions and enhances both well-being and positive personal change, regardless of differences in mean scores on transilience, adaptation behaviours, and well-being across countries and time points. Additionally, in the longitudinal study we test whether the relationship between transilience and relevant outcomes is similar across time points. Next, to gain insight into whether transilience is causally related to adaptation behaviours and well-being, we examine whether transilience at a given time can predict behaviours and well-being at a later stage in time.

In Chapter 4, we examine whether transilience can be perceived also at the collective level, and whether higher collective transilience promotes community-based adaptation behaviours in the face of climate change risks. We test our rationale across two studies conducted in the US and also in the Netherlands, where we focus on a Dutch local community initiative for climate change adaptation. First, based on the individual transilience scale, we adapt and validate the collective transilience scale to capture whether people perceive that they can persist, adapt flexibly and positively transform in the face of climate change *as a community.* We hypothesise that people

perceive that they can be transilient as a community, and that collective transilience can be empirically distinguished from individual transilience. We also aim to examine to what extent people engage in community-based adaptation behaviours. Next, we test whether higher collective transilience increases the likelihood of different examples of community-based adaptation actions. We also test whether collective transilience is more strongly related to community-based adaptation intentions, whereas individual transilience is more strongly related to individual adaptation intentions. Further, we examine whether collective transilience is uniquely related to community-based adaptation actions when individual transilience is controlled for.



2

Individual Transilience in the face of Climate Change

ABSTRACT

Climate change is negatively affecting people's health, safety, and well-being. Therefore, it is crucial to understand whether people perceive they have the capacity to adapt to climate change. Most studies on whether people can adapt to climate change focus on preventing negative outcomes and the ability to 'bounce back'. We propose that adaptation may have positive consequences too. We introduce the construct of transilience to capture people's perceived capacity to persist, adapt flexibly, and positively transform in the face of climate change risks. We developed a scale to assess transilience in the context of climate change risks and conducted four empirical studies to validate it. Overall, the findings support the content, concurrent, discriminant and predictive validity of the transilience scale. People generally perceive they can be transilient in the face of climate change risks, and higher transilience is, as expected, positively related to climate change adaptation actions and general well-being. Our findings indicate that people perceive adapting to climate change can not only minimize harm, but also provide beneficial opportunities. Theoretical implications and future directions are discussed.

Chapter 2 is based on:
Lozano Nasi, V., Jans, L., & Steg, L. (2023). Can we do more than "bounce back"? Transilience in the face of climate change risks. *Journal of Environmental Psychology*, *86*. https://doi.org/10.1016/j.jenvp.2022.101947

2.1. INTRODUCTION

Climate change is causing various risks, including extreme weather events (e.g., flooding, bush fires) and increasing temperatures, that have detrimental material, physical, and psychological consequences (IPCC, 2018; Sauerborn & Ebi, 2012; Schneider et al., 2007; Solomon et al., 2008), and affect people's health, safety, and well-being (Clayton et al., 2015; Doherty, 2018; Fritze et al., 2008; Manning & Clayton, 2018). It is essential that people adapt to climate change, which is defined as 'moderate or avoid harm or exploit beneficial opportunities' (IPCC 2014b). Climate adaptation is not only a responsibility of governments, as people themselves can and need to take action to protect themselves from climate change risks too (van Valkengoed & Steg, 2019a). It is, thus, key to understand whether people perceive they can adapt to climate change.

In the past, humans have been able to successfully adapt to climate change. Studies have shown that people were able to not only persist, but also flexibly adapt and thrive in the face of past climate change (Degroot et al., 2021). For example, during the Late Antique Little Ice Age (sixth century AD) and the Little Ice Age (thirteenth to nineteenth century AD), humans adapted to climate change by introducing novel agriculture activities and water management strategies which allowed for economic expansion (Izdebski et al., 2016); they also shifted to new sources of energy, developed new trading methods, and developed new practices and languages by migrating to different areas (Degroot et al., 2021). These findings suggest that humans have not only been able to 'bounce back' in the face of climate change by recovering and maintaining what they had, which is commonly referred to as resilience (Bonanno, 2004). Instead, they have been able to change for the better, by exploiting new opportunities and shifting to new, beneficial ways of life. The question remains whether positive change is also possible in the face of contemporary climate change, and whether people perceive they have the capacity to adapt to climate change, not only by preventing harm, but also by changing for the better. The next question is whether such perceived adaptive capacity promotes adaptation behaviours, support for adaptation policies, and general well-being. We address these questions in the present paper by introducing a novel construct: transilience.

Transilience

The construct of *transilience* captures people's perceived capacity to adapt to climate change risks. Drawing on historical analyses (Degroot et al., 2021) and the resilience literature (Davoudi et al., 2013, Folke et al., 2010), we theorise that transilience comprises three components: people's perceived capacity to persist (persistence),

adapt flexibly (adaptability), and positively transform (transformability) in the face of climate change risks.

The first component of transilience indicates the *perceived capacity to persist in the face of climate change risks*, that is, whether people perceive they have the resources to cope and carry on in the face of climate change risks. Persistence is at the core of resilience, commonly understood as the capacity to 'bounce back' from stressful events (Bonanno, 2004; Fletcher & Sarkar, 2013; Galli & Vealey, 2008; Tugade & Fredrickson, 2004). Yet, climate change adaptation may not only require preserving the status quo, but also challenging it, e.g., finding alternative ways and exploiting new opportunities (Adams, 2021; cf. Davoudi et al., 2013; Pelling, 2011). As such, we propose that the capacity to adapt to climate change is about more than persistence alone.

The second component of transilience reflects *the perceived capacity to adapt flexibly to climate change risks*, that is, the extent to which people perceive a *broad* range of options to adapt to climate change risks. Adaptability allows people to respond *flexibly* to climate change by revising and switching between adaptation strategies when needed. Such a flexible approach may be important for long-term adaptation to climate change, which likely requires a variety of responses (Barnes et al., 2020; Cinner et al. 2018; Linquiti & Vonortas, 2012). Adaptability differs from people's perception of their own ability to engage in protective adaptive behaviours (i.e., self-efficacy; van Valkengoed & Steg, 2019b), as it specifically reflects whether people perceive they have *multiple* options to adapt, rather than whether they think they can adapt at all.

The third component of transilience is the *perceived capacity to positively transform by adapting to climate change risks*, that is, whether people perceive they can positively evolve by dealing with climate change, for instance by learning something new. Although transformability is reflected in prominent definitions of climate change adaptation, which refer to 'finding beneficial opportunities' (IPCC, 2014b), to the best of our knowledge, this aspect is not examined in studies aiming to understand individual adaptive responses to contemporary climate change (see Reser & Swim, 2011). However, other domains do suggest that experiencing stress and adversity can have beneficial effects. For example, people indicate that their lives have positively changed by dealing with health problems and trauma (Carver & Antoni, 2004; Helgeson et al., 2006), and dealing with severe childhood adversity can enable the development of unique strengths (Ellis et al., 2017; Jay, 2018). Climate-related hazards could also have beneficial effects, such as an increase in innovation and creativity (Fritze et al., 2008; Doherty, 2018; Degroot et al., 2021). Indeed, there is initial evidence that indigenous communities have developed better technologies and practices in response to environmental changes (Ford et al., 2020). Transformability differs from

outcome efficacy (i.e., the extent to which people think adaptation actions are effective in reducing climate change risks; van Valkengoed & Steg, 2019b), as transformability reflects whether people perceive the possibility for *positive* and *transformative* outcomes deriving from dealing with climate change.

In sum, in the context of climate change, higher transilience means that people more strongly perceive they can persist in the face of climate change risks, can have a broad range of options to deal with these risks, and can positively change by adapting to these risks.

The Present Research

We aim to study to what extent people perceive transilience in the face of climate change risks, and whether higher transilience indeed predicts adaptation behaviours, support for adaptation policies, and general well-being. To understand the value of the construct of transilience in the context of climate change adaptation, we need to measure it. Hence, we aim to develop and validate a scale to assess transilience in the context of climate change, based on our theoretical framework. First, we generated a pool of items that reflect persistence, adaptability, and transformability. Next, these items were evaluated by experts in terms of relevance and clarity, and adapted accordingly, when needed. Thereafter, we conducted four online studies to assess the content, concurrent, discriminant, and predictive validity of the transilience scale. All studies were approved by the Ethical Committee of the University of Groningen.

We tested *content* validity by examining whether the items capture the three components of transilience. In addition, we tested whether the transilience scale indeed assesses a *single* construct, as we propose transilience comprises all three components.

We tested *concurrent* and *discriminant* validity by examining the correlation between transilience and theoretically related constructs (Boateng et al., 2018). First, as indicated above, we expect higher transilience to be positively related to self- and outcome efficacy for climate change adaptation. Furthermore, we expect that transilience is positively related to general psychological resilience (i.e., the general capacity to bounce back in life in general; Smith et al., 2008, 2010), as we draw on it for the persistence component. Yet, as we propose that transilience is different from self-efficacy, outcome efficacy, and general resilience, we expect that the relationship with these constructs is not too strong (i.e., correlations should be below the cut-off for construct overlap of around $r = .85$; Kenny, 2016). Moreover, we expect higher transilience to be related to more positive affect about climate change (e.g., optimism), as people acknowledge many ways to adapt, as well as potential beneficial

opportunities. At the same time, we do not assume higher transilience implies that people perceive less the risks posed by climate change or are less worried about climate change, as perceiving climate change as an adversity is key for engaging in adaptive action (Van Valkengoed & Steg, 2019a).

We tested *predictive validity* by examining whether transilience is positively related to relevant outcome variables in the context of climate change adaptation (Boateng et al., 2018), namely more adaptation behaviours (van Valkengoed & Steg, 2019a, 2019b) and stronger support for adaptation policies (Dietz et al., 2009; García de Jalón et al., 2013). Furthermore, we assessed whether higher transilience is associated with higher general well-being. Finally, we explore *incremental* validity by examining whether transilience still relates to relevant outcome variables when controlling for other indicators of adaptive capacity, i.e., self-efficacy, outcome efficacy, and resilience, respectively.

Items Generation and Selection

Based on our definitions, we compiled items to measure persistence, adaptability and transformability, by selecting and adapting items from existing measures (Carver et al., 1989; Connor & Davidson, 2003; Martin & Rubin, 1995; Watson & Homewood, 2008). We also developed new items to ensure sufficient items for each component. The initial pool consisted of 24 items (8 items per component; see Appendix A).

We invited 18 experts in climate change adaptation and/or resilience to evaluate our items. Those who agreed (n = 11) were provided with our definitions of transilience and the three components. Experts rated each item in terms of *relevance* for the component and general *quality* (e.g., clarity) on a scale from 1 = *terrible* to 5 = *excellent*. They could also comment on each item. Based on the experts' judgement we improved some phrasings and selected six items per component for the initial transilience scale (Table 2.1).

Table 2.1. Items Included in Study 1 Based on Expert's Evaluation

	Persistence
1.	I can handle unpleasant feelings caused by climate change risks.
2.	I can persist when faced with climate change risks.
3.	I can be brave in the face of climate change risks.
4.	I will not give up when faced with climate change risks.
5.	Climate change risks discourage me. (R)
6.	I feel paralyzed in the face of climate change risks. (R)
	Adaptability
1.	I think I can take different actions to deal with climate change risks.
2.	I think I have several options to deal with climate change risks.
3.	I believe I can find multiple means to deal with climate change risks.
4.	There are different ways in which I can cope with climate change risks.
5.	I think there are no effective ways to deal with climate change risks. (R)
6.	I think I have very limited options to deal with climate change risks. (R)
	Transformability
1.	Coping with the stress caused by climate change risks can strengthen me.
2.	There can be additional advantages for me in dealing with climate change risks.
3.	I can find new opportunities by adjusting to climate change risks.
4.	Dealing with climate change risks can make me grow as a person.
5.	I can learn something good from dealing with climate change risks.
6.	Dealing with climate change risks can only make my life worse. (R)

Note. (R) = reverse coded item.

2.2. STUDY 1

In Study 1, we aimed to test the validity of the transilience scale in a sample from the United States population. This study was part of a larger study on climate change adaptation which also aimed to validate a climate change perceptions scale (see van Valkengoed et al., 2021).[1] To test concurrent and discriminant validity, we assessed how transilience relates to climate change risk perception, negative affect about climate change, self-efficacy, and outcome efficacy. Predictive validity was tested by examining relationships between transilience and adaptation behaviours, as well as support for adaptation policies. Incremental validity was examined by running the same analyses while controlling for self- and outcome efficacy, respectively.

1 Apart from the transilience scale, self- and outcome efficacy, the other measures reported here were also used in van Valkengoed et al. (2021). Full list of items can be found in Appendix B.

Method

Participants and Procedure

We aimed for around 10 participants per scale item (i.e., around 180 participants; Boateng et al., 2018). A random sample of 194 participants was recruited via Amazon MTurk.[2] After data inspection and cleaning,[3] 178 responses (46% male; M_{age} = 39; SD_{age} = 12.5) were retained (see more demographics in Supplementary Material). After agreeing to participate, participants were directed to the survey in Qualtrics, where they could fill in the questionnaire and be compensated $1.20 for participation.

Measures

All measures were assessed on a seven-point Likert-scale, from 1 = *strongly disagree* to 7 = *strongly agree*, unless otherwise specified (see all items in Appendix B). In the case of reverse-coded items, scores were recoded so that a higher score reflected stronger endorsement of the construct. For all scales, we computed mean scores. The questionnaire started with the climate change reality items and ended with the climate change transilience scale (the transilience items were presented in randomized order). The other measures were presented in a randomized order. See Table 2.4 for descriptives and reliability indicators.

Climate Change Reality. Three items assessed the extent to which people believe in climate change (e.g., 'I believe climate change is real'; van Valkengoed et al., 2021). We excluded responses from participants who do not believe in climate change. We believe the transilience scale does not make sense when people do not believe climate change is real. Climate deniers would likely not agree with the transilience items. Furthermore, for climate change deniers variations in responses on transilience items (e.g. scoring a 1 = *strongly disagree* vs a 4 = *neither agree nor disagree*) likely do not reflect variations in perceived adaptive capacity, as responses are rooted in a disbelief in climate change. Thus, we used the reality items only for data cleaning purposes.

Negative Affect about Climate Change. Participants indicated the extent to which they feel negative affect about climate change (three items, e.g., 'I worry about climate change').

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2 Participants were randomly allocated to the present study or another study assessing whether people perceive they can adapt to climate change collectively, that is, as a community. As the second study did not include any item on individual transilience, we do not discuss it here.

3 From the initial sample we removed 16 participants (8.2%) based on the following criteria. First, duplicated IP addresses were removed (n = 2). Second, participants who consistently scored above or below the midpoint of the scale for the reality of climate change items (i.e., only '5', '6' or '7' or only '1', '2', '3') were removed (n = 11), as these items were mutually exclusive (Meade & Craig, 2012; e.g. 'I believe that climate change is real' and 'I do NOT believe that climate change is real'). Third, one participant was removed because they did not believe in the reality of climate change. Finally, we removed participants who completed the survey within 3 minutes (n = 2), as it seems unrealistic to accurately fill in the questionnaire this time (median completion time = 9.1 minutes).

Climate Change Risk Perception. Participants indicated the extent to which they perceive climate change poses risks to various relevant entities (four items, e.g., themselves and their family).

Self-efficacy to Engage in Adaptation Actions. Participants indicated their perceived ability to engage in actions aimed to protect themselves from climate-change risks (two items, e.g., 'I feel capable of taking actions aimed to protect myself and close others against the negative impacts of climate change').

Outcome Efficacy of Adaptation Actions. Participants indicated to what extent they think their actions can be effective in protecting themselves from climate change risks (two items, e.g., 'My personal actions can be effective in protecting myself and close others from the negative impacts of climate change').

Climate Change Adaptation Intentions and Behaviours. Participants were asked whether they have engaged or intend to engage in nine adaptive behaviours that can help to protect them from climate-related risks (e.g., 'Looking up information about whether my house is at risk of natural hazards'), on a 3-point ordinal scale (0 = *No*, 1 = *No, but I am planning to do this* and 2 = *Yes*). We calculated scores on adaptation behaviour by counting, for each participant, the number of behaviours for which '2' was selected. Next, we calculated a score on intention (to engage in those behaviours that were not implemented already) by averaging the 9 items into one scale, after converting the value '2' to missing.

Support for Climate Change Adaptation Policies. Participants indicated to what extent they support five adaptation policies, e.g., 'Investing public money to make vital infrastructure (for example, energy utilities, power lines, cell towers) more resistant to climate change risks'. Items were rated on a scale from 1 = *strongly oppose* to 7 = *strongly support*.

Results

Content Validity

We ran the same analyses in all the studies reported in this paper. First, we tested content validity by verifying that the items developed for the transilience scale adequately capture the three components of transilience via the oblique multiple group method (MGM, performed with a designated macro for SPSS - version 25; Stuive et al., 2008). The MGM is an established type of confirmatory factor analysis that investigates whether items correlate highest with their expected component (controlling for self-correlation). Most items correlated more strongly and positively with their expected component (see Table 2.2), indicating that the transilience scale captured the three

theory-based components of transilience reasonably well. However, for each component, a reverse-coded item correlated more strongly with a component they were not assigned to (see Table 2.2). Therefore, we removed these three items from the scale before calculating mean scores. Furthermore, correlations were relatively lower for the persistence component, compared to the other two components, suggesting that the persistence items had lower quality.

Next, we tested whether a three-factor model fits the data better than a unidimensional model, using the package *lavaan* in R for SEM. As expected, the three-factor model fitted the data significantly better than a unidimensional model, $\chi 2\ (3) = 29.3$, $p < .001$ (see model fit indices in Supplementary Material), indicating that transilience consists of three distinct components.

We further examined content validity by testing whether the transilience scale, though comprising of three components, indeed assesses a *single* construct. For this, we used two indicators: the Haberman method (Haberman, 2008; Reise et al., 2013), and omega hierarchical (ω_h; Revelle, n.d.). The Haberman method is considered a minimal test to establish whether sub-scores in a multidimensional scale have any psychometric justification (Reise et al., 2013). In multidimensional scales with inter-correlated components (as we assume is the case for transilience), the aggregated total score (i.e., transilience) is often a better estimate of the true score on a component (e.g., persistence) than the observed score on the component; in this case, the latter provides no added value to the total score and is therefore recommended neither to report nor interpret it (see Reise et al., 2013 for elaboration). The Haberman method compares the proportional reduction in mean squared error based on total scores ($PRMSE_T$) and subscale scores ($PRMSE_S$). When $PRMSE_T > PRMSE_S$, the score on a component adds little value to the aggregated total score (Reise et al., 2013). Using the package *subscore* in R (version 4.0.2), we found that $PRMSE_T > PRMSE_S$ for all transilience components (see Table 2.3), suggesting that the total transilience score is what should be reported and interpreted. Omega hierarchical reflects the proportion of variance in a multidimensional instrument that can be attributed to a common factor (Revelle, n.d.). Using the *psych* package in R (Revelle, 2022), we found $\omega_h = .67$, thus 67% of the variance in the transilience scale can be attributed to a common factor.[4] The reliability of the resulting overall transilience scale (15 items) was good (see Table 2.4). The mean score on the transilience scale was well above the mid-point scale (see Table 2.4), indicating that, on average, people perceive they can be transilient in the face of climate change risks.

4 Although there are no official guidelines on the interpretation of omega hierarchical, according to Revelle (n.d., p. 228-230) a value of $\omega_h = .48$ indicates a large general factor and small group factors. Hence, $\omega_h = .67$ indicates that the scale mostly reflects a single, general factor.

Table 2.2. Results of the Oblique Multiple Group Method (MGM) in Study 1

	Persistence	Adaptability	Transformability
Persistence			
1. I can handle unpleasant feelings caused by climate change risks.	**.360**	.270	.225
2. I can persist when faced with climate change risks.	**.364**	.345	.342
3. I can be brave in the face of climate change risks.	**.437**	.373	.300
4. I will not give up when faced with climate change risks.	**.387**	.386	.223
5. ~~Climate change risks discourage me.~~ (R)[a]	.316	**.318**	.223
6. I feel paralyzed in the face of climate change risks. (R)	**.352**	.301	.135
Adaptability			
1. I think I can take different actions to deal with climate change risks.	.368	**.449**	.371
2. I think I have several options to deal with climate change risks.	.336	**.418**	.329
3. I believe I can find multiple means to deal with climate change risks.	.371	**.465**	.409
4. There are different ways in which I can cope with climate change risks.	.276	**.376**	.363
5. ~~I think there are no effective ways to deal with climate change risks.~~ (R)[a]	**.320**	.266	.190
6. I think I have very limited options to deal with climate change risks. (R)	.321	**.357**	.273
Transformability			
1. Coping with the stress caused by climate change risks can strengthen me.	.228	.329	**.447**
2. There can be additional advantages for me in dealing with climate change risks.	.131	.248	**.449**
3. I can find new opportunities by adjusting to climate change risks.	.268	.348	**.361**
4. Dealing with climate change risks can make me grow as a person.	.220	.341	**.498**
5. I can learn something good from dealing with climate change risks.	.284	.373	**.457**
6. ~~Dealing with climate change risks can only make my life worse.~~ (R)[a]	**.318**	.298	.213

Note. Coefficients in bold represent the highest overall item-total correlations. (R) = reverse coded item.

[a] Item removed from the transilience scale before calculating scale scores.

Table 2.3. Results of the Haberman Procedure across all Studies

	Study 1		Study 2		Study 3		Study 4	
	$PRMS_S$	$PRMS_T$	$PRMS_S$	$PRMS_T$	$PRMS_S$	$PRMS_T$	$PRMS_S$	$PRMS_T$
Persistence	0.740	0.781	0.877	0.878	0.805	0.842	0.817	0.842
Adaptability	0.791	0.859	0.851	0.855	0.832	0.872	0.861	0.881
Transformability	0.835	0.850	0.785	0.793	0.823	0.841	0.800	0.825

Note. $PRMS_T$ = proportional reduction in mean squared error based on total score
$PRMS_S$ = proportional reduction in mean squared error based on subscale score

Concurrent and Discriminant Validity

We examined concurrent and discriminant validity of the transilience scale by computing bivariate correlations with relevant variables, using the custom function *corstars* in R (Bertolt, 2008). Higher transilience was associated with higher perceptions of climate change risks and higher negative affect about climate change, with a medium effect (i.e., above .24; Lovakov & Agadullina, 2021), indicating that, as expected, higher transilience does *not* imply perceiving climate change as *less* problematic. Interestingly, higher transilience is associated with higher perceived climate change risks. Furthermore, as expected, transilience was positively and significantly related to both self-efficacy and outcome efficacy (see Table 2.4), with a medium-to-large effect size (i.e., above .41; Lovakov & Agadullina, 2021). Yet, as expected, these correlations were far below the cut-off for construct overlap (i.e., around .85; Kenny, 2016).

Predictive and Incremental Validity

As expected, higher transilience was associated with more climate change adaptation behaviours and higher support for adaptation policies, with a medium effect (see Table 2.4). Yet, unexpectedly, transilience was not significantly related to adaptation intentions. Next, we found that transilience was still significantly correlated with adaptation behaviours and policy support when controlling for self- or outcome efficacy (see Table 2.5).

Table 2.4. Descriptive Statistics, Reliability and Bivariate Correlations between the Measures Included in Study 1

	M	*SD*	α	ω_t	1	2	3	4	5	6	7
1. Transilience	5.02	0.80	.88	.92							
2. Self-efficacy	4.90	1.45	.90[b]		.47***						
3. Outcome efficacy	4.99	1.43	.93[b]		.43***	.84***					
4. Risk perception	5.86	1.21	.93	.94	.37***	.21**	.19*				
5. Negative affect	5.35	1.37	.88	.89	.26***	.16*	.17*	.80***			
6. Policy support	5.56	1.14	.86	.90	.40***	.24**	.20**	.72***	.61***		
7. Adaptation Behaviours	4.00[a]	2.61			.29***	.30***	.30***	.12	.12	.04	
8. Adaptation Intentions	0.41	0.40	.86	.89	.11	.23**	.29***	.10	.27***	.12	.29***

Note. M = mean; *SD* = standard deviation; [a] = Median; α = Cronbach's alpha; ω_t = McDonald's omega; [b] = Spearman-Brown coefficient, as measure assessed with two items.
*p < .05; **p < .01; ***p <.001

Table 2.5. Partial Correlation Between Transilience and Relevant Outcomes when Controlling for Efficacy beliefs in Study 1

	Controlling for self-efficacy	Controlling for outcome efficacy
1. Adaptation behaviours	.17*	.19*
2. Policy Support	.34***	.36***

Discussion

Study 1 provided preliminary evidence for the reliability and validity of the transilience scale. Confirmatory factor analysis indicated that the items captured the three components well, apart from three reverse-coded items, although the persistence items could be improved. The transilience scale had good reliability, and we found support that, although consisting of three components, it assesses a single construct. On average, people perceive that they can be transilient in the face of climate change risks. We also found support for the concurrent, discriminant, predictive, and incremental validity of the transilience scale. As expected, transilience, though correlated, did not strongly overlap with self-efficacy and outcome efficacy. Interestingly, people perceive higher climate change risks and experience stronger negative affect towards climate change, the more they perceive they can be transilient. Next, higher transilience was associated with stronger support for adaptation policies and more adaptation behaviours, also when controlling for efficacy beliefs, but it was not significantly related to adaptation intentions. This may be because people had already engaged in several behaviours, leading to little variance in the intentions measure.

2.3. STUDY 2

In Study 2 we aimed to further test the validity of the transilience scale in a different context, and to improve the persistence component of the scale. We rephrased persistence items to reflect an attribute (i.e., a quality or a characteristic), rather than feelings or actions (see Table 2.6): 'I can persist' was changed into 'I can be persistent', 'I can handle unpleasant feelings caused by climate change risks' into 'I can stay determined in the face of climate change risks' (drawing on Maltby et al., 2015), and 'I will not give up when faced with climate change risks', into 'No matter what climate change brings about, I can remain strong-willed' (drawing on Maltby et al., 2017).

Table 2.6. Adapted Persistence Items included in Studies 2, 3, 4

1. I can be brave in the face of climate change risks.
2. I can be persistent when faced with climate change risks.
3. I can stay determined in the face of climate change risks.
4. No matter what climate change brings about, I can remain strong willed.
5. I feel paralyzed in the face of climate change risks. (R)

Study 2 was conducted in The Netherlands and focused on a specific local climate change risk: flooding. Flooding is a major threat associated with climate change in The Netherlands (Ministerie van Infrastructuur en Milieu, 2016). Greening one's backyard can reduce the negative impacts of flooding, as backyards with more vegetation can absorb overflowing water (Lennon et al., 2014). To test concurrent and discriminant validity of the transilience scale, we examined whether transilience is either positively associated or not significantly associated with the perceived risks of flooding, and positively related to but not overlapping with self-efficacy and outcome efficacy for greening one's backyard. We tested predictive validity by examining how transilience relates to behaviours that reduce the risks caused by flooding, and to greening one's backyard, and we examined incremental validity by controlling for either self-or outcome efficacy in these relations. The study was set up in the context of a bachelor research practicum at the University of Groningen, where students investigated whether components of Protection Motivation Theory, namely Threat Appraisal and Coping Appraisal (Rogers, 1997), influence the intention to green the backyards. We included transilience as an additional measure to further test the validity of the transilience scale in a different context. Threat appraisal for flooding (high/low) and coping appraisal for greening the backyard (high/low) were manipulated at the start of the study. We controlled for the effects of these experimental conditions (which

are beyond the scope of the present paper, as our aim was to test the validity of the scale) in all analyses.[5]

Method

Participants and Procedure

Questionnaires were distributed by students in specific areas of the city of Groningen (north-east of the Netherlands), where a high number of houses had a backyard. After introducing the purpose of the study, students asked one person per household for informed consent and agreed on a pickup time for the questionnaire; participants did not receive any compensation. The questionnaire was first developed in English and then translated into Dutch. A total of 212 participants were recruited for the study through door-to-door recruitment - data collection was stopped abruptly due to the COVID-19 pandemic in early 2020. After data inspection and cleaning,[6] 192 responses were retained (39% male; M_{age} = 39; SD_{age} = 16.2; see more demographics in Supplementary Material). This sample meets the minimum required for scale validation (Boateng et al., 2018).

Measures

Measures were assessed on a 7-point scale from 1 = *strongly disagree* to 7 = *strongly agree*, unless otherwise specified. For scales, we computed mean scores. See Table 2.8 for descriptives and reliability indicators.[7]

Climate Change Reality. The item 'I believe climate change is real' (van Valkengoed et al., 2021) was used for data cleaning purposes.

Perceived Risks of Flooding. Participants were asked to rate the following two items: 'If a flood happens, there is a high chance that I will have to deal with it' (vulnerability); 'If a flood happens, the consequences will be severe' (severity). Scores on perceived risks were calculated by multiplying the perceived vulnerability and perceived severity scores (de Zwart et al., 2009).

5 The manipulation did not significantly affect any of the measures relevant for our research, and results of the analyses without these covariates are similar (see Supplementary Material).

6 We removed 20 participants (9.47%) from the initial sample, based on the following criteria. First, we removed participants who did not believe in the reality of climate change or who did not answer the climate change reality item (n = 3). Second, we removed participants who had missing values in any of the climate change transilience scale items (n = 17), given that having complete responses for all transilience items was key for validating the scale.

7 The survey included also measures of: current and intended effort put in greening the backyard; how green was the backyard when participants moved in the house; if the backyard has more concrete or plants; perceptions of human causes and consequences of climate change; number of residents in household; number of residents with an income; whether the house is owned or rented; whether people from outside the household take care of the garden; how long have participants lived in the house; how long they are planning to stay; manipulation checks. We do not report results on these variables as they are beyond the scope of the present paper.

Self- Efficacy and Outcome Efficacy for Greening the Backyard. Self-efficacy was assessed with the item 'I can make my backyard greener'. Outcome Efficacy was assessed with the item 'A greener backyard can reduce the negative consequences of a flood'.

