Exploring the Role of Collective Efficacy, Self-Efficacy, and Group Identification in Motivating Climate Change Adaptation

Master Thesis – Environmental Psychology

Lea Sophie Dittrich

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Department of Psychology
University of Groningen
Examiner/Daily supervisor:
Dr. Gabriel Muinos

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Abstract

As climate change is a multifaceted issue that cannot be solved by governments alone, individuals need to adapt to the place-specific impacts. Building on prior research, our study investigated the role of collective efficacy, self-efficacy, and group identification in understanding climate change adaptation intentions by using a person-by-treatment design with a two-level between-subject design for collective efficacy (*N* = 138). We hypothesized that self-efficacy and adaptation intentions are positively related. Moreover, we expected that collective efficacy increases self-efficacy, and that self-efficacy mediates the path between collective efficacy and adaptation intentions. Additionally, we tested whether identifying with a group strengthens the relationship between collective efficacy and adaptation intentions. Although our manipulation successfully raised collective efficacy beliefs, we did not find experimental evidence. However, we found correlational evidence that self-efficacy is significantly related to collective efficacy and adaptation intentions. Moreover, self-efficacy positively mediated the relationship between collective efficacy and adaptation intentions. Our findings suggest that collective and self-efficacy should be regarded cohesively when motivating climate change adaptation. Yet, further experimental research needs to clarify if these variables are just related to each other or if collective efficacy is truly a motivator of self-efficacy and adaptation intentions. Implications and limitations of our findings are discussed.

Keywords: climate change, adaptation, collective efficacy, self-efficacy, group identification

Exploring the Role of Collective Efficacy, Self-Efficacy, and Group Identification in Motivating Climate Change Adaptation

Climate change is widely recognized as a long-term global driver of various natural disasters (IPCC, 2021). Among the most prevalent hazards are floods, which have caused significant casualties and property losses in the last few years (Zhang et al., 2021). Low-lying regions in the Netherlands, Belgium, and Germany, with several major rivers flowing through the country, have been especially affected (Brönnimann et al., 2019). A recent report shows the alarming trend that the total urban area exposed to floods in Central Europe has increased by 1000% during the past 150 years and that it will further grow by another 200% by 2050 (Paprotny et al., 2018). As a result, flood-related events will occur more frequently and increase in severity. Developments like these will fundamentally change our planet and pose various challenges to humanity, such as significant economic damage, traumatization, or numerous casualties (IPCC, 2021). Therefore, it is highly relevant to gain insight into measures that can be taken to cope with the inevitable consequences of climate change.

Climate Change Adaptation

One basic strategy that is increasingly taking center stage in the current climate change debate is adaptation. According to the Intergovernmental Panel on Climate Change (IPCC), adaptation refers to "the process of adjustment to actual or expected climate and its effects, to moderate harm or exploit beneficial opportunities" (IPCC, 2014, p. 118). Today, most adaptation approaches are based on the decisions taken by governments, the United Nations, and stakeholders (Dunford et al., 2015; Moser & Ekstrom, 2010). Examples of successfully implemented adaptation measures are flood defenses, dikes, or warning systems. However, a growing field of research argues that structural efforts are limited in guaranteeing and implementing adequate adaptation measures for the various affected areas (Bamberg et al., 2017; Brink & Wamsler, 2019; Fox-Rogers et al., 2016). Significant reasons are that climate events vary within and between places due to multiple factors such as different physical features or financial resources. In other words, there is no "one-size-fits-all solution" that can be applied to such situational problems. Therefore, it can be expected

that governments will not always respond effectively to place-specific impacts and will soon become overwhelmed (Sinay & Carter, 2020).

Attributing greater responsibility to people has been an essential consequence of this development. More specifically, professionals in the environmental sector recommend that individuals, households, and communities actively engage in climate change adaptation to protect themselves from the local impacts (Elrick-Barr et al., 2016; Kievik & Gutteling, 2011; Kuruppu & Liverman, 2011). Examples of such small-scale interventions frequently used in flood prevention are preparing sandbags, harvesting rainwater, or supporting environmental policies. Multiple studies have underlined the effectiveness of these actions. For instance, it was shown that individuals in Germany (Kreibich et al., 2015), France (Poussin et al., 2015), and India (Hochrainer-Stigler et al., 2019) were able to reduce the impacts of local flooding by installing flood-proofing measures to avoid water entering their houses. Similarly, Kreibich et al. (2015) demonstrated that specific preventive measures could reduce up to 80% of household property damage. Thus, private adaptation seems highly effective in reducing the impacts of flood hazards.

Although studies indicate that individuals, households, and communities can significantly contribute to climate change adaptation, many citizens do not seem to be sure what actions should be taken or whether their efforts will be effective (Bamberg et al., 2017; Sinay & Carter, 2020). Therefore, it is important to understand factors that motivate people to take actions in favor of climate change adaptation.

Self-Efficacy: I Can Make a Difference

Human behavior is significantly determined by an individual's belief in their capabilities to achieve certain goals. This phenomenon is called self-efficacy and defines a personal judgment of how well one can execute courses of actions required to deal with prospective situations (Bandura, 1982). After Bandura had laid the groundwork of the construct, self-efficacy has been proven valid by various theories such as the Protection Motivation Theory (Floyd et al., 2000), the Theory of Planned Behavior (Ajzen, 2002), or the Social Cognitive Theory (Benight & Bandura, 2004).

Individuals with high levels of self-efficacy are more likely to persist in the face of difficulties, become acquainted with necessary skills to achieve goals, and to affect change in their environment (Bandura, 1982; Bostrom et al., 2019; Metag et al., 2016). Alternatively, if individuals believe that they do not have the capability to perform a behavior, they tend to lose interest in the task or even engage in defensive behavior, leading to inaction (Bandura, 1982). Consequently, self-efficacy is a strong predictor of whether a person will engage in certain behaviors or not.

