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Can neighbourhood interventions strengthen collective climate action?

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Abstract

This paper builds on a model of individual and collective climate action on the neighbourhood level recently presented by Klöckner et al. [1]. In this model, types of local climate action were empirically categorized (diet, travel, protest, other climate actions) and it was found that both individual and collective intentions contribute to self-reported climate actions in these categories and that collective intentions were weaker than individual. Based on these findings, the current paper presents the results of an intervention study where a series of neighbourhood events in the same neighbourhoods as used for Klöckner et al. were implemented over the course of 9 months, aiming at strengthening the collective motivation to act against climate change in the neighbourhoods. These events comprised of hands-on work on contextualized climate action, experiential learning, and creative and disruptive communication techniques. The effects of these interventions were evaluated in seven European neighbourhoods with replicating key elements of the pre-intervention survey after the intervention series. In total, 46 respondents answered the survey both before and after the interventions, 13 of which were participants of at least one of the intervention events. Despite the small sample size, we find indications that the interventions were successful in increasing the perceived social norms in the neighbourhoods, the identification with the neighbourhoods, and decreasing perceived barriers to action. Smaller positive effects seem to occur for collective intentions and collective efficacy, and behaviour change. The individual factors appear to be mostly unaffected by the interventions, with potentially some improvement in individual efficacy. Overall, this study – while being partly inconclusive due to small sample size – points at the potential of neighbourhood-based climate interventions as a new methodology for activating a path to climate action underutilized in current campaigns. The preliminary findings we present here help generating studies to test them under more robust conditions.

Keywords

Climate change mitigation action, collective action, neighbourhood interventions, transformative learning, disruptive communication

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administration, Funding acquisition; **CW** – Conceptualization, Methodology, Investigation, Writing - Original Draft; **VK** – Conceptualization, Methodology, Investigation, Writing - Original Draft; **EDG** – Conceptualization, Investigation, Writing; **GC** – Conceptualization, Methodology, Investigation, Writing - Original Draft, Funding acquisition.

Ethical clearance

The study was approved by the following committees for research ethics: Norwegian Agency for Shared Services in Education and Research, Ref.nr. 121957; VTT Ethical Committee (statement code 8_2022); Ethical Commission Roma Tre (meeting 15 Feb 2023).

Data availability

The data these analyses are based on can be accessed here: https://zenodo.org/records/10992143

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Introduction

Fast and deep changes on all levels of society are imperative if the target of limiting to anything close to 1.5 degree should remain realistically achievable [2]. While many of these transition decisions need to be made and implemented on the inter-governmental level, they include components of citizen action and behaviour change at one point or another, as mere technical transitions will not be able to get the world on the right track towards a sustainable future [3]. This might contain anything from everyday behaviours in diet choices or energy use, investment decisions in efficiency, sufficiency decisions (reducing consumption), or political action. Consequently, individual climate action and its drivers has attracted substantial interest by researchers from the more individual-focused social sciences like psychology [4-7] or behavioural economics [8]. At the same time, this perspective has been criticized for blaming the individual for the failures of the higher order socio-techno-political systems [9-11]. In this paper, we take a recently published model joining individual and collective drivers on a multitude of climate actions as a starting point [1]. Klöckner et al. conclude that the potential of collective climate action is underutilized and that an approach strengthening collective action-taking might break the limits of individual action. Based on these hypotheses, we designed an experience-based series of neighbourhood interventions using disruptive communication strategies to strengthen the capacity of neighbourhoods to take climate action. This paper presents the results of an evaluation of these interventions on self-reported climate action and its drivers.

Individual vs. collective drivers of climate action

Drivers and barriers of individual climate action have been extensively studied, often using popular psychological decision models like the Theory of Planned Behaviour [12], the Norm-Activation Model [13], or the Value-Belief-Norm Theory [14] as an inspiration. More recently, there have also been attempts to integrate some of these theories into more comprehensive models [15, 16]. These models identify factors as individual **intentions** to act (the will to make an effort to implement a climate action in the near future), **attitudes** towards different climate actions (a general evaluation of the behavioural alternatives), perceived **efficacy** or behavioural control (the ease of implementing different climate action), **social norms** (the influence of other people's expectations and actions), **personal norms** and **values** (moral considerations about the behaviours in question) as important drivers of an individual's climate-related behaviour. Other authors have explored the important role of a **personal environmental identity** as a driver of climate action across different situational contexts [17-19].