Climate Change Adaptation Intentions. Participants indicated to what extent they intend to engage in four adaptation behaviours within the next year: 'Green my own backyard'; 'Donate money to a local organization aiming to make the city greener'; 'Make an evacuation plan'; 'Seek information about climate change', on a scale from 1 = *Not at all* to 7 = *Very much*. The first two items are adaptive measures that particularly reduce the risk of flooding, whilst the latter two focus on climate adaptation more broadly. We averaged the four items into one adaptation intentions scale.[8]

Results

Content Validity

Table 2.7 shows that transilience items generally correlated most strongly with the component they were assigned to. We found that the reverse-coded items were either more strongly related to another component, or weakly related to the expected component (see Table 2.7).[9] Therefore, we removed these reverse-coded items before calculating average scale scores. To have an equal number of items from each sub-component, we removed the transformability item 'I can find new opportunities by adjusting to climate change', as this has the lowest face validity in comparison to the other transformability items. Again, the three-dimensional model fitted the data significantly better than a unidimensional model $\chi 2\ (3) = 238$, $p < .001$ (see model fit indices in Supplementary Material).

Again, the Haberman procedure indicated that the total transilience score is the most meaningful (see Table 2.3). Omega hierarchical showed that around 43% of the variance is attributable to a common factor ($\omega_h = .43$) - somewhat lower compared to Study 1, but still adequate.[10] The reliability of the resulting transilience scale (12 items) was good (see Table 2.8). Again, we found that the mean score for the transilience scale was above the mid-point scale (see Table 2.8), indicating that, also in a Dutch sample, people on average perceive they can be transilient in the face of climate change risks.

8 Although the scale's reliability was rather low, we opted for keeping all items, as removing items worsened reliability. The results were similar when analysing intention items separately; only the intention to make an evacuation plan was not significantly related to transilience.

9 These findings are in line with recent discussions in the literature, where the practice of using reverse items in combination with regular items has been put into question (see Suarez Alvarez et al., 2018 for more details). We inspected the ranges of the items (reported in Supplementary Material for Study 4) to exclude the possibility of acquiescence bias.

10 According to Revelle (n.d., p. 228-230) a value of ω_h =.48 indicates large general factor and small group factors, while a value of ω_h = .35 indicates large group factors and small general factor. Hence, a value of ω_h =.43 reflects that the scale somewhat assesses a single construct.

Table 2.7. Results of the Oblique Multiple Group Method (MGM) in Study 2 (translated from Dutch)

	Persistence	Adaptability	Transformability
Persistence			
1. I can be brave in the face of climate change risks.	**.478**	.131	.136
2. I can be persistent when faced with climate change risks.	**.481**	.017	.077
3. I can stay determined in the face of climate change risks.	**.554**	.058	.139
4. No matter what climate change brings about, I can remain strong willed.	**.477**	.131	.111
~~5. I feel paralyzed in the face of climate change risks.~~ (R) [a]	.068	.022	**-.192**
Adaptability			
1. I think I can take different actions to deal with climate change risks.	.079	**.431**	.304
2. I think I have several options to deal with climate change risks.	.033	**.527**	.229
3. I believe I can find multiple means to deal with climate change risks.	.088	**.571**	.293
4. There are different ways in which I can cope with climate change risks.	.134	**.542**	.182
5. ~~I think I have very limited options to deal with climate change risks.~~ (R) [a]	.025	**.290**	.143
Transformability			
1. Coping with the stress caused by climate change risks can strengthen me.	.024	.199	**.394**
2. There can be additional advantages for me in dealing with climate change risks.	.021	.204	**.498**
3. ~~I can find new opportunities by adjusting to climate change risks.~~ [a]	.035	.270	**.551**
4. Dealing with climate change risks can make me grow as a person.	.048	.218	**.573**
5. I can learn something good from dealing with climate change risks.	.142	.259	**.525**

Note. [a] = item removed before calculating the scores.

Concurrent and Discriminant Validity

Concurrent and discriminant validity were supported. As expected, but contrary to Study 1, transilience and perceived risks of flooding were not significantly related (see Table 2.8). This again illustrates that higher transilience does not imply that people perceive less the risks of climate change. Furthermore, transilience was positively related to both self- and outcome efficacy for greening one's backyard, yet the medium

effect size (i.e., around r = .20) indicated that transilience does not overlap with both types of efficacy beliefs.

Predictive and Incremental Validity

As expected, higher transilience was associated with a stronger intention to engage in adaptation measures, with medium-to-large effects (i.e., between .20 and .40), supporting the predictive validity of the scale. Transilience still correlated with adaptation intentions when controlling for self-efficacy (.28, p <.001) and outcome efficacy (.32, p <.001), respectively.

Table 2.8. Descriptive Statistics, Reliability and Bivariate Correlations between the Measures Included in Study 2

	M	*SD*	α	ω_t	1	2	3	4
1. Transilience	4.80	0.71	.81	.90				
2. Self-Efficacy to green backyard	4.87	1.70			.20**			
3. Outcome efficacy for greening backyard	4.78	1.48			.23**	.04		
4. Perceived risks of flooding	18.24	11.29			.08	.08	.18*	
5. Intention to engage in adaptation behaviours	3.54	1.13	.66	.70	.35***	.21**	.26***	.26***

Note. We controlled for both experimental manipulations in the analyses.
M = mean; *SD* = standard deviation; α = Cronbach's alpha; ω_t = McDonald's omega.
*p < .05; **p < .01; ***p < .001

Discussion

Study 2 replicated the findings of Study 1 in a Dutch sample and in the context of a specific climate-related risk (i.e., flooding). The results of the MGM showed again that, after removing the remaining reverse-coded items, the items reflect well the three components of transilience. Again, we found that the scale, although three-dimensional, is meant to assess a single construct. The scale showed good reliability, and people on average perceived they can be transilient. Concurrent, discriminant, predictive and incremental validity of the transilience scale in this context was also supported. In contrast to Study 1, yet in line with our expectations, we found that transilience did not significantly relate to perceived risks of flooding, which supports that higher transilience does not imply perceiving climate change as less threatening. In contrast to Study 1, but as expected, higher transilience was related to stronger intentions to adapt to the risk of flooding, also when controlling for self- or outcome efficacy. This may be due to the higher variance in intentions, as we assessed intentions with a Likert scale in Study 2. All correlations were lower than in Study 1, perhaps because the constructs were not assessed at the same level of specificity (compatibility principle; Ajzen, 2020): while transilience is about general climate change risks, all other variables focused specifically on flooding or greening the backyard. The study has two main limitations:

first, it was not set up with the main purpose of scale validation; second, most of the constructs were measured with only one item. We address these limitations in the next studies.

2.4. STUDY 3

Study 3 was set up to further validate the transilience scale, by including additional measures. To test concurrent and discriminant validity, we examined whether transilience is related to positive affect about climate change. Feeling positive emotions, such as hope and optimism, is typically associated with resilience (Tugade & Fredrickson, 2004) and can promote well-being and adaptive responses in the face of adverse events (Scheier & Carver, 1992; Tugade et al., 2004). Thus, we expect climate change positive affect to be positively related to transilience. Additionally, we included general psychological resilience to further assess discriminant validity. We expect transilience to be positively related to general resilience, as we incorporate the idea of 'bouncing back' in the face of climate change with the persistence component. However, we expect that these constructs will not overlap, as transilience acknowledges that humans can do *more* than 'bounce back', and thus assesses something different from resilience. Furthermore, transilience is assessed at the more specific level of climate change, while resilience is measured at a general level. To test predictive validity, we included both individual and collective adaptation behaviours, i.e. behaviours performed with and for other people (also called community responses; Reser & Swim, 2011). Furthermore, we included political forms of collective action (e.g., protesting and signing a petition for climate change adaptation; van Zomeren & Iyer, 2009; van Zomeren et al., 2019). We tested incremental validity of transilience on these measures by controlling for self- or outcome efficacy. We also tested whether higher transilience is positively related to people's general well-being, and verified incremental validity of transilience by controlling for resilience. To account for the fact that people may face different climate change risks depending on the region they live (e.g. inhabitants of a coastal area in the North-East of the US may face a higher risk due to increase rainfall and sea-level rise, whereas those who live in the South-West face higher risks of droughts and wildfires; Clayton et al., 2016), we adjusted some of the measures by explicitly referring to climate change risks affecting the local community or municipality, making the items directly relevant for participants.

Method

Participants and Procedure

We used amazon MTurk to invite a random sample of 198 members of the United States population to participate in our study, with a compensation of $1.[11] Participants who disagreed with the reality of climate change were directly sent directly to the end of the survey. After data inspection and cleaning,[12] 192 responses were retained (61% male; M_{age} = 36; SD_{age} = 10.8; see more demographics in Supplementary Material). Again, this sample meets the minimum size appropriate for scale validation (Boateng et al., 2018).

Measures

All measures were assessed on a seven-point Likert-scale, from 1 = *strongly disagree* to 7 = *strongly agree*, unless otherwise specified.[13] The survey started with the transilience scale, and ended with measures of well-being, psychological resilience, and demographics. All other measures were presented in randomised order. Most measures were like in Study 1, and we report below when and how they differed (see all items in Appendix B). For all scales, we computed mean scores and recoded reverse-coded items. Descriptives and reliability coefficients for the measures are provided in Table 2.10.

Climate Change Transilience. Participants responded to the same 15 transilience items as in Study 2, presented in randomised order. The same three reverse-coded items were again not working well, so we report on the final 12 climate change transilience items (4 items for each component) used in Study 2.

Climate Change Affect. Participants rated to what extent they experience certain emotions when they think about dealing with climate change risks, on a 7-point Likert scale from 1 = *not at all* to 7 = *very strongly.* Negative affect was assessed with five items (distressed, concerned, paralyzed, pessimistic, angry). Positive affect was assessed with two items (optimistic, hopeful).

Climate Change Risk Perception. We included the same items as in Study 1, with the additional item 'climate change poses a risk to my community'.

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11 As in Study 1, we conducted another study at the same time to assess whether people perceive they can adapt to climate change collectively, that is, as a community. As the second study did not include any item on individual transilience, we do not discuss it here.

12 From the initial sample we removed 6 participants (3%) based on the following criteria. First, one duplicated IP address was removed. Participants who filled the survey within 2 minutes were removed (n = 2), as we did not consider this a realistic time to provide accurate responses (median completion time = 6.2 minutes). Finally, participants who failed an attention check asking them to select the response 'agree' were removed (n = 3). Analyses with the total sample led to similar results as those reported.

13 We also included measures to assess political and party preference, perceived consequences of climate change, common fate, and social identification. As these measures are not relevant for the purpose of the present study, they are not further discussed.

Self-efficacy and Outcome Efficacy for Climate Change Adaptation. We included the same items as in Study 1.

Support for Local and National Adaptation Policies. We slightly adapted the items from Study 1. Specifically, participants rated to what extent they support or oppose implementing adaptation policies *in their municipality*. Two items regarding funds and investments were rephrased to stress that the money would come from taxes, hence that participants would pay themselves for them (see Appendix B). We used a separate item to assess to what extent participants support 'implementing *national* policies aiming to protect US citizens from climate change risks'.

Individual Climate Change Adaptation Intentions and Behaviours. We slightly adapted the items from Study 1. Specifically, we asked participants to what extent they intend to engage in adaptation behaviours *within the next year*. Further, we removed behaviours that participants themselves would not realistically engage in (i.e., preparing an evacuation plan) or that were not clearly linked to climate change adaptation (i.e., house maintenance; see Appendix B). Participants rated items on a scale from 1 = *not at all*, to 7 = *very much*. We included the option 8 = *I already did it* as an indicator of adaptation behaviour. We calculated the intentions score (for the behaviours not yet performed) by averaging the 7 items into a reliable scale, after converting the value '8' to missing. We calculated the behaviours score by counting the number of behaviours for which '8' was selected.

Collective Climate Change Adaptation Intentions and Behaviours. Six items assessed collective adaptation behaviours that people engage in as a group (e.g., 'Joining a community initiative to make my neighbourhood greener to better protect against climate change risks, for example, by planting trees, building green roofs or parks'; see Appendix B). We introduced the items by specifying that there are actions that *communities* can take to reduce the negative effects of climate change, and we asked participants to what extent they intend to take the measures within the next year *together with their community*. The response format, and the procedure to create the intentions and behaviours scale, respectively, was the same as for individual adaptation behaviours.

Political Collective Action. Participants indicated to what extent they are willing to engage in two political forms of collective action (e.g., 'Participating in a demonstration in favour of climate change adaptation policies, namely policies aiming to protect people against climate change risks', adapted from van Zomeren et al., 2019) on a scale from 1 = *not at all* to 7 = *very much*.

General Resilience. We used The Brief Resilience Scale (Smith et al., 2008) to assess the extent to which people feel capable to bounce back from adversities in general. The scale consists of three positively-worded (e.g., 'I tend to bounce back quickly after hard times'), and three reverse-coded items (e.g., 'I have a hard time making it through stressful events'; see Appendix B). Items were rated on a 5-point scale from 1 = *strongly disagree* to 5 = *strongly agree*.

Well-being. We used The Satisfaction with Life Scale (Diener et al., 1985), consisting of 5 items (e.g., 'In most ways my life is close to my ideal'), to assess general well-being.

Results

Content Validity

The results of the MGM showed that all items in the transilience scale were most strongly correlated with the components they were assigned to (see Table 2.9), indicating that the 12 items captured well the three components of transilience. Again, the three-dimensional model fitted the data significantly better than a unidimensional model $\chi 2$ (3) = 62.9, $p < .001$ (see model fit indices in Supplementary Material). Both the Haberman (see Table 2.3) and omega hierarchical ($\omega_h = .74$) indicated that the transilience scale assesses a single construct. The reliability of the transilience scale was excellent (see Table 2.10). Again, average scores indicated that people perceive transilience in the face of climate change.

Concurrent and Discriminant Validity

Again, concurrent and discriminant validity was supported (see Table 2.10). As expected, higher transilience was significantly related to more positive affect, but not to negative affect about climate change, and to stronger perceptions of climate change risks, indicating that higher transilience was not associated with downplaying climate change risks. As expected, transilience was positively related to self-efficacy, outcome efficacy and general resilience, yet the effect sizes did not indicate construct overlap (they were all between $r = .30$ and $r = .60$).

Predictive and Incremental Validity

Again, predictive validity was supported (see Table 2.10). Higher transilience increased the likelihood that respondents engaged in all types of climate adaptive behaviours and supported policies, both at the local and national level, with effects ranging from .16 to .41. When controlling for self- or outcome efficacy, transilience remained related to collective behaviours, policy support, and well-being (see Table 2.11). Furthermore, higher transilience was related to higher general well-being, as expected, and this relation remained when controlling for self- and outcome efficacy or for resilience (see Table 2.11).

Table 2.9. Results of the Oblique Multiple Group Method (MGM) in Study 3

	Persistence	Adaptability	Transformability
Persistence			
1. I can be brave in the face of climate change risks.	**.495**	.423	.224
2. I can be persistent when faced with climate change risks.	**.491**	.413	.261
3. I can stay determined in the face of climate change risks.	**.459**	.455	.394
4. No matter what climate change brings about, I can remain strong willed.	**.553**	.548	.360
Adaptability			
1. I think I can take different actions to deal with climate change risks.	.404	**.526**	.406
2. I think I have several options to deal with climate change risks.	.469	**.594**	.424
3. I believe I can find multiple means to deal with climate change risks.	.442	**.555**	.356
4. There are different ways in which I can cope with climate change risks.	.523	**.548**	.298
Transformability			
1. Coping with the stress caused by climate change risks can strengthen me.	.334	.442	**.570**
2. There can be advantages for me in dealing with climate change risks. [a]	.288	.379	**.546**
3. Dealing with climate change risks can make me grow as a person.	.265	.310	**.495**
4. I can learn something good from dealing with climate change risks.	.352	.353	**.549**

Note. [a] We removed the term 'additional' included in Studies 1, 2, to make the item easier to comprehend for participants.

Table 2.10. Descriptive Statistics, Reliability and Bivariate Correlations between the Measures Included in Study 3

	M	*SD*	α	ω_t	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1. Transilience	5.29	0.79	.90	.92														
2. Self-efficacy	5.15	1.35	.90 [b]		.58***													
3. Outcome efficacy	5.14	1.35	.89 [b]		.60***	.84***												
4. Risk perception	5.77	1.01	.88	.92	.23**	.07	.10											
5. General resilience	3.25	0.91	.87	.95	.33***	.30***	.22**	-.03										
6. CC positive affect	3.89	1.68	.87 [b]		.34***	.38***	.36***	-.18*	.18*									
7. CC negative affect	4.06	1.57	.88	.91	.06	-.02	.02	.43***	-.35***	.09								
8. Individual behaviours	1.61	1.92			.17*	.13	.14	.25***	-.02	-.06	.18*							
9. Individual intentions	4.79	1.58	.88	.93	.26***	.43***	.43***	.14	-.06	.36***	.30***	.12						
10. Collective behaviours	0.47	1.17			.30***	.22**	.21**	.13	-.02	.34***	.33***	.42***	.24**					
11. Collective intentions	4.27	1.88	.94	.96	.22**	.38***	.38***	.04	.03	.39***	.27***	.10	.70***	.28***				
12. Collective action	4.91	1.81	.74 [b]		.22**	.27***	.28***	.46***	-.02	.21**	.50***	.19**	.52***	.25***	.54***			
13. Local policy support	5.38	1.10	.85	.88	.30***	.27***	.26***	.63***	.01	.00	.41***	.25***	.34***	.22**	.19*	.53***		
14. National policy support	5.91	1.32			.22**	.16*	.15*	.65***	-.02	.00	.37***	.22**	.22**	.16*	.14	.54***	.61***	
15. Well-being	4.51	1.57	.93	.94	.40***	.37***	.30***	.02	.42***	.48***	.00	.06	.25***	.29***	.38***	.22**	.07	.04

Note. CC = Climate Change; *M* = mean; *SD* = standard deviation; α = Cronbach's alpha; ω_t = McDonald's omega; [b] = Spearman-Brown reliability coefficient for measure with two items.
*p < .05; **p < .01; ***p < .001

Table 2.11. Partial Correlation between Transilience and relevant Outcomes when controlling for Efficacy Beliefs and General Resilience in Study 3

	Controlling for self-efficacy	Controlling for outcome efficacy	Controlling for resilience
1. Individual intentions	.02	.01	
2. Individual behaviours	.12	.11	
3. Collective intentions	-.00	-.02	
4. Collective behaviours	.22**	.23**	
5. Policy support	.19**	.19**	
7. Collective action	.07	.06	
8. Well-being	.25***	.29***	.31***

Discussion

Study 3 replicated most of the findings of Study 1 and Study 2, while focusing on climate risks in one's local community and considering a broader range of variables. Again, on average, people perceived they can be transilient. Furthermore, we again found support for the content, concurrent, discriminant and predictive validity - and partly support for incremental validity - of the transilience scale. Extending Studies 1 and 2, we found that higher perceived transilience was associated with higher general well-being.

2.5. STUDY 4

In Study 4 we aimed to replicate the findings for content, concurrent, discriminant, predictive and incremental validity of the transilience scale in a pre-registered study (https://aspredicted.org/661_8T7), with a bigger representative sample of another country. Thereby, we could address the limitation that all our previous studies were conducted with convenience samples which met just the minimum size required for scale validation. We included the same measures as in Study 3, with some minor modifications. We aimed to ensure that all constructs were sufficiently identified, namely measured with at least 3 items. Thus, we included one additional item in case of climate change positive affect, self-efficacy, outcome efficacy and political collective action. We further included examples of transformative policies and transformative individual adaptation behaviours, which aim to deviate from the status quo rather than to maintain it (Wilson et al., 2020), as transilience may be particularly relevant for these examples. To keep the length of the survey around 10-12 minutes, and to maximise the accuracy of the responses, we shortened collective adaptation and risk perception measures to 3 items, and we only included one type of policy support (i.e., local policy support). In addition, we wanted to explore whether transilience is positively associated with experiencing positive change because of being confronted with climate change risks (often referred to as posttraumatic growth; Carver & Antoni,

2004). Note that posttraumatic growth differs from transilience as, first, transilience reflects the perceived possibility of positive change deriving from adversity in the future, while posttraumatic growth focuses on the aftermath of a traumatic event. Second, climate change risks do not always match the definition of 'trauma', which is typically a one-time very acute personal stressor (Bonanno, 2004). We also wanted to explore the relationship between transilience and the Climate Change Anxiety scale (Clayton & Karazsia, 2020), a validated measure which assesses the extent to which people experience both cognitive and functional impairment as a result of being confronted with climate change risks.[14] We expect that higher transilience is either non-significantly related or negatively related to climate change anxiety, as transilience implies that people perceive they do have the capacity to adapt to climate change.

Method

Participants and Procedure

We used the survey platform Prolific to collect responses from 800 members of the general public in the United Kingdom. We requested data collection from a representative sample in terms of age, ethnicity, and sex (accuracy around 95%). In total, 793 people consented to participate in our study, and they were compensated £1.80 for participation. A total of 7 participants who indicated not to believe in the reality of climate change were automatically sent to the end of the survey, as in Study 3. After data inspection and cleaning,[15] 782 responses were retained (see demographics in Supplementary Material).

Measures

Most of the measures were the same as in Study 3, with some minor modifications. Below we only specify the changes made, as well as the additional measures. See full overview of the items in Appendix B. Descriptives and reliability coefficients are found in Table 2.13.

Individual Adaptation Intentions and Behaviours. We added three transformative items (e.g., 'Shifting my diet to incorporate food that are more resistant to and/or better suited for the changing climate in my area'). A factor analysis with principal axis extraction and oblimin rotation showed that the transformative items did not load on a separate factor, thus we incorporated the transformative behaviours in the scale used

14 We do not measure climate change negative affect in this study, since it is reflected in the validated climate change anxiety scale.

15 Participants who failed an attention check asking them to select the response 'agree' were removed (n = 4). No participant completed the survey within 3 minutes (median completion time = 9,4 minutes). Analyses with the total sample, led to similar results as those reported, only the correlation between transilience and risk perception (already weak) became non-significant.

in Study 3. We used the exact same procedure as in Study 3 to calculate a separate intentions and behaviours score.

Support for Local Adaptation Policies. We added three transformative policies (e.g., 'Change working hour schedules around hot weather during spring/summer (for example, working early morning and late afternoon/evening and rest during the day'). A factor analysis with principal axis extraction and oblimin rotation showed that the transformative policies items did not load on a separate factor, thus we incorporated the transformative policies in the scale used in Study 3.

Collective Climate Change Adaptation Behaviours. We kept the three items that better reflected working for and with others to protect the community from the risks of climate change (e.g., 'Joining a community initiative to make my neighbourhood greener to better protect against climate change risks, for example by planting trees, building green roofs or parks'; see Appendix B).

Climate Change Risk Perception. We kept the three items that assessed the risks that climate change poses to entities that are most relevant for participants (e.g., themselves and their household; see Appendix B).

Self-Efficacy and Outcome Efficacy for Climate Change Adaptation. We included the additional item 'I trust that I can take actions aimed to reduce the negative impacts of climate change on myself and close others' to measure self-efficacy. We added the item 'My own behaviour can help reducing the negative impacts of climate change on myself and close others' to measure outcome efficacy.

Climate Change Positive Affect. We included the additional option 'confident' to assess to what extent people experience positive affect in the face of climate change.[16]

Political Collective Action. We included the additional item 'Blocking roads while demonstrating in favour of accelerating climate change adaptation' (adapted from Van Zomeren et al., 2019).

Positive Change Derived from Climate Change. We asked participants to what degree they experienced three positive changes *because of being confronted with climate change risks in the last few years* (e.g., 'I am able to do better things with my life', see Appendix B). We adapted the scale from the Posttraumatic Growth Short Inventory (Cann et al., 2010), and we aimed to cover three dimensions that are most in line with the components of transilience: personal strength, new possibilities,

16 'Distressed' and 'concerned' were included as negative valence fillers.

and appreciation of life. For each dimension, we selected the item that most clearly reflected positive change.[17] Participants rated the items on a scale from 1 = *very small degree* to 5 = *very great degree*. We also included the option 'did not experience this', that was coded as 0.

Climate Change Anxiety Scale. We included the 13-item Climate Change Anxiety Scale (Clayton & Karatzsia, 2020) which assesses with what frequency people experience two forms of impairment associated to climate change: cognitive (e.g. 'Thinking about climate change makes it difficult for me to concentrate') and functional (e.g. 'My concerns about climate change can make it hard for me to have fun with my family or friends'). Participants rated each of the items on a scale from 1 = *never* to 5 = *almost always*.

Results

Content Validity

We replicated the findings supporting content validity of the transilience scale. The results of the MGM, again, supported the three-factor structure of the transilience scale (see Table 2.11). Only one persistence item (the one mentioning 'persistent') correlated similarly strong with adaptability. Again, the three-dimensional model fitted the data significantly better than a unidimensional model, $\chi 2\ (3) = 424\ p < .001$ (see model fit indices in Supplementary Material). Again, The Haberman procedure (see Table 2.3) and omega hierarchical ($\omega_h = .71$) indicated that the scale reflects a single construct. The transilience scale showed very good reliability (see Table 2.13). Again, the average scores showed that people perceive they can be transilient in the face of climate change (see Table 2.13).

Concurrent and Discriminant Validity

We mostly replicated the findings supporting the concurrent and discriminant validity of the transilience scale (see Table 2.13). As expected, higher transilience was associated with more positive affect about climate change. Yet, unexpectedly, higher transilience was associated with perceiving slightly less climate change risks, although the effect size in this last case was very small ($r = -.07$, $p = .044$). As expected, the correlation between transilience and psychological resilience, self-efficacy, and outcome efficacy, respectively, was positive, and did not suggest construct overlap (i.e., the effects were between $r = .30$ and $r = .45$; see Table 2.13).

17 The original scale has 2 items for each dimension. The correlations when using the original 6 items scale were similar. The remaining dimensions were Relating to Others and Spiritual Growth (Cann et al., 2010), which we consider outside the scope of the present paper.

Table 2.12. Results of the Oblique Multiple Group Method (MGM) in Study 4

	Persistence	Adaptability	Transformability
Persistence			
1. I can be brave in the face of climate change risks.	**.546**	.439	.267
2. I can be persistent when faced with climate change risks.	.452	**.466**	.246
3. I can stay determined in the face of climate change risks.	**.570**	.413	.368
4. No matter what climate change brings about, I can remain strong willed.	**.549**	.377	.332
Adaptability			
1. I think I can take different actions to deal with climate change risks.	.361	**.597**	.415
2. I think I have several options to deal with climate change risks.	.424	**.633**	.428
3. I believe I can find multiple means to deal with climate change risks.	.442	**.606**	.338
4. There are different ways in which I can cope with climate change risks.	.469	**.606**	.327
Transformability			
1. Coping with the stress caused by climate change risks can strengthen me.	.343	.356	**.467**
2. There can be advantages for me in dealing with climate change risks.	.293	.341	**.461**
3. Dealing with climate change risks can make me grow as a person.	.284	.402	**.555**
4. I can learn something good from dealing with climate change risks.	.294	.409	**.542**

Predictive and Incremental Validity

We mostly replicated the findings supporting the predictive validity of the transilience scale. Higher transilience increased the likelihood that participants intended to engage in both collective and individual adaptation behaviours, engaged in individual adaptation behaviours, and reported higher levels of general well-being, with effects ranging from .13 to .21 (see Table 2.13). Contrary to our expectation and to Study 3, transilience was not significantly related to collective adaptation behaviours, support for local adaptation policies, and intention to engage in political collective action. Transilience still correlated with individual behaviours when controlling for outcome efficacy and with well-being when controlling for self-, outcome efficacy and resilience, respectively (see Table 2.14).

Exploratory Analyses

Higher transilience was associated with a higher degree of positive changes experienced because of being confronted with climate change, with a medium effect (see Table 2.13). Furthermore, higher transilience was associated with lower levels of climate change anxiety, with a small effect (r = -.09, p = .012; see Table 2.13).

Discussion

In Study 4 we replicated most of the findings of Study 3, supporting the content, concurrent, discriminant and predictive validity of the transilience scale, in a big representative sample of the United Kingdom population. Again, we found that people on average perceive they can be transilient. Contrary to Study 3, higher transilience was associated with perceiving less climate change risks, and transilience was not significantly related to support for local adaptation policies, political collective action, and collective adaptation behaviours. This last finding can be due to the lack of variance in collective adaptation behaviours, as 95% of the sample had not engaged in any of these behaviours. Furthermore, contrary to Studies 1 and 2, the relationship between transilience and adaptation behaviours and intentions was mostly no longer significant when controlling for self- or outcome efficacy. Yet, transilience remained consistently related to well-being, when controlling for self- and outcome efficacy, or for well-being.

Table 2.13. Descriptive Analyses, Reliability and Bivariate Correlations between the Measures included in Study 4

	M	*SD*	α	ω_t	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1. Transilience	4.84	0.80	.89	.93														
2. Self-efficacy	4.40	1.37	.89	.89	.44***													
3. Outcome efficacy	4.41	1.47	.92	.92	.33***	.80***												
4. Risk perception	5.55	1.24	.92	.93	-.07*	.22***	.35***											
5. Resilience	3.23	0.89	.93	.95	.27***	.22***	.10**	-.18***										
6. CC positive affect	3.46	1.33	.91	.92	.48***	.35***	.23***	-.33***	.36***									
7. Individual behaviours	1.11	1.58			.13***	.22***	.17***	.17***	.08*	-.01								
8. Individual intentions	3.61	1.42	.88	.90	.17***	.33***	.37***	.29***	.03	.11***	.13***							
9. Collective behaviours	0.06	0.30			.00	.11**	.10**	.07*	.03	.02	.25***	.05						
10. Collective intentions	3.40	1.84	.88	.88	.13***	.32***	.40***	.30***	.00	.11**	.16***	.55***	.11**					
11. Collective action	3.26	1.48	.72	.79	-.07	.20***	.25***	.57***	-.14***	-.23***	.11***	.30***	.10**	.39***				
12. Local policy support	5.11	1.01	.85	.89	.02	.27***	.37***	.58***	-.04	-.15***	.26***	.37***	.08*	.38***	.55***			
13. Well-being	4.39	1.35	.92	.94	.21***	.24***	.16***	-.02	.43***	.34***	.08*	.11**	.00	.17***	.02	.06		
14. Positive change	2.42	1.40	.89	.89	.24***	.32***	.36***	.27***	.11**	.18***	.08*	.35***	.08*	.41***	.27***	.20***	.18***	
15. CC anxiety	1.36	0.47	.91	.93	-.09*	.10**	.14***	.28***	-.17***	-.06	.06	.34***	.13***	.37***	.44***	.25***	.00	.28***

Note. CC = Climate Change; *M* = mean; *SD* = standard deviation; α = Cronbach's alpha; ω_t = McDonald's omega.
*p < .05; **p < .01; ***p < .001

Table 2.14. Partial Correlation Between Transilience and Relevant Outcomes when Controlling for Efficacy Beliefs and General Resilience in Study 4

	Controlling for self-efficacy	Controlling for outcome efficacy	Controlling for resilience
1. Individual intentions	.02	.05	
2. Individual behaviours	.04	.08*	
3. Collective intentions	-.02	-.01	
4. Well-being	.12***	.17***	.11**

2.6. GENERAL DISCUSSION

In this paper we introduced the construct of transilience, defined as people's perceived capacity to persist, adapt flexibly, and positively transform in the face of climate change risks. We proposed that transilience can be an important construct for advancing our understanding of climate change adaptation, as it acknowledges that people's perceptions may not only regard ways to reduce and avoid the harm of climate change, but also ways to exploit beneficial opportunities.

