Resilience on Climate Change through the Literature

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It is vital to understand resilience as it applies to the field of climate change and disaster. The concept of resilience has drawn the interest of climate scientists and psychologists who want to better understand how we can improve individual's and society's resilience in the face of a quickly worsening climate as a result of man-made climate change. Resilience is defined as a process, ability, or outcome of successful adaptation to the environment, despite dangerous or adverse conditions. The objective of this study is to run review research through contemporary studies to summarize the cumulative documents in the area of resilience and climate change to investigate the contributing factors to climate change resilience. A search was carried out on the Web of Science, Google Scholar, and PubMed. A set of keywords was used, followed by filtering main keywords, resulting in a review of 70 articles. The results demonstrated that resilience was the main target of various researchers on climate change globally. Moreover, results indicate various waves of resilience and components of resilience including exposure, susceptibility, and capacity to cope with environmental issues. Besides that, this research revealed coping strategies on climate change and factors that have been correlated with climate change resilience (e.g., psychological, social, and family and community factors). In conclusion, resilience has been identified as a core concept in both the mitigation of climate change and climate change disasters, as well as the capacity to cope with these when they occur. Future research should focus on identifying core features of climate change specific resilience so that vulnerable populations can be identified and useful policies implemented to protect them. These results serve as a source of reference for future research.

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Introduction

People can feel helpless when facing danger and adversity. Performing adequately despite adverse circumstances is often referred to as resilience (Connor et al., 2003). Resilience is defined as a process, ability, or outcome of successful adaption to the environment, despite dangerous or adverse conditions. Everyone will face adversity at some point and resilience is a significant factor in wellbeing (Karam et al., 2014). Resilience is the ability or skill that allows us to overcome life's obstacles and maintain our mental and physical health in the face of adversity (Clauss-Ehlers, 2008). Resilience can therefore be used as a measure of a person's capacity to handle stress that could negatively impact their mental health (Connor et al., 2003).

The word resilience comes from latin roots, coming from the latin work "resilio" meaning "to jump back" (Klein et al., 2003; Cimellaro et al., 2010). The concept of resilience has changed significantly over time. It was initially understood to be a system's capacity to remain constant despite external change (Manyena et al., 2019; Holling, 1973). Over time, resilience has grown as a concept and has encompassed more attributes related to the core theme, including capacity to learn (Dovers & Handmer, 1992), the ability to return to a homeostatic state (Tilman &Downing, 1994), manage external shocks, stresses, and hazards (Mileti, 1999; Adger, 2005, Bruneau et al., 2003), maintain a systems internal function (Walker et al., 2002), and thrive despite adverse circumstances (Magis, 2010)

Resilience theory is a conceptual framework for understanding how some individuals can recover from experiencing adverse conditions in a strength-focused approach (Masten et al., 2005). Understanding resilience is essential to help people to cope with inevitable events such as natural disasters, crime, war, accidents, and abuse. There has been a long fascination with resilience, due to the observation that some people are able to emerge from incredibly difficult situations relatively unscathed psychologically, while others are significantly harmed.

Resilience is not understood to be a personality trait, but rather a dynamic process to successfully adapt to threats and adversities in life. Resilience as a complex process can be viewed with many factors, including biological, psychological, and social/cultural factors which interact in complex ways to result a given person's response to an adverse situation (Southwick et al., 2014). Resilience should also be thought of as a continuum, rather than a binary concept, with individuals or groups being more or less resilient, rather than being viewed as not being resilient at all. Such a complex view of resilience, though more accurate, can make it difficult to clearly define the concept and study the factors that most strongly impact on people's ability to cope with life's stressors. It is it therefore essential to be clear when discussing and defining resilience, whether the terms is being used to describe a process, a trait, or an outcome, and whether this is viewed in the context of an individual, a group, a non-organism, or even an entire ecosystem. The factors that influence resilience will vary significantly depending on the specific scenario in which is it being defined and studied.

Methodology

The review was based on the qualitative methodology through four steps: collection, descriptive analysis, selection of categories, and evaluation of the material. This type of review uses methods that can be replicated to identify, select, and evaluate papers in the literature on the subject of research studied. First a search was conducted for primary studies in the main collection of the Web of Science, Google Scholar, and PubMed using three sets of keywords identified by the authors during a brainstorming process. These consisted of search terms that were considered to be obligatory for this study to collect the relevant information to the main terms on climate change resilience. The key words were as follows; three waves of resilience, components of resilience, coping with climate through resilience, and contributing factors related to climate change resilience. After applying the filters due to considering the exclusion criteria, 70 articles were obtained for review.

Findings

Of the 70 articles identified, each was analysed for their general characteristics (e.g., definition, dimensions, contributing factors, and outcomes) so as to extract data on climate change resilience in greater detail. Following this, an in depth read of each article was performed by the primary author, before the main commonalities and themes were identified and synthesised into the following literature review.