Moreover, several studies have linked self-efficacy with behavioral engagement in the environmental domain. Burnham & Ma (2017) demonstrated that farmers in China are more likely to adapt their farming practices and prevent damage caused by climate change if they perceive themselves capable of doing so. Furthermore, research by Bostrom et al. (2019) points in a similar direction, finding a positive association between self-efficacy and certain pro-environmental behaviors, such as purchasing eco-friendly products or reducing household energy usage. Besides correlational research, Ung et al.'s (2016) experimental design reveals a causal link between self-efficacy and adaptive actions concerning flood risks in coastal Cambodia. Moreover, a recent meta-analysis provides further evidence for the significance of self-efficacy in motivating pro-climate behaviors (van Valkengoed & Steg, 2019). This systematic review offers an examination of 13 factors across more than 100 studies that can encourage or inhibit adaptation behavior. Among other predictors such as descriptive norms, negative affect, and outcome efficacy, perceived self-efficacy was one of the strongest predictors of adaptation behavior. These promising findings signify the importance of an individual's belief in their ability to affect environmental change. Consequently, we hypothesize a positive association between self-efficacy and climate change adaptation (H1).

However, it is also evident that global crises such as climate change are multifaceted and that no individual will be able to solve them on their own (IPCC, 2021). As such, single contributions are limited in effectiveness if they are not carried out by many others, meaning that people need to work together to address the challenges caused by climate change. Therefore, it is crucial to understand the processes and conditions that enable individuals to act in concert.

Collective Efficacy: We Can Make a Difference

Because most of the actions that can be effective against climate change require collective engagement, the belief that a group can successfully coordinate and integrate their resources to reach a common goal can be a key predictor in this context. This type of belief is collective efficacy (Bandura, 2000). The importance of the concept has been displayed through survey and experimental research in various domains, including politics (Halpern et al., 2017), educational systems (Donohoo et al., 2018), and athletics (Hampson & Jowett, 2014). These studies have demonstrated that individuals with high collective efficacy beliefs are more likely to commit to their group goals, provide support for others, and show emotional resilience during challenging times. Taken together, there is promising evidence that collective efficacy beliefs are essential factors in stimulating group-level behaviors.

Furthermore, it has been demonstrated that collective efficacy can motivate people to engage with environmental topics. For example, Barth et al. (2016) analyzed intentions to use electric vehicles instead of regular cars and found a strong predictive power of perceived collective efficacy. Similarly, experimental research by Morton et al. (2011) demonstrated that households were more likely to use green electricity and reduce household waste when they perceived themselves as capable of doing so. However, although most of the available literature on collective efficacy deals with pro-environmental behaviors, some promising findings show that the concept is also strongly related with climate change adaptation. Thaker (2012) provided correlational evidence by showing that collective efficacy is positively associated with behavioral adaptation to drinking water scarcity in India. Additionally, Paton et al. (2010) showed that high collective efficacy beliefs positively influence communities' adaptation to earthquake threats in Japan and New Zealand. Moreover, Benight (2004) took one step further and found that collective efficacy beliefs could buffer the effects of psychological distress after a series of natural disasters. Such beliefs helped the communities put pressure on external agencies and adapt to their local vulnerabilities. Hence,

promising evidence demonstrates that collective efficacy beliefs predict an individual's engagement with climate-related problems.

Linkage Between Self-Efficacy, Collective Efficacy, and Climate Change Adaptation

Morton et al. (2011) and Barth et al. (2016) independently found that appraisals of collective efficacy were more strongly connected to the choice of pro-environmental behaviors than appraisals of self-efficacy. While this evidence suggests that focusing on collective efficacy might be more critical in mobilizing behavioral change, recent findings by Jugert et al. (2016) indicate a link between collective efficacy and self-efficacy. Specifically, their experimental study shows that the manipulation of collective efficacy could raise pro-environmental intentions by providing a sense of efficacy transferred from the group to the self. The researchers explain this process with the model of group-based control, which states that groups can make individuals feel capable and help them overcome personal paralysis. In a similar vein, Cocking and Drury (2004) showed that collective efficacy beliefs empowered individuals to participate in anti-road building protests in the United Kingdom.

In sum, research seems to suggest that collective efficacy and self-efficacy are closely linked. Specifically, that people's beliefs about their group's abilities can influence beliefs about personal capabilities. Drawing from this reasoning, we hypothesize that collective efficacy is a positive predictor of self-efficacy (H2). Furthermore, given the promising evidence linking collective efficacy with self-efficacy in motivating human responses to environmental degradation, we hypothesize a mediating effect of self-efficacy in the relationship between collective efficacy and climate change adaptation. More specifically, we predict that higher levels of collective efficacy increase self-efficacy, which will positively affect climate change adaptation (H3).

Group Identification

When it comes to individuals forming a group to solve specific tasks or goals, different factors can influence this process. One facilitator or barrier may be the degree of how strongly one identifies with their group. Evidence suggests that the stronger an individual experiences this

identification as positive, the more perceived affiliation occurs, and the more likely they are to act in concert with the different members (Turner, 1991). Specifically, group identification is defined by the extent to which a person evaluates and emotionally experiences the relationship to a particular group as positive (Steg et al., 2013).

Furthermore, research has linked the concept of group identification with behaviors in the environmental domain. It was found that identifying with a group that deals with ecological topics can change behavior towards a more climate-friendly direction. For example, Fresque-Baxter & Armitage (2012) demonstrated that identifying with climate activism movements (e.g., Fridays for Future) successfully predicts climate-protective behaviors. Additionally, evidence shows that people who strongly identify with their pro-environmental group are more likely to reduce carbon emissions (Fielding et al., 2008), engage in recycling (White et al., 2009) as well as engage in agricultural practices (Masson & Fritsche, 2014). Consequently, it seems that identifying with groups that engage with pro-environmental topics can increase climate-friendly actions.