We first developed a set of items that align with our definition of the three components of transilience (i.e., persistence, adaptability, transformability), and selected the most appropriate items based on experts' assessments of their face validity and quality. Next, we conducted four questionnaire studies to test the validity of the climate change transilience scale. Confirmatory factor analyses generally showed that the items captured well the three components of transilience, particularly after we improved the persistence items based on Study 1, although we found one minor cross-loading in the last study. We further found consistent evidence that the transilience scale, though three-dimensional, reflects a single construct, and that the scale shows high reliability. Further, we found that people, on average, score above the midpoint of the scale, which suggests that they perceive they can be transilient in the face of climate change risks.

The four studies provided support for the scale's concurrent and discriminant validity (see overview in Table 2.15). Higher perceived transilience was associated in the expected direction with theoretically related constructs, such as more positive affect towards climate change, higher self-efficacy and outcome efficacy, and higher general resilience. Moreover, as expected, higher transilience was not associated to lower climate change risk perceptions, except for the last study, although the relationship was very weak. Transilience was also either positively or not significantly related to negative affect towards climate change, except for the last study, where we found it associated to a slightly lower climate change anxiety (in an exploratory analysis). Importantly,

across all studies, the effect sizes showed that self-efficacy, outcome efficacy, and general psychological resilience do not overlap too much with transilience, indicating that transilience captures something different.

Table 2.15. Overview of Results for Validity of the Transilience Scale

	Study 1	Study 2	Study 3	Study 4
Concurrent and discriminant validity				
Positive affect	n.a.	n.a.	+	+
Negative affect	+	n.a.	0	n.a.
Climate change anxiety (exploratory)	n.a.	n.a.	n.a.	-
Perceived risks	+	0	+	-
Self-efficacy	+	+	+	+
Outcome efficacy	+	+	+	+
Resilience	n.a.	n.a.	+	+
Predictive validity				
Individual behaviours	+	n.a.	+	+
Individual intentions	0	+	+	+
Collective behaviours	n.a.	n.a.	+	0
Collective intentions	n.a.	n.a.	+	+
Political collective action	n.a.	n.a.	+	0
Policy support	+	n.a.	+	0
Well-being	n.a.	n.a.	+	+
Positive change (exploratory)	n.a.	n.a.	n.a.	+

Note. + indicates a statistically significant positive relationship between transilience and the variable; 0 indicates a non-significant relationship; - indicates a significant negative relationship. n.a. indicates that the measure was not included in the study.

The four studies generally supported the scale's predictive validity (Table 2.15). Higher perceived transilience was associated with more individual climate adaptive behaviours (when included), and higher intentions to engage in such adaptive behaviours (except for Study 1). Furthermore, in one study higher transilience was associated with higher collective climate change intentions (when included), and to collective behaviours. Next, higher transilience was associated with more support for climate change adaptation policies and higher willingness to engage in political collective action, although not in the last study. Additionally, higher transilience was related to higher general well-being, and to experiencing positive change because of climate change risks (exploratory). When controlling for self-efficacy, outcome efficacy, or resilience, transilience was still consistently related to general well-being, but less consistently to intentions, behaviour and policy support, particularly in the last two studies. Together,

these results generally provide robust evidence that we succeeded in developing a reliable and valid scale to assess perceived transilience associated with adaptive responses to climate change risks.

Theoretical Implications

Our research indicates that people perceive that climate change may not only have detrimental consequences for people (Fritze et al., 2008; Manning & Clayton, 2018), but offers opportunities for positive change as well. Specifically, we consistently found that people, on average, perceive they can be transilient in the face of climate change risks. This brings forward a novel understanding of human capacity to adapt to adversities such as climate change: rather than only 'bouncing back' and recovering (Bonanno, 2004; Tugade & Fredrickson, 2004), it seems that people also see opportunities for positive change (see Davoudi et al., 2013; O'Hare et al., 2016, for similar reasoning in other domains). This aligns with a prominent definition of climate change adaptation, which refers to *both* minimizing damage *and* finding beneficial opportunities (IPCC, 2014b).

Some scholars have proposed that climate change reduces individual's quality of life and does not elicit positive emotions (Doherty, 2018). However, we found that higher perceived transilience is associated with feeling more positive emotions about climate change and being more satisfied with one's life. Additionally, higher perceived transilience seems positively associated with experiencing positive change because of dealing with climate change risks. At the same time, in most (but not all) studies we found that higher perceived transilience does not imply that people perceive less climate change risks or are less worried about climate change. Our results generally seem to indicate that transilience does not imply that climate change is no longer seen as an adversity; it also seems that, although people may feel negative affect about climate change, they may still feel that they can do something about it (i.e., they feel less impaired). Altogether, our research allows to broaden and bring a positive angle on the psychological responses to climate change (Reser & Swim, 2011). Future research is needed to examine under which circumstances transilience is associated with perceiving more/less climate change risks and with feeling more/less negative affect about climate change.

Notably, we generally found support for the validity of the transilience scale over four different studies, which included population samples from different countries (i.e. US, the Netherlands, and UK), focusing on different climate change risks (i.e. climate change risks in general, risks of flooding caused by climate change, and perceived climate change risks at the community level) and adaptation behaviours (i.e. adaptive behaviour in general and more specific behaviours to reduce the risk of flooding;

individual and collective behaviours; support for national and local adaptation policies; political collective action). Although the findings were not always consistent, and many questions remain open for further investigation, the results presented here seem to suggest that transilience can be a relevant construct across multiple contexts.

Limitations and Future Research

More research is needed to further validate the transilience scale. First, our findings were not fully consistent across studies. Specifically, we could not replicate the finding that transilience is associated with policy support and political collective action in Study 4. These are measures that aim to protect the broader collective from the risks of climate change, and that urge others besides the individual to act for climate change adaptation. It may be that perceiving transilience at the individual level is not sufficient to motivate actions that involve and protect the collective. Future research could assess whether a collective form of transilience (i.e., perceiving that the community or collective can persist, adapt flexibly and positively transform) can motivate adaptive action at the collective level, such as supporting policies to protect the collective from climate change risks.

Our studies focused on samples from WEIRD countries (Western, Educated, Industrial, Rich and Democratic). The question remains how robust our findings are across different cultures, and whether similar results would be found in developing countries, which are the most vulnerable to climate change risks and which most urgently need to adapt to climate change (Mertz et al., 2009). Hence, future studies could further examine the validity of the transilience scale across different risks and cultural contexts. Future research could also assess whether transilience is relevant to explain adaptation to other adversities, for instance the COVID-19 pandemic, or personal trauma.

Our findings are based on correlations and cross-sectional designs, which do not allow to establish causal relationships. Hence, more research is needed to corroborate the predictive validity of the transilience scale. Experimental designs could be used to examine the extent to which transilience causes adaptation intentions, behaviours, and well-being. Longitudinal studies could be conducted to examine whether transilience can predict adaptation intentions, behaviours, and well-being over time. This would also allow to examine how stable transilience is over time (i.e., test-retest reliability), which in turn would provide insight into whether transilience, which we propose as a state, can also be (partly) considered as a trait. Longitudinal studies over multiple waves would also allow to investigate whether transilience precedes other constructs (e.g., experiencing positive change, well-being), is a consequence of them, or if they are mutually reinforcing. This could shed light on whether and how perceived transilience could be induced and strengthened. The latter is an urgent question, given that our

findings suggest that transilience could potentially promote adaptation intentions and behaviours and general well-being in the face of climate change risks.

Lastly, our results indicated that self-efficacy and outcome efficacy beliefs may be equally if not more strongly related to adaptive measures, positive emotions, and well-being. More specifically, transilience consistently explained additional variance in general well-being when controlling for self-efficacy, outcome efficacy, and resilience. However, transilience mostly did not explain unique variance in intentions, behaviour, and policy support, particularly in the last two studies. The question remains whether this is generally the case, or whether transilience has added value in specific circumstances. More research is needed to answer these questions. Still, it seems that transilience plays a unique role in making people feel better overall in the face of climate change.

Practical Implications

Our research has potentially relevant practical implications. Our findings suggest that it is important to consider the potential beneficial side of dealing with climate change risks, as this may not only promote climate adaptive actions that would reduce individuals' vulnerability to climate change risks, but also make people feel better overall. Specifically, it seems that a potential way to promote adaptation behaviour and well-being is emphasising how people can persist, adapt flexibly, and positively transform by adapting to climate change risks. For example, a campaign aiming to encourage house urban greening could show residents and make explicit how they are *determined* to adapt to climate change risks, emphasise the *many* ways in which greening can be implemented (green rooftops, planting trees, removing tiles from backyards) and point out that people can *learn* new things (e.g. about plant caretaking and gardening) and benefit (e.g. more aesthetically pleasant garden, cooler temperatures in the summer, cleaner oxygen) by engaging in these behaviours. More research is needed to test the effectiveness of messages about transilience in encouraging adaptation behaviours and examine whether this would also enhance well-being.

A Chinese proverb states: "When the wind of change blows, some people build walls while others build windmills". We introduced transilience to show that, despite the 'gloom and doom' side of climate change, there is still room for a more positive perspective on climate change adaptation. Our research highlights that people perceive they can do more than 'bounce back' in the face of climate change. Moreover, the more people perceive they have the capacity to persist, adapt flexibly and positively transform in the face of climate change risks, the more they take concrete action to adapt, and the higher their general well-being. As such, perceived transilience might be relevant to ensure that by adapting to climate change we are able to both minimize harm (i.e., build walls), and exploit beneficial opportunities (i.e., build windmills).

APPENDIX A

Pool of Transilience Items and Evaluation by Experts

		Mean Relevance	Mean Clarity
	Persistence		
1.	**I can withstand the potential stress derived from climate change risks. [CD-RISC] ***	3,91	3,09
2.	**I can persist when confronted with climate change risks. ***	4,18	3,73
3.	**I can be strong when confronted with climate change risks. ***	3,73	3,55
4.	**I will not give up when encountering climate change risks. [CD-RISC]***	3,82	3,45
5.	Climate change risks are a challenge for me, rather than a threat. [MACS]	3,36	3,36
6.	**I am discouraged by climate change risks. (R) ***	3,82	3,64
7.	**I feel paralyzed in the face of climate change risks. (R)**	4,18	4,09
8.	Climate change risks will bring me down. (R)	3,45	3,27
	Adaptability		
1.	**I am confident that I can take different actions to deal with climate change risks. ***	4,45	4,09
2.	**I am confident that I have several options to manage climate change risks. ***	4,18	3,82
3.	**I am confident that I can find multiple means to deal with climate change risks. ***	3,91	4,00
4.	**I am confident that there are different ways of coping with climate change risks. [CFS] ***	3,91	3,82
5.	I think I have several ways of dealing with climate change risks, when necessary [CFS]	3,82	3,27
6.	I am unsure that I have ways to deal with climate change risks, when necessary (R)	3,55	2,82
7.	**I think I cannot find means to deal with climate change risks, when necessary. (R) ***	3,73	3,09
8.	**I think I have very limited options to cope with climate change risks, when necessary (R) ***	3,91	3,55
	Transformability		
1.	**Dealing with climate change risks can strengthen me. [CD-RISC] ***	4,09	3,36
2.	**I can also make my life better by dealing with climate change risks. ***	4,00	3,64
3.	**I can find new opportunities by adjusting to climate change risks.**	4,27	4,09
4.	**Dealing with climate change risks can make me grow as a person. [COPE]**	4,00	4,00
5.	**I can learn something good from dealing with climate change risks. [COPE]**	4,09	3,82
6.	**Dealing with climate change risks cannot make my life better. (R) ***	4,00	3,27
7.	When dealing with climate change risks I can at best repair damage (R)	3,45	2,73
8.	I cannot positively evolve by dealing with climate change risks (R)	3,64	2,82

Note. * = item rephrased based on specific comments given by experts; (R) = reverse-coded item. Items in bold were included in the final scale

APPENDIX B

Measures in Study 1 (from van Valkengoed, Perlaviciute & Steg 2021) and Study 3

Measure	Study 1	Study 3	Study 4
Climate change reality	1. I believe climate change is real 2. Climate change is not occurring 3. I do not believe that climate change is real	1. I Believe climate change is real	(Measure identical to Study 3)
Climate change negative affect	1. I worry about CC 2. I am concerned about climate change 3. When I think about climate change, I get distressed	When I think about climate change, I feel... ... distressed ... concerned ... paralyzed ... pessimistic ... angry	(Measure not included)
Climate change positive affect	(Measure not included)	When I think about climate change, I feel... ... hopeful ... optimistic	Additional item: ... confident
Climate change risk perception	Climate change poses a risk to: 1. Myself and my family 2. National economy 3. The environment 4. Public health	Climate change poses a risk to: 1. Myself and my family 2. National economy 3. The environment 4. Public health 5. My community	Selected items: 1. Myself and my family 2. National economy 3. The environment
Self-efficacy	1. I feel capable of taking actions aimed to protect myself and close others against the negative impacts of climate change 2. I am confident that I can take actions aimed to protect myself and close others from the negative impacts of climate change	(Identical measure to Study 1)	Additional item: 3. I trust that I can take actions aimed to reduce the negative impacts of climate change on myself and close others.
Outcome efficacy	1. My personal actions can be effective in protecting myself and close others from the negative impacts of climate change 2.My personal efforts can make a difference in protecting myself and close others from the negative impacts of climate change	(Identical measure to Study 1)	Additional item: 3. My own behaviours can help reducing the negative impacts of climate change on myself and close others.

Measure	Study 1	Study 3	Study 4
Local climate change policy support	To what extent do you oppose or support implementing the following policies in the United States? 1. Implementing heat warning systems in every city so that people can better protect themselves against heatwaves caused by climate change. 2. Investing public money to make vital infrastructure (for example, energy utilities, power lines, cell towers) more resistant to climate change risks. 3. Launching an awareness campaign that provides people with information on how to prepare for climate change risks. 4. Requiring cities to invest in protection against increases in flooding due to climate change. 5. Increasing funding for farmers to help them prepare for increases in flooding or drought.	To what extent do you oppose or support implementing the following policies in your municipality? 1. Implementing heat warning systems in every city so that people can better protect themselves against heatwaves caused by climate change. 2. Investing public money to make vital infrastructure (for example, energy utilities, power lines, cell towers) more resistant to climate change risks. 3. Launching an awareness campaign that provides people with information on how to prepare for climate change risks. 4. *Increase local taxes to invest in measures that protect people against potential natural hazards (for example, flooding) caused by climate change.* 5. *Invest public money in helping local farmers to prepare for increases in flooding or drought due to climate change.*	Additional items: 6. Increase local taxes to invest in changing the city infrastructure (for example, elevate houses to protect from flooding, or make city centres car free to plant trees and protect from heatwaves) 7. Change working hour schedules around hot weather during spring/summer (for example, working early morning and late afternoon/evening and rest during the day) 8. Lower taxes when climate change friendly infrastructure is implemented in your house (for example, if you have a green roof, a backyard with no tiles/stones, a rain harvesting system)
National Climate Change Policy Support	(Measure not included)	To what extent do you oppose or support implementing national policies aiming to protect US citizens from climate change risks?	(Measure not included)
Individual climate change adaptation behaviours	Have you recently performed the following behaviours to protect yourself from the risks of climate change? 1. Preparing a household emergency kit, containing for example a flashlight, a radio, emergency blankets, first aid kit 2. Adjusting my home to better withstand natural hazards, for example installing wind shutters against hurricanes or painting my house in a lighter colour to reduce heating. 3. Preparing an evacuation plan in the event of a natural hazard. 4. Storing bottled water and canned food in case a natural hazard occurs. 5. Purchasing insurance against losses from natural hazards. 6. Looking up information about whether my house is at risk of natural hazards. 7. Looking up information about what I can do to prepare for natural hazards. 8. Making sure that my home is maintained well to avoid damage from natural hazards, for example cleaning gutters and repairing the roof. 9. Actively checking and following weather forecasts.	To what extent do you intend to take the following measures to protect yourself against climate change risks within the next year? 1. Preparing a household emergency kit, containing for example a flashlight, a radio, emergency blankets, first aid kit 2. Adjusting my home to better withstand natural hazards, for example installing wind shutters or painting my house in a lighter colour to reduce heating. 3. Storing bottled water and canned food in case a natural hazard occurs. 4. Purchasing insurance against losses from natural hazards. 5. Looking up information about whether my house is at risk of natural hazards. 6. Looking up information about what I can do to prepare for natural hazards. 7. *Checking weather forecasts to be prepared for natural hazards, such as a heatwave or extreme rain.*	Additional items: 8. Shifting my diet to incorporate foods that are more resistant to and/or better suited for the changing climate in my area. 9. Setting up a relocation plan together with my household, in case climate change risks make it too dangerous to keep living in our current house. 10. Actively question and revise what I value, how I see the world and my daily habits as a response to climate change risks.

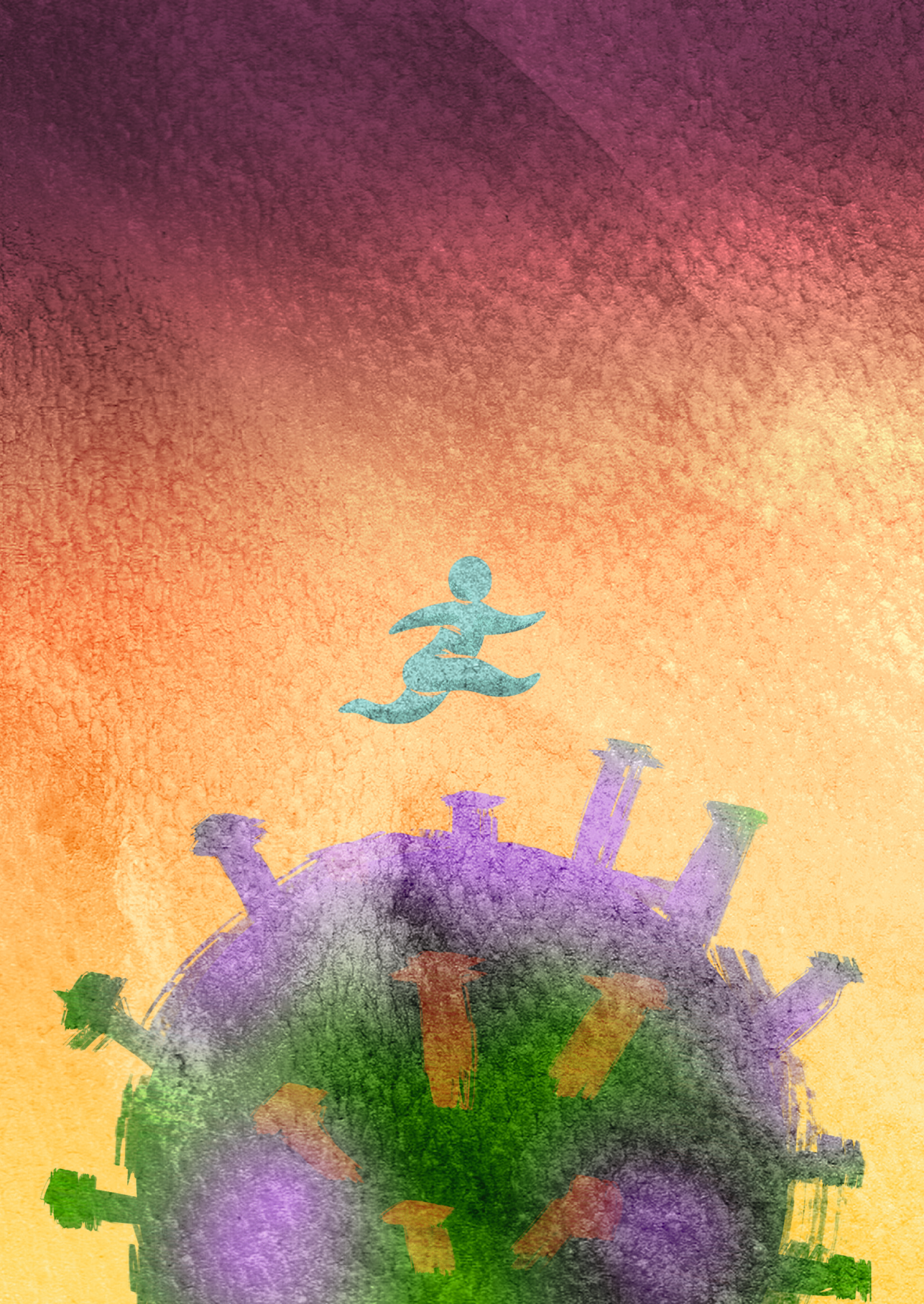
Measure	Study 1	Study 3	Study 4
Collective climate change adaptation behaviours	(Measure not included)	To what extent do you intend to take the following measures together with your community within the next year? 1. Contributing to the development of an evacuation plan in case of an emergency due to a natural hazard. 2. Motivating people in our neighbourhood to maintain their houses well to avoid damage from natural hazards caused by climate change. 3. Joining an app that allows to warn the people in our neighbourhood about a natural hazard, such as heatwave or extreme rainfall, and to check on their safety. 4. Considering and discussing a migration plan, in case climate change risks make it too dangerous to keep living in our area. 5. Joining a community initiative to make my neighbourhood greener to better protect against climate change risks, for example by planting trees, building green roofs or parks. 6. Helping my neighbours to prepare for natural hazards caused by climate change, for instance by sharing knowledge.	Selected items: 1. Joining an app that allows to warn the people in our neighbourhood about a natural hazard, such as heatwave or extreme rainfall, and to check on their safety. 2. Joining a community initiative to make my neighbourhood greener to better protect against climate change risks, for example by planting trees, building green roofs or parks. 3. Helping my neighbours to prepare for natural hazards caused by climate change, for instance by sharing knowledge.
Collective action	(Measure not included)	1. Participating in a demonstration in favour of climate change adaptation policies, namely policies aiming to protect people against climate change risks (adapted from van Zomeren et al., 2019). 2. Signing a petition to make climate change adaptation a priority in the national agenda (drawing on van Valkengoed & Steg, 2019).	Additional item: 3. Blocking roads while demonstrating in favour of accelerating climate change adaptation (adapted from van Zomeren et al., 2019).
Brief Resilience Scale (Smith et al., 2008)	(Measure not included)	1. I tend to bounce back quickly after hard times. 2. I have a hard time making it through stressful events. (R) 3. It does not take me long to recover from a stressful event. 4. It is hard for me to snap back when something bad happens. (R) 5. I usually come through difficult times with little trouble. 6. I tend to take a long time to get over set-backs in my life. (R)	(Identical measure to Study 3)

Measure	Study 1	Study 3	Study 4
Satisfaction with Life (Diener et al., 1985)	(Measure not included)	1. In most ways my life is close to my ideal 2. The conditions of my life are excellent 3. I am satisfied with my life 4. So far I have gotten the important things I want in life 5. If I could live my life over, I would change almost nothing.	(Identical measure to Study 3)
Positive Change derived from Climate Change (adapted from Cann et al., 2010)	(Measure not included)	(Measure not included)	To what degree did you experience the following changes as a result of being confronted with climate change risks in the last few years? 1. I am able to do better things with my life. 2. I know better that I can handle difficulties. 3. I have a greater appreciation for the value of my own life.
Climate Change Anxiety (Clayton & Karazsia, 2020)	(Measure not included)	(Measure not included)	Please rate how often the following statements are true for you: 1. Thinking about climate change makes it difficult for me to concentrate 2. Thinking about climate change makes it difficult for me to sleep 3. I have nightmares about climate change 4. I find myself crying because of climate change 5. I think, “why can’t I handle climate change better?” 6. I go away by myself and think about why I feel this way about climate change 7. I write down my thoughts about climate change and analyse them 8. I think, “why do I react to climate change this way?” 9. My concerns about climate change can make it hard for me to have fun with my family or friends 10. I have problems balancing my concerns about sustainability with the needs of my family 11. My concerns about climate change interfere with my ability to get work or school assignments done 12. My concerns about climate change undermine my ability to work to my potential. 13. My friends say I think about climate change too much.

Note. (R) = reverse scored item. Items in cursive are modifications of specific items in Study 1 that were included in Study 3, 4. Study 2 is not in the table as the measures (most of which had only 1 item) are all mentioned in the main text.

Supplementary information associated with Chapter 2 can be found online:

See also https://doi.org/10.1016/j.jenvp.2022.101947



3

Individual Transilience in the face of the COVID-19 Pandemic

ABSTRACT

Transilience, the perceived capacity to persist, adapt flexibly, and positively transform in the face of an adversity, is a promising construct for understanding human adaptation to climate change risks. However, the question remains wither transilience is also relevant for adaptation to other adversities. In this paper we investigate the role of transilience in the context of the COVID-19 pandemic, which posed a more urgent and acute threat to individuals compared to climate change. We conducted two studies in Italy and The Netherlands to examine whether people perceived transilience in the face of COVID-19 across different time points and countries, in which the severity of the pandemic and the government measures varied. Furthermore, we studied the relationship between transilience and adaptive responses, including individual and collective adaptation behaviours, cognitive coping, well-being, and positive personal change. The results suggest that people perceived transilience in the face of COVID-19, and that higher transilience promoted adaptive responses and mental health in the face of COVID-19 in the Netherlands, but not in Italy, where freedom to act was severely restricted. Moreover, longitudinal analyses indicate that transilience may be causally related to adaptive behaviours and well-being. These findings suggest that transilience may be a robust predictor of adaptive responses and well-being in the context of different adversities, although transilience may be less predictive in restrictive contexts. We discuss future research directions and theoretical implications.

Chapter 3 is based on:
Lozano Nasi, V., Jans, L., Steg, L. Individual Transilience in the Face of the COVID-19 Pandemic. [Manuscript currently under review]

3.1. INTRODUCTION

In March 2020, the World Health Organisation declared the rapid spread of the Coronavirus Disease 2019 (COVID-19), a deadly viral infection caused by a severe acute respiratory syndrome (i.e., SARS-Cov_2), as a global pandemic. The virus posed a severe threat to people's health. In many countries across the world, unprecedented containment measures (i.e., working remotely, national lockdowns, curfews, quarantine) were imposed to limit the spread of the virus and to avoid overloading healthcare systems. People needed to adapt to the novel situation by engaging in a series of new behaviours, such as keeping 1.5m distance, avoiding contact with others, working from home and sanitising hands regularly. Furthermore, the disruption caused by the pandemic and the consequences of the lockdowns (e.g., home schooling, working from home, unemployment, isolation) threatened people's well-being (Bridgland et al., 2021; O'Connor et al., 2020; Restubog et al., 2020; Zacher & Rudolph, 2021). Considering that pandemics are expected to keep happening in the future (Kretzschmar et al., 2022), it is crucial to understand which factors motivated people to take action to adapt to the COVID-19 pandemic and helped them to maintain well-being.

In this paper we investigate whether transilience, a novel construct that explains adaptation in the context of climate change (Lozano Nasi et al., 2023a; 2023b), is relevant also for understanding adaptation to the COVID-19 pandemic. Transilience reflects the perceived capacity to persist, adapt flexibly, and positively transform in the face of an adversity. Studies have shown that people perceive transilience in the face of climate change, and that the more strongly they do so, the more likely they are to engage in different types of climate change adaptation behaviours, and the higher their general well-being (Lozano Nasi et al., 2023a; 2023b). Notably, the risks posed by the COVID-19 pandemic were significantly more acute and directly threatening for individuals' lives compared to risks associated with climate change, especially during the initial stages of the pandemic. This raises the question whether transilience is also a relevant construct for understanding adaptation to acute and directly threatening adversities, like the COVID-19 pandemic. We aimed to investigate, first, whether people perceived transilience in the face of COVID-19. Next, we aimed to study whether higher transilience is positively associated with a wide range of adaptive responses in the face of the COVID-19 pandemic, as well as with mental health, despite contextual and situational differences in the acuteness of the threat posed by COVID-19 and in the national policies implemented to limit the spread of the virus. Studying the relevance of transilience in the face of this different adversity, and across different contexts and times in which the seriousness of the threat varies, will provide insight into the extent to which transilience is generalizable and relevant to understand human adaptation to (various) adversities.

Transilience: Beyond 'Bouncing Back' in the Face of Adversity

Transilience acknowledges that adapting to an adversity, such as climate change or a pandemic, may also imply changing for the better, thus doing more than merely 'bouncing back' by minimising harm (i.e., resilience; Bonanno et al., 2004; cf. Davoudi et al., 2013; Smith et al., 2010). Transilience is an overarching construct that comprises three key components: persistence, adaptability, and transformability (Lozano Nasi et al., 2023a).

Persistence reflects the extent to which people perceive they can persist and have the resources to cope and carry on in the face of an adversity, which is important to (at least) maintain and recover the status quo (i.e., to 'bounce back'; Bonanno, 2004; Smith et al., 2010). *Adaptability* reflects whether people perceive they can adapt flexibly and have a broad range of options to adapt to an adversity, which allows people to revise and switch strategies when needed. Such a flexible approach is important for long-term adaptation to an adversity, which may likely require a variety of responses (Barnes et al., 2020; Cinner et al., 2018; Linquiti & Vonortas, 2012). *Transformability* captures whether people perceive that they can positively transform by adapting to an adversity, for instance by learning something good. We propose that a stronger perception of one's capacity to carry on, to find multiple ways to adapt, and to change for the better by adapting, may increase the likelihood that people engage in concrete adaptation actions and show good mental health in the face of an adversity.

Indeed, historical analyses have shown that humans were able to not only persist and adapt flexibly, but also to thrive in the face of climate change in the past (see Degroot et al., 2021). There is also evidence that past pandemics, like the Black Death, have led to improvements both in prevention methods (e.g., the introduction of quarantine) and in medicine (Benedictow, 2004). Yet, the potential positive side of adapting to adversities, like contemporary climate change (IPCC, 2023) or the COVID-19 pandemic, has hardly been studied.