More recently, however, the focus has changed away from analysing and understanding individual actions to studying collective actions in the environmental domain [20-22]. In this perspective, the assumption is that demanding and complicated actions which often require sacrifices are more easily taken by people if they take them as part of a group and where the group derives an advantage that outweighs the individual losses (and gains). The **social identity** (identification with a specific group and willingness to contribute to the success of that group) becomes a central variable. In the Social Identity Model of Pro-Environmental Action (SIMPEA) [22], for example, the key assumptions are that environmental crisis are assessed (depending on both individual and group specific norms), which leads to personal and collective emotional responses. If the **in-group norms** (social norms) are in favour of action, **collective efficacy** (we can do this together) is experienced, and people **socially identify** with the group, then collective action is likely. In their paper, Barth et al. [21] argue that collective climate action is triggered in the same way by **collective intentions** to act (together) as individual actions are by individual intentions.

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Based on this brief literature review, we developed a model combining individual and collective motivation of climate action and tested it in a survey in nine European neighbourhoods [1]. We focused on the neighbourhood as a social unit, as it can be easily identified for interventions, and as people usually spend sufficient time within the area and with neighbours, as well as that people often identify with the place they live [23]. In our study, we found that individual and collective intentions are relevant drivers of climate action in four domains (**diet**, **travel**, **protest**, and **general climate behaviour**, including for example energy use, less food waste, or consumption reduction). However, in the current conditions, the individual intentions exceeded about three times the influence on climate action than the collective intention (controlling for socio-structural differences between people). Individual intentions were mostly driven by feelings of individual efficacy, whereas collective intentions were driven by social norms, collective efficacy, and the perceived social capital in the neighbourhood. **Social capital** was added to the model of neighbourhood-based climate action, since it captures well the capacity of a neighbourhood to act together [24-26].

Transformative learning, experiential learning, and disruptive interventions

Taking our analysis of nine neighbourhoods and the existing climate actions (and their drivers and barriers) as a starting point, we designed an intervention strategy to strengthen the collective pathway on stimulating climate action. We developed three contextualized intervention events in each neighbourhood, that included components of transformative and experiential learning and disruptive communication, along activities that were designed to engage as many representatives of the neighbourhood as possible in fun social activities. The activities should be low-threshold and should appeal to a wider audience than just the already climate motivated. They included elements of knowledge dissemination (both about climate change and the results of our analysis of the neighbourhoods [27]).

For the design of our interventions, we built upon the Transformative Learning Theory [28]. The theory assumes that people can change their perspectives and beliefs through critical reflection, which then might lead to a personal transformation (hence transformative learning). The theory was conceived to understand how people learn and grow when being confronted with challenging situations and disorienting dilemmas (both of which apply well to climate change actions). The theory assumes that people have stable **frames of reference**, which consist of their habits of mind, viewpoints, and established cognitive response patterns. These stable frames make people non-responsive to new situations unless they are encountering what the theory refers to as **disorienting dilemmas**, hence experiences that challenge an individual's frames of reference strong enough to cause discomfort. Consequently, frames of reference might be questioned, and **critical reflection** starts. This stage of critical reflection is essential for transforming the reference frames. Finally, critical reflection can lead to the acknowledgement of new reference frames. This then constitutes the **transformation**. For our design of the intervention events, this means that we were aiming to create disorienting dilemmas and encourage critical reflection, while creating arenas for open dialogue and exchange. We aimed at empowering participants in our interventions to take meaningful action and establish learning communities, where knowledge and experiences are shared between peers.

As such, the concept of our interventions shows a certain overlap with **experiential learning** [29]. Kolb describes experiential learning as a circular process where a concrete (often physical) experience of something leads to critical reflective observation, which triggers an abstract conceptualization, which then is broken down again into pragmatic active experimentation, which then again leads to the next cycle starting with contextually rich concrete experiences [30]. For our intervention plan, this means that we aimed to create episodes of hands-on experiences, which then were iterated with periods of reflection and abstraction, before breaking it down again to pragmatic, actionable assumptions, which lead to new experiences.