If identifying with a pro-environmental group can change what we achieve, it should also explain our belief to affect the desired change. Surprisingly, this cognitive dimension (i.e., do we as a group perceive ourselves to be collectively effective?) has not received much attention in the context of group identification and climate change adaptation. Yet, it may be that the degree of identification can strengthen the relationship between collective efficacy and pro-climate actions. In other words, the magnitude of the relationship between collective efficacy and climate adaptation might become greater if people identify with their relevant group. Interestingly, although previous research has assessed the moderating role of group identification in the environmental context (see Terry et al., 1999 for specific information), the literature on collective efficacy and adaptation behaviors is far from clear on the concept of group identification. Hence, questions arise about whether collective efficacy is a better predictor of climate change adaptation the more a person identifies with a relevant group; and thus, whether group identification could be a possible facilitator between collective efficacy and climate change adaptation. We aim to solve this lack of clarity with

our current research by investigating the moderating role of group identification in more detail. More precisely, we predict that as group identification increases, the relationship between collective efficacy and climate change adaptation increases (H4).

Overview of the Present Research

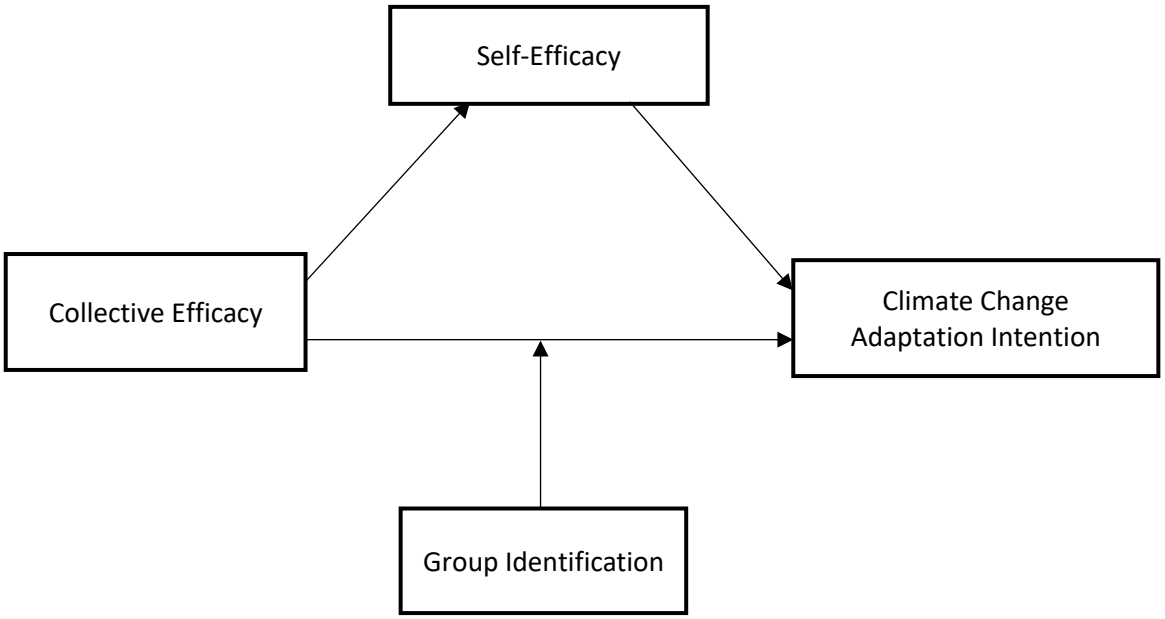
Until now, very limited research has shown that self-efficacy and collective efficacy are related to pro-climate actions (Barth et al., 2016; Paton et al., 2010; Ung et al., 2016; van Valkengoed & Steg, 2019). Moreover, there is also limited evidence showing whether collective efficacy affects pro-climate intentions through self-efficacy (Jugert et al., 2016). This means that groups can empower individuals by increasing their perception of their own effectiveness in adapting to climate change. In contrast, despite evidence pointing towards a moderation of group identification in the relationship between collective efficacy and climate change adaptation, no study seems to have clarified this.

With the present study, we aim to provide the following contributions: First, despite some evidence showing the importance of self-efficacy and collective efficacy in motivating climate change adaptation, research in the adaptation domain is relatively rare and under-studied compared to research on mitigative actions (i.e., pro-environmental behaviors). Thus, we will extend the small body of available literature explicitly focusing on factors that motivate climate change adaptation. For simplification purposes, we will focus on the intention to engage in climate adaptive behaviors instead of actual behavioral implementation. Second, we will fill knowledge gaps by testing the moderating role of group identification in the relationship between collective efficacy and climate change adaptation. Knowing whether identifying with a group can be beneficial in this process might yield innovative ideas for motivating group-level adaptation. Finally, while previous studies investigated the involved variables separately, the present research aims to clarify their interplay as visualized in Figure 1. A more comprehensive understanding of the interrelationships may provide valuable insights into the pressing topic of mobilizing adaptation. This is highly relevant given the

severe consequences of climate change that are already being felt today and which are expected to become even worse in the near future.

Figure 1

Research Model



Method

Participants

A total of 146 people were recruited online through convenience sampling. We excluded subjects that took longer than two standard deviations above the average time or took less than five minutes due to pre-specified criteria (*n* = 8). This resulted in a final data set of 138 participants. The age of the participants ranged from 18 to 65 years old (*M* = 28.8, *SD* = 9.7). Around 61.6% of the participants identified as female participants (*n* = 85), 48.9% identified as male participants (*n* = 48), 2.9% identified as non-binary participants (*n* = 4), and 0.7% preferred not to disclose their gender identity (*n* = 1). Approximately 78.3% lived in Germany (*n* = 108), 13.8% in the Netherlands (*n* = 19), and 8% in other countries (*n* = 11). Apart from being older than 16 years and understanding written English, no other participation requirements were given.

Procedure

Before data collection, the Ethics Committee of the Psychology Department of the University of Groningen approved the study. Recruitment was ensured via the social circles and environmental groups of the involved researchers. Using Qualtrics survey software, participants received a link to the online study. After opening the link, all participants received detailed information about the purpose of the research, their rights as participants and were asked for informed consent. Subsequently, respondents were randomly assigned to either a high collective efficacy or a low collective efficacy condition. Participants were instructed to carefully read two newspaper articles shown on the following pages and to remember as much as possible. The newspaper articles included fictitious scenarios about groups of people engaging in flood prevention measures. Depending on the assigned condition, participants read two stories about groups that either were or were not able to organize actions oriented to prevent the effects of flooding in their surrounding area. After reading the texts, participants reported their level of agreement with scales measuring collective efficacy, self-efficacy, general climate change adaptation intention, flood-specific adaptation intention, and group identification. Afterward, demographic data was collected. Participants were asked to indicate their age, gender identity (female, male, non-binary, prefer not to say or I identify as …), and country of residence (Germany, the Netherlands, or other …). Finally, they were debriefed and received the option to leave a comment. None of the participants received a reward for taking part in the research, and all answers were collected anonymously and voluntarily. The average completion time of the study was 11.42 minutes (*SD* = 5.9).

