

Article

Collectively Remembering Environmental Disasters: The Vaia Storm as a Case Study

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Abstract: This study investigated the relatively unexplored topic of the collective memory of environmental disasters from a psychosocial perspective. To achieve this, we conducted an exploratory case study on the Vaia storm, which hit the Italian Alps in October 2018, causing significant social and ecological damage. We carried out thirteen in-depth semi-structured interviews with members of the enunciatory community of Vaia as follows: groups of people who either experienced the disaster firsthand, studied it, or had a particular interest in it. Through a thematic analysis of the interview transcripts, the four following key themes emerged that illustrate the forms taken by the collective memory of the disaster: (1) a sensory dimension; (2) an emotional dimension; (3) a narrative dimension; and (4) a material dimension. Our findings suggest a non-anthropocentric, hybrid understanding of collective memory, aligning with emerging concepts in the psychosocial literature on the emotional impacts of environmental disasters. We also advance potential future research questions at the intersection of memory studies, resilience, and sustainability and stress the practical implications of collective memory in fostering sustainable practices and enhancing climate resilience.

Keywords: collective memory; environmental disasters; climate change adaptation; community resilience; environmental stewardship



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1. Introduction

Climate change refers to long-term alterations in the Earth's average weather and atmospheric patterns, broadly associated with human activities, especially the burning of fossil fuels and deforestation, which increase the concentration of greenhouse gases (GHGs) in the atmosphere. Anthropogenic climate change is affecting meteorological regimes worldwide, and extreme climate-induced events are becoming more frequent and dangerous for all life forms and ecosystems [1]. This includes windstorms hitting European woods and inflicting serious damage to forests [2,3]. In the coming years, Europe will be affected by increasingly extreme events, such as heat waves, droughts, floods, and storms due to the convergence of different driving forces, such as growing urbanisation, construction in dangerous areas, unsustainable land use, and climate change [4]. Environmental disasters occur when such natural hazards encounter a pattern of local vulnerabilities and exposure, leading to a serious disruption in the local socio-ecological balance [5].

When dealing with environmental disasters, the process through which collective memories are formed and transmitted has been relatively unexplored in the scientific literature. However, this area may warrant greater attention due to its theoretical and practical implications, as well as its potential contribution to the transdisciplinary exchange required to address complex and multilayered crises like climate change. In the aftermath of a disaster, collective memory work aims to establish and transmit a shared representation of the event [6,7]. For environmental and ecological catastrophes, the framing of such disasters and the experiences reported can influence risk perception and lead to the

adjustment of environmental management practices to prevent future negative outcomes, e.g., [8,9]. Shared knowledge, practices, and heightened environmental awareness may lead to cultural changes in the relationship between people and the environment, moving toward more sustainable paradigms, e.g., [10]. Moreover, community memory work can aid in recovery from emotional impacts by making sense of what happened and strengthening social cohesion [11,12], or alternatively, it may spark disputes over the interpretation of the catastrophe and the attribution of responsibility [13,14]. Studying the collective memory of environmental and ecological disasters may also require adjustments to existing theoretical frameworks in order to acknowledge the essential contributions of the landscape and non-human beings to the process of remembering.

In this paper, we present the results of a qualitative case study that explores the emerging forms of collective memory related to the Vaia disaster, a windstorm that struck the Italian Alps in October 2018. We discuss our findings in the context of recent environmental psychology and memory study developments, highlighting potential avenues for future research and practical applications related to community adaptation to climate change. By integrating psychosocial perspectives with sustainability frameworks, we can better understand how collective memory contributes to adaptive responses and ecological stewardship.

2. Vaia Storm

In 2018, an extratropical cyclone named Vaia struck northern Italy, bringing heavy precipitation and strong winds. It caused extensive infrastructural, environmental, economic, and psychosocial impacts, making it one of the most impactful events on Italian forest ecosystems [15,16]. The storm originated from a deep meteorological depression which impacted northern Italy between 27 and 30 October 2018. The low point was on 29 October, with gale force winds and violent storm surges in the upper Adriatic and excessive rainfall in the eastern Alps, where the wind reached peaks of more than 200 km/h. The most affected regions were Trentino Alto Adige and Veneto, followed by Lombardy, Friuli Venezia Giulia and, limitedly, Piedmont and Valle d'Aosta. Regarding forest damage (see Figures 1 and 2), it is estimated that the Vaia storm significantly damaged around 42,500 ha of forest area distributed across 494 municipalities, with around 8.5 million m³ of trees being uprooted [15]. It also caused flooding, landslides, static instability, general blackouts, and problems with the distribution of electricity and gas, interrupted telephone lines, and widespread damage to structures and infrastructure, including household damages, i.e., the destruction of homes, roofs, and the loss of personal belongings. The storm resulted in an estimated economic loss of approximately EUR 2.6 billion, encompassing recovery and restoration efforts, timber value, and the broader repercussions on the forestry sector and related industries [17,18].

Vaia mostly injured pure Norway spruce stands and mixed Norway spruce–European beech stands, which are prevalent in the area hit. This configuration is the result of centuries of silvicultural choices which prioritised the planting of Norway spruces, the most cost-effective in the wood market. This species is characterised by a more superficial root system, which renders it less resilient to episodes of strong wind, as in the case of Vaia. Hence, disasters like Vaia arise from the intersection of atmospheric alterations caused by carbon dioxide emissions from human activities and long-standing problematic forest management practices that have shaped forest biodiversity [19].