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Finally, we also utilized the idea of **disruptive communication** [31-33] to create moments in the events where the disorienting dilemmas as outlined above were provoked. Disruptive communication as we understand it is meant to be communication that is designed to trigger emotional reactions by interfering with people's established way of living (following the frames of reference mentioned above). These disruptive communication elements often have a creative of art related element, which make them more stimulating and easier to tolerate than blunt and brutal interferences with people's lives. Following this idea, we implemented creative disruptive elements to energize the participants in our events (see below for a more detailed description).

The present study

Joining now what has been presented in the previous sections, this study tests the effects of a **neighbourhood-based intervention campaign** designed following principles of transformative and experiential learning to stimulate collective climate action. In our study, we build on the model developed in our previous paper [1] and track the effects on key variables identified as relevant for local climate action (see Table 1). We assess the effects by comparing participants of our intervention events with non-participants from the same neighbourhood. We implemented this evaluation by repeating central parts of the survey that lead to our previous paper in the same neighbourhoods. Table 1 presents an overview of our hypotheses and a justification for each of them. In addition to the factors derived from the theoretical overview above, we also tested potential effects in perceived barriers towards climate action in the neighbourhood and if people perceive manifestations of climate change in the neighbourhood.

Table 1: *Hypotheses for effects of the neighbourhood interventions on behaviour and determinants of behaviour.*

		Aspect	Expected effect	Justification
Behaviour	H1	Diet	+	Neighbourhood interventions increase action of the individuals in the neighbourhood. Diet is rather private sphere, though, so the effects should be relatively small.
	H2	Travel	(+)	Neighbourhood interventions increase action of the individuals in the neighbourhood. Travel choices are often strongly depending on structural conditions, though. Therefore, motivations to act may be counteracted by missing opportunities.
	H3	Protest	+++	Neighbourhood interventions increase action of the individuals in the neighbourhood. Protest behaviour is often a collective and public sphere action, which therefore should be more than the other behaviours be affected positively by neighbourhood interventions.
	H4	General climate behaviour	+	Neighbourhood interventions increase action of the individuals in the neighbourhood. Many of the general climate change mitigation behaviours are private sphere behaviours, though, so effects of the interventions might be limited.
Individual factors	H5	Individual intention	0	The neighbourhood interventions were designed to impact collective action, thus, the effects on individual factors should be limited. Individual intentions should be rather unaffected, because

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				they do not depend on the action of others.
	H6	Attitudes	(+)	The neighbourhood interventions were designed to impact collective action, thus, the effects on individual factors should be limited. However, the interventions might make more beliefs salient, which might make attitudes more positive.
	H7	Individual efficacy	(+)	The neighbourhood interventions were designed to impact collective action, thus, the effects on individual factors should be limited. However, if collective action stimulated by the neighbourhood interventions leads to positive experiences of efficacy, then the individual efficacy might benefit indirectly as well.
	H8	Environmental identity	0	The neighbourhood interventions were designed to impact collective action, thus, the effects on individual factors should be limited. Environmental identity is an individual identity, which should not be affected within short time frames by the neighbourhood interventions.
Collective factors	H9	Collective intention	++	The neighbourhood interventions were designed to impact collective action, thus, the effects on collective factors should be strongest. Collective intentions should increase considerably. However, collectively experienced barriers might limit the intervention effect to some degree.
	H10	Collective efficacy	+++	The neighbourhood interventions were designed to impact collective action, thus, the effects on collective factors should be strongest. Since the collective perspective is mostly absent in the dominating discourse about climate change action, the neighbourhood interventions should strengthen the perceived efficacy of collective action substantially.
	H11	Identification with neighbourhood	+	The neighbourhood interventions were designed to impact collective action, thus, the effects on collective factors should be strongest. A series of social interventions in the neighbourhood should increase the degree inhabitants identify with the neighbourhood (given the events are experiences in a positive way).
	H12	Social norms	+++	The neighbourhood interventions were designed to impact collective action, thus, the effects on collective factors should be strongest. Probably the strongest effect of the interventions should be on social norms, as the events make it very salient that other people in the neighbourhood have expectations about climate action and may also act already.
Other	H13	Perceived barriers	-	If the neighbourhood intervention leads to positive experiences of collective efficacy, the degree of barriers against action might be reduced: Together,

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				people might feel to be able to overcome more of the barriers.
	H14	Climate change perception	(+)	Depending on the exchange of experiences and narratives during the neighbourhood interventions, local manifestations of climate change might become more salient, and a consensus might develop that climate change is visible in the neighbourhood. However, people with high personal awareness of local climate change effects might also adjust to a more moderate level when being confronted with neighbours who have lover levels.
	H15	Social capital	0	Perceived social capital of the neighbourhood should not be affected by a series of rather short interventions as this depends more on everyday experiences.