Design and Instruments

The study consisted of a person-by-treatment quasi-experimental design to test the hypotheses. The experimental independent variable used was collective efficacy. The measured but not manipulated independent variable was self-efficacy, and we treated it as a mediator in the relationship between collective efficacy and intention to engage in climate change adaptation. The dependent variable used was the intention to engage in climate change adaptation. More specifically, the dependent variable was operationalized as two different measures, (a) general

intention to engage in climate change adaptation and (b) flood-specific intention to engage in climate change adaptation. Lastly, the variable group identification was included as a moderator between collective efficacy and intention to engage in climate change adaptation.

Collective Efficacy Manipulation

Collective efficacy was manipulated by asking participants to read two fictitious newspaper articles about groups of people implementing measures to protect their environment from flooding. Both conditions showed the same articles about how the different groups introduce new ideas towards finding flood prevention measures and implement them in their surrounding area. However, the headlines and outcomes of the stories differed in how much people were able to organize themselves to prevent the worst consequences of flooding. To achieve this, we modified the articles as followed: In the high efficacy condition, the headlines of the articles were “Floods in the Hague: Collective efforts are strong enough to organize a flood prevention system in the small village Vissenhaven” and “Collective Power in Belgium: Industrial workers from Esseghem can protect their district from flooding” (see Appendix A). In the corresponding low efficacy condition, the headlines were “Floods in the Hague: Collective efforts are not strong enough to organize a flooding prevention system in the small village Vissenhaven” and “Collective Failure in Belgium: Industrial workers from Esseghem unable to protect their district from flooding” (see Appendix B). In addition to changing the headlines, we also modified the last part of the stories. In the high efficacy condition, it was indicated that the groups were able to collaborate and organize to protect their environment from flooding (see Appendix A). In the low efficacy condition, the last part of the articles indicated that the groups were not able to collaborate effectively enough to organize protection for their environment from flooding (see Appendix B). A total of 66 participants (47.8%) were assigned to the high collective efficacy condition and 72 participants (52.2%) to the low collective efficacy condition. The manipulation was specifically designed for the current study.

Collective Efficacy Scale

In addition to the manipulation, we also measured collective efficacy to check whether the manipulation was successful. The self-developed scale contained four items "I trust that we can contribute to flood prevention in our environment"; "I am optimistic that we can take actions to prevent our neighborhood from flooding"; "I think that we will find ways to learn more about flood prevention"; and "I am certain that we can exchange ideas about flood prevention strategies with others". Participants were told to think about the people that live in their street or neighborhood and then asked to indicate their level of agreement with the statements. Answer options were rated on a 5-point Likert scale from 1 (*strongly disagree*) to 5 (*strongly agree*) (M = 3.6*, SD* = 0.9*,* α = .78). The items were formulated similarly to previous items assessing efficacy beliefs (Cocking & Drury, 2004; Jugert et al., 2016), but were adjusted to the flooding context.

Self-Efficacy

Self-efficacy was measured with the same four items as collective efficacy. However, "We" and "our environment" were substituted with "I" and "my environment". Items were rated on a 5-point Likert scale ranging from 1 (*strongly disagree*) to 5 (*strongly agree*) (M = 3.4*, SD* = 0.8*,* α = .80).

General Climate Change Adaptation Intention

Individual's intention to engage in general climate change adaptation behavior was assessed by means of 10 self-developed items such as "Purchasing insurance against losses from natural hazards" or "Looking up information about what I can do to prepare for natural hazards". Participants were asked how likely it is that they engage in the presented actions in the next few weeks on a 5-point Likert scale from 1 (*extremely unlikely*) to 5 (*extremely likely*) (M = 2.9*, SD* = 0.7, α = .79) (see Appendix C).

Flood-Specific Climate Change Adaptation Intention

In addition to general adaptation intentions, flood-specific adaptation intentions were measured with five self-developed items "I am willing to learn more about things I can do to prevent my environment from flooding"; "I am planning to talk about flood-prone areas with other people"; "I intend to seek information about ways of adapting to flooding"; "I want to exchange ideas of how

to adapt to flooding"; and "I will take actions to prevent my environment from flooding". Participants were asked how likely it is that they engage in the presented actions on a 5-point Likert scale from 1 (*extremely unlikely*) to 5 (*extremely likely*) (M = 2.7, SD = 0.9, α = .87).

Group Identification

Participants indicated their extent of neighborhood identification based on the single-item measure social identification (SISI) developed by Postmes et al. (2013). They answered the question "I identify with people living in my neighborhood" on a 5-point Likert scale with the following answer options: "Strongly disagree" (8%, n = 11), "Somewhat disagree" (31.9%, n = 44), "Neither agree nor disagree" (14.5%, n = 20), "Somewhat agree" (42%, n = 58), and "Strongly agree" (3.6%, n = 5).

Data Analysis

It is worth mentioning that all analyses involving the dependent variable climate change adaptation intention were done (a) with the general adaptation intention scale and (b) with the flood-specific adaptation intention scale. When referring to climate change adaptation intentions, analyses will be reported with both variables successively. Therefore, the current research findings can be applied to a general and a flood-specific adaptation context.