The catastrophic impacts of Vaia extended beyond wind damage, encompassing serious long-term consequences for biodiversity and the landscape. The broken and uprooted trees provided an ideal breeding environment for bark beetle (*I. typographus*), a Norway-spruce-specific parasite which, in normal conditions, plays a regulatory function within forest ecosystems. After the storm, the endemic pest began to spread, attacking living and standing spruces [17,20,21]. The infestation of *I. typographus*, entering into an epidemic phase, configured itself as a new emergency faced by forest managers engaged in several attempts to mitigate the damage caused by the disaster [17]. The outbreak of such

pests due to a set of stress factors affecting trees after windstorms and a rise in temperature can lead to the exponential killing of trees, which may exceed the timber loss provoked by storms themselves [22]. These various sudden and gradual transformations deeply affect the psychosocial fabric of local communities, particularly their sense of place and identity. The storm exposed the region's vulnerability and challenged established forest management practices, resulting in a collective effort to recover and adapt to the new reality [19].

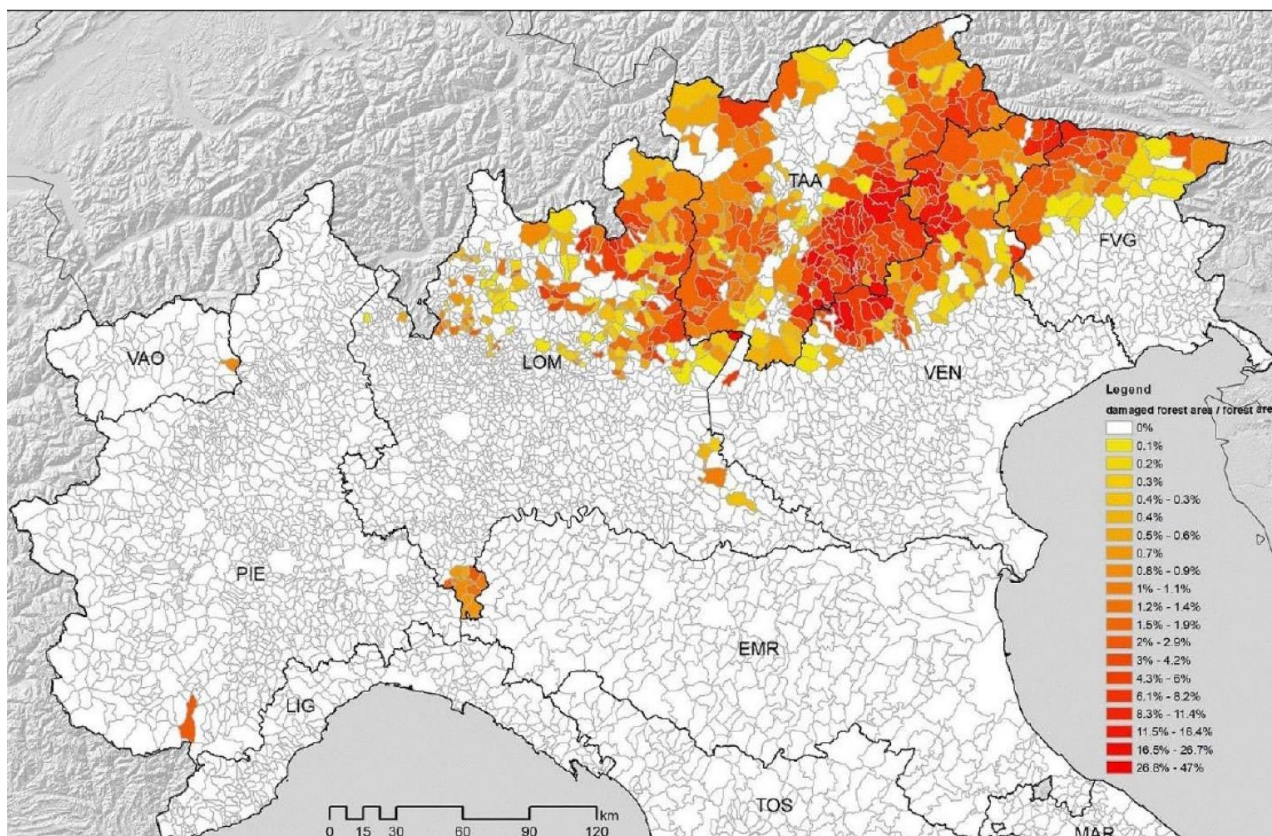


Figure 1. Percentage of forest area destroyed by storm Vaia [15].



Figure 2. Example image of the devastation of Vaia, relating to the Remotely Piloted Aircraft Systems (RPAS) survey carried out in the Grigna Valley (province of Brescia) [15].

3. Conceptual Framework

3.1. Climate Change, Environmental Disasters, and Psychological Impacts

Climate change and the degradation of ecosystems have been recognised as being among the main threats to the survival of all species, regarding living environments, livelihoods, physical and mental health, and psychosocial well-being [23–26].

Disasters are typically differentiated into natural disasters and technological or human-made disasters based on the natural or anthropic factors that provoke them, as follows: natural hazards or human actions and omissions [27]. Finally, there are hybrid or ‘natech’ disasters, which have mixed aetiologies [27,28]. Natural disasters, compared to human-made disasters, are relatively more predictable in their outcomes and their temporal developmental trajectory of alert, impact, and recovery. However, in the case of disasters like storms, earthquakes, and volcanic eruptions, predictions are often made with a low spatial and temporal resolution [27,29].