Methods

Ethical clearance

This study was approved by the following committees for research ethics: Norwegian Agency for Shared Services in Education and Research, SIKT (Ref.nr. 121957, approved on 22/04/2022), Roma Tre Ethics Commission (approved in commission meeting 15/02/2022). For the Austrian sample, an ethical clearance was not required for an anonymous paper-pencil survey as per ethical procedures of Joanneum Research. Participants gave informed consent to participate after being informed about their rights at the beginning of the surveys. No minors or people unable to give consent were included in the study.

Interventions

To test our hypotheses about the effects of an experience-based intervention program in neighbourhoods, we designed a series of contextualized neighbourhood interventions, all including elements of creative stimulation and disruptive communication (see next section for a detailed description) following principles of transformative learning. We implemented three events in each of nine neighbourhoods, specifically designed for the local neighbourhood conditions (please see the appendix of our previous paper [1] for a detailed description of the neighbourhoods). As we conducted a comprehensive survey study in the nine neighbourhoods before the interventions (for detailed results see [1]), we built the evaluation strategy on the results of the first paper and test now if key variables identified as drivers of individual and collective climate action were changed by our interventions. Unfortunately, a survey after the intervention series could not be implemented in the Finnish neighbourhoods, so that this paper is based on results from seven of our nine initial neighbourhoods. The following events were organized in the neighbourhoods:

Austria

In Austria, we strived to have comparable interventions in all of the three selected neighbourhoods: Admont, a rural municipality with approx. 5,000 inhabitants; Eggenberg, a middle-class district of the city of Graz with approx. 20,000 inhabitants; and Jakomini, a diverse, densely built district of the City of Graz with approx. 30,000 inhabitants.

The **first intervention** (performed in all three neighbourhoods) consisted of the presentation of the respective survey results on climate change perceptions in the three neighbourhoods, followed by an interactive workshop to jointly compile challenges and solutions in relation to the climate crisis in the neighbourhoods, triggering collective reflection and dialogue. The

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compiled challenges were then used as input for an interactive impro-musical play: a theatre group transformed the previously discussed content as well as spontaneous reactions of the audience into improvised musical performances. The artists engaged the audience in a spontaneous conversation in which there was space for worries, concerns, fears and hopes regarding the climate crisis. By means of music, transformative and experiential learning, together with disruptive communication about climate-relevant topics were conveyed in a respectful but also humorous way.

The **second intervention**, a multi-ethical polylogue was performed as a joint event in Eggenberg and Jakomini but had unfortunately to be cancelled on short notice in Admont. At the multi-ethical polylogue, representatives of different religions discussed the ethics of climate responsibility with local citizens. The aim of this intervention was to promote a deeper understanding of climate change from an ethical perspective and address questions such as morally appropriate action in times of climate crisis, collective responsibility for climate protection, and humanity's relationship to nature. Speakers' contributions from Christianity, Buddhism, Islam, and Judaism enriched the discussions and contributed to a comprehensive exploration of ethical responsibility in times of the climate crisis, triggering transformative and experiential learning. The polylogue provided a platform for critical self-examination of ethical beliefs and values in relation to climate responsibility, deepening participants' self-reflection and awareness.

For the **third intervention**, we invented a throwing game called "Hit Climate-Friendly Decisions". Again, this intervention was performed in all three neighbourhoods separately. The game was especially designed to engage children, teens, and their parents in reflecting on climate-friendly behaviours, triggering transformative and experiential learning. In a throwing gallery, participants attempt to hit targets that represent climate-friendly decisions (e.g., vegetarian diet, no flying, buying local food); the harder the decision is to implement in daily life, the smaller the target is. By posing complex climate change related choices in an interactive and playful environment, the game is designed to prompt reflections on current habits and to foster a sense of personal responsibility towards the climate. The throwing game resulted in a high level of enthusiasm and engagement among the – mostly – children who played the game. The incorporation of gamification elements, such as rewards, challenges, and social interaction, contributed to sustained interest and motivation to explore climate-friendly behaviours beyond the game itself. By awarding points depending on the hit targets and handing out certificates and little gifts, a competitive spirit was perceived by many children. The game also encouraged reflection on personal actions.