Based on this theorising, a climate change transilience scale was developed and tested to examine the relevance of transilience in the context of climate change. The results suggest that transilience is a relevant and valid construct for understanding adaptation in the face of climate change risks (Lozano Nasi et al., 2023a). Specifically, a series of studies indicated that transilience can be reliably assessed, and that people perceive they can be transilient in the face of climate change risks. The transilience scale further showed good psychometric properties in terms of concurrent and discriminant validity: transilience can be distinguished theoretically and empirically from related constructs for understanding adaptation, like self-efficacy, outcome efficacy, and resilience. Moreover, transilience was not negatively associated with perceived climate change

risks, indicating that higher transilience does not reflect denying or downplaying the threat posed by climate change.

Importantly, the transilience scale also showed good predictive validity: higher individual transilience increased the likelihood that people engaged in a wide range of adaptation behaviours, ranging from incremental (i.e., aiming to preserve the status quo, for example purchasing insurance) to transformative (i.e., aiming to challenge the status quo and finding new opportunities, for example shifting diets to incorporate crops that are more resistant to the changing climate; see also Wilson et al., 2020), and from individual (i.e. aiming to protect individual and their household) to collective (i.e., aiming to act within and for the interest of the local community, for example joining a community initiative to green the neighbourhood). Transilience was also positively related with general well-being and with experiencing personal positive change because of being confronted with climate change (Lozano Nasi et al., 2023a).

Overall, these findings indicate that people perceive they can do more than 'bounce back' in the face of climate change, and that higher transilience can encourage concrete adaptation actions and enhance mental health in the context of climate change risks. Yet, the question remains whether people perceive they can be transilient in the face of other adversities, such as the COVID-19 pandemic, and whether higher transilience increases the likelihood of adaptation behaviours and better mental health in the face of such adversities as well.

COVID-19 Pandemic: A Different Adversity

The risks posed by COVID-19 differ from the risks posed by climate change in several ways. First, the start of the COVID-19 pandemic was very sudden and represented an immediate, direct, and clear threat to individual personal health and survival. Instead, the potential consequences of climate change tend to be more gradual and cumulative (Fuentes et al., 2020; IPCC, 2022). The effects of COVID-19 on people's personal health were visible within a few days or weeks, while the severity of the risks posed by climate change may take longer periods of time to clearly manifest, particularly in western countries (IPCC, 2014a; Nath & Behera; 2011). As such, the context of the COVID-19 pandemic is useful to examine whether people perceive transilience when facing risks that are more immediate and sudden, and whether this in turn makes them more likely to engage in adaptive behaviours to protect themselves and to show better mental health.

We expect that people perceived they can persist, adapt flexibly, and positively transform in the face of COVID-19, even if this adversity was much more acute and its threat was much more direct compared to climate change risks. Notably, research

has shown that people report higher degrees of personal positive change (thus doing more than 'bouncing back') after facing serious personal adversities, including chronic health issues like cancer (posttraumatic growth; Carver & Antoni, 2004; Helgeson & Tomich, 2006) and childhood abuse (Hartley et al., 2016; Woodward & Joseph, 2003). Instead, we aim to test whether people perceived transilience *during* the emergency caused by COVID-19, when the risks were very acute and serious. Moreover, we aim to test to what extent higher transilience predicts a wide range of adaptive behaviours relevant in the face of COVID-19, including individual behaviours (i.e., actions aiming to protect people themselves, such as washing hands regularly), collective behaviours (i.e., actions aiming to protect and support others, such as educating others to take measures to limit the spread of COVID-19), and employing cognitive strategies to manage the emotions associated with the threat, such as making the best out of the situation (cognitive coping; Carver et al., 1989). Next, we aim to test whether higher transilience is related to better mental health, including subjective well-being and personal positive change derived from the confrontation with the COVID-19 pandemic (e.g., being better able to handle difficulties; Carver & Antoni, 2004).

Contextual and Situational Differences in the COVID-19 Pandemic

Interestingly, different countries were affected differently by the spread of COVID-19 and implemented different policies and measures to deal with the threat (Capano et al., 2020; Yan et al., 2020). Italy, for instance, was at the forefront of the COVID-19 outbreak in Europe and experienced one of the highest infection rates in the world during its initial stages (Bezzini et al., 2021). The virus had devastating consequences on people's health, overwhelming the national healthcare system, and resulting in thousands of deaths (WHO, n.d.). The situation in Italy was characterised by high levels of uncertainty and fear, as the virus was new and little was known about how to treat it (Bezzini et al., 2021). To address the emergency, the Italian government implemented strict lockdown measures, which prohibited personal mobility and most economic activities (see Masotti et al., 2022). In contrast to Italy, The Netherlands experienced a less severe impact of the pandemic and at a later stage in time (WHO, n.d.). Notably, by the time the virus began spreading in the Netherlands, more knowledge about the nature and the treatment of the COVID-19 disease was available based on the experiences of countries like Italy (Bastoni et al., 2021). Therefore, the Dutch national healthcare system faced somewhat less pressure, and there was a lower level of uncertainty about how to deal with the disease. The Dutch government implemented measures that allowed for some personal freedom of movement; besides, non-essential economic activities could continue under the so-called "intelligent lockdown" (Masotti et al., 2022), which was far less strict than the Italian lockdown. As the infection and death rates in The Netherlands increased over time, some additional measures were introduced, such as

the closure of restaurants and bars. However, these measures did not reach the same level of restrictiveness as in Italy (Bastoni et al., 2021; Masotti et al., 2022).

We expect that people perceived transilience in the face of COVID-19 and that higher transilience promotes adaptive responses, despite variations in the seriousness, severity, and acuteness of the pandemic, and despite different policy responses across different countries and time periods. As such, we propose that the relationship between transilience and relevant outcome variables will uphold even when levels of transilience and the other variables of interest differ across countries and time points.

Furthermore, studies so far have assessed the relationship between transilience and adaptation behaviour and well-being cross-sectionally (see Lozano Nasi et al., 2023a; 2023b). Extending this research, we aim to study these relationships across multiple time points to get a better insight into the causal relationship between transilience and adaptation behaviours and well-being. More precisely, we expect that transilience in the face of COVID-19 at a given time can predict relevant outcomes also later in time, reflecting that transilience can potentially play a causal role in predicting adaptive responses and mental health in the face of adversity.

An important question related to the generalizability of transilience is whether perceiving a strong capacity to adapt in one domain, such as COVID-19, is associated with a higher perceived adaptive capacity and intention to adapt in another domain, such as climate change. Some studies suggest that the confrontation with COVID-19 has made people more concerned about the risks of climate change (Ekinci & van Lange, 2023). The question remains whether transilience experienced in the face of COVID-19 might also make it more likely that people perceive a stronger ability and intention to adapt to climate change. This could suggest that higher perceived adaptive capacity (i.e., transilience) in one domain may enhance the perceived adaptive capacity across different adversities. We aim to explore this in the current paper.

The Present Research

Our aim is to examine whether transilience promotes a broad range of adaptive actions and indicators of mental health across different adversities, as well as across specific contexts and situations with varying levels of severity and acuteness of a threat. Specifically, we tested the following hypotheses:

H1) People perceived transilience in the face of COVID-19 pandemic, across different countries and time points, in which the acuteness and the severity of the COVID-19 pandemic differed.

H2) Higher transilience in the face of COVID-19 is associated with more adaptive responses (i.e., individual, and collective adaptation behaviours, cognitive coping) as well as with better mental health (i.e., well-being, and positive personal change) in the face of COVID-19 pandemic, even if the average levels of transilience and these outcome variables differ across countries and time points.

H3) Higher transilience at a given time point predicts more adaptation behaviours and higher well-being in the face of COVID-19 pandemic at a later time point.

We also explored whether higher transilience in the face of COVID-19 is associated with higher perceived adaptive capacity and intention to adapt in the face of climate change (as a result of confronting COVID-19).

We tested these hypotheses across two studies conducted during different stages of the first wave of the COVID-19 pandemic, when mortality rates, severe health consequences, and levels of uncertainty about treatment options were generally high (Coccia, 2021; Soriano et al., 2021). The first study employed a cross-sectional design and was conducted in Italy, a few weeks after the implementation of a highly restrictive national lockdown that prohibited personal movement and non-essential economic activities (commonly referred to as a 'hard' lockdown; Bastoni et al., 2021). The second study was conducted in the Netherlands, shortly after the country's first COVID-19 case was reported, when the Dutch government introduced measures which progressively limited personal mobility and economic activities to some degree (so-called 'soft' lockdown; Bastoni et al., 2021). This study employed a longitudinal design with two time points, where the second time point (T2) was characterised by higher severity and acuteness of the threat posed by the COVID-19 pandemic and more restrictive containment measures implemented by the Dutch government (i.e., the 'intelligent lockdown'; Masotti et al., 2022), compared to the first time point (T1). Both studies received ethical approval from the University of Groningen.

3.2. STUDY 1

Study 1 took place in Italy between April 28 and May 20, 2020, approximately 10 weeks after the country's first confirmed case of COVID-19 (Il Post, 2020). During this period, the number of weekly infections gradually decreased from around 14,000 to 4,500, and the number of deaths decreased from around 2,300 to 970 (WHO, n.d.). Additionally, the Italian government gradually relaxed the strict national lockdown (which started on March 4, 2020; Il Post, 2020) by reopening essential shops and by permitting people to leave their house alone to visit close family members within the same region or to do essential groceries; notably, people needed to carry an official declaration (to be

found on the website of the Italian government for download) stating the reasons for leaving the house, along with the address of departure and destination, which could be checked by the police (Il Post, 2020). Gatherings, even in small groups or outdoors, were forbidden. All non-essential public spaces, including restaurants, hair salons, and gyms, were still shut down. We examined whether Italians perceived transilience in the face of the COVID-19 pandemic, and we tested whether higher transilience is related to more adaptation behaviours, cognitive coping, positive personal change, and well-being.

Method

Participants and Procedure

We recruited a convenience sample of the Italian adult population via social media (e.g., Facebook, WhatsApp), the network of the research team and snowball sampling. A total of 190 participants consented to participate in our study. We excluded a total of 61 participants (32%) who either did not complete the transilience scale (n = 54) or completed the survey in under 3 minutes or over 2 hours (n = 7), which we considered unlikely to yield accurate responses (median completion time = 14 minutes). Hence, after data cleaning, 129 responses were retained for analyses (30% men and 70% women; M_{age} = 40.00; SD_{age} =13.40; see full overview of demographics in Supplementary Material). A post-hoc power analysis (G*Power: Faul et al., 2007) showed that we had sufficient statistical power (.97) to detect an effect of r = .30 (i.e., a medium effect). After consenting, participants answered a series of questions about the COVID-19 pandemic in Italian, including questions on perceived transilience and their adaptive responses.

Measures

Measures were assessed on a seven-point Likert-scale, ranging from 1 = *strongly disagree* to 7 = *strongly agree*, unless otherwise specified. See Table 3.1 for descriptive statistics and reliability coefficients. Appendix B provides an overview of all items.[18]

Transilience in the Face of COVID-19. We adapted the validated climate change transilience scale (Lozano Nasi et al., 2023a, 2023b), to the COVID-19 adversity. Specifically, before listing the 12 transilience items, we stated: 'The following questions are about how you think that being confronted with the risks of COVID-19 in Italy

18 Both studies were part of a larger project and also included measures of risk perception (all studies), number of known people who were infected with COVID-19 (all studies), emotions towards COVID-19 (all studies), common fate (all studies), entitativity (study 1 and study 2, time 2), efficacy beliefs (all studies), injunctive social norms (all studies), opinion about the national social norms (study 1 and study 2, time 2), trust in national institutions (all studies), perceived responsibility for limiting the spread of COVID-19 (all studies), identification with the local community, with people affected by COVID-19, with their national country and with people in the world (all studies), opinion about future measures to protect the population against COVID-19 (study 1 and study 2, time 2); perception of climate change risks (study 1 and study 2, time 2); and political orientation (study 1; study 2, time 1). These measures are not relevant for the purposes of the present manuscript and are therefore not discussed.

affects you'. Example items are: 'I can stay determined' (persistence); 'I think I can find multiple means to deal with this' (adaptability); 'I can grow as a person by dealing with this (transformability)'.[19]

Individual Adaptation Behaviours. Participants indicated to what extent they currently engaged in twelve individual behaviours to reduce the risks of COVID-19, on a scale from 1 = *not at all* to 7 = *very much*. We included a general item (i.e., 'I try to protect myself from the coronavirus'), and eleven specific behaviours either recommended by the World Health Organisation (e.g., 'I wash my hands regularly') or found in outlets about the COVID-19 pandemic (e.g., 'I avoid people from other countries/areas with corona infections').

Collective Adaptation Behaviours. Participants indicated to what extent they were currently engaging in five collective behaviours to adapt to the COVID-19 pandemic, such as protecting others from the virus, supporting others affected by it, or educating others to take measures to adapt ('e.g., I try to protect others from the coronavirus'). The scale ranged from 1 = *not at all* to 7 = *very much*.

Cognitive Coping. Participants reported their use of cognitive coping strategies, namely cognitive strategies to manage negative emotions (Lazarus, 1990). Two items reflecting opposite approaches were used, namely indicating positive reappraisal and behavioural disengagement (Lazarus, 1990; Carver et al., 1989): 'I try to make the best out of the situation' and 'I do nothing, because there is no point' (reverse scored). As the two items did not form a reliable scale ($r_{sb} < .60$), we only used the first item as a measure of cognitive coping, and report results on the second item for completeness.

Positive Personal Change due to the COVID-19 Pandemic. We asked participants to what extent they experienced five positive personal changes as a result of facing COVID-19 in Italy (e.g., 'It helped me become a better person'), on a scale from 1 = *not at all* to 7 = *very much*. Items were adapted from measures of post-traumatic growth (PTG) and benefit finding (McMillen & Fisher, 1998; Tomich & Helgeson, 2004).[20]

Well-being. General well-being was measured with the single item 'I am satisfied with my life' (from the Satisfaction with Life Scale; Diener et al., 1985).

19 We also examined whether a shorter version of the transilience scale (i.e., 6-items) performs equally well as the full scale, as such version can be of more practical use when there are space or time constraints. These results can be found in Appendix A and in the Supplementary Materials.

20 We also included the item 'It made me more aware of human vulnerability', which was not included in this scale as it does not indicate a positive change.

Climate Change Adaptive Capacity (due to COVID-19). We asked participants to indicate their level of agreement with the following item: 'Due to COVID-19, I think I am more resilient in the face of the serious consequences of climate change'.[21] We focused on resilience as this term is more easily understood by people than the term 'transilient', and resilience is a key component of transilience (i.e., the persistence component).

Climate Change Adaptation Intentions (due to COVID-19). We asked participants to indicate their agreement with the following item: 'Due to COVID-19, I intend to engage in measures to address the negative consequences of climate change'.[22]

Results and Discussion

We used R (version 4.1.2) and Jamovi (The Jamovi Project, 2022; version 2.3) for the analyses. Using the *psych* package (Revelle, 2022), we examined the mean scores of all measures. Table 3.1 shows that the mean score for transilience were above the midpoint of the scale (M_{diff-4} = 1.12, $t(128)$ = 12.01; d = 1.06; $p < .001$). This indicates that respondents, on average, perceive that they can persist, adapt flexibly, and positively transform in the face of COVID-19, supporting hypothesis 1.

We used the custom function *corstars* (Bertolt, 2008) to calculate bivariate correlations between all relevant variables (see Table 3.1). As expected, the more strongly participants perceived transilience, the more positive personal changes they experienced due to the COVID-19 pandemic, with a large effect size (i.e., above 0.40; Lovakov & Agadullina, 2021). Yet, contrary to our expectations, higher perceived transilience did not increase the likelihood that people engage in individual or collective adaptation behaviours and in cognitive coping, nor that they display higher levels of general well-being. Thus, we found little support for hypothesis 2. Interestingly, the more people perceive transilience in the face of COVID-19, the more they perceive they are resilient in the face of climate change due to having faced COVID-19, with a medium effect size (i.e., above 0.24; see Table 3.1). Yet, higher transilience in the face of COVID-19 did not increase the intention to adapt to the negative consequences of climate change. The weak and non-significant relationships between transilience and adaptive responses (i.e., adaptive behaviours and well-being) may be due to the severity of the restrictions imposed by the Italian government at the time of this study, which seriously limited people's freedom to act.

21 This scale initially included two additional items, which we excluded from the analyses: 'I think Italians are more resilient in the face of the serious consequences of climate change' was excluded as we focus on perceived adaptive capacity at the individual level. Moreover, 'I am confident that I can adapt to the serious consequences of climate change' was excluded as it did not correlate strongly with the other item (i.e., $r < .30$, $p < .01$).

22 The scale included the item 'I think Italy should take measures as soon as possible to adapt to the serious consequences of climate change', which we excluded from the analyses as it does not reflect individual adaptation intentions.

Table 3.1. Descriptive Analyses, Reliability and Bivariate Correlations between the Measures included in Study 1

	M	*SD*	α	ω_t	1	2	3	4	5	6	7	8
1. Transilience	5.12	1.06	.92	.94								
2. Individual adaptation behaviours	5.91	0.99	.87	.91	-.04							
3. Collective adaptation behaviours	5.05	1.24	.77	.83	.16	.59***						
4. Cognitive coping	5.92	1.31			.11	.28**	.21*					
5. Positive personal change	4.63	1.38	.85	.90	.45***	.03	.26**	.07				
6. Well-being	5.39	1.21			.16	-.11	-.12	.09	.21*			
7. CC adaptive capacity	3.95	1.89			.30***	-.04	.13	.01	.61***	.25**		
8. CC adaptation intentions	5.47	1.49			.05	-.06	.08	-.16	.13	.09	.25**	
9. Disengagement	1.85	1.33			.01	-.34***	-.28**	-.33***	-.03	-.09	-.02	-.10

Note. M = mean; *SD* = standard deviation; α = Cronbach's alpha; ω_t = McDonald's omega; CC = Climate Change
*p < .05; **p < .01; ***p < .001

3.3 STUDY 2

Study 2 was conducted in The Netherlands over two time points. In April 2020, Italy recorded 115,242 infections and 13,915 deaths, while The Netherlands had only 16,627 infections and 1,651 deaths (WHO, n.d.). The Netherlands, being somewhat better prepared for the pandemic, had a healthcare system that was less overwhelmed by patients (Hoekman et al., 2020). Moreover, the Dutch government implemented less restrictive measures that had a smaller impact on personal freedom and daily life (Masotti et al., 2022). Thus, the Dutch context offered a distinct setting to test our hypotheses, with lower levels of emergency associated with COVID-19 and individuals having greater freedom and more control over their behaviour, compared to Italy.

Data for Time 1 (T1) was collected between March 11 and March 22, 2020. The number of infections (from around 800 to around 6000 weekly cases, WHO, n.d.), as well as the number of deaths (from around 9 to around 500 weekly deaths, WHO, n.d.) increased considerably during this period in the Netherlands. The Dutch government issued that all non-essential economic activities, such as restaurants, schools, gyms, and cafes, had to remain closed (so-called 'intelligent lockdown'; DutchNews, 2020). Working from home was strongly advised, meetings of more than 100 people were forbidden, yet it was allowed to go outside and meet in small groups, with the strong advice of keeping a 1.5m distance. Data for Time 2 (T2) was collected between April 6 and April 15, 2020, shortly after stricter social distancing measures were introduced. These

measures prohibited gatherings of more than three people, required shops to enforce a 1.5m distance, and made working from home mandatory for most organisations (DutchNews, 2020). As such, the Dutch measures were less restrictive than those implemented by the Italian government during the same period. The number of daily deaths increased until reaching a peak around April 7 (i.e., 230; WHO, n.d.; DutchNews, 2020). Afterwards, both the death and the infection rates seemed to flatten for the first time since the start of the pandemic (WHO, n.d.). As such, the severity and acuteness of the threat posed by the COVID-19 pandemic was worse and the containment measures implemented were more restrictive at T2, compared to T1.

We again examined whether people perceived transilience in the face of COVID-19. Next, we tested whether higher perceived transilience is related to more individual and collective adaptation behaviours, cognitive coping, personal positive change, and well-being in the Dutch context, where people had more freedom compared to Italy. We also wanted to probe the robustness of transilience as a predictor of adaptation behaviours and well-being over time. First, we examined whether the relationships between transilience and relevant outcome variables were similar at both time points, even though the absolute levels of the variables may differ. Second, to gain some insight in causality, we tested whether transilience at T1 predicts adaptation behaviours and well-being also at T2.

Method

Participants and Procedure

We invited a random sample of the Dutch adult population to participate in our study via Panel Inzicht, a professional online research panel in The Netherlands (https://panelinzicht.nl). A total of 497 participants consented to participate in our longitudinal study and filled in our survey at T1, of which 364 also filled in the questionnaire at T2. We excluded a total of 62 participants (12.5%) at T1 and 32 participants (9%) at T2 based on the following criteria. First, we removed participants who did not complete the transilience scale, our main variable of interest (n = 33 at T1; n = 3 at T2). Next, we excluded participants who completed the survey in less than 3 minutes or more than 2 hours (n = 25 at T1; n = 23 at T2) as we considered their responses unlikely to be accurate (median completion time: T1 = 8.5 minutes; T2 = 11 minutes). Also, we removed duplicated IP addresses (n = 4 at T1; n = 6 at T2). Thus, a total of 435 responses were retained for the analyses at T1 (46.7% identified as men; < 1 % identified as 'other'; M_{age} = 52.00; SD_{age} = 19.00), and 332 responses were retained for T2 (46.4% identified as men; < 0.5 % identified as 'other'; M_{age} = 54.00; SD_{age} = 18.00). The final merged dataset, which we used for the longitudinal analyses, contained a total of

321[23] responses (47% identified as men; < 0.5% identified as 'other'; M_{age} = 54.00; SD_{age} = 18.00; see all demographic information for T1, T2 and the merged dataset in Supplementary Material). A post-hoc power calculation (G*Power; Faul et al., 2007) showed that with these samples we had a power of .99 to detect a medium-to-large correlation (r = .30) and a power of higher than .99 to detect a medium effect (f = .25) with a repeated-measures design with one group and two measurement levels. After consenting, participants responded to the relevant questions in Dutch.

Measures

The full list of items is provided in Appendix B. At T2, the measures were identical to Study 1. Specifically, we assessed transilience in the face of COVID-19 (12 items), individual and collective adaptation behaviours, general well-being, cognitive coping, positive personal change derived from COVID-19, climate change adaptive capacity and climate change adaptation intentions (both due to COVID-19). For all measures we referred to 'the Dutch' and 'The Netherlands' instead of 'Italians' and 'Italy'. In comparison to Study 1 and T2, T1 included fewer measures and a few different items, to keep the survey short and secure a high response rate. More precisely, at T1 we assessed transilience in the face of COVID-19, collective adaptation behaviours and general well-being as in Study 1 (thus cognitive coping, positive personal change, and the measures related to climate change were not included). The individual adaptation behaviours scale was slightly different at T1: it included the item 'I call the doctor if I have early symptoms' (which was recommended at that time, but later was no longer recommended to avoid saturating the healthcare facilities), instead of the item 'I keep 1.5m distance' (which was not yet recommended officially). Descriptive statistics and reliability coefficients are provided in Tables 3.2- 3.4.

Results and Discussion

Perceived Transilience and Relationships with Relevant Outcomes at T1

Table 3.2 shows that at T1 the mean scores for transilience were above the midpoint of the scale ($M_{diff\text{-}4}$ = 0.94, $t(434)$ = 20.57; d = 0.99; p < .001), indicating that on average Dutch respondents perceived they can persist, adapt flexibly, and positively transform in the face of COVID-19, supporting hypothesis 1. Notably, and contrary to Study 1, the more people perceived transilience in the face of COVID-19, the more likely they were to engage in individual and collective adaptive behaviours, and the higher their general well-being, with a medium-to-large effect (i.e. .24 < r < .45; Lovakov & Agandulina, 2021), supporting hypothesis 2.

23 We cleaned the datasets for T1 and T2 separately, before creating the merged dataset. As such, the merged dataset only includes responses from people who answered accurately at both T1 and T2. The fact that the merged dataset contains less participants than the dataset at T2 indicates that some respondents responded accurately at T2, but not at T1. We calculated bivariate correlations for all separate datasets (T1, T2, and merged), whereas we ran the longitudinal analyses only with the merged dataset.

Table 3.2. Descriptive Analyses, Reliability Coefficients and Correlations between Measures in Study 2, T1 (n = 435)

	M	*SD*	α	ω_t	1	2	3
1. Transilience	4.94	0.95	.91	.94			
2. Individual adaptation behaviours	4.95	0.94	.82	.86	.31***		
3. Collective adaptation behaviours	4.64	1.17	.80	.82	.42***	.62***	
4. Well-being	5.56	1.28			.33***	.18***	.17***

Note. *M* = mean; *SD* = standard deviation; α = Cronbach's alpha; ω_t = McDonald's omega.
*p < .05; **p < .01; ***p < .001

Perceived Transilience and Relationships with Relevant Outcomes at T2

Table 3.3 shows the correlations between transilience and all relevant variables at T2. Again, people perceived transilience in the face of COVID-19 ($M_{diff\text{-}4}$ = 1.23, $t(330) = 23.74$; $d = 1.30$ $p < .001$), and higher transilience was associated with more individual and collective adaptation behaviours and with higher well-being, as at T1, supporting hypothesis 2. As in Study 1, higher transilience was associated with higher levels of personal positive change derived from the confrontation with COVID-19. Contrary to Study 1, yet in line with our expectations, higher transilience was associated also with more cognitive coping. Furthermore, higher transilience was associated with higher perceived resilience in the face of climate change (due to COVID-19) and, contrary to Study 1, also with higher intention to adapt to climate change (due to COVID-19). Again, the effects were medium-to-large (i.e., .24 < *r* < .45; Lovakov & Agandulina, 2021).

All in all, the cross-sectional results from the Dutch sample show that higher transilience in response to COVID-19 is associated with increased engagement in individual and collective adaptation behaviours, more cognitive coping, higher well-being, and more positive change, regardless of the differences in the severity of the threat of the pandemic and the implemented measures across time points. It is likely that in Study 2, higher transilience did promote adaptive responses due to the less restrictive context in The Netherlands during the study period, where individual had greater freedom compared to Italy during the time of Study 1. In such situations, psychological factors such as transilience may be more likely to exert influence on people's choices and actions (cf. Guagnano et al., 1995; cf. Stern, 2000).

Table 3.3. Descriptive Analyses, Reliability and Bivariate Correlations between the Measures included in Study 2, T2 (n = 332)

	M	*SD*	α	ω_t	1	2	3	4	5	6	7	8
1. Transilience	5.23	0.94	.92	.94								
2. Individual adaptation behaviours	5.90	0.75	.87	.91	.42***							
3. Collective adaptation behaviours	5.36	1.01	.77	.83	.46***	.57***						
4. Well-being	5.53	1.26			.26***	.16**	.16**					
5. Cognitive coping	6.32	0.98			.43***	.59***	.45***	.26***				
6. Positive personal change	4.36	1.27	.88	.91	.49***	.25***	.34***	.12*	.13*			
7. CC adaptive capacity	3.92	1.67			.25***	.15**	.24***	.10	-.06	.51***		
8. CC adaptation intentions	4.18	1.69			.25***	.27***	.34***	.05	.08	.40***	.60***	
9. Disengagement	2.26	1.83			-.08	-.19***	-.05	.00	-.31 ***	.15**	.26***	.12*

Note. *M* = mean; *SD* = standard deviation; α = Cronbach's alpha; ω_t = McDonald's omega; CC = climate change. *p < .05; **p < .01; ***p < .001

Transilience Predicting Adaptation Behaviours and Well-being across time points

Table 3.4 shows the bivariate correlations between all relevant variables for T1 and T2 (based on the merged dataset). Interestingly, people seem to perceive transilience more strongly at T2 compared to T1 (M_{diff} = 0.28, $t(320) = 5.11$; $d = .29$ $p < .001$). The positive relationship between transilience and adaptation behaviours and well-being, respectively, seemed to be robust across both time points (see Tables 3.2, 3.3, 3.4). To formally test this, we conducted three linear mixed models using the Gamlj module (Gallucci, 2019) in Jamovi. In each model, transilience measured at both time points, time, and their interaction were included as predictors; individual adaptation behaviours, collective adaptation behaviours and well-being from both time points were included as outcome variables, respectively. Subjects were included as random effects to account for the within-subject correlation of the data. Transilience (ICC = .45) was centred at the grand mean. Time was coded according to simple code (T1 = - 0.5; T2 = 0.5) to get the average effect of transilience over the outcome variables across time points. To limit chances of type I error, we applied the Bonferroni correction and adjusted the significance level to p < .016 (i.e., .05/3).

As shown in Table 3.5, time had a main effect on all outcome variables, indicating that the average engagement in individual and collective behaviours significantly

increased over time, while the average levels of general well-being significantly decreased. Transilience had a positive main effect on all three outcomes, suggesting that higher levels of transilience, on average, were associated with higher engagement in individual and collective behaviours and with higher levels of well-being across both time points. We did not find a significant interaction between transilience and time for any of the outcome variables, indicating that the relationship between transilience and the outcomes was similar across time points, corroborating hypothesis 2.

Transilience at T1 predicting Adaptation Behaviours and Well-being at T2

As shown in Table 3.4, transilience at T1 was significantly and positively correlated with all relevant outcome measures at T2, providing some preliminary indication that transilience may cause adaptative responses also later in time. We ran three additional mixed models to formally test whether initial levels of transilience can cause relevant outcomes later in time, again using the Gamlj module (Gallucci, 2019). In each model, transilience measured at T1, time, and their interaction were included as predictors, whereas individual adaptation behaviours, collective adaptation behaviours, and well-being, measured at both T1 and T2, were included as outcome variables, respectively. Again, subjects were included as random effect, and transilience was centred at the grand mean. For these analyses, time was dummy-coded (T1 = 0; T2 = 1) to represent the two time points of data collection and to get the main effect of transilience for the reference level (i.e., T1), as the model included an interaction term. Again, we adjusted the significance level to $p < .016$ (i.e., 05/3) using Bonferroni correction to limit the chances of type I error.