The recognised anthropogenic root causes of the climate crisis blur the distinction between these natural and human-made disasters and highlight the interdependence between environmental and sociotechnical systems in the genesis of extreme weather events, such as floods or storms [30]. The dichotomic classification of disasters is, thus, overcome by the acknowledgement that all disasters are inherently social phenomena, since their outcomes are partially dependent on human-administrated processes, such as environmental management practices, building choices, and social vulnerabilities, and their effects comprise the psychological and relational disruption of community socio-ecological niches [31]. Therefore, aligning with McGee and Penning-Rowsell (2022), we prefer to use the term environmental rather than natural disasters to reflect this multilayered conception [5].

The negative psychological impacts of climate change can be classified into the following different categories: the acute effects of extreme meteorological events and environmental transformations such as those aroused by environmental disasters; widespread emotional distress and uncertainty due to perceptions of or concerns for climate impacts; and the chronic psychosocial consequences for societies facing the social, economic, and environmental upheavals of climate change [30,32].

Hence, research in psychology has attempted to describe the diverse trajectories of stress, resilience, and sensemaking following environmental disasters [29,33], as well as the ongoing psychological and emotional consequences due to both acute and chronic environmental transformations [34]. In this vein, the so-called ‘psychoterratic syndromes’ [35,36] comprise eco-anxiety for the future of the Earth and humanity, e.g., [37], ecological grief for the experienced or anticipated losses of species, ecosystems, and landscapes, e.g., [38], and solastalgia for the gradual degradation of familiar and meaningful places, e.g., [39]. These place-based forms of distress underscore the close implications between people and the environment, reflected in the literature on place identity [40] and place attachment [41]. This also refers to an extended conceptualisation of the self, qualified by the socioecological relations in which it is entangled [42]. Natural elements, such as trees, may become infused with place-based meanings and values that concur to forge one’s identity [43].

3.2. The Sociocultural Perspective on Collective Memory

The literature on collective memory was first systematised by Maurice Halbwachs in 1950 and refers to shared and socially constructed representations of relevant past events experienced by a social group [7]. This umbrella notion has been articulated by various scholars from diverse disciplinary perspectives, leading to a multifaced and stratified conceptualisation within the ‘non-paradigmatic, transdisciplinary, and centreless’ field of memory studies [44] (p. 25). Attention has been drawn to the social, material, and cognitive dimensions of collective memory [45], focusing on its narrative and social genesis and forms [46], the psychological processes underlying its formation [47], and the social practices and material–symbolic artefacts in which it is embedded, e.g., [48].

Hirst and Manier [47,49], aiming to deepen the understanding of collective memory from a psychological perspective, distinguished two interrelated uses of the concept. The first pertains to enduring cultural formations and symbols within the social environment, while the second focuses on the individual memories shared by a community, which circulate through conversations and social interactions.

The sociocultural psychology perspective has advanced the notion of collective remembering, which foregrounds the processual aspect of collective memory work, understood as a mediated action and not merely as a static representation of past events and their permanence in the mind. This is in opposition to the traditional psychological conception of memory as an archive or an operation of the mind detached from context [50]. Moreover, collective memory as a social and cultural phenomenon is embodied and mediated by a series of cultural/semiotic tools such as discourses, objects, technological devices, sites, and practices [50–52]. Memory work is, thus, reflected in one's multilayered lifeworld, cultural–semiotic, and natural environment.

This theoretical angle also emphasises the dynamic and reconstructive features of collective memory [53]. In this vein, some scholars have highlighted the nonlinear temporality of remembering, which entails a stratified multidirectional relationship between the past, present, and future, i.e., a prospective function, and, thus, a reciprocal influence between the memory of collective pasts and the imagination of collective futures [54,55]. This becomes particularly relevant when confronting climate change and the interlinkages between its anthropogenic causes, ongoing impacts, and the need to shape more sustainable futures.

3.3. *Collective Remembering of Environmental Disasters*

When dealing with environmental and climate change issues, social-ecological memory has been described as a source of community resilience in socioecological systems, supporting the process of recovery in the aftermath of an environmental disaster and preserving important ecosystem services from the threats of climate change, e.g., [9,56,57]. The role of collective memory in the aftermath of an environmental disaster has been investigated concerning its contribution to climate change adaptation and environmental risk preparedness, awareness, and mitigation, e.g., [8,58], often leveraging shared affective responses [57]. However, the potential to learn from past events and mistakes is not always straightforward, encountering some obstacles, for example, the ageing of the eyewitnesses of such events and the clash between divergent and misleading narratives, priorities, and political contestations [58–60].

More than that, social and collective memory may acquire healing and transformative potential, helping to integrate disruptive lived experiences after disasters [11,12], fostering a non-dualistic human–nature relationship [10] and transformative practices [61] in the face of environmental changes and exploitation.

Another research hotspot concerns the material and symbolic dimensions of post-disaster memories. Materialisation into physical sites, such as ruins or official memorial buildings [13] and signs such as water lines on the walls of flooded areas, is a way to make the memory of a disaster last over time [59,62]. These sites engage people in mnemonic and commemorative practices and rituals, allowing communities to mourn their victims and recover from pain and loss through social support [11,14]. In the long term, official and grassroots memorials and commemorations may become hotspots of political tension and competitive views, struggling to affirm the official narrative pattern of events [11,13,14].