Before starting the analyses, new variables showing each participant's mean score of each involved variable were computed. Moreover, the manipulation variable was coded as either low (0) or high (1). We conducted an ANOVA to check whether the high collective efficacy condition increases collective efficacy beliefs. Another ANOVA was performed to check whether the high collective efficacy condition raises self-efficacy beliefs. Additionally, we computed Pearson correlations to investigate whether self-efficacy and adaptation intentions are positively related. Mediation analyses were performed with the PROCESS Model 4 (v3.5 by Andrew F. Hayes) to check whether self-efficacy mediates the effect of the high collective efficacy condition on adaptation intentions. Lastly, we conducted moderation analyses with the PROCESS Model 1 (v3.5 by Andrew F. Hayes) to investigate whether group identification moderates the effect of the high collective

efficacy condition on adaptation intentions. SPSS (Version 25.0.0) was used for all confirmatory and exploratory analyses.

Results

Manipulation check

To test if the manipulation of collective efficacy was effective, we checked if there were differences in reported collective efficacy depending on the experimental condition using an ANOVA. We found that participants in the high collective efficacy condition scored higher (M = 3.7, SD = 0.9) than participants in the low collective efficacy condition (M = 3.4, SD = 0.8); ($R^2 = .035$, $F(1, 136) = 4.95$, $p < .05$). Consequently, the collective efficacy manipulation was successful in raising perceptions of collective efficacy.

Relationship Between Self-Efficacy and Adaptation Intention

We computed Pearson correlations to check whether self-efficacy and adaptation intentions are positively related. As expected, we found a significant association between self-efficacy and general adaptation intentions ($r(136) = .240$, $p < .05$). Similarly, self-efficacy was significantly associated with flood-specific adaptation intentions ($r(136) = .380$, $p < .01$). Thus, evidence was found for H1; that is, self-efficacy positively correlates with climate change adaptation intentions (general and flood-specific).

Effect of Collective Efficacy on Self-Efficacy

We conducted an ANOVA to test whether participants in the high collective efficacy condition reported greater levels of self-efficacy than those in the low collective efficacy. No significant differences between the low collective efficacy condition (M = 3.37, SD = 0.8) and the high collective efficacy condition were found (M = 3.40, SD = 0.9); ($R^2 < .001$, $F(1, 136) = 0.06$, $p = .809$). Consequently, we cannot say that raising collective efficacy increased self-efficacy, and thus, we did not find evidence for H2.

Although participants in the high collective efficacy condition did not report statistically higher levels of self-efficacy than those in the low collective efficacy condition, we previously

observed that the manipulation successfully raised levels of collective efficacy. Thus, although initially unplanned, we tested the idea of whether collective efficacy and self-efficacy are positively correlated, using the reported measure of collective efficacy instead of the experimental groups. For that, Pearson correlations were computed. Analyses did indeed reveal a significant relationship between collective efficacy and self-efficacy ($r(136) = .499$, $p < .01$). Therefore, we observed a significant relationship between collective efficacy and self-efficacy when testing association but not when testing causation.

Self-Efficacy Mediating Collective Efficacy and Adaptation Intention

To check whether self-efficacy mediates the path between collective efficacy and adaptation intentions, we used the PROCESS Model 4 (v3.5 by Andrew F. Hayes). The model uses ordinary least square regressions and yields unstandardized coefficients for total, direct, and indirect effects. Moreover, bootstrapping with 5000 samples and heteroscedasticity consistent standard errors (HCs; Davidson & MacKinnon, 1993) were employed to calculate inferential statistics and confidence intervals. Following recommendations by Zhao et al. (2010) and Rucker et al. (2011), mediation effects would be considered significant if the confidence interval (CI) did not include zero.

We conducted a mediation analysis to investigate the mediating role of self-efficacy in the relationship between the experimental condition and general adaptation intentions. No significant differences in general adaptation intentions depending on the experimental condition were detected ($b = .017$, $p = .897$). Likewise, we did not find that self-efficacy scores were different depending on the experimental condition ($b = .034$, $p = .809$). Finally, self-efficacy did not significantly mediate the effect of the experimental groups on general adaptation intentions, $b = .007$, 95% CI [-0.060, 0.076].

We conducted the same statistical analysis with the flood-specific adaptation intention variable instead of the general adaptation intention variable. No significant differences in flood-specific adaptation intentions depending on the experimental condition were found ($b = 0.169$, $p = .309$). Likewise, we did not find significant differences in the self-efficacy scores depending on the

experimental group (b = .034, p = .809). The analysis did not show that self-efficacy significantly mediates the effect of the experimental condition on flood-specific adaptation intentions, b = .015, 95% CI [-0.113, 0.148]. Because we did not find that self-efficacy mediates the relationship between the experimental conditions and adaptation intentions, we did not find evidence for H3.

Since we did not find evidence for the mediating role of self-efficacy in the relationship between the experimental conditions and adaptation intentions, we wanted to test correlational mediation effects. Thus, although initially unplanned, we tested the idea of whether self-efficacy mediates the path between collective efficacy and adaptation intentions but using the reported collective efficacy measure instead of the experimental groups.

We did not find a significant direct effect of collective efficacy on general adaptation intentions (b = .043, p = .568). However, after entering the mediator into the model, collective efficacy predicted self-efficacy significantly (b = .480, p < .01), which in turn predicted general adaptation intentions significantly (b = .259, p < .01). We found that the relationship between collective efficacy and general adaptation intentions is fully mediated by self-efficacy, b = .124, 95% CI [0.047, 0.233].

The same statistical analysis was conducted with the flood-specific adaptation intention variable instead of with the general adaptation intention variable. We detected a direct effect of collective efficacy on flood-specific adaptation intentions (b = .253, p < .05). After entering the mediator into the model, collective efficacy predicted self-efficacy significantly (b = .480, p < .001), which in turn predicted flood-specific adaptation intentions (b = .423, p < .01). We found that the relationship between collective efficacy and flood-specific adaptation intentions is fully mediated by self-efficacy once self-efficacy is included in the model, b = .203, 95% CI [0.079, 0.363].

Group Identification Moderating Collective Efficacy and Adaptation Intention

We performed moderation analyses to determine if the relationship between collective efficacy and adaptation intentions is stronger the higher the group identification of the participants. More specifically, we tested if the interaction between experimental conditions and group

identification significantly predicts adaptation intentions. Analyses were conducted using the PROCESS Model 1 (v3.5 by Andrew F. Hayes), which uses ordinary least squares regressions and yields unstandardized coefficients for all effects. Moreover, bootstrapping with 5000 samples and heteroscedasticity consistent standard errors (HCs; Davidson & MacKinnon, 1993) were used to calculate confidence intervals. Variables were centered, and effects would be considered significant if the CI did not include zero.