As shown in Table 3.5, individual and collective behaviours significantly increased between T1 and T2. Furthermore, the interaction between T1 transilience and time was significant for individual adaptation behaviours and well-being, but not for collective adaptation behaviours. Thus, while T1 transilience had a similar positive relationship with collective adaptation behaviours both at T1 and T2, the effect of T1 transilience on individual adaptation behaviours and well-being appears to decrease significantly over time. Still, simple slope analyses showed that T1 transilience was positively and significantly related to individual adaptation behaviours (T2: *b(SE)* = .18(.05); $t = 3.76$, $p < .001$) and well-being at T2 (T2: *b(SE)* =.24(.07); $t = 3.39$, $p < .001$), although less strongly than at T1. In addition to the interaction, transilience had a main effect on well-being, whereas the main effect of time on well-being became non-significant due to the significant interaction (see Table 3.5). Overall, we found that transilience measured at T1 had a positive main effect on all three outcomes at T2, suggesting that higher levels of transilience at T1 are also associated with more individual and collective behaviours and with higher levels of well-being at T2. As such, these results provide preliminary evidence that transilience may predict adaptation behaviours and well-being at a later stage in time too, although with only two waves of data collection we cannot make robust causal claims.

Table 3.4. Descriptive Analyses, Reliability and Bivariate Correlations Between the Measures Included in the Merged Dataset (T1 & T2; n = 321)

	M	*SD*	α	ω_t	1	2	3	4	5	6	7	8	9	10	11	12
1. Transilience T1	4.96	0.96	.91	.94												
2. Individual adaptation behaviours T1	4.94	0.97	.82	.86	.31***											
3. Collective adaptation behaviours T1	4.63	1.16	.80	.82	.40***	.62***										
4. Well-being T1	5.63	1.26			.31***	.16**	.15**									
5. Transilience T2	5.24	0.93	.92	.95	.48***	.29***	.27***	.22***								
6. Individual adaptation behaviours T2	5.91	0.73	.77	.86	.24***	.64***	.38***	.19***	.39***							
7. Collective adaptation behaviours T2	5.35	1.00	.75	.78	.38***	.40***	.52***	.14*	.44***	.55***						
8. Well-being T2	5.54	1.26			.19***	.06	.09	.72***	.24***	.12*	.14*					
9. Cognitive coping T2	6.35	0.95			.32***	.35***	.28***	.23***	.42***	.57***	.45***	.22***				
10. Positive personal change T2	4.35	1.27	.88	.91	.27***	.28***	.33***	.06	.48***	.23***	.33***	.10	.13*			
11. CC adaptive capacity T2	3.89	1.68			.14*	.17**	.22***	.11*	.26***	.15**	.23***	.10	-.04	.52***		
12. CC adaptation Intentions T2	4.17	1.69			.19***	.25***	.28***	.10	.23***	.25***	.33***	.04	.08	.39***	.61***	
13. Disengagement	2.19	1.78			-.04	-.11*	-.05	-.09	-.08	-.22***	-.08	.00	-.31***	.16**	.24***	.10

Note. *M* = mean; *SD* = standard deviation; α = Cronbach's alpha; ω_t = McDonald's omega; CC = Climate Change.
*p < .05; **p < .01; ***p < .001

Table 3.5. Results of the mixed model analyses conducted to test the effect of transilience on behaviours and well-being across time points

Predictor	Individual adaptation behaviours				Collective adaptation behaviours				Well-being			
	b(SE)	95% CI for *b*	*t*	*p*	*b*(SE)	95% CI for *b*	*t*	*p*	*b*(SE)	95% CI for *b*	*t*	*p*
Intercept	5.43 (.04)	5.35; 5.51	135.13	<.001	4.99 (.05)	4.90; 5.08	107.03	<.001	5.59 (.06)	5.46; 5.71	89.03	<.001
Time	0.90 (.04)	0.82; 0.98	21.19	<.001	0.60 (.06)	0.49; 0.72	9.94	<.001	-0.16 (.05)	-0.26; -0.05	-2.99	.003
Transilience	0.23 (.03)	0.17; 0.30	7.17	<.001	0.41 (.04)	0.33; 0.49	9.80	<.001	0.26 (.04)	0.17; 0.34	5.80	<.001
Transilience* time	-0.06 (.05)	-0.15; 0.04	-1.20	.232	0.01 (.07)	-0.12; 0.15	0.21	.833	-0.09 (.06)	-0.22; 0.03	-1.52	.129

Table 3.6. Results of the Mixed Model Analyses conducted to Test the Effect of Transilience at T1 on Relevant Outcomes across time points

Predictor	Individual adaptation behaviours				Collective adaptation behaviours				Well-being			
	b(SE)	95% CI for *b*	*t*	*p*	*b*(SE)	95% CI for *b*	*t*	*p*	*b*(SE)	95% CI for *b*	*t*	*p*
Intercept	4.94 (.05)	4.85; 5.03	107.91	<.001	4.63 (.06)	4.52; 4.74	83.06	<.001	5.63 (.07)	5.49; 5.76	82.79	<.001
Time	0.97 (.04)	0.88; 1.05	23.35	<.001	0.72 (.06)	0.60; 0.84	12	<.001	-0.09 (.05)	-0.19; 0.01	-1.71	.088
Transilience_T1	0.31 (.05)	0.22; 0.40	6.51	<.001	0.49 (.06)	0.37; 0.60	8.37	<.001	0.40 (.07)	0.27; 0.54	5.72	<.001
Transilience_T1* time	-0.13 (.04)	-0.22; -0.05	-3.04	.003	-0.09 (.06)	-0.21; 0.03	-1.48	.140	-0.16 (.05)	-0.27; -0.06	-3.04	.003

3.4. GENERAL DISCUSSION

The COVID-19 pandemic posed a significant threat to people's health and well-being and disrupted daily lives, forcing individuals to adapt in a short amount of time. In this paper we aimed to understand whether transilience, reflecting the perceived capacity to persist, adapt flexibly and positively transform in the face of an adversity, is relevant in the context of adaptation to the COVID-19 pandemic. Transilience has been found to make people more likely to engage in adaptive behaviours and to show higher levels of well-being in the context of climate change risks (Lozano Nasi et al., 2023a). We studied whether similar patterns can be found in the context of the COVID-19 pandemic, which, compared to climate change risks, posed a much more acute and immediate threat to people's lives. Across one cross-sectional study in Italy and one longitudinal study in the Netherlands, we investigated whether people perceive transilience in the face of COVID-19, and whether higher transilience is positively related to adaptive responses and well-being across different countries and time points, despite varying levels of the threat posed by the pandemic and differences in the containment policies that were implemented by the relevant national government. Next, we tested whether transilience is causally related to adaptation behaviours and well-being. Furthermore, we explored whether higher transilience in the face of COVID-19 is associated with higher perceived adaptive capacity and intention to adapt to climate change, due to the confrontation with COVID-19.

People Perceive Transilience in the Face of COVID-19

First, we found support for Hypothesis 1: people, on average, perceived transilience across different countries (Italy and The Netherlands) and time points (in The Netherlands), despite differences in the severity and acuteness of the threat posed by the COVID-19 pandemic. Previous research has shown that people perceive they can do more than just 'bounce back' (i.e., maintain or recover the status quo; Bonanno, 2004) in the face of climate change, and that they see possibilities for positive change as well (Lozano Nasi et al., 2023a). We consistently found that people, on average, perceived they can persist, adapt flexibly, and positively transform in the face of COVID-19 as well. These results suggest that people perceive transilience even when facing an acute, immediate, direct, and clear threat to individual personal health and survival, as experienced during a pandemic. Such a threat is rather different from climate change risks, which, especially in western countries, tend to be associated with more gradual and cumulative risks (IPCC, 2014c; Nath & Behera, 2011; Poortinga et al., 2022).

Importantly, our findings indicate that people perceived they can persist, adapt flexibly, and positively transform across contexts with varying degrees of severity and

acuteness posed by the COVID-19 pandemic. People reported perceived transilience in Italy, which was the first country in Europe hit by the pandemic and had significant morbidity and mortality rates (Bezzini et al., 2021; Masotti et al., 2022), and in the Netherlands, where the effects of the pandemic were comparatively less severe and the country had more time to prepare (Bastoni et al., 2021). Notably, individuals in The Netherlands perceived transilience both at the onset of the pandemic and later in time, when the situation worsened. Thus, our research shows that people perceive they can do more than 'bounce back' and see opportunities for positive change in the face of adversities other than climate change risks, even when the threats are very acute and severe, and even when the levels of threat differ across specific contexts and time points.

The Relationship Between Transilience and Adaptive Responses May be Context Dependent

Second, we found partial support for Hypothesis 2. As expected, in the Dutch sample, higher transilience was associated with more individual and collective adaptation behaviours, cognitive coping, higher levels of general well-being, and experiencing more personal positive change because of the pandemic. These results were consistent across different time points, despite variations in average levels of the variables. However, in the Italian sample, higher transilience was only associated with experiencing more personal positive change, while transilience was not significantly related to individual and collective adaptation behaviours, cognitive coping, and well-being. Overall, our findings indicate that perceiving higher levels of transilience may be linked to a wide array of adaptive responses and better mental health, with some relationships consistent across time points and others consistent across different countries, although this seems to depend on the context examined. The positive association between transilience and cognitive coping, however, was supported only at T2 of Study 2.

The lack of significant relationships in Italy between transilience and individual and collective adaptation behaviours, cognitive coping, and well-being may be attributed to the highly restrictive measures imposed by the Italian government during our study period. These policies severely limited individuals' freedom and choices regarding their behaviour and potential strategies for maintaining well-being, resulting in a particularly constraining environment. It is likely that due to such dominant and limiting contextual factors, psychological factors like transilience did not play a strong role in predicting adaptation behaviours and well-being. In The Netherlands, instead, where the government responses were relatively less restrictive and allowed for greater freedom, psychological factors like transilience could play a more prominent role and promote adaptation behaviours and general well-being. These results are in line

with the A-B-C model (Guagnano et al., 1995; Stern, 2000), which suggests that the relationship between psychological factors and behaviour depends on the level of contextual constraints, with psychological factors being less predictive of behaviour when contextual constraints are high (in which case people cannot act in line with their motivations and beliefs) or when contextual constraints are very low (in which case everyone would engage in the behaviour anyway). Further research is needed to investigate how contextual factors moderate the relationship between perceived transilience and adaptive responses and well-being, respectively. This could shed light on the conditions under which transilience is particularly likely to predict adaptive actions and mental health and provide a more nuanced understanding of its relevance for human adaptation in the face of different adversities.

Transilience may play a Causal Role in Predicting Behaviours and Well-being

Third, we found preliminary support for Hypothesis 3. In our longitudinal study in the Netherlands, we found that transilience at T1 significantly predicted individual and collective adaptation behaviours and well-being also at T2, suggesting that transilience can potentially cause adaptation behaviours and well-being. These results suggest that the extent to which people perceive transilience at a given time may influence the likelihood that they engage in adaptation behaviours and affect their well-being at a later stage, provided that the context is not too restrictive. However, more research is needed to corroborate this claim. Specifically, longitudinal studies spanning across at least three waves allow for more robust conclusions on the causal relationships over time. Next, experimental studies can also be conducted to establish whether transilience causes adaptive responses and well-being.

Transilience in the Face of COVID-19 may also Enhance Adaptive Capacity in The Face of Climate Change

Our exploratory findings suggest that higher transilience in the face of COVID-19 was associated with higher perceived resilience in the face of climate change (Study 1; Study 2, T2) and with higher intention to adapt to the consequences of climate change (Study2; T2) due to the confrontation with the COVID-19 pandemic.[24] These results indicate that the more strongly people perceive transilience in the face of COVID-19, the more likely it is that dealing with COVID-19 enhances their perceived adaptive capacity (i.e., resilience) and their intention to adapt to the negative consequences of climate change. These findings suggest that because of being confronted with a certain adversity (e.g., COVID), people may perceive higher transilience in general, which, in turn, may influence their perceived adaptive capacity and adaptation intentions across other adversities. Importantly, this proposal needs to be thoroughly tested in future

24 Notably, all findings remained consistent across both studies when using a shorter, six-item version of the transilience scale (see details in Appendix A and Supplementary Materials).

studies. Such studies could examine whether people indeed can perceive general transilience (i.e., in the face of 'adversity' without further specification), and if this can in turn predict adaptive responses and mental health across different specific types of adversities (e.g., climate change risks, other epidemics, personal trauma).

Limitations and Future Research

Our research has some limitations that can be addressed in future studies. First, our studies focused on Italy and The Netherlands, which had varying levels of severity and preparedness during the COVID-19 pandemic. Yet, the question remains whether similar findings would emerge in other countries, facing different threats and having different political systems. Future research could aim to replicate our findings in countries with different healthcare systems, government policies, and resources. In this regard, it is crucial to include samples from non-WEIRD (Western, Educated, Industrialised, Rich, and Democratic) countries, which may have responded to the pandemic differently. For example, the African continent exhibited unexpectedly low rates of mortality and disease despite limited resources and high vulnerability (Maeda & Nkengasong, 2021). Replicating our study in such distinct contexts would not only allow to validate the robustness of transilience, but also provide insights into contextual factors that may influence the relationship between transilience, adaptive responses, and mental health. These factors may likely encompass local and personal resources, as well as prior experiences with similar risks (cf. Cinner & Barnes, 2019). Exploring transilience across diverse contexts and cultures is important for comprehending the conditions under which transilience can foster adaptive responses and well-being in the face of pandemics and other adversities.

While our research aimed to capture a wide range of adaptive responses, including individual and collective adaptation behaviours, well-being, and personal positive change, future research could explore additional relevant outcome variables. Specifically, future studies could consider examining transformative behaviours that better align with the essence of transilience, namely going beyond mere 'bouncing back'. Such transformative behaviours could involve actively challenging and reshaping the existing dynamics within local healthcare systems, for example advocating for meaningful engagement of marginalized communities in the design and delivery of health interventions, along with identifying and dismantling barriers to equitable access to care (Haldane & Morgan, 2021; King et al., 2020). Additionally, political forms of collective action, such as protesting or lobbying for healthcare reforms, could provide valuable insights as they typically advocate for radical changes at the system level (Van Zomeren & Iyer, 2009).

The study designs used in our research have some limitations that can be addressed in future research. Study 1 was cross-sectional, thus hindering causal inferences about the relationships between transilience and relevant outcomes, and the possibility to test our hypotheses over time. Study 2, while longitudinal, only had two time points, and some outcome measures (e.g., personal positive change, cognitive coping) were measured only at time 2. This prevented the possibility to probe the robustness of the relationships across time for all relevant outcome variables, and to make solid claims about causal relationships. As such, future research could include multiple time points and consistently measure all relevant variables, or use experimental designs. Besides, some measures (i.e., general well-being, cognitive coping, climate change adaptive capacity, climate change adaptation intentions) were assessed with only one item, which may result in measurement error and limit the precision of estimates. To increase the reliability of the measures and the validity of the conclusions, future research could ensure the use of multi-item measures.

Practical Implications

The findings of our research also have important implications for practice. Given our findings that transilience may make people more likely to engage in adaptive responses and to display higher levels of general well-being in the face of COVID-19, strengthening transilience may be an effective strategy to encourage people to adapt to pandemics, which are likely to occur again in the future (Kretzschmar et al., 2022), and to other adversities. As such, it is important to find ways to boost individuals' capacity to persist, adapt flexibly and positively transform in the face of adversities.

A plausible way to enhance transilience may be emphasising how people have persisted, adapted flexibly, and changed for the better thanks to the COVID-19 pandemic (e.g., development of new hobbies and interests; find innovative ways of working that are more in alignment with personal needs; more awareness about personal physical and mental health; Ogueji, 2022). This approach is consistent with the idea that both information about one's previous accomplishments (i.e., mastery experience; Bandura; 1989; 1997) and the observation of others' performance (i.e., vicarious learning; Bandura, 1997) may increase people's perceived capacity to achieve specific tasks (i.e., their self-efficacy; Bandura, 1997). Thus, it is plausible that reflecting on one's own and others' transilience in the face of the COVID-19 pandemic may foster individuals' perception of their capacity to persist, adapt flexibly and positively transform in the face of current and future pandemics, and other adversities as well. Additionally, based on our exploratory findings that transilience in one domain may enhance adaptive capacity in another domain, it may be that interventions that aim to promote transilience in general (i.e., in the face of adversities or challenges in general) can enhance adaptation and well-being across different domains, thus be

more effective than interventions focusing on promoting domain-specific transilience. Yet, more research is needed to test whether such a strategy is effective.

In conclusion, our results show that transilience can be relevant for understanding adaptation beyond the context of climate change risks. Specifically, people perceived transilience also in the face of the COVID-19 pandemic, across contexts with varying levels of severity and acuteness posed by the threat of the pandemic. Furthermore, the more strongly individuals perceive transilience, the more likely they are to engage in adaptive behaviours and to display higher levels of general well-being in the face of COVID-19, provided that the contextual factors do not seriously restrict people's actions. All in all, our research sheds light on the human capacity to adapt and thrive in the face of different environmental adversities, offering a positive and promising outlook on how humanity can confront and even evolve in the face of both present and future challenges.

APPENDIX A

6-items version of the Transilience Scale

We acknowledge that, in certain research settings, it may not be practical or desirable to use a scale with 12 items due to time or resource constraints. In those cases, we recommend using the six items version of the Transilience scale (see Table A1 below), including the items that best capture our definition of the three dimensions of transilience (i.e., persistence, adaptability, and transformability) while maintaining high levels of internal consistency (see Supplementary Material).

We ran again all the analyses for both Study 1 and Study 2 using the 6-items version of the transilience scale. The results remain almost identical to those found with the overall 12-items scale (see details in Supplementary Material). As such, the 6-items scale showed similar performance to the 12-item scale. The advantage of the short transilience scale is its ease of inclusion in studies that aim to minimize questionnaire length without significantly compromising scale validity. However, if transilience is a crucial aspect of the study, and if precise measurement accuracy is desired, we recommend using the 12-items version of the scale

Table A1. 6-items version of the Transilience Scale, recommended in case of studies that aim to minimize questionnaire length without significantly compromising scale validity. We recommend using the 12-items version to maximise measurement accuracy.

	Persistence
1.	I can be persistent.
2.	I can stay determined.
	Adaptability
3.	I think I can take different actions to deal with this.
4.	I believe I can find multiple means to deal with this.
	Transformability
5.	I can grow as a person by dealing with this.
6.	I can learn something good by dealing with this.

APPENDIX B

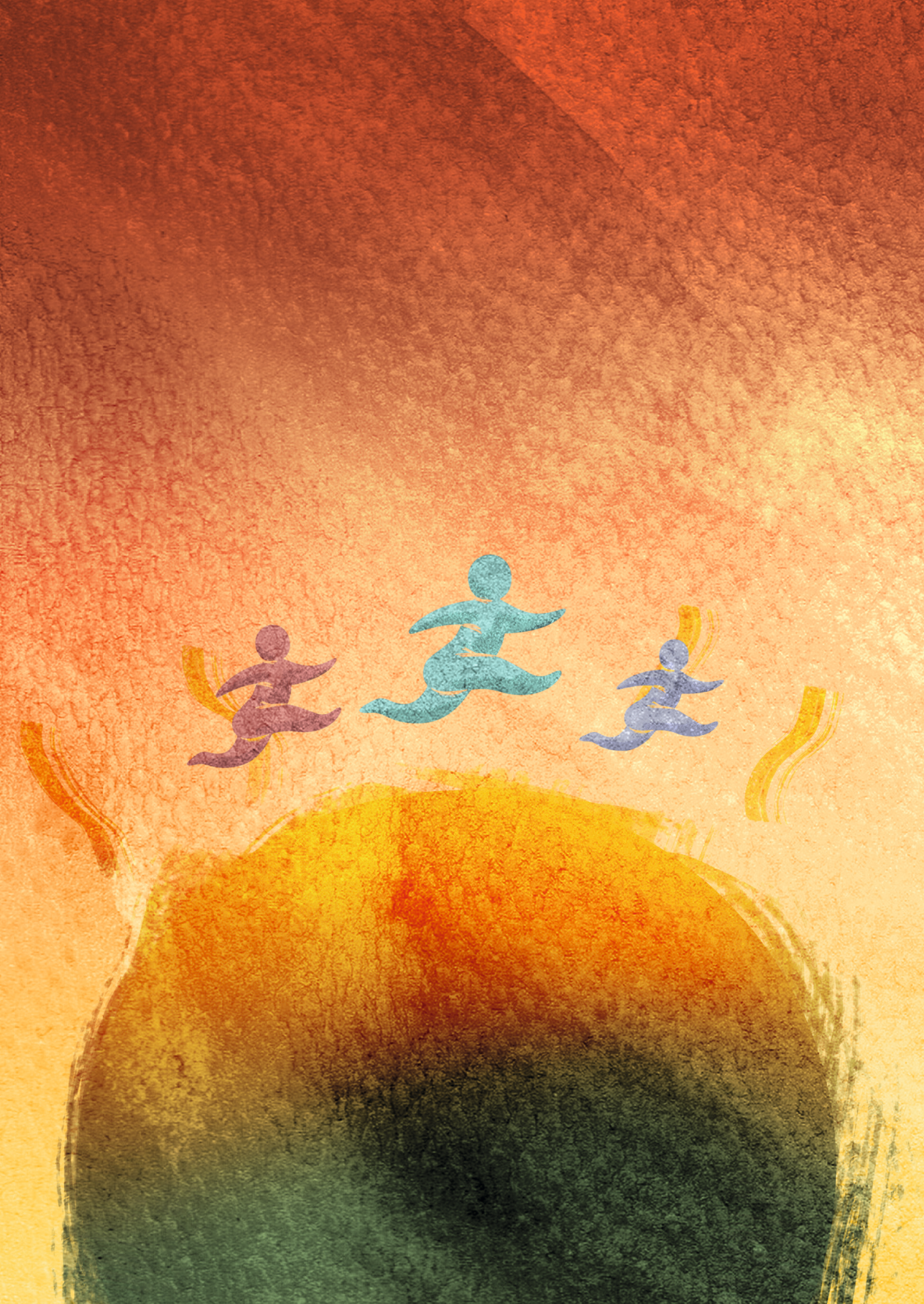
Full List of Measures Included in Study 1 and Study 2

Measure	Study 1 / Study 2 (T2)	Study 2 (T1)
Transilience in the face of COVID-19	The following questions are about how you think that the confrontation with the risks of coronavirus in Italy / in The Netherlands affects **you**. To what extent do you agree with the following statements? 1. I can be brave 2. I can be persistent 3. I can stay determined 4. I can remain strong-willed 5. I think I can take different measures to deal with this 6. I think I have several options to deal with this 7. I think I can find multiple means to deal with this 8. There are different ways I can deal with this 9. Dealing with the stress this causes can strengthen me 10. Dealing with this can have additional benefits for me 11. By dealing with this I can grow as a person 12. I can learn something good by dealing with this	(Identical measure)
Individual adaptation behaviours	The following statements are about the measures that can be adopted to limit the spread of coronavirus. To what extent do you currently engage in the following measures? 1. I wash my hands regularly 2. I sneeze and cough in my elbow 3. I use paper tissues 4. I don't shake hands *5. I keep 1.5m distance from others* 6. I wear a mask 7. I try to stay at home as much as possible 8. I stockpiled for basic products (e.g., toilet paper) 9. I stay home if I have early symptoms 10. I follow the news about COVID-19 in Italy / in the Netherlands 11. I avoid people from infected areas/countries 12.I try to protect myself from COVID-19	Identical measure, except item 5 that was replaced by: *5. I call the doctor if I have symptoms of COVID-19*

Measure	Study 1 / Study 2 (T2)	Study 2 (T1)
Collective adaptation behaviours	The following statements are about the measures that can be adopted to limit the spread of coronavirus. To what extent do you currently engage in the following measures? 1. I educate others to take measures against COVID-19 2. I support those negatively affected by COVID-19 3. I work with others to protect our community from COVID-19 4. I talk a lot to others about COVID-19 in Italy/ in the Netherlands 5. I try to protect others from COVID-19	(identical measure)
Cognitive coping	To what extent do you currently engage in the following measures? 1. I try to make the best out of the situation	(measure not included)
Positive Personal Change derived from the COVID-19 pandemic	The following statements regard the impact that COVID-19 has on your life: Dealing with COVID-19 in Italy / in The Netherlands... 1. ...helped me value more my direct environment 2. ...helped me become a better person 3. ...helped me set different priorities 4. ...made me more resilient 5. ...helped me deal better with stress and problems	(measure not included)
Well-being (Diener et al., 1985)	1. I am satisfied with my life	(identical measure)
Climate change adaptive capacity	The following questions are about the impact that COVID-19 has on your perception of other risks. To what extent do you agree with the following statements? Due to COVID-19... 1. ... I think I am more resilient in the face of the serious consequences of climate change	(measure not included)
Climate change adaptation Intentions	The following questions are about the impact that COVID-19 has on your perception of other risks. To what extent do you agree with the following statements? Due to COVID-19... 1. ... I intend to engage in measures to address the serious consequences of climate change	(measure not included)
Disengagement	To what extent do you currently engage in the following measures? 1. I do nothing, because there is no point	(measure not included)

Note. The measures included in Study 1 were translated into Italian, whereas the measures included in Study 2 were translated into Dutch.

Supplementary information associated with Chapter 3 can be found online:



4

Collective Transilience in the face of Climate Change

ABSTRACT

Climate change is happening and has negative impacts on communities. To adapt to climate change risks, people need to take action to protect, not only themselves, but also their community. We study whether collective transilience predicts community-based adaptation, such as joining a community initiative to protect the community from climate change risks. Collective transilience reflects the extent to which people perceive they can persist, adapt flexibly, and positively transform as a community in the face of climate change. Two studies (in the United States and The Netherlands) showed that, as expected, higher collective transilience is associated with increased engagement in different examples of community-based adaptation, even when controlling for individual transilience (the perceived capacity to persist, adapt flexibly, and positively transform in the face of climate change as an individual). Notably, collective transilience was the only significant predictor of individual adaptation behaviours, corroborating the relevance of examining transilience at the collective level to promote widespread adaptation. Theoretical and practical implications are discussed.

Chapter 4 is based on:
Lozano Nasi, V., Jans, L., & Steg, L. (2023). Do I perceive that We as a Community can Persist, Adapt Flexibly and Positively Transform? The relationship between Collective Transilience and Community-Based Adaptation. [Accepted Manuscript]. *Global Environmental Psychology*. https://doi.org/10.23668/psycharchives.13163

4.1. INTRODUCTION

Climate change poses various risks for communities in specific ways. For instance, in the United States, inhabitants of a coastal area in the North-East face increased rainfall and sea-level rise, while those living in the South-West face risks of droughts and wildfires (Clayton et al., 2016). There is an increasing interest in understanding climate change adaptation at the community level (McNamara & Buggy, 2017; Schlingmann et al., 2021). Studies have provided insights on the vulnerabilities, adaptive capacities, and adaptation strategies of specific communities (e.g., Ahmed, 2021; Cinner et al., 2018; Galappaththi et al., 2020; Mees et al., 2019; Nguyen & James, 2013; Truelove et al., 2015; Ziervogel et al., 2022), as well as on community resilience in the face of climate change (Carmen et al., 2022; Fazey et al., 2018; Ensor, 2016; Faulkner et al., 2018; Ntontis et al., 2018). Yet, little is known about what encourages people to engage in concrete actions to protect their community from climate change risks. Community-based adaptation behaviours reflect actions within and in the interest of one's community, such as helping others prepare for natural hazards, joining initiatives to purchase sandbags or replacing concrete and tiles with greenery (i.e., trees and bushes) for flood protection, sharing knowledge, developing measures to protect one's community from climate-related hazards, and supporting local climate adaptation policies.

Research on how to motivate climate change adaptation behaviours has mainly focused on individual behaviours that people can take to protect themselves and their household from climate change risks (van Valkengoed & Steg, 2019a, 2019b). We aim to extend this research by studying a) to what extent people (intend to) engage in community-based adaptation behaviours; b) which factors predict community-based adaptation behaviours, and whether these differ from what has been found to promote individual adaptation behaviours. Specifically, we studied to what extent collective transilience, reflecting the extent to which people perceive they, as a community, can persist, adapt flexibly, and positively transform in the face of climate change risks, can predict community-based adaptation responses. We elaborate on our reasoning below.

Individual Transilience and Adaptation to Climate Change

Transilience was proposed as a novel way to assess individuals' perceived adaptive capacity in the face of climate change (Lozano Nasi et al., 2023). It acknowledges that humans may be able to change for the better by adapting to climate change, and thus do more than 'bounce back' by maintaining or recovering what they had (as captured by psychological resilience; Bonanno et al., 2004; Smith et al., 2010). Transilience

comprises three key components: persistence, adaptability, and transformability (Lozano Nasi et al., 2023).

Persistence reflects the extent to which people perceive they can persist and have the resources to cope and carry on in the face of climate change risks, which is important to (at least) maintain and recover the status quo (i.e., to 'bounce back'; Bonanno, 2004; Smith et al., 2010). *Adaptability* reflects whether people perceive they can adapt flexibly and have a broad range of options to adapt to climate change risks, which allows people to revise and switch strategies when needed. Such a flexible approach is important for long-term climate change adaptation, which likely requires a variety of responses (Barnes et al., 2020; Cinner et al. 2018; Linquiti & Vonortas, 2012). *Transformability* captures whether people perceive they can positively transform by adapting to climate change, for instance by learning something good. Although prominent definitions of climate change adaptation explicitly refer to "finding new opportunities" (IPCC, 2014a, 2014b), this positive side of climate change adaptation has remained under-investigated. Importantly, historical analyses have shown that humans were able to not only persist and adapt flexibly, but also thrive in the face of past examples of climate change (Degroot et al., 2021). For instance, during the Little Antique Ice Age (sixth century AD) and the Little Ice Age (thirteenth to nineteenth century AD), communities responded to climate change by introducing new and better economic practices, technologies, customs, and traditions (Degroot et al., 2021). Although the current rates of global warming are unprecedented (IPCC, 2022), it is plausible that present climate change adaptation also implies challenging and improving the status quo (e.g., finding new ways and exploiting new opportunities; cf. Davoudi et al., 2013; IPCC, 2023).

Individual transilience is theoretically and empirically distinct from related constructs like self-efficacy, outcome efficacy and resilience, and it is generally found to be positively associated with climate change risks, indicating that higher transilience does not reflect denying or downplaying climate change risks (Lozano-Nasi et al., 2023). Higher individual transilience predicts individual and some community-based adaptation behaviours, although the latter not consistently (Lozano-Nasi et al., 2023). Perhaps, protecting the community from climate change risks requires not only perceiving transilience at the individual level, but also at the community level.