Zavar and Schumann (2019) underscored the primacy of place-based commemorations in preserving cultural memories and prompting the restoration of relevant places through imagination and emotional engagement [14]. Both the built environment—with its cultural artefacts such as museums and monuments—and geological, natural, and atmospheric elements deserve attention as anchors and means of collective remembering, e.g., [63], with the potential to become 'sites of memory' [62]. However, natural elements have seldom been considered as active agents of remembering [10]. Some notable exceptions can be

found in studies on hybrid community practices engaging trees and people in citizen-led living memorials of Hurricane Katrina, e.g., [64].

In a scenario marked by the Anthropocene and the climate crisis, memory studies have approached a so-called nonhuman turn in the social sciences and humanities [65], which implies questioning the distinction between the natural and social worlds and history, e.g., [66]. This recalls the perspective of planetary memory, in which the planet and nonhuman beings are infused with agency and the capacity to remember in constant relation and tension with human acts of remembering [67,68]. This requires researchers interested in the collective memory of environmental disasters to consider the multidirectional relations between people and the environment—that is, to adopt a markedly ecological viewpoint [48,69].

4. Materials and Methods

4.1. Aims and Rationale

This study aligns with the psychosocial [70], sociocultural [51,52,71], and ecological approaches [69] to memory studies and attempts to widen the narrow understanding of the phenomenon of collective memory concerning environmental disasters. For this purpose, we performed a qualitative case study analysis of the Vaia storm that hit northeast Italy in October 2018.

The choice to deepen the study of the Vaia storm stemmed from the subsequent reasons. Firstly, Vaia displayed all the main features of an environmental disaster concerning its intensity and the extent of the damage caused in different domains (c.f. Section 2). Second, although this disaster has been extensively studied by environmental sciences due to the profound repercussions it had on the Alpine ecosystem and forest management, e.g., [20,21,72], it has been poorly investigated from the perspectives of the social and psychological sciences (for a good exception, cf. [19]). An integrated perspective that takes into due consideration the experiential, relational, and psychological implications might be essential for improving disaster management and enhancing socio-ecological resilience to extreme events like Vaia.

Therefore, this research aimed to identify thematic nuclei related to the collective memory of Vaia, paying particular attention to the psychosocial processes associated with them. Hence, with specific reference to our case study, we asked the following research question: what shapes, modes, and dimensions does the collective remembering of the Vaia storm take on? While our analysis focused on this specific event, the results may offer valuable insights for future research in the broader field of collective memory related to environmental disasters and provide practical recommendations for collectively addressing ecological and climate challenges.

4.2. Research Design

This research employed an explorative case study design, which is a suitable methodology for mapping little-explored topics—such as the collective memory of environmental disasters—and finding emergent thematic hotspots [73]. The case study methodology also promotes a nuanced understanding of the reciprocal relationships between context and the phenomenon under study [73], without excluding the chance of gaining insights for broader theoretical and conceptual developments [74].

This case study allowed us to trace multiple emerging forms of memory and remembering, as they are produced in translations between people and between people and the environment, expanding the possibilities of development for social and ecological psychology [69,75] and for a sociocultural approach to collective memory [51,52].

The data were collected through in-depth, semi-structured interviews [76]. The interview protocol was built by integrating constructs from the scientific literature on collective memory and environmental disasters, information gathered from studies and press articles describing the Vaia storm and its consequences, and specific themes suggested by the first interviews. The main areas investigated were the personal memories of Vaia and their associated emotions; the sensemaking and memorialisation processes and their form

and meaning; the symbols or cultural artefacts in which the memory of the disaster is objectified; possible changes in the human–nature relationship triggered by the disaster; and the expected ways in which Vaia will be memorialised.

4.3. Recruitment and Data Collection

To recruit participants, we first engaged a PhD candidate who, during his fieldwork, extensively studied the aftermath of the Vaia storm from an anthropological perspective. In the role of mediator, he made it easier for us to contact a range of potential participants. We then employed a combination of purposive and snowball strategies to involve the most informative participants for our study.

The inclusion criteria for the study were (1) being of legal age and (2) being part of the so-called enunciatory community surrounding Vaia. With the concept of an enunciatory community, the anthropologist Kim Fotun (2001), in her masterwork *Advocacy after Bhopal*, indicated that this a group of people that emerges in the aftermath of a disaster, who, despite not necessarily sharing the same culture and values, are united by their attempts to make sense of the catastrophe and react to it [77]. The lens of the enunciatory community allowed us to include people from different personal and professional backgrounds and geographical areas who were directly affected by the disaster. The individuals involved, therefore, were people interested and deeply engaged in the Vaia storm because they experienced it firsthand, studied it, or their occupation and life experience put them in close contact with this event. Thus, they can be considered as highly informative witnesses, as well as cultural, scientific, and memory agents.

Finally, 13 people ($n = 9$ male and $n = 4$ female) who met the inclusion criteria joined the study and were interviewed between May and July 2023. All interviews were conducted through a video conferencing platform, lasted between 90 and 120 min, and were audio-recorded, transcribed verbatim, and translated into English. We collected written informed consent from all participants, who reaffirmed their consent verbally before starting the online interview. This research followed the American Psychological Association Ethical Principles of Psychologists and the Code of Conduct and the principles of the Declaration of Helsinki.