Body

Three Waves of Resilience

A meta-analysis conducted by Richardson (2002) identified three waves of resilience research, with the different waves adding their own contributions to the understanding or resilience and resulting in improved therapeutic and educational interventions. The first wave of research involved scientists studying traits and environmental factors that promote resilience, such as educational interventions that build confidence and self esteem. Researchers in the second wave focused on stress

and coping practices. This wave of research led to family based interventions, and focused on not just the individual themselves but their interactions and origins as factors in their resilience. Finally, in the third and current wave of resiliency research, researchers are focusing on ongoing resiliency factors including factors that determine how people change and grow after stressful life events. The concepts being developed based on this research are helping to design interventions focused on helping individuals move toward self actualisation and growth throughout their recovery.

Table 1 Three Waves of Resilience Inquiry: Practice Implications

Wave	Description	Outcome	Interventions
First Wave: Resilient Qualities	Identified people's traits and environmental characteristics related to resilience	Provided a list of traits and environmental factors to help people overcome adversity	Interventions were intended to prevent and reduce risk.
Second Wave: Resilient Processes	Focused on the processes used to overcome stress and regain balance	Established which processes contribute to recovery	Interventions aimed to return people to equilibrium.
Third Wave: Innate Processes	Identifies the motivational forces within individuals and groups that allow them to self-actualize	Distinguishes experiences that foster and activate growth-producing forces	Interventions tap innate creative and transformational processes.

Source. Adapted by Greene (2007) from ''The metatheory of resilience and resiliency,'' by G. E. Richardson, 2002, Journal of Clinical Psychology, 58, 308.

Components of Resilience

As discussed above, the concept or resilience can be too broad and complex to be useful in many situations, it is therefore important to be able to identify the individual factors and components within resilience so that the research and interventions can be more specifically targeted and are able to measure progress more effectively. Resilience can be viewed as the inverse of vulnerability (Walker et al., 2011). In this conceptualization, resilience and vulnerability are comprised of the same factors. Vulnerability is defined using the factors of exposure, susceptibility, and capacity to cope (UNISDR, 2009; White et al., 2005; Molarius et al., 2014). Coping capacity can be defined as the "ability of people, organizations, and systems, to use available skills and resources in order to face and manage adverse conditions, emergencies, or disasters" (UNISDR, 2009). Exposure can be defined as; "people, property, systems, or other elements present in hazard zones that are thereby subject to potential losses" (UNISDR, 2009). Finally, susceptibility can be defined as; "the characteristics or circumstances of community, system, or asset that make it susceptible to the damaging effects of a hazard" (UNISDR, 2009). This can be applied to individuals through a slight rewording of the definition, with susceptibility now being defined as; the characteristics or circumstances of a person that make them susceptible to the negative impacts of adverse effects. Susceptibility can also be defined as a "state or character of being capable of receiving, admitting, undergoing, or being affected by some harmful effect" (Molarius et al., 2014). By viewing resilience as the inverse of vulnerability, we can define resilience as an individual, group, or ecosystem which has low exposure, susceptibility, and a strong capacity to cope.

Climate Change Resilience

As discussed above, the concept of resilience is multifaceted and complicated. Nevertheless, it is important to understand resilience as it applies to the field of climate change and disaster. The concept of resilience has drawn the interest of climate scientists and psychologists who want to better understand how we can improve individual's and society's resilience in the context of a quickly worsening climate due to man made climate change (Rana, 2020).

Despite the potential utility of resilience research to improve our capacity to handle climate change and disasters, it is nevertheless difficult to operationalise resilience in terms of climate change, limiting the scope of research into this topic (Manyena et al., 2019). This is

because resilience is a complex phenomena which has different interpretations depending on the context, the individual or group, and the type of issue being studied (Roostaie et al., 2019; Meerow et al, 2016; Allen et al., 2016; Manyena et al., 2019). The study of resilience was started by Holling's (1973) study on ecological resilience (Klein et al., 2003).

Understanding resilience in the context of climate change is essential for improving coping and adaptive capacities when a disaster hits, as well as improving preparedness before anything happens. By improving resilience, societies, organisations, and individual's can better cope with climate disasters and minimise disruption to societal function. Research in this field aims to understand resilience in terms of climate change risk and therefore improve our ability to achieve sustainability.

In terms of climate resilience, the IPCC has defined resilience as "the ability of a system to anticipate, absorb, accommodate or recover from the effects of a hazardous event" (Field et al., 2012). The United Nations Office of Disaster Risk Reduction (UNDRR) has defined resilience as "the ability to resist, absorb, accommodate and recover from the effects of a hazard" (Wannous & Velasquez, 2017). Climate change resilience can therefore be defined as the capacity of human and natural systems to cope with climate related disasters and disastrous events (Field & Barros, 2014).