Collective Transilience and Community-Based Adaptation

We define collective transilience as individuals' perception that they, *as a community*, can be transilient in the face of climate change risks. Hence, collective transilience does not reflect the aggregate of individual transilience within a community, but rather the extent to which an individual perceives that their community (including

themselves) can persist, adapt flexibly, and positively transform in the face of climate change risks (cf. Bandura, 2000). It follows that community-based adaptation, which implies that people act for and within the interest of their community, is more likely when collective transilience is high, as individual transilience may not be sufficient to promote adaptation at the community level (cf. Chen, 2015; cf. Van Zomeren et al., 2008, 2010). Our proposal is in line with the compatibility principle (Ajzen, 2020), which states that constructs are more strongly related when they are assessed at the same level of specificity. Yet, collective transilience might also predict individual adaptive actions, as these may contribute to protecting one's community in some cases (e.g., greening one's own backyard can help protect the neighbourhood from heatwaves and flooding; Lennon et al., 2015).

Perceptions of collective efficacy, namely the perceived ability of a community to achieve specific goals (Bandura, 1998), have been found to promote community-based adaptation behaviours. For example, people report stronger intentions to address drinking water scarcity when they believe their community can ensure an adequate drinking water supply (Thaker et al., 2016). We aim to expand upon previous studies by investigating whether collective transilience, which captures the perceived adaptive capacity of the community beyond the pursuit of specific goals, and that comprises of flexibility and the possibility of positive change, can predict different types of community-based adaptive actions across different contexts (i.e., can be a 'general antecedent' of community-based adaptation; cf. Van Valkengoed et al., 2022). It remains an empirical question whether people can perceive collective transilience and whether such general perceived adaptive capacity can translate into concrete actions and intentions. We expect that the more strongly people perceive collective transilience, the more likely they are to engage in different types of community-based adaptive actions (Hypothesis 1). Furthermore, in line with the compatibility principle (Ajzen, 2020), we expect collective transilience to be more strongly related to community-based adaptation behaviours (compared to individual transilience), and individual transilience to be more strongly related to individual adaptation behaviours (compared to collective transilience; Hypothesis 2). Next, although both collective and individual transilience may reflect the perceived capacity to adapt to climate change, we expect that collective transilience is uniquely related to community-based adaptive action when controlling for individual transilience (Hypothesis 3).

The Present Research

We conducted two studies to test our reasoning. In Study 1, a correlational study among a US sample, we examined whether people perceive collective transilience. We also examined whether they (intend to) engage in community-based adaptation behaviours that aim to protect the local community they live in. Next, we tested whether higher

collective transilience is associated with more community-based adaptation intentions and behaviours and higher support for local adaptation policies (Hypothesis 1). We also explored the relationship between collective transilience and individual adaptation behaviours and intentions, such as checking weather forecasts.

Study 2 was conducted in the neighbourhood of Stadshagen, in Zwolle, The Netherlands, where a community initiative was launched to encourage residents to make their neighbourhood more climate adaptive. As in Study 1, we examined whether people perceive collective transilience. Next, we examined whether people intend to engage in community-based adaptation behaviours, and whether higher collective transilience is associated with stronger community-based adaptation intentions, including interest to join the community initiative (Hypothesis 1). Additionally, we examined whether collective transilience, compared to individual transilience, is more strongly related to community-based adaptation intentions and less strongly related to individual adaptation intentions (Hypothesis 2). Finally, we examined whether collective transilience is uniquely related to community-based adaptation intentions when individual transilience is controlled for (Hypothesis 3). Both studies were approved by the Ethical Committee of Psychology of the University of Groningen.

4.2. STUDY 1

Method

Participants and Procedure

We recruited participants from the US population via Amazon MTurk (a crowdsourcing platform), a convenient sample to initially test our hypotheses. To ensure good quality of the data, only participants with a high reputation were allowed to participate in our study (i.e., > 90% approval rate; Peer et al., 2014). Participants were randomly assigned to the present study or a parallel study on individual transilience; 197 participants consented for the present study, and received 1 USD compensation. We removed one duplicated IP address and one participant who failed the attention check question (where we asked participants to select the option '6' on a 7-point scale). We excluded 10 participants who completed the survey within 2.5 minutes, as it was unrealistic to accurately fill in the questionnaire in such a short time (median completion time = 6.2 minutes). Thus, 185 responses were retained for analyses (60.5 % identified as men; M_{age} = 36.6; SD_{age} = 10.9; detailed demographics provided in the Supplementary Material). A post-hoc power calculation (G*Power; Faul et al., 2007) showed that we had a power of .90 to detect a small-to-medium effect for correlations (r = .20) with this sample.

After consenting, participants indicated to what extent they agreed with the statement: 'I believe climate change is real' (Van Valkengoed, Perlaviciute & Steg, 2021), as we assume that people who deny climate change cannot provide meaningful answers concerning the capacity to adapt to climate change. None of the participants denied the reality of climate change, and people generally perceived climate change as a serious risk to their community (M = 5.69, SD = 1.33; see Appendix B). Participants then completed questions about collective transilience, climate change risks, and climate change adaptation.

Measures

Measures were assessed on a Likert-scale, from 1 = *strongly disagree* to 7 = *strongly agree*, unless otherwise specified. Measures for individual and community-based adaptation behaviours, including adaptation policy support, were developed based on literature (van Valkengoed & Steg, 2019b; Reser & Swim, 2011) and in consultation with experts on climate change adaptation. Descriptive statistics and reliability coefficients are provided in Table 4.1 (full list of items in Appendix B).

Collective Climate Change Transilience. We asked participants to what extent they perceive they can persist, adapt flexibly, and positively transform as a community, bearing in mind the negative consequences that climate change can have for their community. We adapted the individual transilience scale (Lozano Nasi et al., 2023a), by replacing the pronouns "I" and "me" with "we" and "us", respectively. As a result, collective transilience captures the interdependent perspective of community members on the adaptive capacity of their community (cf. Bandura, 1998; 2000).

Community-based Adaptation Intentions and Behaviours. We asked participants to what extent they intend to engage in six adaptation behaviours together with their community *within the next year* (e.g. 'Motivating people in our neighbourhood to maintain their houses well to avoid damage from natural hazards caused by climate change'). Participants rated the items on a scale from 1 = *not at all* to 7 = *very much*. We also included the option 8 = *I already did it*, which we used to compose a measure of community adaptation behaviour. We calculated the behaviour score by counting, for each participant, the number of behaviours for which '8' was selected. We calculated scores on the intentions scale by averaging the scores on the intention items for those behaviours that were not already implemented (after converting '8' to 'missing').

Support for Local Adaptation Policies. We asked participants to what extent they would support the introduction of five climate change adaptation policies in their municipality (e.g., 'Investing public money to make vital infrastructure (for example,

energy utilities, power lines, cell towers) more resistant to climate change risks'), on a scale from 1 = *strongly oppose* to 7 = *strongly support*.

Individual Adaptation Intentions and Behaviours. Participants indicated to what extent they intend to engage in seven adaptation behaviours to protect themselves against climate change risks within the next year (e.g., 'Preparing a household emergency kit, containing for example a flashlight, a radio, emergency blankets, first aid kit'). The response and the procedure to create a behaviours and intentions scale was the same as for community-based adaptation.

Results and Discussion

We conducted our analyses using R (version 4.1.2) and Jamovi (version 2.2). We first confirmed content, concurrent, and discriminant validity of the collective transilience scale (see Supplementary Material). Next, using the *psych* package (Revelle, 2019), we examined the mean scores of all measures. As shown in Table 4.1, on average respondents perceived they can be transilient as a community (i.e., mean scores above the midpoint of the scale). On average, they also supported local adaptation policies and intended to engage in individual adaptation behaviours. Respondents were less likely to engage in community-based adaptation behaviours than in individual adaptation behaviours (M_{diff} = 0.66; $t(175) = 6.46$; $p < .001$; $d = .49$). While participants on average had engaged in at least one individual adaptation behaviour, the majority (i.e. 141 participants, reflecting 76.2% of our total sample) had not engaged in any community-based adaptation behaviours (M_{diff} = 1; $t(184) = 7.20$; $p < .001$; $d = .53$).

We used the custom function *corstars* (Bertolt, 2008) to calculate bivariate correlations between all variables (Table 4.1). As expected, the higher perceived collective transilience, the more participants intended to engage in community-based adaptation behaviours and the more they would support local adaptation policies, with a medium effect (i.e., above 0.24; Lovakov & Agadullina, 2021). Unexpectedly, collective transilience was not significantly related to community-based adaptation behaviours. This may be explained by the lack of variance in community-based adaptation behaviour. Certain behaviours we assessed may not have been feasible in some communities; notably, we were unable to check this, as we did not ask in which community participants lived. Interestingly, higher collective transilience was related with stronger individual adaptation intentions and behaviours, with a medium effect size (see Table 4.1).

Table 4.1. Descriptive Analyses, Reliability Coefficients, and Correlations between Measures included in Study 1

	M	*SD*	α	ω_t	1	2	3	4	5
1. Collective transilience	5.61	0.80	.91	.92					
2. Community-based adaptation intentions	4.17	1.95	.95	.95	.26***				
3. Community-based adaptation behaviours	0 [a]	1.30			.13	.38***			
4. Local policy support	5.38	1.03	.79	.85	.33***	.35***	.17*		
5. Individual adaptation intentions	4.83	1.52	.88	.92	.24**	.72***	.29***	.38***	
6. Individual adaptation behaviours	1.55	2.03			.32***	.02	.43***	.15*	.09

Note. [a] = median; * p < .05, ** p < .01, *** p < .001; *M* = mean; *SD* = standard deviation; α = Cronbach's alpha; ω_t = McDonald's omega

4.3. STUDY 2

Study 2 took place in the neighbourhood of Stadshagen in Zwolle (a city in the North-East of The Netherlands), where the community initiative SensHagen was established (https://senshagen-zwolle.opendata.arcgis.com). This initiative asks residents to install a sensor in their backyard to collect data on climate change consequences (precipitation, evaporation, heat, and wind). The municipality will use this data to map local climate risks and decide on adaptation policies and measures to reduce these risks. Joining the SensHagen initiative can be considered a proxy of community-based adaptation, as residents take an action (i.e., installing the sensors) that contributes indirectly to protecting their neighbourhood from the risks of climate change.

We first examined whether participants perceive collective and individual transilience. Next, we tested whether collective transilience is positively associated with community-based adaptation (H1), including a more positive evaluation of the SensHagen initiative (reflecting public support for the project, which is an indicator of behaviour, cf. Stern, 2000; Perlaviciute & Steg, 2014), a higher interest to join the initiative, a stronger intention to support the initiative (e.g., by motivating others to join the initiative), and more information seeking about the initiative. Furthermore, we tested whether higher transilience is associated with stronger community-based adaptation intentions not specifically related to SensHagen (e.g., using a neighbourhood app to warn neighbours about heatwaves and check on their safety). Again, we explored the relationship between collective transilience and individual adaptation intentions. Next, we tested whether collective transilience, compared to individual transilience, is more strongly related to community-based adaptation intentions and less strongly to individual adaptation intentions (H2). Furthermore, we tested whether collective transilience

predicts unique variance in community-based adaptation intentions when controlling for individual transilience (H3).

Study 2 included an experimental manipulation aiming to strengthen collective transilience, to test whether this would in turn promote community-based adaptation intentions. We hypothesised that emphasising that climate change poses risks to the community of Stadshagen (e.g., 'Climate change poses a risk to *us, residents of Stadshagen*') would lead to higher levels of collective transilience, compared to emphasising the risks posed by climate change only to the individual (e.g. 'Climate change poses a risk to *you and your household*'). This hypothesis was based on research showing that when people are reminded that they are facing a certain threat *as a group* (i.e. they perceive common fate, that it is "us" against the threat; Drury, 2018), they are more likely to show collective resilience and to engage in actions that serve the interests of the group (as opposed to individual interests; Drury, 2018; Drury et al., 2019; Ntontis et al., 2020). Yet, we found no difference between the two conditions, neither in collective transilience ($F(1, 288) = 0.11$; $p = .740$), nor in any of the community-based or individual adaptation intentions (see Appendix A). Therefore, we conducted the analyses without considering these conditions as separate groups.

Method

Participants and Procedure

Data was collected in collaboration with the municipality of Zwolle among inhabitants of Stadshagen, thus among members of the community that could join the SensHagen initiative. Via a panel of residents in Stadshagen, a total of 1250 residents were invited to fill in an online survey, of which 456 consented to participate and filled in our questionnaire (response rate = 36.5%) at least partially. Participants were not yet members of the SensHagen initiative, and were unlikely to know about it, although we did not formally verify this. From the initial sample, 158 participants were removed as they did not fill in the collective and/or the individual transilience scale. The final sample consisted of 298 participants (59% identified as men; $M_{age} = 49.40$; $SD_{age} = 13.30$; see more demographic information in Supplementary Material). A post-hoc power analysis (G*Power; Faul et al., 2007) showed that we had a power of .95 to determine a medium effect (i.e., $r = .30$ for correlations, $f^2 = .15$ for a multiple regression), thus we had enough participants to test our hypotheses.

After consenting, participants read a short text on the climate change risks and the need for climate change adaptation in StadsHagen (i.e., the experimental manipulation, which was not effective, as explained above), followed by a short description of the SensHagen initiative (see full text in Appendix A). Participants then completed questions about the SensHagen initiative, adaptation intentions, and individual and

collective transilience, respectively. While we did not formally assess belief in climate change reality, on average participants indicated they believe that climate change poses a risk to the community of Stadshagen (*M* = 4.67, *SD* = 1.66 on a 7-point scale; see Appendix B). Participants on average identified with the community of Stadshagen to some extent (*M* = 4.27; *SD* = 1.49, based on the single item 'I identify with the residents of Stadshagen' (Postmes et al., 2013), with response scale 1 = *strongly disagree* to 7 = *strongly agree*), indicating that 'the community of Stadshagen' was meaningful for participants to some extent.

Measures

Measures were assessed on a scale from 1 = *strongly disagree* to 7 = *strongly agree*, unless otherwise specified. Measures for individual and community-based adaptation intentions were again developed based on the literature and consultation with experts on climate change adaptation from academia and the municipality of Zwolle. Descriptive analyses and reliability coefficients are presented in Table 4.2. See full list of items in Appendix B.

Individual and Collective Transilience. We slightly adapted the individual transilience scale (Lozano Nasi et al., 2023a) and the collective transilience scale of Study 1. Specifically, in the introductory text, we made explicit that the items referred to the risks of flooding and heatwaves in Stadshagen, hence we did not repeat the risks in every item (e.g., 'I can be brave' replaced 'I can be brave in the face of climate change risks'). This made the items more concise and easier to read for participants. In the case of collective transilience, we included the community (i.e., 'residents of Stadshagen') in each of the items (e.g., 'We, residents of Stadshagen, can be brave').

Evaluation of the SensHagen Initiative. Participants responded to the question 'I think the SensHagen project is...' on three scales, ranging from 1 = *a very bad idea* to 7 = *a very good idea*; 1 = *totally not relevant* to 7 = *totally relevant*; and 1 = *totally unacceptable* to 7 = *totally acceptable,* respectively (adapted from Liu et al., 2020).

Interest to Join the SensHagen Initiative. We measured interest to join the SensHagen initiative with three items (e.g., 'I am interested in the SensHagen project'; adapted from Sloot et al., 2019).

Intentions to Support the SensHagen Initiative. We measured intentions to support SensHagen with two items (e.g., 'I am planning to motivate other inhabitants of Stadshagen to participate in the SensHagen project'; adapted from Sloot et al., 2019).

Information Seeking about the SensHagen Initiative. Participants indicated whether they wanted to receive a link to the SensHagen website at the end of the survey, by answering either 1 - *yes* or 2 - *no*. The link was provided to all participants at the end of the survey because the survey platform used (Enalyzer) did not allow for selective distribution based on participant responses. Furthermore, we could not verify whether participants clicked on the link, which implies this measure is not a true behavioural measure.

Community-based Adaptation Intentions. We asked participants to what extent they intend to engage in six community-based adaptation behaviours *within the next year*. We aimed to capture a broad range of behaviours, thus we included three incremental behaviours that preserve the status quo (van Valkengoed & Steg, 2019b; e.g., 'participate in a neighbourhood initiative to protect Stadshagen against flooding, for example by jointly purchasing sandbags to hold back the water') and three transformative behaviours that challenge the status quo by developing new alternatives and seeking opportunities (Fedele et al., 2019; Wilson, 2020; e.g., 'contribute to a plan for the redevelopment of Stadshagen to reduce flood risks'). Two items focused on adapting to climate change risks in general, two items focused on flooding and two items on heatwaves, as these are climate change risks faced by residents of Stadshagen. Participants rated each item on a scale from 1 - *not at all* to 7 - *certainly yes*.

Individual Adaptation Intentions. We asked participants to what extent they intend to engage in six individual adaptation behaviours *within the next year*. As for community-based adaptation intentions, we included three incremental behaviours (e.g., 'buy insurance to cover the costs of the consequences of a flood on my household effects and/or house') and three transformative behaviours (e.g., 'greening my backyard and/or getting a green roof to keep cool during a heatwave'). Again, items were about adapting to climate change risks in general, or to the specific risks of flooding and heatwaves, respectively. Participants rated each item on a scale from 1 - *not at all* to 7 - *certainly yes*.

Results and Discussion

First, we confirmed the content, concurrent, discriminant and incremental validity of the collective transilience scale (see Supplementary Materials). Next, using the *psych* package (Revelle, 2019), we examined the mean scores of all measures. Table 4.2 shows that respondents perceived they could be transilient, although more strongly as an individual than as a community (M_{diff} = 0.46, $t(297) = 8.22$; $p < .001$; $d = .48$). Respondents evaluated the SensHagen initiative positively, showed interest to join SensHagen (i.e., both mean scores were above the midpoint of the scales), and

generally seemed interested to seek additional information about the SensHagen initiative (62.8% of respondents wanted more information). However, respondents on average showed somewhat low intentions to engage in both community-based and individual adaptation behaviours (i.e., identical mean scores slightly below the scale midpoint). On average, respondents did not intend to support the SensHagen initiative by motivating others to join or participate in related activities. This may be due to their unfamiliarity with the initiative before taking our survey, which may have made them hesitant to immediately intend to act to support it.

Collective Transilience and Community-Based Adaptation

We used the custom function *corstars* in R (Bertolt, 2008) to examine bivariate correlations between collective transilience and community-based adaptation intentions (Hypothesis 1). Table 4.2 shows that collective and individual transilience were both positively associated with all community-based adaptation intentions, and with individual adaptation intentions, with a medium to large effect (i.e., correlation between .20 and .40; Lovakov & Agadullina, 2021). Note that these significant positive correlations uphold (except for information seeking), when controlling for collective efficacy (see Supplementary Material). Individual transilience showed a similar correlations pattern. Stronger individual transilience was related to stronger collective transilience, yet these constructs did not overlap (i.e., the correlation was below .85; Kenny, 2016). Thus, although collective and individual transilience are related, they reflect different constructs.

Table 4.2. Descriptive Analyses, Reliability, and Bivariate Correlations between the Measures Included in Study 2

	M	*SD*	*α*	ω_t	1	2	3	4	5	6	7	95% CI comparison 1-2[†]
1. Collective transilience	4.52	1.05	.96	.98								
2. Individual transilience	4.98	1.01	.93	.97	.57***							
3. Evaluation SH	5.65	1.26	.92	.92	.37***	.25***						0.02; 0.22
4. Interest to join SH	4.46	1.82	.86	.86	.39***	.30***	.65***					-0.01; 0.19
5. Intention to support SH	3.32	1.64	.83[b]		.35***	.30***	.53***	.72***				-0.04; 0.15
6. Information seeking SH	0.63	0.48			.21***	.16**	.45***	.63***	.46***			-0.05; 0.15
7. Community-based adaptation intentions	3.92	1.44	.89	.93	.44***	.31***	.54***	.63***	.68***	.49***		0.03; 0.23
8. Individual adaptation intentions	3.92	1.30	.80	.88	.32***	.24***	.45***	.50***	.57***	.33***	.74***	-0.02; 0.18

Note. SH = SensHagen; *M* = mean; *SD* = standard deviation; *α* = Cronbach's alpha; ω_t = McDonald's omega; [b] = Spearman-Brown reliability coefficient for measure with two items. [†] = Procedure recommended to statistically compare correlations: the correlations are significantly different if the 95%CI does not contain 0 (Diedenhofen & Musch, 2015; Zou, 2007).
*p < .05; **p < .01; ***p < .001

Collective Transilience, Individual Transilience, and Adaptation Intentions

We used the package *cocor in R* (Diedenhofen & Musch, 2015) to test whether collective transilience, compared to individual transilience, is more strongly associated with community-based adaptation intentions and less strongly associated with individual adaptation intentions (Hypothesis 2). Collective transilience was indeed more strongly related to the evaluation of the SensHagen initiative and to community-based adaptation intentions, compared to individual transilience (i.e., Zou's confidence intervals did not include zero; Zou, 2007; see Table 4.2). Yet, we did not find a significant difference in the strength of the correlations between the other adaptation intentions and individual and collective transilience, respectively (i.e., Zou's confidence intervals included zero; see Table 4.2). Hence, we found partial support for Hypothesis 2 in the case of community-based adaptation measures, and no support for Hypothesis 2 in the case of individual adaptation intentions.

We conducted a series of two-step hierarchical multiple regressions using the *jmv* package (Jamovi, 2021) to assess whether collective transilience predicts unique variance in community-based intentions when controlling for individual transilience. For information seeking, which is a dichotomous variable, we conducted a hierarchical binary logistic regression. We applied the Bonferroni correction to limit chances of type I error, leading to an adjusted significance level of $p < .008$ (i.e., .05/6). For each dependent variable, individual transilience was entered at Step 1, and collective transilience was entered at Step 2. Multicollinearity was not an issue (VIF = 1.48).

Table 4.3 shows that individual transilience was significantly related to all indicators of individual and community-based adaptation. As expected, adding collective transilience to the model consistently led to a significant increase in explained variance. Interestingly, in all cases collective transilience became the only significant predictor in the model. The effect sizes for collective transilience were small-to-medium (i.e., $.02 < f^2 < .10$; Selya et al., 2012), except for community-based adaptation intentions, where the effect was medium (i.e., around $f^2 = .15$; Selya et al., 2012). Thus, collective transilience seems more relevant than individual transilience for predicting different types of climate change adaptation intentions.

Table 4.3. Hierarchical Regressions conducted in Study 2

Predictor	Evaluation SH				Interest to join SH				Intentions to Support SH				Information seeking SH				Community adaptation				Individual adaptation			
	b (SE)	95% CI for *b*	*p*	f^2	*b* (SE)	95% CI for *b*	*p*	f^2	*b* (SE)	95% CI for *b*	*p*	f^2	*OR* [a] (SE)	95% CI for *OR*	*p*	f^2	*b* (SE)	95% CI for *b*	*p*	f^2	*b* (SE)	95% CI for *b*	*p*	f^2
Step 1																								
Individual transilience	0.31 (0.07)	0.17; 0.65	<. 001	-	0.49 (0.09)	0.32; 0.67	<.001	-	0.49 (0.09)	0.32; 0.67	<.001	-	0.33 (0.12)	0.09; 0.57	.007	-	0.44 (0.08)	0.29; 0.60	< .001	-	0.31 (0.07)	0.17; 0.46	< .001	-
Step 2																								
Individual transilience	0.06 (0.08)	-.01; 0.23	.434	.00	0.22 (0.12)	-.00; 0.45	.051	.01	0.25 (0.11)	0.04; 0.46	.019	.02	0.12 (0.15)	-0.17; 0.41	.408	.00	0.12 (0.09)	-0.05; 0.30	.175	.01	0.11 (0.09)	-0.06; 0.28	.204	.01
Collective transilience	0.41 (0.08)	0.26; 0.57	< .001	.09	0.55 (0.11)	0.33; 0.77	<.001	.08	0.41 (0.10)	0.21; 0.61	<.001	.06	0.38 (0.15)	0.09; 0.67	.009	.02	0.54 (0.09)	0.37; 0.71	< .001	.14	0.34 (0.08)	0.28; 0.51	< .001	.06
Total R^2				.14				.16				.14				.04				.21				.11
ΔR^2				.08				.07				.05				.02 [b]				.11				.05
ΔF				27.72 ***				23.65 ***				15.94 ***				7.06 [c] ***				39.19 ***				17.00 ***

Note. *** p < .001; [a] = Odds Ratio; [b] = McFadden's R^2 for binomial logistic regression; [c] = Chi square statistic for binomial logistic regression

4.4. GENERAL DISCUSSION

Protecting one's own community from the negative impacts of climate change is as important as protecting oneself. In this paper we studied which factors may motivate individuals to engage in community-based adaptation measures (e.g., joining a community initiative to protect the community from climate change risks). These are measures aiming to help protect the community from climate change risks, rather than focusing solely on individual protection (e.g., purchasing insurance). We focused on collective transilience, which captures the extent to which people perceive they, as a community, can persist, adapt flexibly, and positively transform in the face of climate change risks.

Our scale to measure collective transilience showed good validity (content, concurrent, discriminant and incremental; see Supplementary Material). Across two studies, we found that on average people perceive they can be transilient as a community, yet they do not strongly (intend to) engage in community-based adaptive actions. As expected, across both studies we found that stronger collective transilience is related to stronger community-based adaptation intentions (Hypothesis 1), such as installing an app that allows to warn neighbours in the case of a climate related hazard and to check on their safety (Study 1 and 2). Unexpectedly, higher collective transilience was not significantly associated with more community-based adaptation behaviours (Study 1). Collective transilience was positively related to community-based adaptation indicators associated with SensHagen, a community initiative for making the Dutch neighbourhood of Stadshagen more climate adaptive. Specifically, higher collective transilience was associated with more positive evaluation of, higher interest to join, and a stronger intention to support SensHagen, as well as higher likelihood to seek information about the initiative (Study 2). Furthermore, higher collective transilience was associated with stronger support for local adaptation policies (Study 1). Interestingly, higher collective transilience was also associated with more individual adaptation intentions (exploratory analysis, Study 1 and 2) and behaviours (Study 1).

We found that higher collective transilience was related to higher individual transilience, indicating that people who perceive they can be transilient as an individual are also more likely to perceive they can be transilient as a community. Collective and individual transilience are probably related, as they both capture individuals' perceptions about the capacity to adapt to climate change risks. Yet, our results indicate that these, not only theoretically, but also empirically reflect different constructs, as individual transilience captures the perceived adaptive capacity of the individual, while collective transilience captures the perceived adaptive capacity of one's community. Individual and collective transilience are also likely influenced by different factors, which we did

not aim to examine in the current studies. Both individual and collective transilience were positively related to all adaptation indicators. Yet, collective transilience was significantly more strongly related to community-based adaptation indicators, compared to individual transilience (Hypothesis 2), only in the case of community-based adaptation intentions and evaluation of SensHagen (Study 2). We did not find that individual transilience was more strongly related to individual adaptation intentions compared to collective transilience (Hypothesis 2). Thus, we found limited support for the compatibility principle (Ajzen, 2020).

Remarkably, as expected, we found that collective transilience explains unique variance and is the only significant predictor of community-based adaptation indicators when controlling for individual transilience (Hypothesis 3). Interestingly, this was also found for individual adaptation intentions. All in all, our results support the relevance of collective transilience for motivating adaptation behaviour, both at the individual and community level.

Theoretical Implications

Our findings have important theoretical implications. Our results indicate that a more positive perspective is possible on how communities, not just individuals, can adapt to climate change. The literature suggests that climate change is predominantly viewed as having negative effects on individuals and communities (Fritze et al., 2008; Manning & Clayton, 2018). Yet, research showed that people perceive they can persist, adapt flexibly, and positively transform in the face of climate change risks as an individual (Lozano Nasi et al., 2023). Our research extends these findings by showing that people perceive they, as a community, can also do more than 'bounce back' in the face of climate change by recovering and maintaining what they had (cf. Davoudi et al., 2013), and that they see opportunities for positive change for their community as well. As such, our results bring forward a novel understanding of how communities can adapt to adversities such as climate change, in line with prominent definitions of climate change adaptation, which explicitly refer to both minimising damage and finding new opportunities (IPCC, 2014b).

Our research also extends previous work on community-based adaptation which showed that the perceived capacity to ensure an adequate drinking water supply as a community (i.e., collective efficacy; Bandura, 1998, 2000) plays a relevant role in predicting intentions to participate in activities to address drinking water scarcity in the community (e.g., encouraging other members to reduce water waste; Thaker et al., 2016). Collective transilience enables a broad assessment of perceived community adaptive capacity, acknowledging flexibility and the possibility for positive change, without being tied to a specific goal. Additionally, our findings show that the more

strongly people perceive they can persist, adapt flexibly, and positively transform as a community, the more they intend to engage in a wide range of community-based adaptation actions. Notably, we tested our hypotheses across two different countries (the United States and The Netherlands) where communities likely face different climate-related risks. As such, it seems that collective transilience can predict different types of community-based adaptation actions, in the face of different climate risks, across different contexts, and thus can be a relevant 'general antecedent' of community-based adaptation.

Our research suggests that perceiving collective transilience is more relevant than perceiving individual transilience when predicting community-based adaptation. While both individual and collective transilience can predict community-based adaptation responses, our study showed that collective transilience is the most relevant predictor of community-based adaptation indicators when individual transilience is also considered. To the best of our knowledge, our research is the first to formally compare perceptions of adaptive capacity at the community and individual level in motivating community-based adaptation to climate change, making a valuable contribution to the literature on community-based climate change adaptation.

Notably, it seems that collective transilience is the most relevant in predicting climate change adaptation also at the individual level, a rather unexpected finding, which does not align with the compatibility principle (Ajzen, 2020). One explanation for this finding could be that some adaptive actions that are taken at the individual level also benefit the collective. For example, greening one's own backyard can contribute to protecting the entire neighbourhood from flooding. Similarly, people may engage in actions to protect the community (e.g. supporting better infrastructure in the neighbourhood) for personal benefits. In general, different adaptation responses may have benefits for both the individual and community.

Another explanation for the relevance of collective transilience also for individual adaptation could be that people may believe the threat of climate change can only be addressed by individual efforts to a limited extent (cf. Fritsche et al., 2018; cf. van Zomeren et al., 2010). Given that climate change affects entire communities rather than individuals in isolation (e.g., damaged public infrastructure, food shortages, compromised mobility, disrupted communication or broken energy supplies; IPCC, 2022), protection is likely more effective when other community members engage in adaptive measures as well (e.g., everyone greens their backyard) and when all work together to protect the community. Climate change is a threat that potentially affects 'us' as a collective. Thus, perceiving that 'we' can be transilient as a collective may

be especially important to encourage a variety of actions meant to address such a collective threat (cf. Chen, 2015).