No significant effect was found that group identification significantly moderates the relationship between the experimental conditions and general adaptation intentions, R^2 = .016, F(2, 135) = 2.088, p = .151, 95% CI [-0.394, 0.055]. The same statistical analysis was computed with the flood-specific adaptation intention variable instead of the general adaptation intention variable. Here too, the analysis did not show that group identification moderates the effect of the experimental conditions on flood-specific adaptation intentions, R^2 < .001, F(2, 135) = 0.051, p = .822, 95% CI [-0.254, 0.220]. Consequently, we cannot say that group identification moderated the relationship between the experimental conditions and adaptation intentions, and thus, we did not find evidence for H4.

As we could not establish evidence that group identification moderates the path between the experimental groups and climate change adaptation intentions, we tested correlational moderation effects. Thus, although initially unplanned, we checked the idea of whether group identification moderates the relationship between collective efficacy and adaptation intentions but using the reported collective efficacy measure instead of the experimental groups.

We did not find a significant effect that group identification moderates the path between collective efficacy and general adaptation intentions, R^2 = .01, F(2, 135) = 0.112, p = .739, 95% CI [-0.177, 0.122]. Likewise, we did not find that group identification significantly moderates the relationship between collective efficacy and flood-specific adaptation intentions, R^2 = .005, F(2, 135) = 0.594, p = .442, 95% CI [-0.125, 0.251].

Discussion

With the present research, we aimed to investigate the role of collective efficacy, self-efficacy, and group identification in explaining climate change adaptation intentions. Consistent with our expectations, a positive association between self-efficacy and adaptation intentions was found (H1), showing that the higher the self-efficacy of an individual, the more likely they are to report adaptation intentions (general and flood-specific). This outcome is in line with previous research that proposes self-efficacy as one of the most significant determinants of behavioral change (Bandura, 1982; Bostrom et al., 2019; van Valkengoed & Steg, 2019).

Moreover, we hypothesized that collective efficacy is a positive predictor of self-efficacy (H2). The data does not show a significant difference between the high and low collective efficacy experimental condition, meaning that collective efficacy did not raise self-efficacy. Other researchers, however, clearly indicate a positive causal effect of collective efficacy on self-efficacy in the environmental context (Jugert et al., 2016). Nevertheless, while we did not establish a causal effect, we observed a significant correlation between the variables. Specifically, participants with greater collective efficacy reported higher self-efficacy irrespective of the assigned condition.

Furthermore, we expected that subjects in the high collective efficacy condition would report greater self-efficacy than those in the low condition, positively affecting their adaptation intentions (H3). However, no significant effect for the causal mediation effect was detected. This finding is inconsistent with previous research; Jugert et al. (2016) showed that activated levels of collective efficacy increased self-efficacy, which in turn positively affected pro-environmental intentions. Even though we expected a causal mediation effect, a correlational mediation effect was found. More precisely, we observed that self-efficacy is a significant mediator in the relationship between reported collective efficacy and adaptation intentions (both general and flood-specific).

Considering the essential role of groups in mobilizing individuals for climate change adaptation, we hypothesized that the interaction between collective efficacy and group identification would predict adaptation intentions (H4). However, the interaction effect did not reveal a significant effect. This implies that greater group identification and collective efficacy levels

could not raise adaptation intentions. Interpreted with caution, the findings suggest that group identification does not influence the relationship between collective efficacy and climate change adaptation.

Explanations, Implications, and Relevance

Research in the climate change adaptation context is largely dominated by correlational research, with only a few experimental studies published. We aimed to fill this gap by investigating whether collective efficacy predicts self-efficacy and adaptation intentions. Contrary to our expectations, we could not establish causal inferences. However, we found significant correlations, which shows that the variables are related. One possible explanation for the lack of causal effects is that, rather than determinants, collective efficacy and self-efficacy are consequences of adaptation intentions, implying a reversed causality. Interestingly, some related ideas can be found in Samaddar et al.'s (2014) study. The researchers challenged the idea that self-efficacy and outcome expectancy are predictors of flood preparedness and provided an alternative account. They showed that self-efficacy and outcome expectancy are rather expressions of general intentions towards flood adaptation. Precisely, that individuals who have engaged in adaptation perceive certain measures as more effective (i.e., outcome expectancy) and themselves as more capable (i.e., self-efficacy). Applying this reasoning to our study, it seems plausible that adaptation intentions influenced efficacy beliefs instead of efficacy beliefs being the cause of intentions.

Another explanation for not finding the expected effects is that confounding variables might have affected our results. It is important to note that the extent to which individuals can implement self-protective actions depends significantly on their living situation and available resources. First, people owning a house have more opportunities to engage in specific measures than people renting an apartment. As such, homeowners will experience less barriers in adapting to climate change with activities included in the scale that we used to measure intentions, such as painting one's house in a lighter color, repairing the roof, or storing bottled water in case a natural hazard occurs. Tenants of flats who may lack the legal entitlement or necessary space to do these actions would have less

opportunity to implement these types of changes. Consequently, participants owning a house likely reported more adaptation intentions and higher self- and collective efficacy, while those renting a flat likely disagreed on various questions due to unavailable resources and reported lower levels of self- and collective efficacy. Thus, possibly showing the correlations we observed and not showing the causations that we did not observe. It appears likely that a study solely targeting homeowners would have strengthened our results.

Second, the duration of residence can substantially determine whether a person will affect change in their environment or not. Research has shown that individuals who have lived in a particular neighborhood for many years report stronger place attachment than those who have lived there for a shorter period (Clark et al., 2017). Interestingly, it was found that place attachment can give rise to a sense of personal responsibility toward that place's environment, thus encouraging sustainable activities (Daryanto & Song, 2021; Scannell & Gifford, 2013). Beyond that, Yu et al. (2019) demonstrated that place attachment is strongly related to people’s intention to combat local climate change problems. Moreover, Scannell & Gifford (2013) went one step further and provided evidence that place attachment significantly predicts engagement with climate change mitigation strategies. Following this reasoning, it seems plausible that participants who have lived in their place for a shorter time lowered the average intention as well as self-and collective efficacy scores of our study. Consequently, we expect higher average scores of adaptation intentions and efficacy beliefs when we had solely recruited long-term residents.