4.4. Data Analysis

We performed a thematic analysis [78] of the textual data obtained from the interviews. This process consisted of the following different iterative phases: familiarisation with the interview transcripts through careful reading, individual coding of the transcripts by two analysts through open coding and the generation of initial ideas about the themes, dialogical confrontation about the initial coding, and grouping codes into thematic categories. We scheduled periodic meetings to discuss the identified codes and refine the coding grid, aiming to enhance its consistency and reliability. The whole process followed an abductive and iterative logic of analysis [79,80], according to which, we went back and forth between emergent themes and the participants' words, ensuring rigour and consistency and, at the same time, combining engagement with theoretical concepts and an open attitude towards novel insights from the data. In this way, thematic coding and theme generation seek a balance between induction (from data to theory) and deduction (from theory to data), strengthening the rigour of the analysis and its generative potential [81].

5. Results

As shown in Figure 3, the results of this study are grouped into the following four themes that describe the different forms or dimensions in which the collective memory of the Vaia storm presents itself: (1) sensory, (2) emotional, (3) narrative, and (4) material.

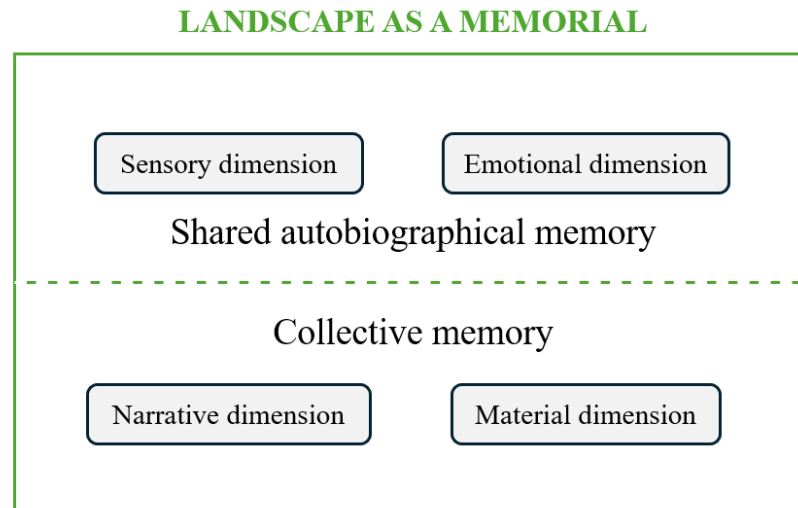


Figure 3. Themes, interpretative levels, and framework.

5.1. Theme 1: Sensory Dimension

The shared memory of the hours and days of Vaia is rich in perceptual and sensory elements. The low point of the storm occurred overnight between 29 and 30 October 2018. The ability to see was, therefore, initially hindered by darkness, reappearing only later with the first light of the day. The general electrical blackout and the interruption of the telephone line that led the inhabitants of the affected valleys to isolation amplified the disorienting effect of the darkness, “Nothing was working. We were at the mercy of ourselves” (M.C.). Interestingly, the dominant sensory component in the interviewees’ stories was the strong wind noise, “and it had started that noise that if I try to describe it sounded like a landslide from how loud it was” (M.L.), and similarly, “A very strong but also very hot wind arose, so a very special wind that will always remain impressed on me” (L.C.). Subsequently, another sensory aspect recounted by the interviewees was the smell of spruce resin that reached the settlements from the devastated forests, as emerged from the words of the writer, D.Z., as follows:

“On the second day, I went along the Assa Valley on the state road that had been opened and it was raining again. Among other things, I smelled a very strong scent of resin. That scent that I have always experienced as a caress, an embrace, in that moment I felt it as a cry of pain from the forest”. (D.Z.)

The interviewees narrated the very first consequences of the storm discovered at dawn on October 30 as an apocalyptic scenario, “it felt like living through an apocalypse”, said logger M.C. Images of the devastated slopes with an incredible number of uprooted trees remained etched in their memories, “the next day we understood what had really happened, from the window we could see a slaughter” (M.C.); “the thing that impressed me the most was the woods; the mountains seemed combed due to all the trees on the ground” (P.K.). Many participants, in an effort to convey the intensity of the storm and the extent of its impact on the territory, referred to the collapse of a bridge in Cavalese (Fiemme Valley), “I saw that the bridge over the Avisio [the stream crossed by the bridge] was no longer there, and at that moment, I truly began to grasp the full magnitude of what had happened that night” (L.C.).

5.2. Theme 2: Emotional Dimension

The shared memories of the storm were also deeply charged with emotions. Fear was the first emotion that gripped the witnesses during the low point of the storm, amplified by the darkness and the storm’s threatening sounds. Related to this is also the feeling of a lack of control over what was happening, “It was a situation of absolute lack of control; I was very afraid” (A.S.). In the following days, once they became aware of the disaster, shock and