Limitations and Future Research Directions

Our research presents compelling findings, yet it also has some limitations and raises important questions for future research. First, we did not examine which factors influence collective (and individual) transilience. Future studies could examine which individual (e.g., individual resources), social (e.g.., social networks and support; Barnes et al., 2020), socio-political (unequal power relations; Barnwell et al., 2020), and contextual factors (e.g., local resources or ecological characteristics; Clayton et al., 2016; Galappaththi et al., 2020) may influence collective (and individual) transilience, and in turn the extent to which it can promote a range of community-based (and individual) adaptive actions. Future studies could also aim to replicate our findings among different samples not taken from WEIRD countries (Western, Educated, Industrial, Rich, and Democratic), such as developing countries, which are the most affected by climate change risks (Mertz et al., 2009) and likely to have less resources to adapt.

Particularly in the second study, a big portion of the original sample (35%) filled in neither the individual nor the collective transilience scale. It may be that the similarity between the scales made the survey quite lengthy and repetitive. Future studies can reduce repetitiveness by randomising the order of the transilience items. Additionally, among those who filled in the scales, there were several people (around 20%) who scored neutral (i.e., they selected 4 on a 7-point scale) on the full collective transilience scale, particularly in Study 2. People may have difficulties to answer collective transilience items, and more research is needed to examine whether this is systematically the case. It may also be that questions regarding the community of 'inhabitants of Stadshagen' were difficult to answer, as this community may not be very relevant to people. Future studies could examine whether including different groups with varying levels of self-relevance in the collective transilience scale (e.g., the neighbourhood, a church, a club, the Dutch, EU-citizens) affects response rates and patterns. Notably, the transilience scales showed very high reliability across studies, thus some of the items may be redundant. Future research could explore if a shorter scale (e.g., one or a few items per component) yields comparable results to the full scale, potentially enhancing its practicality.

We included a wide range of community adaptation indicators. Yet, we did not examine to what extent people felt able to engage in the adaptation actions or to support the hypothetical policies we measured. Transilience may be less strongly (or not significantly) related to adaptation actions that are difficult or not feasible to people.

Additionally, the community initiative we studied (i.e., SensHagen) centred on a proxy behaviour that contributes to adaptation only indirectly (i.e. installing a sensor). Thus, future studies could probe the perceived ability to engage in relevant adaptation behaviours and to support relevant policies within the specific communities studied. Future research could also include more adaptive actions to validate the predictive power of collective transilience, such as support for local adaptation policies (measured only in Study 1) and political actions like protests or petitions urging local institutions to protect the community from climate risks (van Zomeren & Iyer, 2009). Such actions typically encourage others, beyond individuals alone, to also act. Moreover, including collaborative adaptive actions (e.g., pooling resources to plant trees in the neighbourhood) can highlight the relevance of collective transilience for promoting collaboration within the community. Besides adaptation actions, future studies could assess whether perceived collective transilience helps communities to change for the better, for instance whether members develop new and better ways of living as a community, such as more social cohesion and closer caring relationships. A shift towards a more collective and caring society has been proposed as a fundamental aspect of addressing climate change (Weintrobe, 2020).

Given our cross-sectional design, causal conclusions cannot be drawn. Longitudinal or experimental designs are needed to determine if higher collective transilience leads to engagement in later adaptive actions, and if community-based adaptation can foster later collective transilience as well. Besides, sampling procedures may account for some differences in the results. Thus, more research is necessary to corroborate the generalizability of our findings.

Practical Implications

Climate change consequences are apparent worldwide, affecting individuals and communities. Therefore, individuals must act to protect both themselves and their communities from climate risks. While most of the participants in our studies had not engaged in community-based adaptation and showed low intentions to do so, our research implies that promoting collective transilience may foster such adaptive actions. Thus, strengthening collective transilience may boost community-based adaptation. Remarkably, we failed to increase levels of collective transilience using a message that emphasised only the risks posed by climate change to the community, compared to the individual (see Appendix A). It may be that messages also need to emphasise the capacity to persist, adapt flexibly, and positively transform as a community to effectively induce perceived collective transilience. Indeed, threat messages alone may fail to motivate action, as people also require information on what actions they could take (McLoughlin, 2021). Future research should examine how to induce collective transilience and promote widespread adaptation effectively.

In conclusion, our research highlights that people perceive they can do more than just 'bounce back' in the face of climate change risks, also as a community. Specifically, the more people perceive collective transilience, the more likely they are to engage in a wide range of climate change adaptive measures to protect themselves, both as a community and as individuals. As we navigate the complex and uncertain terrain of climate change, collective transilience provides a hopeful and promising approach for us to be able to adapt and even thrive, together.

APPENDIX A

Manipulation used in Study 2: Full Text (translated from Dutch)

Community risks	Individual risks
Climate change poses a risk to **us**, **people living in Stadshagen**. **Our community** will likely face extreme weather events more often in the future, including floodings and heatwaves. These climate related hazards can have negative consequences **for us, inhabitants of Stadshagen**.	Climate change poses a risk to **you and your household**. **You** will likely face extreme weather events more often in the future, including floodings and heatwaves. These climate related hazards can have negative consequences **for you and your household**.
For example, **our** houses and the roads **in our neighbourhood** may face severe damage, making **our mobility** more difficult. Furthermore, rising temperatures may limit **our** possibility to use public spaces (for instance during heatwaves) and can have serious negative effects on the physical and mental health **of our inhabitants**.	For example, **your** house and the roads **around your house** may face severe damage, making **your mobility** more difficult. Furthermore, rising temperatures may limit **your** possibility to be outside your house (for instance during heatwaves) and can also have serious negative effects on **your** physical and mental health.
Therefore, it is important that **we as a community** take action to prepare **ourselves** against these (future) impacts of climate change.	Therefore, it is important that **you as an individual** take action to prepare **yourself** against these (future) impacts of climate change.

Table A1. Effect of the manipulation used in Study 2 on relevant variables

	F	df1	df2	*p*
Collective transilience	0.111	1	288.483	0.740
Individual transilience	0.320	1	281.380	0.572
Evaluation of SH	0.621	1	288.717	0.431
Interest to join SH	1.100	1	288.374	0.295
Intentions to support SH	1.379	1	281.066	0.241
Information seeking about SH	0.890	1	287.293	0.346
Community adaptation	1.882	1	289.164	0.171
Individual adaptation	1.272	1	287.181	0.260

Description of the SensHagen initiative (Translated from Dutch)

Note: this text was not part of the manipulation and was therefore presented to all participants

In response to concerns from inhabitants of Stadshagen about climate change risks, a new initiative has been set up, called the SensHagen project. The SensHagen project generally aims to protect Stadshagen against the risks of climate change by making Stadshagen climate adaptive. If you join the SensHagen project, you will get sensors installed in your backyard. These sensors will monitor air quality, precipitation, evaporation, heat and wind to establish what kind of climate risks Stadshagen faces. Based on the data collected, the municipality can learn what policies they need to implement to make Stadshagen more adaptive to climate change.

We will now ask some questions about your thoughts and opinions on the SensHagen project. Please read the statements carefully.

APPENDIX B

Overview of all measures included in Study 1 and Study 2

Measure	Study 1	Study 2 (translated into Dutch)
Collective transilience	Please indicate how much you agree or disagree with the following statements. Please bear in mind that the questions refer to the negative consequences that climate change can have *for your community* *Persistence* 1. We can be brave in the face of climate change risks 2. We can be persistent when faced with climate change risks 3. We can stay determined in the face of climate change risks 4. No matter what climate change brings about, we can remain strong willed *Adaptability* 5. I think we can take different actions to deal with climate change risks 6. I think we have several options to deal with climate change risks 7. I believe we can find multiple means to deal with climate change risks 8. There are different ways in which we can cope with climate change risks *Transformability* 9. Coping with the stress caused by climate change risks can strengthen us 10. There can be advantages for us in dealing with climate change risks 11. Dealing with climate change risks can make us grow as a person 12. We can learn something good from dealing with climate change risks	The following questions are about how you think that the confrontation with climate change affects **the residents of Stadshagen**. Specifically, we want to ask you to think about how being confronted with **the risks of flooding and heat-waves in Stadshagen** affects **the residents of stadshagen**. *Persistence* 1. We, residents of Stadshagen, can be brave 2. We, residents of Stadshagen, can be persistent 3. We, residents of Stadshagen, can stay determined 4. We, residents of Stadshagen, can remain strong- willed *Adaptability* 5. I think we, residents of Stadshagen, can take different measures to deal with this 6. I think we, residents of Stadshagen, have several options to deal with this 7. I think we, residents of Stadshagen, can find multiple means to deal with this 8. There are different ways we, residents of Stadshagen, can deal with this *Transformability* 9. Dealing with the stress this causes can strengthen us, residents of Stadshagen 10. Dealing with this can have advantages for us, residents of Stadshagen 11. By dealing with this we, residents of Stadshagen can grow as a group* 12. We, residents of Stadshagen, can learn something good by dealing with this
Individual Transilience (Lozano Nasi et al., 2023)	(measure not included)	The following questions are about how you think that the confrontation with climate change affects **you**. Specifically, we want to ask you to think about how being confronted with **the risks of flooding and heat-waves in Stadshagen** affects you 1. I can be brave 2. I can be persistent 3. I can stay determined 4. I can remain strong-willed 5. I think I can take different measures to deal with this 6. I think I have several options to deal with this 7. I think I can find multiple means to deal with this 8. There are different ways I can deal with this 9. Dealing with the stress this causes can strengthen me 10. Dealing with this can have additional benefits for me 11. By dealing with this I can grow as a person 12. I can learn something good by dealing with this

Measure	Study 1	Study 2 (translated into Dutch)
Community based adaptation intentions (and behaviours)	To what extent do you intend to take the following measures **together with your community** *within the next year*? 1. Contributing to the development of an evacuation plan in case of an emergency due to a natural hazard. 2. Motivating people in our neighbourhood to maintain their houses well to avoid damage from natural hazards caused by climate change. 3. Joining an app that allows to warn the people in our neighbourhood about a natural hazard, such as heatwave or extreme rainfall, and to check on their safety. 4. Considering and discussing a migration plan, in case climate change risks make it too dangerous to keep living in our area. 5. Joining a community initiative to make my neighbourhood greener to better protect against climate change risks, for example by planting trees, building green roofs or parks. 6. Helping my neighbours to prepare for natural hazards caused by climate change, for instance by sharing knowledge.	To what extent do you intend to take the following measures within the next year? I intend to... 1. Contribute to measures to prevent residents of Stadshagen from being harmed by the risks of climate change. 2. Use a neighbourhood app to warn other residents of Stadshagen about a heat wave and to check if they are safe. 3. Participate in a neighbourhood initiative to protect Stadshagen against flooding, for example by jointly purchasing sandbags to hold back the water. 4. Changing the way of life in Stadshagen together to make us, residents of Stadshagen, less vulnerable to climate change risks. 5. Participate in a neighbourhood initiative to make Stadshagen greener (tiles out, plants in) to keep temperatures lower in Stadshagen. 6. Contribute to a plan for the redevelopment of Stadshagen to reduce flood risks.
Local climate change adaptation policy support	To what extent do you oppose or support implementing the following policies *in your municipality*? 1. Implementing heat warning systems in every city so that people can better protect themselves against heatwaves caused by climate change. 2. Investing public money to make vital infrastructure (for example, energy utilities, power lines, cell towers) more resistant to climate change risks. 3. Launching an awareness campaign that provides people with information on how to prepare for climate change risks. 4. Increase local taxes to invest in measures that protect people against potential natural hazards (for example, flooding) caused by climate change. 5. Invest public money in helping local farmers to prepare for increases in flooding or drought due to climate change.	(measure not included)
Interest to join SensHagen initiative (adapted from Sloot et al., 2021)	(measure not included)	1. I would like to receive more information about SensHagen by subscribing to the SensHagen newsletter 2. I would like to participate in the SensHagen project (by installing sensors at my house. 3. I am interested in the SensHagen project

Measure	Study 1	Study 2 (translated into Dutch)
Intentions to Support the SensHagen initiative (adapted from Sloot et al., 2019)	(measure not included)	1. I am planning to motivate other inhabitants of Stadshagen to participate in the SensHagen project 2. I am planning to participate in activities organised within the SensHagen project
Individual climate change adaptation behaviours	To what extent do you intend to take the following measures to protect yourself against climate change risks within the next year? 1. Preparing a household emergency kit, containing for example a flashlight, a radio, emergency blankets, first aid kit 2. Adjusting my home to better withstand natural hazards, for example installing wind shutters or painting my house in a lighter colour to reduce heating. 3. Storing bottled water and canned food in case a natural hazard occurs. 4. Purchasing insurance against losses from natural hazards. 5. Looking up information about whether my house is at risk of natural hazards. 6. Looking up information about what I can do to prepare for natural hazards. 7. *Checking weather forecasts to be prepared for natural hazards, such as a heatwave or extreme rain*	To what extent do you intend to take the following measures within the next year? 1. take measures to prevent my household from being harmed by the risks of climate change 2. 'buy insurance to cover the costs of the consequences of a flood on my household effects and/or house 3. stay indoors as much as possible during a heat wave 4. change my lifestyle so that my household and I are less vulnerable to the risks of climate change 5. greening my backyard and/or getting a green roof to keep cool during a heat wave 6. create a migration plan if it is too dangerous to keep living in my area due to flooding
Community climate change risk perceptions	1. Climate change poses a risk to my community	1. Climate change poses a risk to the inhabitants of Stadshagen

Note. * Item rephrased compared to study 1 (i.e. 'grow as a person') to make it more appropriate for the collective level. Measures relevant for the collective transilience scale validity are described in Supplementary Material.
Study 1 also included the following measures: valence of consequences of climate change; climate change affect; political collective action; support for national adaptation policies; self-efficacy and outcome efficacy for climate change adaptation; brief resilience scale; identification with US; satisfaction with life; political preference; party vote.
Study 2 included the following measures: self-efficacy; bottom-up initiative formation; number of housemates. These measures are not relevant for the purposes of the present manuscript and therefore they are not discussed.

Supplementary information associated with Chapter 4 can be found online:

5

General Discussion

5.1. INTRODUCTION

We must accept an undeniable and harsh truth: we live in an era that relentlessly confronts us with a multitude of crises, including devastating natural disasters (e.g., Hurricane Katrina in 2005, earthquake in Haiti in 2010, earthquake in Turkey in 2023) and global pandemics (e.g., the COVID-19 pandemic). Amidst these unprecedented contemporary challenges (Lagadec, 2009; Lagadec & Topper, 2012) lies a remarkable potential: crises can allow us to question the status quo, find new opportunities and change for the better, instead of merely preserving and/or recovering what we had (i.e., "bouncing back"; Bonanno, 2004). Although this proposition finds support in analyses of human confrontation with past examples of climate change and pandemics (Benedictow, 2004; Degroot et al., 2021), as well as in research on trauma and chronic illness (Bostock et al., 2009; Carver & Antoni, 2004; Meyerson et al., 2011; Tomich & Helgeson, 2004), the possibility of adapting through positive change has remained mostly overlooked by studies on how people can adapt to large-scale contemporary adversities, like climate change and the COVID-19 pandemic.

In this PhD dissertation we introduced the novel construct *transilience* to examine whether people perceive they can do more than 'bounce back' in the face of adversities (cf. Davoudi et al., 2013), and specifically whether they perceive they can adapt to such adversities through positive change. We define transilience as the perceived capacity to persist (persistence), adapt flexibly (adaptability), and positively transform (transformability) in the face of an adversity. As such, transilience allows to broaden the perspective on human adaptation to adversities while also bringing a positive outlook on it.

Across three empirical chapters, we addressed two main overarching research questions. Firstly, we examined whether individuals perceive transilience in the face of contemporary adversities. We hypothesised that people perceive transilience across different threats with varying levels of severity, as well as at different levels (i.e., individual and collective). To test this, we wanted to develop and validate a measure of transilience. Secondly, we examined the association between transilience and different types of adaptation actions, as well as indicators of mental health. Generally, we expected that higher transilience is associated with more adaptation actions and with better mental health across different socio-political contexts with varying levels of threat severity.

In the following sections, we summarise the main findings of this dissertation and we elaborate on the main theoretical implications of our research. After that, we discuss

key open research questions, as well as relevant practical implications deriving from our overall findings.

5.2. SUMMARY OF THE FINDINGS AND THEORETICAL IMPLICATIONS

Transilience can be Assessed in a Valid and Reliable Way

First, in this PhD dissertation we set out to develop a valid and reliable scale to measure human transilience in the face of an adversity. As a case in point, we tested the validity and reliability of the transilience scale in the context of climate change. We expected the scale to capture well the three components of transilience, yet to reflect that transilience is an overarching construct. Additionally, we expected transilience to be positively associated with theoretically related constructs (i.e., self-efficacy, outcome efficacy, resilience), yet not to overlap with any of them. We also expected that transilience does not imply that people deny or downplay the threat posed by the adversity under consideration. Furthermore, we expected the transilience scale to be applicable both at the individual and at the collective level; this is relevant considering that the threat of certain adversities, particularly large-scale adversities like climate change, likely affects both individuals and groups.

Overall results show that we succeeded in developing a valid and reliable transilience scale. In Chapter 2, we developed a scale to assess individual transilience, and we tested its validity in the context of climate change risks; the scale comprises items reflecting the three components of transilience (i.e., persistence, adaptability, and transformability), which we developed in consultation of the literature and with experts in the field of climate change adaptation (see Table 5.1 below). We found support for the reliability and validity of the climate change transilience scale across four empirical studies, conducted in three different countries (USA, The Netherlands, UK). As expected, the individual transilience scale showed good content validity, as it accurately reflected the three components of persistence, adaptability, and transformability. Yet, as expected, the overall transilience score appeared the most meaningful to report and interpret, indicating that transilience is an overarching construct.

The climate change transilience scale showed to have good concurrent and discriminant validity. As expected, transilience was found to be positively related, yet not overlapping with self-efficacy (i.e., the extent to which people think they are capable of engaging in adaptation behaviour; van Valkengoed & Steg 2019b), outcome efficacy (i.e., the extent to which people think their adaptation actions would reduce climate change risks; van Valkengoed & Steg 2019b) and resilience (i.e., the extent

to which people consider themselves able to 'bounce back' from setbacks in life in general; Smith et al., 2008), respectively, indicating that individual transilience captures a distinct and novel construct. In line with our expectations, we found that transilience was either positively or not significantly related to climate change risks perceptions, except for one study (where we found a small negative effect), indicating that transilience generally does not imply that people downplay climate change risks.

Table 5.1. Final Transilience Scale

Transilience Scale
Introductory text:
The following questions are about how you think that the confrontation with [specific adversity] affects you / you, as [specify community].
Specifically, we want to ask you to think about how being confronted with the risks of [an adversity] affects you/ you as [specific community].
To what extent do you agree or disagree with the following statements?
Items:
(Persistence)
1. I/we [specific community] can be brave.
2. I/we [specific community] can be persistent. (s)
3. I/we [specific community] can stay determined. (s)
4. I/we [specific community] can remain strong-willed.
(Adaptability)
5. I/we [specific community] can take different measures to deal with this. (s)
6. I /we [specific community] have several options to deal with this.
7. I/we [specific community] can find multiple means to deal with this. (s)
8. There are different ways I/we [specific community] can deal with this.
(Transformability)
9. Dealing with the stress that this causes can strengthen me/us [specific community].
10. Dealing with this can have additional benefits for me/us [specific community].
11. I/ we [specific community] can grow as a person/group by dealing with this. (s)
12. I/we [specific community] can learn something good by dealing with this. (s)

Note. (s) = item to be selected for using the 6-items version of the scale

The reliability of the transilience scale was quite high in Chapter 2, suggesting that some of the components may be overly identified by the developed items. Therefore, in Chapter 3 we explored whether a shorter scale comprising of 6 items could also be used to reliably assess transilience, which may increase the applicability of the transilience scale in research studies with constraints on time or resources. The shorter version of the scale (with 2 items per subcomponent) led to similar findings compared

to the full 12-items scale (see Chapter 3). Indeed, some of the items of the transilience scale are very similar (e.g., the items assessing adaptability), which may explain why the shorter version of the scale works well. Still, we recommend using the full version of the scale to capture the full complexity of the construct, unless external limitations impede to do so.

In Chapter 4, we adapted the individual climate change transilience scale to assess transilience at the collective level, and we tested its validity in the context of climate change risks. Results across two studies conducted in the US and the Netherlands indicated good psychometric properties of the collective transilience scale (i.e., the perceived capacity to persist, adapt flexibly, and positively transform in the face of climate change risks *as a community*). As expected, we found that the collective transilience scale captures well the three theorised components, yet that it should be interpreted and reported as an overarching construct.

The collective transilience scale also showed good concurrent and discriminant validity. As expected, collective transilience was positively related to higher collective efficacy (i.e., the perceived ability of a community to achieve specific (climate change adaptation) goals; Bandura, 1998). Yet both constructs did not overlap, indicating that collective transilience reflects a different construct. Again, as expected, we found that higher collective transilience does not imply that people downplay or deny that climate change poses risks to one's community. Additionally, we found that collective transilience is positively related to individual transilience, yet the two constructs can be empirically distinguished. As such, our findings suggest that the more people perceive they can be transilient as individuals, the more they perceive they can be transilient as a community. At the same time, while both collective and individual transilience tap into people's perceived capacity to adapt to an adversity, individual transilience specifically captures the perceived adaptive capacity of the individual, while collective transilience captures the perceived adaptive capacity of one's community.

All in all, in this PhD dissertation we succeeded in developing a valid and reliable scale to measure transilience, at the individual as well as collective level, which can be used in the face of threats with different levels of severity, including different adversities (e.g., climate change, COVID-19 pandemic) and countries. In line with our proposition, the transilience scale captures three distinct components, which are all relevant parts of the overarching construct of transilience. Moreover, transilience is related to, yet distinct from, existing relevant constructs in the domain of human adaptation to adversities, such as self-efficacy, collective efficacy, and general resilience. In line with our expectations, when people strongly perceive transilience they don't seem to downplay the threat posed by an adversity, which indicates that transilience is

an adaptive response, as denial of the adversity is typically considered maladaptive (Carver et al., 1989). However, the findings in this regard were not fully consistent (i.e., in some studies we found a positive relationship, in others no significant relationship, and in one study a small negative relationship), and we did not test this specifically in the context of COVID-19. As such, more research is needed to understand the relationship between transilience and perceived risks associated with an adversity.

People Perceive Transilience in the Face of Large-Scale Contemporary Adversities

Transilience is Perceived across Different Adversities and Countries

Next, we wanted to examine whether people indeed perceive transilience in the face of contemporary adversities. We expected that, on average, people perceive they can persist, adapt flexibly, and positively transform in the face of adversities, despite variations in specific risks and in the level of severity of the relevant threat. In general, we found that people perceive transilience in the face of different adversities and across socio-political contexts with different specific vulnerabilities and with varying levels of threat severity.

In Chapter 2, we tested to what extent people perceive transilience in the face of climate change risks in the US, in the UK, and in a specific municipality in the Netherlands. As expected, we found that people on average perceive they can be transilient in the face of climate change risks, across contexts that face various types of risks (e.g., The Netherlands is particularly vulnerable to flooding, whereas different regions in the US face different climate-related risks depending on the specific location; Clayton et al., 2016; Ministerie van Infrastructuur en Milieu, 2016). This suggests that people generally perceive they can do more than 'bounce back' to the status quo in the face of climate change, and that they acknowledge the possibility for positive change as well.

In Chapter 3, we tested whether people also perceive transilience in the face of the COVID-19 pandemic, an adversity that, compared to climate change, posed a much more acute, direct, and immediate threat for people's lives. In line with our expectations, we found that people perceive transilience in the face of COVID-19 too, across different countries (i.e., both Italy and the Netherlands), and at different points in time; notably, these were contexts in which the severity of the threat posed by COVID-19 and in the governmental policies implemented to limit the spread of the virus differed (Capano et al., 2020). As such, our results suggest that people perceive they can do more than 'bounce back' even in the face of very acute and severely threatening adversities, like a sudden pandemic of a deadly virus. Notably, our longitudinal study revealed that the levels of transilience significantly increased over time in the Netherlands, where the second time point was characterised by higher severity and acuteness

of the threat posed by the COVID-19 pandemic and by more restrictive containment measures implemented by the Dutch government, compared to the first time point. Thus, transilience may be subject to change, and it may be that the exposure to an increasingly more severe adversity can increase transilience. More research is needed to test whether transilience becomes higher when people are exposed to a certain adversity for longer time and when the threat of such adversity becomes more severe.

Transilience is Perceived also at the Collective Level

We assumed that transilience can be perceived, not only at the individual level, but also at the community level, as large-scale adversities have impacts also on communities, rather than on individuals in isolation; besides, individual efforts may not be sufficient to adapt to such collective threats (cf. Chen, 2015). Hence, in Chapter 4 we tested whether people perceive they can be transilient in the face of climate change risks as a community (i.e. collective transilience). We also tested whether a message that highlights the risks posed by climate change to the community would enhance collective transilience, compared to a message stressing that climate change poses risks to individuals and their household. This hypothesis was based on research showing that when people are reminded that they are facing a certain threat as a group (i.e. they perceive that it is "us" against the threat; Drury, 2018), they are more likely to show collective resilience and to engage in actions that serve the interests of the group (as opposed to individual interests; Drury, 2018; Drury et al., 2019; Ntontis et al., 2020).

As expected, the results showed that people on average perceive collective transilience across different countries (i.e. the US and The Netherlands) that face different climate change risks (i.e., flooding in The Netherlands, wildfires in the West-coast of the US, sea level rise on the South-East coast of the US; Clayton et al., 2016). Yet, our attempt to enhance collective transilience was unsuccessful. These results suggest that people perceive they can do more than 'bounce back' also as communities, across different threats. However, it may be that making people aware of climate change risks for their community is not an effective way to foster collective transilience. It should be noted, though, that we did not include a control condition, hence it may also be that the two conditions, which both made people aware of climate change risks, were too similar to find a difference. As such, more research is needed to understand which messages and interventions are effective in enhancing (collective) transilience.

All in all, the findings presented in this PhD dissertation indicate that transilience may tap into a fundamental aspect of human capacity to adapt to a wide range of adversities, as it can be displayed regardless of the specific ways in which adversities manifest, and even in the face of very severe threats. Importantly, our results do not imply that

we should minimise the serious and unprecedented threat posed by contemporary adversities (Lagadec & Topper, 2012). Rather, our findings challenge the dominant perspectives on human adaptation to adversities, which tend to focus on finding ways to either maintain/recover what we currently have (see Luceño-Moreno et al., 2020) and/or to minimise the negative consequences that adversities have on people (Fritze et al., 2008; Manning & Clayton, 2018; Doherty, 2018). Transilience broadens and complements these perspectives on human adaptation, by expanding the concept of adaptation beyond preserving the status quo, and by highlighting the potential for finding new opportunities and beneficial change amidst the adverse events that people encounter. As such, this PhD dissertation suggests that human (perceived) capacity to adapt to adversities is in line with a prominent definition of adaptation, namely "moderating or avoiding harm *and* finding new opportunities" (IPCC, 2014b).

Higher Transilience Promotes Adaptation Actions, but Not in All Contexts

Transilience Predicts Individual Adaptation Actions, if People have some Freedom to Act

We expected that the more strongly people perceive they can persist, adapt flexibly and positively transform in the face of an adversity, the more likely they are to engage in a wide range of actions to adapt to the threats posed by such adversity. Our findings generally show that higher transilience indeed promotes different types of adaptation behaviours, in the face of different risks and across different contexts (i.e., it is a 'general antecedent' of adaptation actions; cf. van Valkengoed, 2022). However, our findings also suggest that transilience may not predict adaptive actions when people's freedom to act is seriously restricted.

In Chapter 2 we examined the relationship between transilience and a wide array of adaptation actions in the context of climate change risks. As expected, the results across four studies conducted in different countries (i.e., the US, The Netherlands and the UK) showed that higher transilience in the face of climate change risks increases the likelihood that people engage in various adaptation behaviours, including incremental actions (i.e., aiming to preserve the status quo), transformative actions (i.e., aiming to challenge the status quo and create new opportunities; Wilson et al., 2020), individual actions (i.e., aiming to protect individuals and their household) and collective actions (i.e., aiming to work with and for others to protect the local community). We also found that higher transilience was associated with more support for adaptation policies (both incremental and transformative) and more political collective action (e.g., protesting to demand more adaptive actions and policies; van Zomeren & Iyer, 2009), although this last relationship was not statistically significant in some studies. Thus, it seems that transilience can promote a wide range of adaptation actions across different contexts in which people face various types of climate change risks. Yet, individual transilience may not always promote collective action aimed to urge others beyond oneself to act.

In Chapter 3, we examined the relationship between individual transilience and a wide array of adaptation actions in the context of the COVID-19 pandemic. We expected that higher transilience in the face of COVID-19 promotes various adaptive responses, including individual behaviours aiming to protect oneself and collective behaviours aiming to protect others from the virus. Notably, we expected the relationship between transilience and adaptation actions to uphold despite variations in the seriousness, severity, and acuteness of the threat posed by the pandemic, and despite different policy responses to limit the spread of the virus across different countries and time periods. As expected, the results from The Netherlands showed that higher transilience increases the likelihood that people engage in both individual and collective adaptation behaviours to limit the spread of COVID-19; notably, these relationships were robust across different stages of the pandemic. Additionally, we found preliminary evidence that transilience at a given time may causally influence both individual and collective adaptation behaviours later in time. Yet, in contrast to our expectations, higher transilience did not promote adaptation behaviours in Italy, where the restrictions implemented by the national government severely limited people's freedom of choice. This suggests that transilience may be less likely to promote adaptation actions when the context severely limits people's freedom to engage in adaptation behaviours.

Collective Transilience Predicts Community-Based and Individual Adaptation Actions

We aimed to study whether transilience can promote also community-based adaptation, which implies that people act within and in the interest of their community. Although Chapters 2 and 3 suggested that individual transilience may promote adaptation also at the collective level, we assumed that perceiving transilience at the individual level may not be enough to increase the likelihood that people engage in behaviours to protect their community from climate change risks. Instead, we proposed that particularly collective transilience, which reflects the extent to which an individual perceives that their community (including themselves) can persist, adapt flexibly, and positively transform in the face of climate change risks, is relevant to promote community-based adaptation efforts.