Given the crucial role of groups in combating climate change, we tested whether group identification moderates the relationship between collective efficacy and adaptation intentions. However, we could not find evidence for the hypothesized moderating effect. One plausible explanation is that the conceptualization of group identification was based on neighborhood identification, which might have only been appropriate for a small proportion of individuals: Multiple participants indicated by leaving a comment that they do not have neighbors or barely know their neighbors. Therefore, we conclude that the groups focused on our study were not well-defined and

somewhat nebulous. However, importantly, Simon & Stürmer (2003) demonstrated that knowing one's group is an essential requirement for group identification to be successful. This factor could well be responsible for our lack of effects found. Further work is required to explore the moderating role of group identification in more detail by targeting clearly defined and behaviorally relevant groups.

Strengths, Limitations, and Future Directions

Although we could not draw causal inferences, our findings nevertheless contribute to understanding variables that might encourage or hinder climate change adaptation. First, we showed that our manipulation successfully raised collective efficacy beliefs, extending the small body of literature on this topic. Second, this study was the first that examined the interrelationship of self-efficacy, collective efficacy, and group identification in understanding adaptation intentions. Consequently, our novel design can serve as a conceptual starting point for future experimental studies targeting adaptation behaviors and intervention programs aimed at stimulating collective efficacy beliefs.

However, some limitations may apply, which should be considered in future studies. The primary constraint is that our study might have been underpowered. Possible reasons are small effect sizes, low sample size, or both (Cohen, 1992). Thus, there is a probability that our findings would have shown the expected causality with a larger sample size. Using the software G*Power, we calculated a required sample size of $N = 202$ and a power level of .8 to approximate causality with our study (Faul et al., 2009). Consequently, we recommend future research to orient towards this threshold to clarify assumptions on causality. Moreover, we failed to include a control group which made it difficult to rule out whether the low collective efficacy condition lowered collective efficacy beliefs, whether the high collective efficacy condition raised collective efficacy, or whether both processes were operating. By using a third group, replications of our work can ensure reliable interpretation and conclusions about the direction of the manipulation, thereby increasing the study's internal validity.

Furthermore, we need to consider some methodological limitations. First, our study relied solely on self-reported measures, which may not reflect objective adaptation due to socially desirable responses. Interestingly, for environmental intentions that are morally relevant, it is not unlikely that some people bias their answers to have a better social impression of themselves (Cerri et al., 2019). Indeed, Vesely & Klöckner (2020) conducted three meta-analyses across 29 studies and provided evidence for significant correlations between socially desirable responding and environmentally related intentions. Yet, although the correlations were relatively small, social desirability should not be disregarded as a potential confounder. This is especially important as socially desirable responses can affect research findings significantly, such as increasing or decreasing mean scores or adding noise to data, thereby threatening the accuracy of findings (Ganster et al., 1983; Paunonen & LeBel, 2012). Incorporating social desirability scales in future environmental research might be valuable to gain more refined and robust insights. A second methodological constraint of our research is the self-developed general adaptation scale. Multiple items used, such as “using sunscreen” or “staying at home during heatwaves”, were inappropriate for the autumn period in which this study was conducted and therefore unrealistic to implement. Consequently, we assume that a floor effect might have occurred, leading to a Type II error. We propose future research to consider seasonal factors, thereby covering more appropriate adaptation actions.

Another constraint relates to the geographical characteristics of our sample. Most participants were from Germany (78.3%), a relatively resilient country to climate hazards compared to other regions in the world (UNDRR, 2020). Additionally, many participants indicated by leaving a comment at the end of the survey that floods do not endanger their region and that they feel protected from climate hazards in their living area. Thus, there is reason to assume that participants’ risk perception was quite low. However, interestingly, research has shown that an individual’s risk perception of climate change is a strong predictor to engage in pro-climate actions such as driving less or buying more ecological products (Chen, 2016; Hidalgo & Pisano, 2010; O'Connor et al., 2002).

Alternatively, decreased risk perception may lead people into a false sense of safety, reducing their intention to affect change, as could have been the case with our study. To draw accurate conclusions about the general population, we recommend that future studies use a more representative sample, for example, participants from both developed and developing countries.

Finally, our study measured behavioral intentions instead of actual behaviors, which may not fully translate into real-life adaptation. A meta-analysis by Webb & Sheeren (2006) found that manipulated intentions showed a medium-to-large-sized change in intention only led to a small-to-medium-sized change in behavior. Similarly, de Bruin et al. (2012) demonstrated that intentions usually only explain 20% to 30% of the variance of behavior, suggesting that intentions are relatively weak indicators of behavior. We recommend future studies to bridge the intention-behavior gap by including additional measures of actual behaviors. For example, by using governmental or panel survey data, such as the frequency of flood-prevention activities undertaken in a neighborhood or community.

Conclusion

As climate change adaptation is increasingly becoming a pressing issue, our research aimed to explore possible factors that motivate individuals to engage in adaptive measures. We found that self-efficacy correlates significantly with collective efficacy and adaptation intentions but did not observe causal connections. Moreover, we provided evidence that self-efficacy mediates the relationship between collective efficacy and adaptation intentions. Altogether, our research confirms earlier findings that collective efficacy and self-efficacy are not only clearly associated with adaptation intentions but are also closely related with each other and, therefore, should be regarded cohesively when motivating behavioral change. We recommend future research to further investigate the causal inferences between the variables through experimental studies. Yet, a greater sample size should be used to ensure sufficient power. Furthermore, future work needs to target well-defined groups and consider their contextual factors as well as available resources. In this way, interventions can be explicitly tailored towards changing behavior at a specific community or

household level. Furthering the understanding on how to mobilize individuals for self-protective actions against climate hazards such as floods is among the most pressing tasks of social scientists in the 21st century.