sadness emerged. This shock was also associated with the feeling of disorientation, since no one had foreseen such destruction and the sudden change in the familiar landscape, “Only in the morning opening the door and looking outside I realised that the forest was no longer there” (D.Z.); “for those who have lived in these natural environments and for those who have always frequented the forest to see such a drastic change was something really strong and really impactful” (L.C.). Instead, sadness was associated with the loss of this landscape, a treasure chest of memories, emotions, and beauty, as the forestry technician I.C. explained, “Seeing the number of trees sacrificed for us made me feel depressed for a week. I was shocked and also saddened by this immense sacrifice that the forest had to make so that we could keep going.” Finally, despondency, desolation, and anxiety emerged from the interviewees’ memories. Despondency and desolation originated from “feeling really small in front of the force of nature” (P.K.) and from experiencing a tragic ecological situation without resolution. The latter emotions became dominant with the bark beetle outbreak following the storm and its unpredictable evolution and management. The participants could not remember the storm without evoking the broader, long-term changes it made to the forest ecosystem. As the forestry technicians explained, “In a situation like this post-Vaia, we actually found ourselves and still find ourselves in a situation like COVID: it was impossible to understand how COVID would be distributed and spread in the population, and the bark beetle here, too” (P.K.). Finally, deep anxiety was also experienced with respect to foreshadowing regarding the future of the forest and its inhabitants. Concerning the inhabitants of the valleys, the forestry technician, I.C., said, “I sensed this: that what happened gave them a lot of anxiety and also a lot of sadness, because they got it into their heads that they would never see the forest again”.

5.3. Theme 3: Narrative Dimension

In the interviewees’ accounts, remembering was always accompanied by attempts to make sense of the Vaia storm, figuring out the responsibilities, driving factors, and new ecological meaning that emerged from the extreme event. This was conducted through narrative and argumentative efforts, which took several interpretative directions. Most respondents linked Vaia to climate change, talking about it explicitly, depending on their profession and degree of knowledge of the subject. Forestry technicians and, more generally, the people most informed on the topic explicitly referred to climate change, providing scientific explanations for the formation of the storm. Other people, instead, talked about an anomalous and exceptional event, mentioned the rises in temperature and pollution, and referred to major global meteorological changes with catastrophic atmospheric events that have become more frequent over time:

“It was an exceptional weather event, perhaps the world is changing and perhaps we are moving a little more towards these types of events. There are long periods of drought and after a lot of rain, so perhaps it was a little more regular once, but following a storm, I don’t remember inconveniences and troubles like these”. (M.C.)

Several interviewees also cited as a possible contributing factor the silvicultural mismanagement, which, having prioritised the spruce monoculture for centuries, made the forest fragile. Linked to this, for some interviewees, the storm was an opportunity beyond its disruptive consequences, an event that led to awareness, both from the perspective of forest management and for the inhabitants of the affected valleys. In fact, the loss of the forests generated movements of rediscovery and reconnection with nature, unveiling the otherness of the forest and the Alpine landscape, which had been taken for granted in its immutability and sameness, “Before they had never said: “Look at this beautiful forest we have!—because they were used to it” (N.M.). The ecological loss also initiated a profound reflection on forest management, highlighting the problems of monoculture and, thus, fostering new discussions regarding how to make forests more resilient:

“Even at an academic level, Vaia represented a turning point because many things at the university level are encrusted by dogmas, and you cannot open your eyes. Vaia has

dispelled this myth, in the sense that three hours of wind have been enough to revolutionise what had encrusted the forestry sciences as an unquestionable law for hundreds of years". (I.C.)

Finally, other participants recounted Vaia as a transitional phase of the forests, highlighting the discrepancy between the human and forest temporality, "I know it is a phase, I look at nature in long terms, times that are related to the natural life of the forest which are not the times of humans, humans' times are shorter" (D.Z.). According to some interviewees, the forest will certainly be reborn, probably stronger than it was before, and it will be appreciated by future generations, but not by the current ones. Thus, they acknowledged the active and regenerative potential of the forest and its specific temporalities and rhythms of growth and regeneration.

5.4. Theme 4: Material Dimension

Some artistic productions and new commercial products made of wood from crashed trees held a pivotal role in the process of collectively remembering the Vaia storm, configuring themselves as symbolic devices that catalysed memory work in both conservative and transformative directions. These include, for example, the wooden sculptures of the artist Marco Martalar, which are parts of various naturalistic Land Art itineraries in the mountains of the Veneto and Trentino and became memorials of the catastrophe, engaging the public in a process of remembering and promoting slow and sustainable tourism across these itineraries. The desire to recover the crashed wood also pushed the artist to change his technique from sculptures of large logs to the assembly of chipped wood and branches. Another example of how the memory of Vaia is still embedded in wood artifacts is the VAIA Cube, a speaker for amplifying the sounds of electronic devices, such as smartphones, born from the Vaia project. The purpose of these works was to heal nature's wound and give a new life to this 'waste' material, which would otherwise remain unused or be sold at a very low price. Thereby, the wood remains a living source of remembering through its new shapes and uses. In the case of the VAIA Cube, the special characteristics of spruce wood were leveraged to create an object of design and resonance, a sound amplifier which became a witness of the disaster in the world:

"So the idea is to amplify not only a sound but also amplify a message, an always proactive message that beauty can be created from a catastrophe. And the nice thing is that the VAIA Cube has arrived in around 28 countries around the world, perhaps now a few more, and we like to think that that typically mountain object, which comes from spruce wood, is an ambassador of what happened in the Dolomites". (M.M.)