In Chapter 4 we showed, first, that people are generally not very likely to engage in community-based adaptation behaviour to protect their community from climate change risks. Still, as expected, higher levels of collective transilience increased the likelihood that people engage in a wide range of community-based adaptation actions, including incremental actions (e.g., buying sandbags together with others to protect the local area from floods), transformative actions (e.g., joining a community initiative to reshape the local neighbourhood, by replacing concrete with trees and bushes, to protect the community against heatwaves and floods), support for local adaptation policies, and even intentions to be engaged in a real-life local community initiative

for climate change adaptation in The Netherlands (e.g., interest to join the initiative). The results showed that both individual and collective transilience were positively related to individual as well as community-based adaptation intentions. However, when both were considered, collective transilience was the sole significant predictor of all individual and community-based adaptation actions. This suggests that perceiving one's community to be transilient may be particularly powerful to encourage a wide range of adaptation actions.

All in all, the findings presented in this PhD dissertation indicate that when people strongly perceive that they, as individuals and as a community, can be transilient in the face of an adversity, they are more likely to engage to take concrete actions to adapt to that adversity. Notably, we studied a wide array of behaviours, aiming to adapt to different adversities (i.e., climate change and COVID-19), at different levels (i.e., individual and collective), including incremental and transformative actions, as well as support for policies. Hence, we provide substantial evidence that when transilience is high, people are generally more likely to take different actions to adapt to an adversity, across different contexts and risks and at different levels.

At the same time, our findings suggest that contextual factors may moderate, and even hinder, the extent to which transilience can promote adaptation actions. Specifically, our findings suggest that transilience may not promote adaptation actions in a context that severely limits people's freedom of choice (see Chapter 3, Study 1). This finding is in line with the A-B-C model (Guagnano et al., 1995; Stern, 2000), which suggests that the relationship between psychological factors and behaviour depends on the level of contextual constraints; according to the model, psychological factors are less predictive of behaviour when contextual constraints are high (in which case people cannot act in line with their motivations and beliefs) or when contextual constraints are very low (in which case everyone would engage in the behaviour anyway). Thus, while showing that transilience may be a 'general antecedent' of adaptation behaviours, this PhD dissertation also highlights a potential boundary condition, notably the level of restrictiveness of the context. In this regard, our findings suggest that the basic principle behind the A-B-C model may apply to transilience as well. More research is necessary to better understand the influence of contextual factors on the association between perceived transilience and adaptation actions.

This PhD dissertation also highlights the importance of understanding how to motivate people to engage in adaptation actions specifically for the sake of protecting people's own communities from the threat of an adversity, as people do not seem likely to engage in such community-based adaptation actions (see Chapter 4). Furthermore, our research suggests that perceiving transilience at the collective level may hold

particular relevance in predicting widespread adaptation to an adversity. Considering that the adversities we studied (i.e., climate change, COVID-19 pandemic) typically have implications for entire communities (cf. Chen, 2015), the perceived capacity to adapt at the collective level may be particularly empowering, as it is probably not sufficient that individuals adapt to such collective threats on their own (cf. Van Zomeren et al., 2008, 2010). Yet, it should be noted that we did not study whether collective transilience can also be a powerful predictor of examples of political collective action (e.g., protesting, signing a petition), which were not consistently predicted by individual transilience (see Chapter 2). Hence, whether collective transilience is a better predictor of other forms of collective action, compared to individual transilience, needs to be further tested in future research. Generally, more research is required to understand the relative importance of collective versus individual transilience in promoting different adaptation actions across different types of adversities and contexts.

Higher Transilience Promotes Mental Health, but Not in All Contexts

We expected that higher transilience may enhance mental health, because transilience reflects that people perceive they are capable to carry on, to find multiple options to adapt, and to change for the better by dealing with an adversity. Indeed, our findings generally show that higher transilience is associated with better mental health, as reflected in subjective well-being and personal positive change derived from the confrontation with the adversity. However, our findings also suggest that transilience may not promote mental health in a context that severely restricts people's freedom of choice.

In Chapter 2 we examined the relationship between transilience and indicators of mental health in the context of climate change risks. As expected, the findings across two studies conducted in the US and the UK showed that, the more strongly people perceive transilience in the face of climate change risks, the higher their levels of subjective well-being. Additionally, exploratory results in the UK suggested that higher transilience is associated with a higher degree of personal positive change (e.g., being able to do better things with one's own life) because of the confrontation with climate change.

In Chapter 3 we examined the relationship between transilience and indicators of mental health in the context of the very severe threat posed by the COVID-19 pandemic. Again, as expected, the results showed that higher transilience increases the likelihood that people report a higher degree of personal positive change because of the confrontation with COVID-19, across different countries (i.e., Italy and The Netherlands), which reflected different levels of threat emergency and distinct national policies implemented to deal with the virus. Additionally, as expected, higher

transilience increased the likelihood of higher subjective well-being across different moments in time in The Netherlands, which also reflected different levels of threat severity and national restrictions. Furthermore, we found preliminary evidence that higher transilience at a given time may enhance subjective well-being later in time, indicating that transilience may be causally related to subjective well-being. However, contrary to our expectations, higher transilience did not seem to promote subjective well-being in Italy, where the restrictions implemented by the national government severely limited people's freedom of choice. This suggests that when the context severely limits people's possibility to act, transilience may become less relevant to promote well-being.

All in all, our findings across the chapters of this dissertation support our rationale that transilience may promote mental health in the face of adversities. Importantly, this seems to be the case across varying levels of threat severity, including different adversities (i.e. climate change and the COVID-19 pandemic), countries and moments in time. However, it is noteworthy that higher transilience may not enhance well-being in highly restrictive contexts (see Chapter 3), where individuals cannot act according to what they desire, and hence engage in activities that support their well-being (e.g., meeting up with friends or family, leaving the house to go for a long walk). In such a restrictive context, psychological factors supporting well-being, like transilience, may become less relevant. Notably, whether and how contextual barriers influence the relationship between psychological factors (e.g., transilience) and well-being, to the best of our knowledge, remains understudied. Hence, the influence of contextual factors on the relationship between transilience and well-being represents a promising venue for future research on how to promote mental health in the face of adversities.

5.3 KEY OPEN QUESTIONS

Based on the findings presented in this PhD dissertation, multiple interesting questions arise. In the following sections we discuss two key overarching open queries for future investigation, which we believe are the most compelling in order to advance our understanding of human transilience in the face of adversities. Within each overarching query, we discuss some specific open questions.

Understanding the Generalizability of Our Findings

Is Transilience Relevant across Other Adversities and Countries?

While we studied transilience across different adversities, we focused on climate change risks and the COVID-19 pandemic. Furthermore, we conducted our studies in WEIRD countries (Wester, Educated, Industrial, Rich and Democratic). As such, it remains open to what extent people perceive transilience, and the extent to which transilience

promotes adaptation actions and mental health, in the face of other adversities and in other countries and cultures than those studied in this PhD dissertation.

Future studies could adapt the transilience scale presented in this dissertation, both at the individual and at the collective level, to study transilience in other domains such as personal adversities (e.g., injuries or illnesses), natural disasters, or economic crises. Moreover, future investigations could further test how experiencing one adversity may influence transilience, adaptation actions, and mental health related to other adversities. Notably, in one of our studies we explored and found that showing higher transilience in the face of one adversity (i.e., COVID-19) may enhance adaptive capacity (i.e., resilience) and intention to adapt to another adversity (i.e. climate change; see Chapter 3). This implies that higher transilience in one domain may allow people to perceive they are capable to adapt in general, and in turn be more likely to engage in adaptation actions and display better mental health in the face of other adversities. As such, transilience may be conceptualised as a general perceived adaptive capacity that is relevant across many different adversities. In this regard, it is important to understand whether people can perceive transilience also on a general level (i.e., in the face of 'adverse events in life'), and to examine the degree to which this general transilience relates to transilience in the face of specific adversities, as well as to adaptation actions and mental health in the context of such specific adversities.

Moreover, future studies could investigate the role of transilience in other countries, especially developing countries in Africa and Asia. This is particularly relevant as non-WEIRD countries are most vulnerable to contemporary adversities such as climate change, and hence face a more urgent need to adapt (Madhav et al., 2018; Mertz et al., 2009; de Souza et al., 2015; Thomas et al., 2020). Considering that in those countries people are more likely to have direct experience with adversities like climate-related hazards and epidemics, it is important to examine whether the levels of transilience are higher or lower compared to those found in the countries we studied in this PhD dissertation. Additionally, it is important to understand whether transilience promotes adaptation actions and well-being also in non-WEIRD countries, given that people's freedom to act may be more limited by constraints such as poverty, lack of resources, or inadequate infrastructure (see de Souza et al., 2015). Notably, our findings suggest that the extent to which the context is restrictive may influence the strength of the relationships between transilience, adaptation actions and mental health, respectively (see Chapter 3), suggesting that transilience is less predictive in contexts and among groups that have less freedom to act. Based on our results, it may be that transilience does not promote adaptation actions and mental health in developing countries where people are severely limited in their possibility to act. Still, it should be stressed that in this PhD dissertation we did not formally examine which factors and variables influence

transilience and/or moderate the extent to which it relates to relevant outcomes; as such, this remains an interesting question for future research.

Understanding Variables and Factors Influencing Transilience

Which Factors Influence Transilience?

To advance our understanding of human transilience in the face of adversity, it is important to study which individual, social and contextual factors may influence transilience. Such factors may either strengthen (or weaken) transilience, which in turn may encourage (or inhibit) people to engage in adaptation actions and to display good mental health. Alternatively, such factors may moderate the relationship between transilience and adaptation actions, or the relationship between transilience and mental health.

First, future research could examine which individual variables affect transilience, such as personality factors or demographic characteristics. It may be that certain personality styles, such as having a strong tendency to commit to whatever one is doing, to believe that one can influence events in life and to consider moments of change as challenges rather than threats (all characteristics of so-called 'hardiness'; Kobasa et al., 1982) strengthen transilience in the face of an adversity (cf. Maddi, 2005). Additionally, certain demographic variables, such as age, may influence the extent to which people perceive transilience in the face of adversities. For instance, older people tend to be more resilient in the face of life stressors (Bonanno et al., 2007), including the COVID-19 pandemic (Holingue et al., 2020), due to more life experience and capacity to regulate emotions. Yet, other studies suggest that age may moderate the relationship between resilience and relevant outcomes, such as experiencing psychological distress (Matzka et al., 2016). As such, more research is warranted to determine whether and how individual factors influence transilience.

Second, future studies could examine to what extent social factors, like perceived social support, influence transilience. Interactions within local communities can offer emotional support, encouragement, and enhance the perceived possibility for collective problem-solving (Feeney & Collins, 2015; Jennings & Bamkole, 2019; Thoits, 2011). As such, having strong social ties and a strong sense of perceived social support may impact the extent to which people develop and maintain transilience in the face of adverse events. Indeed, studies have consistently shown that social support can promote resilience, both at the individual (Bonanno et al., 2007) and at the community level (Ntontis et al., 2021), as well as people's capacity to grow after the confrontation with adverse events (Prati et al., 2009). At the same time, some studies suggest that social support may moderate the relationship between resilience and mental health outcomes (Li et al.,

2021; Khan & Husain 2010). Hence, future studies can examine which social factors are related to transilience in the face of adversities, and in what way.

Third, future research could examine how contextual factors, such as cultural values or national policies, affect transilience. Our findings suggest that contextual factors, notably very restrictive national policies, may moderate the extent to which transilience relates to adaptation actions and mental health indicators, respectively (see Chapter 3). Future studies can examine how these and other contextual factors may influence the level of transilience, or the relationship between transilience, adaptation actions and well-being. For example, the extent to which members of a community can access capital, credit and insurance may likely affect their individual and collective transilience (cf. Cinner et al., 2018), as well as the relationship between transilience and adaptation actions and mental health. Such financial assets allow community members to develop and/or adopt different technologies in order to adapt to adverse events. For example, in some coastal societies where climate change has led to a shift in the fish species available, community members have used local financial savings and credits to purchase new fishing gear that allows them to target the new fish species (Sumaila et al., 2011), as well as to store fish better during farther ashore fishing endeavours (Cinner et al., 2013). As such, it may be that certain contextual features may help individuals to perceive transilience in the face of an adversity. Importantly, identifying the key determinants of transilience can also inform the design and test of interventions aiming to target such determinants and, as a result, foster transilience (and in turn promote adaptative responses).

How Can We Enhance Transilience?

Given the finding that transilience increases the likelihood of adaptation actions and mental health, it is crucial to understand whether we can intentionally foster transilience. For that purpose, two main approaches may be possible. First, as mentioned above, interventions aiming to target the key determinants of transilience could be designed and tested, once more knowledge about such factors is available. Alternatively, interventions could attempt to directly elicit the perceived capacity to persist, adapt flexibly and positively transform in the face of adversity (i.e., transilience). With respect to this last approach, different intervention strategies could be tested in future studies.

One possible approach could be to prompt individuals to reflect on their past experiences of persisting, adapting, and positively transforming in the face of adversities. For example, participants could be invited to describe how they navigated and grew from a specific past adversity, like the first wave of the COVID-19 pandemic. Specific instructions could be provided to reflect specifically on the three components of transilience (e.g., “list at least two ways in which you changed for the better due to

the confrontation of the COVID-19 pandemic"; "describe the multiple ways you found to adapt to the national lockdown"). By reflecting on such past experiences, and especially by recalling personal examples of persistence, adaptability and transformability, participants may realise that they have shown the capacity to adapt and thrive in the face of past challenges, which in turn may enhance their transilience in the face of present and future challenges. This approach is consistent with research showing that information about one's previous accomplishments (i.e., mastery experience; Bandura; 1989; 1997) can increase people's perceived capacity to achieve specific tasks (i.e., their self-efficacy; Bandura, 1997).

Another possible strategy to elicit experiences of transilience in the present moment could be the use of gamification techniques, such as smartphone apps and virtual reality. Participants could be exposed to a simulated adversity, and then guided through a process of finding ways to persist, adapt flexibly and positively transform by dealing with such an adversity; they could also receive feedback on their performance (e.g., scoring points related to transilience) as well as guidelines on how they can improve their levels of transilience. For instance, participants could be exposed to a situation where they own a house with a backyard, and encouraged to increase the greenery in it to help protect themselves and their community from flooding. Prompts and suggestions could be provided to the participant in order to find ways to replace tiles and concrete with bushes and trees, as well as feedback on the beneficial opportunities (e.g., "you just learned something new about gardening, well done!" or "you asked your neighbours to plant a tree together, improving your relationship with them, and increasing protection against flooding for yourself and your community!"). By undergoing such virtual experiences of transilience in the face of adversity, participants may be able to develop a sense of their capacity to persist, adapt flexibly and positively transform in the face of a specific adversity, thus fostering transilience in the face of real-life adversities (cf. Douglas & Brouer, 2021).

To test the effectiveness of these interventions strategies in fostering transilience, future studies could employ experimental designs, where participants are randomly assigned to either an experimental group (where they undergo the intervention) or a control group. Comparisons between the levels of transilience across both groups would shed light into the extent to which the intervention succeeded in fostering transilience. Longitudinal designs could also be used to examine the pre- and post-intervention levels of transilience in both experimental and control groups. Importantly, by focusing on whether transilience can be boosted, future research can provide valuable knowledge into the extent to which transilience is a stable (i.e., a trait) or malleable (i.e., a state) construct, and into how individuals and communities can actively cultivate and strengthen their transilience in the face of contemporary adversities.

These studies can also examine whether enhancing transilience affects the extent to which transilience promotes adaptation actions and mental health.

5.4. PRACTICAL IMPLICATIONS

The research presented in this PhD dissertation holds significant practical implications. Policymakers and practitioners can leverage on our findings that people perceive transilience, and that higher transilience increases the likelihood of adaptation actions and mental health, when developing strategies and policies to deal with adversities like climate change and pandemics. Specifically, incorporating transilience in such processes would imply to move beyond damage control and to also foster opportunities for persisting, adapting flexibly, and changing for the better.

One promising approach may be to integrate transilience-focused initiatives within community-based disaster response and preparedness programs (Johnston et al., 2022). In areas prone to natural disasters, such as hurricanes or flooding, transilience principles could be implemented by emphasizing and leveraging on the capacity of individuals and communities to show persistence, adaptability and transformability in response to the risks in their local environment. Such transilience-focused initiatives can complement traditional 'bouncing back' approaches focusing on, for example, rebuilding and reinforcing infrastructure, establishing warning systems, and creating evacuation plans. For instance, community members could be trained in specific techniques and resources helping them carry on when they are hit by a flood, develop and try multiple ways to adapt to such threat, and come up with (and aim for) positive changes that can be derived from the process of adaptation to flood risks. Examples of such potential positive changes may include novel, useful knowledge and skills that can be shared with other members and future generations, the development of values that are more in harmony and respect with the surrounding natural environment, or an increase in social cohesion and support within the community, all of which could be derived from engaging together in activities to adapt to the unavoidable risks in the local area. By incorporating transilience principles in disaster preparedness and recovery programs in the face of different adversities, policymakers and practitioners may likely encourage communities to take a wide range of concrete actions for adaptation while also supporting the mental health and overall quality of life of community members.

Transilience principles could also be incorporated in campaigns aiming to promote adaptation to large-scale adversities, including climate change risks and future epidemics. For example, in the context of climate change, campaigns aimed at promoting urban greening could make explicit how individuals can persist, adapt flexibly, and positively transform by engaging in such climate-adaptive actions. Such

campaigns can highlight the various ways in which greening can be implemented and the benefits and growth opportunities associated with these actions, such as increased knowledge and new skills or a more pleasant living environment. Based on our research, it may be that messages focused on transilience may be more powerful in encouraging people to take action to adapt, and in enhancing their mental health, compared to messages that refer exclusively to the local threats (cf. McLoughlin, 2021; see Chapter 4). Additionally, it is plausible that focusing on transilience at the community level may be particularly powerful to promote widespread adaptation action across different levels. This is based on our finding that collective transilience appeared to be the only relevant predictor of both individual and community-based adaptation, when considering also individual transilience. By integrating transilience in adaptation policy packages, policymakers and practitioners can empower individuals and communities, helping them not only recover from immediate impacts, but also thrive and evolve in the face of an adversity.

5.5. CONCLUSION

In this PhD dissertation we have introduced the novel concept of *transilience* as the perceived capacity to persist, adapt flexibly, and positively transform when confronted with an adversity. A series of studies conducted across a range of socio-political contexts, which vary in the severity and types of threats encountered, as well as in the policies implemented to mitigate their negative impacts, revealed a consistent observation: individuals perceive transilience amidst various large-scale adversities, such as climate change and the COVID-19 pandemic, and they do so both at the individual and at the community level. Importantly, we generally found that individuals with higher levels of transilience are more likely to engage in adaptation actions and to exhibit better mental health, provided they have some freedom of choice over their behaviours. Our research indicates that, also when adapting to contemporary adversities, people perceive they can change for the better, rather than merely "bouncing back" to pre-adversity conditions (cf., Davoudi et al., 2013). As such, transilience opens up pathways for individuals to adapt to adversities also by trying and developing alternatives, by proactively seeking beneficial opportunities and undergoing positive transformations.

The term "crisis" has a fascinating etymology, originating from the ancient Greek words *krísis* and *krínō*, which signify 'turning point' and 'decision' (www.etymonline.com). We may never be able to evade crises entirely, and it is important to develop ways and to find tools to limit the negative consequences that crises can have on our lives. At the same time, it is imperative to remember that crises inherently represent decisive moments, which may invite us to reassess our present conditions, challenge them,

and evolve into improved versions of ourselves and our communities. Rather than perceiving crises solely as stumbling blocks, we can try to embrace them also as essential stepping stones towards societal progress.

NEDERLANDSE SAMENVATTING

We worden tegenwoordig geconfronteerd met talloze crises, zoals klimaatverandering, natuurrampen en pandemieën. Hoewel de reactie op crises meestal is om de oude situatie te willen behouden en herstellen, bieden crises ook mogelijkheden voor positieve verandering. In dit proefschrift introduceren we een nieuw concept, "transilience": het zelf ervaren vermogen om te volharden, je flexibel aan te passen en positief te veranderen bij tegenspoed. Ten eerste wilden we onderzoeken of individuen, zowel op het individuele als op het collectieve niveau, transilience ervaren als ze geconfronteerd worden met verschillende tegenslagen (zoals klimaatverandering en pandemieën). Ten tweede wilden we onderzoeken of mensen die meer transilience ervaren meer adaptief gedrag (willen) vertonen en meer welzijn ervaren als zij geconfronteerd worden met tegenslag. We hebben deze vragen rondom verschillende crises en onder verschillende sociaal-politieke omstandigheden onderzocht.

Samenvatting van de resultaten en theoretische implicaties

Transilience kan op een valide en betrouwbare manier worden gemeten

Ons eerste doel was om een valide en betrouwbare schaal te ontwikkelen om transilience te meten. We hebben een transilience-schaal ontwikkeld en getest in de context van klimaatverandering, zowel op individueel niveau (Hoofdstuk 2) als op collectief niveau (Hoofdstuk 4). Uit de resultaten blijkt dat de transilience-schaal de drie componenten van transilience goed reflecteert, en dat transilience het best kan worden gezien als een overkoepelend concept. Verder blijkt dat de transilience-schaal een betrouwbaar en valide meetinstrument is: transilience is gerelateerd aan, maar niet hetzelfde als andere concepten, zoals zogenoemde 'self-efficacy', 'outcome efficacy' (van Valkengoed & Steg, 2019b) en 'resilience' (Smith et al., 2008). Bovendien betekent transilience niet dat men klimaatverandering ontkent. Verder blijkt dat transilience, zoals verwacht, een goede voorspeller is van gedrag en mentale gezondheid.

Mensen ervaren transilience bij tegenslagen

Vervolgens hebben we onderzocht of mensen transilience ervaren bij tegenslagen, zoals klimaatverandering en COVID-19. Uit de resultaten blijkt dat mensen in verschillende landen over het algemeen het gevoel hebben dat ze kunnen volharden, zich flexibel kunnen aanpassen en positief veranderen (en dus transilience ervaren) als ze geconfronteerd worden met klimaatverandering (Hoofdstuk 2) en de COVID-19-pandemie (Hoofdstuk 3), ook als er sprake is van grote onzekerheid en risico's, zoals aan het begin van de COVID-19-pandemie in Italië. Uit de resultaten blijkt verder dat individuen in verschillende landen ook het gevoel hebben dat zij als gemeenschap kunnen volharden, zich flexibel aan kunnen passen en positief veranderen (we noemen dit 'collectieve transilience') als ze geconfronteerd worden met klimaatverandering (Hoofdstuk 4).

Samenvattend blijkt uit dit proefschrift dat transilience een fundamentele menselijke capaciteit weerspiegelt om met verschillende tegenslagen om te gaan, zelfs wanneer er sprake is van ernstige bedreigingen (zoals aan het begin van de COVID-19-pandemie). Als zodanig sluit transilience aan bij de definitie van adaptatie als 'schade matigen en nieuwe kansen vinden' (IPCC, 2014b).

Mensen die meer transilience ervaren vertonen over het algemeen meer adaptief gedrag, maar niet in alle omstandigheden

Transilience voorspelt individueel adaptief gedrag, mits mensen enige vrijheid hebben om te handelen

Zoals verwacht, zijn mensen die meer transilience ervaren over het algemeen meer geneigd om adaptief gedrag te vertonen om zichzelf te beschermen tegen de negatieve gevolgen van klimaatverandering en de COVID-19-pandemie. We vonden dat meer transilience zowel incrementeel als transformatief gedrag stimuleert (Hoofdstuk 2) en leidt tot zowel meer individueel als meer collectief adaptief gedrag (Hoofdstuk 4). Transilience hangt echter niet samen met adaptief gedrag als de keuzevrijheid van mensen sterk wordt beperkt, zoals het geval was tijdens de eerste fase van de COVID-19-pandemie in Italië (Hoofdstuk 3). Deze resultaten suggereren dat transilience vooral relevant is voor het bevorderen van adaptief gedrag wanneer mensen enige keuzevrijheid hebben (Guagnano et al., 1995; Stern, 2000).

Collectieve transilience voorspelt adaptief gedrag gericht op de gemeenschap en het individu

Zoals verwacht, blijkt uit de resultaten dat vooral collectieve transilience ertoe bijdraagt dat men meer gedrag wil vertonen dat de gemeenschap kan helpen beschermen tegen de negatieve gevolgen van klimaatverandering (Hoofdstuk 4). Collectieve transilience bleek de belangrijkste voorspeller van zowel individueel als collectief adaptief gedrag, ook als we controleren voor individuele transilience.

Mensen die meer transilience ervaren voelen zich mentaal gezonder, maar niet in alle omstandigheden

Zoals verwacht, hangt hogere transilience samen met een betere mentale gezondheid, zowel in verband met klimaatverandering (Hoofdstuk 2) als met de COVID-19-pandemie (Hoofdstuk 3). Transilience hangt echter niet samen met mentale gezondheid als mensen ernstig worden beperkt in hun keuzevrijheid, zoals in Italië tijdens de eerste golf van de COVID-19-pandemie (Hoofdstuk 3). Deze resultaten suggereren dat transilience vooral relevant is voor het bevorderen van mentale gezondheid wanneer mensen enige keuzevrijheid hebben.

Belangrijke open vragen

Is transilience relevant bij andere tegenslagen en in andere landen?

We hebben transilience onderzocht in relatie tot klimaatverandering en de COVID-19-pandemie, waarbij we alleen onderzoek hebben gedaan in WEIRD-landen (Western, Educated, Industrial, Rich and Democratic). Toekomstig onderzoek kan nagaan of vergelijkbare resultaten worden gevonden in relatie tot andere (collectieve en persoonlijke) tegenslagen in niet-WEIRD-landen, zoals ontwikkelingslanden in Afrika en Azië. Dit is vooral belangrijk omdat deze landen zeer kwetsbaar zijn voor hedendaagse crises zoals klimaatverandering (Mertz et al., 2009).

Welke factoren beïnvloeden transilience?

In dit proefschrift is niet nagegaan welke factoren van invloed zijn op transilience en hoe we transilience kunnen versterken. In vervolgonderzoek kan worden nagegaan welke individuele, sociale, en contextuele factoren transilience kunnen versterken en/of de sterkte van de relatie tussen transilience en adaptief gedrag en mentale gezondheid beïnvloeden.

Relevante individuele factoren zijn bijvoorbeeld persoonlijkheidskenmerken (zoals weerbaarheid) en demografische kenmerken (zoals leeftijd; Bonanno et al., 2007). Relevante sociale factoren zijn de sociale steun die wordt ervaren (Bonanno et al., 2007), en bij contextuele factoren valt te denken aan culturele waarden en nationaal beleid. Daarnaast kan worden getest welke interventies effectief zijn om transilience direct te versterken. Een manier om dat te doen zou kunnen zijn om individuen aan te moedigen te reflecteren op hun eerdere ervaringen van volharding, flexibele aanpassing en positieve veranderingen in het omgaan met tegenslagen, zodat men zich ervan bewust wordt dat ze eerder transilient waren (cf. Bandura, 1997).

Daarnaast kunnen gamification-technieken worden getest, zoals smartphone-apps of virtual reality (cf. Douglas & Brouer, 2021). Door middel van dergelijke virtuele ervaringen kunnen individuen een gevoel ontwikkelen van hun eigen vermogen om tegenspoed te overwinnen, wat uiteindelijk transilience kan bevorderen in het echte leven.

Praktische Implicaties

Het onderzoek in dit proefschrift heeft belangrijke praktische implicaties. De resultaten van ons onderzoek suggereren dat interventies kunnen proberen om transilience te versterken, omdat dit er niet alleen toe kan leiden dat mensen meer acties gaan nemen om zichzelf en hun gemeenschap te beschermen tegen de negatieve gevolgen van crises, maar ook de mentale gezondheid kan bevorderen. In plaats van crises enkel te zien als obstakels, kunnen we proberen crises te omarmen als essentiële stappen voor vooruitgang.

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ABOUT THE AUTHOR

Valentina, born in Bogotá, Colombia, relocated to Italy at a young age. In her school years, she already displayed a profound interest in how crises can act as catalysts for evolution and growth. She even wrote a small thesis on this topic for her high school graduation.

After earning a Bachelor's degree in Psychology at the University of Milan-Bicocca, she moved to Tuscany to pursue a Master's in Philosophy of Cognition and Emotion at the University of Siena. During this time, she spent six months as an Erasmus student at the Philosophy department of the Institute of Cognitive Sciences (IFK) in Osnabrück, Germany.

During a bike tour from New York to Minneapolis, Valentina realised the deep connection between environmental problems and human behaviour. She asked herself to what extent Psychology, as the science of human behaviour, was recognized as a relevant discipline to address the contemporary environmental crisis. This led her to the Environmental Psychology Master's program at the University of Groningen, in the Netherlands.

While still pursuing her master's degree, Valentina received a PhD offer in the Environmental Psychology department, focusing on the Psychology of Climate Change Adaptation. She was immediately drawn to understanding whether and how humans can not merely adapt, but also change and evolve due to the confrontation with contemporary global crises, such as climate change. This interest culminated in the development of Transilience, a novel construct which forms the core of her PhD dissertation.

As humans living in the 21st century, we face a seemingly unending succession of crises (e.g., natural disasters, pandemics, financial crises and political upheavals), many of which will likely become more frequent and severe in the years to come. Amidst these unprecedented contemporary challenges lies a remarkable potential: crises can allow us also to challenge the status quo, find new opportunities and change for the better, instead of merely preserving and/or recovering what we had (typically referred to as "bouncing back"). Remarkably, such positive angle has remained mostly overlooked by studies on how people can adapt to contemporary crises.

This PhD dissertation introduces the novel construct *transilience*, defined as the perceived capacity to persist (persistence), adapt flexibly (adaptability), and positively transform (transformability) in the face of an adversity. The core aim is to investigate whether people perceive they can do more than 'bounce back' to the status quo when confronted with large-scale contemporary adversities, such as climate change and the COVID-19 pandemic.

Specifically, two overarching research questions are addressed in this thesis. First, do people perceive transilience, both in the face of different contemporary threats with varying levels of severity, as well as at different levels (i.e., individual and collective)? Second, to what extent does higher transilience promote engagement in adaptation actions and mental health, across different examples of contemporary threats? All in all, the research presented in this PhD dissertation opens up broader, innovative and hopeful pathways for our understanding of how humans can adapt to the unavoidable crises of our time.

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