Coping with climate change: The role of psychologists in promoting climate resilience

Climate change can be viewed as the single biggest threat to human well being, and is already causing immense suffering and destruction throughout the planet. Climate change is predicted to be a major new source of stress in a variety of contexts in the coming decades. Through understanding resilience, psychologists can help develop interventions and methods of communication which help the most vulnerable people to better manager environmental stresses.

The literature on climate change resilience has identified 3 main lessons which can be applied to helping improve climate change resilience. First is that despite there being best practice techniques for communicating about climate change, there is no single best method that applies to all people in all situations. Second, that when communicating using best practice techniques, communicators should pay attention to the specific type of stress that is being discussed, and the people that it is impacting, keeping in mind how people commonly respond to adverse events and stressors. Third is to ensure that the targeted message includes the individual as well as their community and context. It is impossible

to separate a person from their lived environment, and so that environment should be taken into consideration when designing messaging.

Climate change is expected to have devastating impacts on not only the natural world, but human societies as well. Due to the fact that the majority of human population centres are located in coastal regions, sea level rise is predicted to destroy entire population centres, forcing the people who live there to migrate (Hauer, 2017; Neumann et al., 2015). Climate change is also predicted to impact on places of social and cultural import, such as the mangrove ecosystems in australia which are spiritually significant to the indigenous population, or the flooding of Venice and landmarks such as St. Marks Basilica (Potter, 2020; Berry, 2019). Effective communication about the extreme disruption caused by climate change is essential for people to adapt effectively, and to cope not only in terms of their action, but their mental and physical health as well (Mah et al., 2020).

Psychologists have an important part to play in the development and promotion of communication methods and interventions which are designed to improve resilience; much research is already being done on the best methods for responding to climate change (Hornsey & Fielding, 2020; Swim et al., 2011; Stern, 2011). Through the study of how people cope with threats and adverse conditions, we can better understand how to handle stress in general (Lazarus & Folkman, 1984; Folkman & Moskowitz, 2004). And research is already being conducted on climate specific stressors and anxieties (Hasbach, 2015; Clayton, 2020; Clayton & Karazsia, 2020).

Psychologists are therefore essential in the research and development of methods for improving individual resilience to the future impacts of climate change. Through the development of these programs, psychologists can help to address a much understudied issue, the psychological toll of climate stress on peoples mental health and wellbeing. Though improving resilience is not a goal that is specific to climate change, psychologists can draw from studies of resilience alone, along with climate specific studies, to design interventions to best help people with this new and serious stressor (Mah et al., 2020).

The three legs of climate-change resilience

The concept of community resilience is a new and quickly growing idea governing how groups of people, and entire communities should handle adapting for climate change. Community resilience, much like individual resilience, is about how a community is able to handle and cope with adverse situations and external

stressors. The factors that govern community resilience are significantly different from those that govern individual resilience, and include infrastructure, geographic nnd other climate vulnerabilities, and social cohesion. Resilient communities are those that are able to adapt to new situations while maintaining the core function of the community, providing lives for those in the community to live. Resilient communities are those that are more cooperative, have greater access to resources, strong leadership, social cohesion and strong social networks (Lindberg & Swearingen, 2020). Climate change focused research has tended to focus on community resilience, with significantly less research going into individual resilience. However some research on individual resilience in terms of climate change has been conducted (Compas et al., 2017; Werner, 2000).

Despite the differences in community and individual resilience, these are not entirely separate concepts. When an individual takes action to promote their own resilience, or as a response to a negative external event, the results of that action have impacts not only for themselves, but for the community around them. There are situations in which promoting the resilience of an individual has a secondary benefit of promoting community resilience as well. For example, in urban water harvesting by individual households in drought prone areas of india improve those households resilience to drought. Through harvesting the water that falls on individual properties, it has the beneficial side effect of improving the communal water table, thereby improving the resilience of the community. Additionally, when drought strikes, these resilient households are able to survive off their water stores, reducing the strain on emergency services that would otherwise have to work to handle their need to water as well (Millison, 2020). This may not always be the case however. Some responses which can be seen as promoting individual resilience, can be detrimental to community resilience as a whole. An example of this can be seen in the hoarding of resources during natural disasters or pandemics.

Anxiety and resilience in the face of natural disasters

As climate change disasters increase in frequency and severity, we are seeing more floods, hurricanes, and droughts. These disasters have dramatic impacts on the wellbeing of those that are exposed to them, either directly or indirectly. Despite the traumatic nature of many of these disasters, research finds that the most common response is that of resilience, rather than the development of maladaptive outcomes (Chen et al, 2020). Interestingly, the outcomes of natural disasters bear similar recovery and pathology development patterns as other traumatic life events, with the majority

of individuals demonstrating resilience by adapting and coping with the stress (Bonanno et al., 2010). There is a large variability in expressions of depression and PTSD when communities are followed after experiencing a natural disaster.