Thus, the impressive hearing memories of the night of the catastrophe (Theme 1) here become a regenerative sound, a voice of beauty and rebirth. Furthermore, the proceeds from the sale of the speakers are being used to finance public plantings, thus contributing to the restoration of the forest. Similarly, the installation "Sounds and Signs of Vaia" at the METS—Trentino Ethnographic Museum presents a photographic and auditory journey that recalls the impressive sounds of the storm, intertwining the unique autobiographical memories of direct witnesses and contributing to the formation of an emerging collective memory. The pivotal role of the materiality of wood and trees in the process of remembering can be coupled with the common statement that the memory of Vaia will inexorably decay with the memory of the living witnesses, a belief which was shared by most participants, "In my opinion, only those who experienced it firsthand and within the areas actually affected will remember it" (M.C.). In the task of remembering, humans and trees are, thus, considered on the same level, both carrying signs of what happened imprinted in their flesh:

"In my opinion, it [the memory] will be lost because it is inevitable like all great things are forgotten because other things happen, or because the world moves on. Of course, in the immediate, I think for a decade or two, certainly it will be very present until precisely you are able to see the scars in the forest". (L.C.)

6. Discussion

This qualitative study identified the four following modes or dimensions of the collective memory of the storm Vaia: sensory, emotional, narrative and material.

As depicted in Figure 3, the four identified themes can be grouped in two distinct interpretative levels, based on two different but interrelated conceptualisations of collective memory. On one hand, the sensory memory of the storm and the emotions aroused by it (Themes 1 and 2) mostly relate to the memory of Vaia's days in the last week of October 2018; thus, they are associated with the time of the disaster and the period which followed, as it was personally experienced by the people interviewed and reproduced in their memories with common underlying features. Therefore, these two themes better describe shared autobiographical memories than actual collective memories [47]. On the other hand, the narratives of the event and its material, embodied dimension (Themes 3 and 4) concern the making and transformation of memory over time. They are no longer associated only with the past time of the disaster, but with a dense present, in which memory is evolving and taking shape through social interaction, crystallising into discourses, practices, and sociocultural products, thereby being configured as a dialogical and semiotic process of collective remembering [51,53,71].

Overall, to us, the centrality of the wounded landscape in the different shapes taken by the collective memory of Vaia endorses a conception of landscape as a memorial (see Figure 3), which we propose as the overarching framework for making sense of the themes identified by our analysis and that we advance as a mandatory analytical lens for future research attempting to investigate the collective memory of Vaia and other environmental or ecological disasters. This highlight aligns with some studies, especially in the field of anthropology, which have unveiled the pivotal roles of the spatial and material dimensions of memory embedded in landscapes in collectively remembering environmental disasters, e.g., [19,82,83]. In these cases, the landscape is considered to be a living system which can be affected by adversities and has the power to adjust, keep, witness, catalyse, and transform the memory of impactful events. This is also evident throughout all four themes we describe.

The memories of Vaia are infused with vivid sensory and emotional details, which bring them closer to the concept of flashbulb memories—a specific type of autobiographical memory related to emotionally intense episodes and including sensory information [84]. Our findings are qualified by sounds, images, and odours from the affected forest and sacrificed trees, which made the participants' memories more vivid and enduring.

The emotions of shock and sadness reported by respondents can be interpreted as manifestations of eco-grief [35,38] for the sudden ecological loss of their beloved wooded landscape. This loss disrupted their sense of place, which was deeply intertwined with their collective identity, particularly the aspect of identity rooted in their environment—referred to as place identity [40]. Other feelings like anxiety, worry, helplessness, and a lack of control in the face of the power of nature arose, especially when figuring out the possible trajectories of the transformation that the Alpine ecosystem will go through. These experiences can be understood as ecological emotions in the face of anthropogenic environmental degradation [85]. In particular, they can be traced back to the construct of eco-anxiety, e.g., [37], which, in our view, is not intended to pathologise an intrinsically significant and legitimate reaction to the severity of the climate and ecological crisis. Rather, it reinforces once again the close connection between people and the environment that manifests itself in a profound, sometimes disturbing, emotional resonance and moral attunement, which may lead to changes in attitudes and behaviours towards the environment [85,86]. Similarly, Hellmann (2024) focused on these place-based emotional experiences to explore the link between the collective memory of environmental changes and a sense of connectedness with nature [10]. We argue that this nexus should be analysed in a more systematic and nuanced fashion by future studies in the field, both concerning the case of Vaia and other similar situations.

Moreover, experiences of solastalgia, e.g., [39], were amplified by the epidemic of bark beetle, whose random and unpredictable spread and the impossibility of stopping its proliferation led three interviewees to associate it with the COVID-19 outbreak, which began to spread in Italy in the same period. Thus, the inhabitants of the disaster-stricken valleys simultaneously experienced a parasitic epidemic in the plant world and a pandemic in the human world. This reveals a common root of the vulnerability and exposure of humans and non-humans to similar threats and the role of the anthropogenic footprint in the intersected ecological and health crisis [87,88]. This lived analogy deserves more investigation and could be deepened by future studies.

The emphasis on the long-term effects of Vaia on the Alpine ecosystem also highlights the prospective function of collective memory, i.e., the multidirectional relationships between the collective remembering of an event, the imagination of future scenarios, and the courses of action spawned in the present [54,55].