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Appendix A

Manipulation High Collective Efficacy Condition - Sandbags

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Climate Change

Floods near The Hague

Collective efforts are strong enough to organize a flooding prevention system in the small village Vissenhaven

Kareem Clarke

Mon 06 September 2021

Sandbags in Vissenhaven. Photograph: Cadelijne Oost/ /AFP/Getty

Residents of the small district Vissenhaven, near The Hague, are affected by flooding due to heavy rainfall in this area. Last year, Nico de Jong, one of the neighborhood residents, launched initiatives to counteract the flooding stating that the situation "couldn't go on like this, the incoming water was destroying our properties." Therefore, Nico sought exchange with people in his neighborhood and quickly realized that many other residents were also willing to change things. Together, they found a method used in flood protection: placing sandbags to divert the water and prevent it from entering the houses.

Nico and his neighbors were able to start the project, obtained advice from experts, applied for funding from the government, and divided up tasks. "I am so grateful that my neighbors worked together so enthusiastically and that we were able to build such a simple but great intervention as a group. We could have never achieved this without all the closely collaborating hands," Nico said.

Manipulation High Collective Efficacy Condition – Rain barrels

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Climate Change

Anna Ambrose

Thu 19 August 2021

Collective Power in Belgium

Industrial workers from Esseghem can protect their district from flooding

Rainbarrels in Esseghem. Photograph: Maarten van Elten/ /AFP/Getty

Workers of multiple companies based on an industrial area called Esseghem, nearby Brussels, are directly affected by flooding during heavy rainfalls. Last spring, the head of one of the companies, Marieke Meijer, had the idea to implement measures to counteract the intense flooding in the area. "We had to change something," she says in an interview. Thus, the company started setting up water barrels to collect rainwater. Using rain barrels is a method for flood prevention. The collected water can be used in the factories, and it is safe to drink. Additionally, the surrounding biodiversity can flourish again, and the environment becomes healthier to work in.

Marieke's colleagues were enthusiastic about the idea. Together with other companies, they started to think about the number of rain barrels needed, locations for placing them, specific ways of reusing the rainwater, and created a schedule of when each person is responsible for emptying the barrels. "It's great how we've managed to implement this very simple intervention together. I am so grateful that many people worked together and could save such a large amount of rainwater. We would have never managed to achieve this without all the closely collaborating helping hands and their contributions," Marieke said.

Appendix B

Manipulation Low Collective Efficacy Condition – Sandbags

News | Opinion | Sport | Culture | More

Climate Change

Kareem Clarke

Mon 06 September 2021

Floods near The Hague

Collective efforts are not strong enough to organize a flooding prevention system in the small village Vissenhaven

Sandbags in Vissenhaven. Photograph: Cadelijne Oost/ /AFP/Getty

Residents of the small district Vissenhaven, near The Hague, are affected by flooding due to heavy rainfall in this area. Last year, Nico de Jong, one of the neighborhood residents, launched initiatives to counteract the flooding stating that the situation "couldn't go on like this, the incoming water was destroying our properties." Therefore, Nico sought exchange with people in his neighborhood and quickly realized that many other residents were also willing to change things. Together, they found a method used in flood protection: placing sandbags to divert the water and prevent it from entering the houses.

Nico and his neighbors tried to start the project, obtained advice from experts, applied for funding from the government, and divided up tasks. However, despite initial enthusiasm, it quickly became apparent that the group was overburdened with the project. "I knew it would be a challenging task, but there were just too many factors to consider that went beyond our technical capacities. It is a pity that we could not achieve what we needed despite trying together," Nico said.

Manipulation Low Collective Efficacy Condition – Rain barrels

News | Opinion | Sport | Culture | More

Climate Change

Collective failure in Belgium

Industrial workers from Esseghem unable to protect their district from flooding

Anna Ambrose

Thu 19 August 2021

Rainbarrels in Esseghem. Photograph: Maarten van Elten/ /AFP/Getty

Workers of multiple companies based on an industrial area called Esseghem, nearby Brussels, are directly affected by flooding during heavy rainfalls. Last spring, the head of one of the companies, Marieke Meijer, had the idea to implement measures to counteract the intense flooding in the area. "We had to change something," she says in an interview. Thus, the company tried to start setting up water barrels to collect rainwater. Using rain barrels is a method for flood prevention. The collected water can be used in the factories, and it is safe to drink. Additionally, the surrounding biodiversity can flourish again, and the environment becomes healthier to work in.

Marieke's colleagues were initially enthusiastic about the idea. Together with other companies, they started to think about the number of rain barrels needed, locations for placing them, specific ways of reusing the rainwater, and created a schedule of when each person is responsible for emptying the barrels. However, despite trying, the employees could not organize the construction of the barrels. "I knew it might be challenging to coordinate the project and that everyone would have additional tasks to their work obligations. In the end, we were not able to adequately organize the barrel system. Too bad, I thought we could have managed this together as a group, but, even with a collective effort, we were not able to make this work," Marieke said.

Appendix C

General Climate Change Adaptation Intention Scale

How likely is it that you do the following actions in the next few weeks?

	Strongly disagree (1)	Somewhat disagree (2)	Neither agree nor disagree (3)	Somewhat agree (4)	Strongly agree (5)
Staying at home when it is sunny during a heat wave	○	○	○	○	○
Looking up information about what I can do to prepare for natural hazards	○	○	○	○	○
Using sunscreen	○	○	○	○	○
Regularly checking weather forecast	○	○	○	○	○
Adjusting my home better withstand natural hazards, for example painting my house in a lighter color to reduce the negative impacts of heat waves	○	○	○	○	○
Preparing a household emergency kit, containing for example a flashlight, a radio, emergency blankets, first aid kit	○	○	○	○	○
Storing bottled water and canned food in case a natural hazard occurs	○	○	○	○	○
Making sure that my home is maintained well to avoid damage from natural hazards for example, cleaning gutters and repairing the roof	○	○	○	○	○
Purchasing insurance against losses from natural hazards	○	○	○	○	○
Walking on shadow areas when it is too hot	○	○	○	○	○