One of the most important areas for future researchers to identify is the factors that influence the variety in outcomes after a disaster. This can allow us to better identify and proactively help vulnerable populations (Chen et al., 2020). Some theoretical factors may convey additional risk to those who suffer life traumas, and could even increase the risk of developing post trauma pathologies such as PTSD. However, limitations in the research have prevented psychologists from identifying these factors in practice. One limitation is that these factors are often considered in isolation. This research method reduces external validity by failing to analyse how combinations of factors can influence outcomes, as well as how the individual factor may express differently in different contexts. A multivariate analysis of risk factors would be useful in addressing these shortcomings. Secondly, studies that investigate both beneficial and risk factors are often conducted cross sectionally, or even retrospectively. These methodologies may be invalid due to the traumatic and distressing nature of natural disasters, leading to bias in recall and inaccurate results. (Chen et al., 2020). As mentioned above, natural disasters do not only affect people individually, but also the social fabric in which they live (Fritz, 1961 cited in Chen et al., 2020). Those who survive natural disasters will often lean on family and peer support in order to provide stability and an opportunity to rebuild. This makes community resilience an extremely important factor influencing individual resilience. Unfortunately, research into post disaster community resilience has suffered significant methodological drawbacks. As with individual resilience discussed above, this research often relies on cross sectional methodologies and are not able to accurately identify factors influencing community resilience due to poor control of confounding variables (Chen et al., 2020).

Due to the methodological limitations discussed above, the factors that influence resilience are poorly understood (Aminger et al., 2021). Despite this, it is important to understand what these factors are in order to design effective prevention and intervention initiatives. More research needs to be done in order to identify these factors. The factors that have been identified will be briefly discussed below.

Psychological Factors

It has long been thought that personality traits have significant importance in determining post disaster

individual resilience. One high quality study by Mandavia & Bonanno (2019) has identified negative affect as being a factor influencing depression following disasters. In the study, the researchers found that negative affect was higher in those who manifested symptoms of depression after experiencing hurricane Katrina. Religiosity has been found to both positively and negatively impact post disaster resilience. Looking to God for hope and guidance after a disaster was found to be protective, whereas viewing the disaster as a punishment from God was found to be a risk factor for poorer psychological well being. Substance use has also been found to be a risk factor in resilience research. Lowe et al. (2017) in a study of individuals after hurricane Sandy found that individuals suffering from depression had increased alcohol consumption or "non-medical prescriptions". Protective and enhancing factors include cognitive flexibility and the ability to change one's cognition and behaviours (Bonanno & Burton, 2013; Bonanno et al., 2004).

Social Factors

Social support has been identified as a highly potent protective factor. A study on postpartum mothers who experienced the Iowa Flood identified "perceived informational, psychocal, emotional, and tangible support" from their partner to be protective on both stress and depression. It is important to note that there may be a gap between objective levels of support, and subjective levels of support. A study by Kaniasty & Norris (1995) found that although social support increased after natural disasters, perceived social support actually declined. The importance of social support was also found in a study of Australians exposed to drought and flooding. This study found that social connection was protective for the negative impacts of the external stressors.

Family and community factors

Family support is particularly important in post disaster scenarios, not only from a psychological perspective but also from a practical perspective. Those who have been affected by natural disasters will often rely on family support as they get back on their feet. This can put strain on family dynamics and stress existing tensions. A strong family support system is an important protective factor in determining climate change resilience.

Stress-buffering effects of resilience factors

The majority of studies focusing on the impacts of resilience factors focus on the impact these factors have on outcomes. Few studies have been conducted on how these outcomes may reduce the impact of stress. A review by Kalisch et al. (2017) studied the literature on the interaction between resilience factors and stress. This review found that resilience factors such as the ones discussed above have significant stress buffering capabilities, leading to the individual being less impacted by the stress they are experiencing. Further research is needed to identify the impact of individual resilience factors on stress.

Conclusion

The research clearly identifies resilience as a key concept in both preparing for, and mitigating the consequences of climate change and climate change disasters. Through understanding resilience in its various contexts, including physical, environmental, and psychological resilience, better systems can be developed to both prevent climate change disasters, and to cope with them when they occur. Future research should focus on the identification of core features of climate resilience specifically. The current focus on psychological resilience is useful for understanding how individuals may act post disaster, however through better understanding physical and environmental resilience to climate change, it may be possible to identify vulnerable populations and implement resilience bolstering policies in advance of any climate impact.

Acknowledgments

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