Following the Vaia disaster, the affected communities began to implement various transformative practices and narrative efforts aimed at remembering the storm and making sense of it, which put in the foreground the value of the landscape, the human responsibilities in its degradation, and the need to rethink the relationship with the land (Theme 3). Furthermore, the wood of uprooted trees became a living memorial in which the Vaia storm remained imprinted and resisted oblivion, at the same time encountering multiple uses and transformations through new artistic and symbolic devices (Theme 4) [48]. All these forms are examples of collective remembering through interactions with cultural tools like narratives, practices, and artefacts, that is to say, the distributed and multifaced nature of collective memory [51,52]. Furthermore, they contribute to depicting Vaia not merely as an unprecedented tragedy, but also as a key event unveiling the human footprint in the genesis of extreme meteorological events, as well as fallacies in silvicultural techniques and spurring new ways to manage natural resources [19]. This view endorses the transformative potential of collective memory beyond its merely reproductive and maintaining function [54], which makes it a tool for social thinking that reshapes the present world [71]. From a practical perspective, leveraging the various forms of collective memory and their interactions with autobiographical memories can significantly impact fields such as education, mental health, and public policy [89]. In particular, this could be crucial in engaging citizens in participatory environmental education and stewardship projects, thereby enhancing community resilience and adaptation to climate change [90,91]. Studies to come may deepen this practical and transformative function of the collective memory of past disasters, confronting the need to adapt to ever-worsening meteorological extremes.

In line with this, despite the implementation of practices to make the memory of the disaster last, most respondents claimed that the memory of the storm would inexorably be lost because of the limits of human cognitive capacities and lifespan, cf. [58]. We state that the main goal of the collective memory of Vaia is not to preserve and repeat what happened, but rather to frame a novel environmental sensitivity and awareness, rethinking the relationship with the landscape and engaging with it as an active partner in the process of remembering its past wounds, cf. [19,92].

All these highlights gain prominence in the context of recent developments from the so-called non-human turn in the social sciences and humanities [65] and from the perspective of planetary memory [67,68], which attributes agency and a capacity for memory to natural elements. Thereby, when exploring the role of collective memory in environmental issues, the acknowledged interdependence between humans and nature raises the need to 'think ecologically (rather than merely socially)' [65] (p. 500). A truly ecological stance within the sociocultural perspective on collective memory considers the active and ongoing transactions between people and their socioecological milieu in the work of memory [48,69]. This means overcoming the still-dualistic logic, according to which human agents remember through some cultural tools that become significant in light of human interpretative acts and sensemaking efforts [51], and acknowledging non-human beings like trees as creative presences and active agents in the hybrid process of remembering [64,89,93]. Our results

attested to the need not to forget this hotspot in other studies on similar ground and to deepen the hybrid and distributed character of what is called—even more appropriately—*collective* remembering.

7. Limitations

The main limitations of this study are the small number of interviews conducted due to difficulties in recruiting participants and the limited time available for data collection. However, by choosing a narrative approach to semi-structured interviews, we managed to obtain in-depth and rich qualitative data. Future studies may seek to involve a wider range of people from the enunciatory community of Vaia or from the inhabitants of the disaster-stricken valleys to achieve a better saturation of the themes and to elicit further nuances. Other methods of data collection, such as the analysis of archival documents and participant observations of memory practices, artefacts, and sites, could enrich the understanding of the phenomena provided by the exclusive means of the interviews, promoting direct engagement with the affected environment and the entanglement of its socioecological relations. Moreover, our research took place when the Vaia emergency had not yet fully ended, i.e., five years after the disaster, a period which may be too limited to elucidate questions linked to social identity shaping and the construction or transformation of collective memories through time [11,47]; studies similar to ours could be repeated in several years to better grasp these processes. Lastly, this study focused on the formation of the collective memory of Vaia without systematically investigating the possible relationships between this event and other historical events that could be assimilated with Vaia to consider their impact on the mountain territory. Studies to come could try to reach this temporal depth by seeking historical analogies [54].

8. Conclusions

We conducted a qualitative case study of the emergent forms of the collective memory of the Vaia storm, which hit northern Italy in October 2018 and caused extensive damage to infrastructure and forests.

Our qualitative analysis, guided by psychosocial, sociocultural, and ecological paradigms, allowed us to illuminate the emerging and diverse forms of the collective memory of Vaia as a dynamic and hybrid process that engages both humans and non-humans. This study showed how the memories of Vaia are also deeply connected to other intertwined ecological challenges, such as the bark beetle epidemic, and can serve as catalysts for sustainable practices and climate resilience. The qualitative case study design provided rich and vivid descriptions of local dynamics and experiences. Furthermore, our iterative analytical approach enabled us to bridge theoretical concepts with in vivo insights drawn directly from participants' stories. In brief, our work leads to the following suggestions and recommendations for future research in the field:

- Deepen the material–spatial dimension of collective memory, i.e., the role of the landscape as a living memorial and an active agent in the process of collectively remembering environmental disasters like Vaia.
- Deepen the practical, adaptive, and transformative potential of the collective memory in the face of ever-worsening meteorological extremes, beyond its mere conservative function. This involves emphasising how communities can harness their collective memory to foster long-term ecological stewardship and adapt to the growing challenges posed by climate change.
- Analyse in depth the link between collective memories and collective ecological emotions and their potential to foster changes in people's values and behaviours, as well as in environmental management and policies.
- Perform an in-depth study of the memory and psychosocial processes implied in the chronic effects of the Vaia storm on the Alpine ecosystem, i.e., the bark beetle epidemic and the lived analogy with the COVID-19 outbreak, focusing on human–nature identification.

- Track the construction and transformation of the memories of Vaia through time and their implications in terms of identities, worldviews, and future perspectives.
- Investigate the possible link between the collective memory of Vaia and of other catastrophes—both in the history of the stricken valleys and other geographic scenarios—which have similarly transformed the landscape.

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