Italy

A **first intervention** for the Rome case study in Italy involved citizens and stakeholders of the Marco Simone neighbourhood and other surrounding areas (such as the Torraccia neighbourhood) counting about 1000 inhabitants. The intervention consisted in informing citizens (mostly young people) about the existence, scope and aims of the project. We were able to reach a good audience, and to elicit discussions and innovative ideas about how to promote more sustainable behaviours and climate-friendly actions among the citizens in the neighbourhood, thanks to the concurrency of a rock music event that took place in the Torraccia square, located near the case study area. We were able to exploit the contribution of music and the presence of a live rock music concert to disseminate the project ideas and the innovative thinking about sustainability and climate issues in the neighbourhood. The intervention was also made possible thanks to the collaboration and support of a local music school and of a local music bar, and most importantly thanks to the kindness and enthusiasm of the rock bands that were playing during the event. This helped us to stimulate the public discussion around the Clean Cultures themes. The event ended with very positive vibes.

The other neighbourhood involved in the project is located in Sardinia. The intervention involved citizens of Macomer, and consisted in informing citizens about the existence, scope and aims of the project. We were able to reach a relatively small but extremely committed

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audience. The intervention took place during an art exhibition at the presence of artists and general public, and it gave us the possibility of discussing the innovative and provocative potential of visual and field art works with citizens, through the presence of the artists themselves. This helped us to elicit discussions and ideas about lifestyle changes and about the promotion of more sustainable behaviours and climate-friendly actions in the neighbourhoods.

The **second intervention** in Macomer was entitled "I caught a crab"[1] and implemented as a creative art and sustainability-oriented workshop: here children from the preschool "Binna Dalmasso" created crab-shaped artwork using recycled materials such as wood, leaves and other natural elements collected in the park. Lead by Cagliari artist Davide Volponi, the young artists learned the importance of respect for nature and our planet and why sustainable action is needed to address climate change. Engaging the citizens of tomorrow and exploring how action at the local level can catalyse significant changes in the area of climate sustainability is the basis of the CLEANcultures project. This intervention emphasized an educational approach through creativity and art; the presence of local artists and the use of art as a means of reflection fostered experiential and transformative learning, stimulating awareness and dialogue on sustainable lifestyle changes.

Other topics include:

- focus on local sustainability: the emphasis on sustainable art and respect for nature introduced concepts of ecological transformation through reflection and practical engagement, especially among younger generations;

- cultural impact: the dialogue between artists and citizens created a foundation for critical reflections and discussions on innovative strategies for collective action within the local context.

In the Marco Simone neighbourhoods, the intervention took place during a rock music event, which attracted young people and other segments of the population. The initiative leveraged music as a "disruptive" communication tool, effectively stimulating discussions on sustainability and climate-friendly actions.

Collaboration with musicians and local cultural venues made the message more accessible and created a shared experience. This was an opportunity to foster dialogue into the community. The combination of entertainment and information allowed citizens to engage in participatory discussions, using elements of experiential learning to foster critical reflections and the formation of new perspectives. The inclusive approach highlighted the importance of a community response to climate change, strengthening neighbourhood identification and promoting a sense of collective efficacy.

In both cases, transformative learning was supported by experiences that created "disorienting dilemmas" (situations that challenge existing paradigms), fostering critical reflections and the adoption of new collective perspectives.

Norway

The first intervention in Driva exemplified transformative and experiential learning through intimate, trust-building home visits and a collaborative workshop with local stakeholders. These activities, grounded in community engagement, encouraged participants to critically reflect on their beliefs and habits around sustainability and climate change. Through a group interview and spontaneous discussions with school personnel, diverse perspectives were exchanged, fostering a deeper understanding of shared challenges and opportunities. This

[1] In Italian, the expression "prendere un granchio" (literally, "to catch a crab") means making a significant mistake while being convinced you were doing the right thing.

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process disrupted conventional communication norms by bringing often-unheard voices into the conversation, catalysing collective reflection and dialogue. By empowering participants with a sense of agency and shared responsibility, the intervention cultivated collective efficacy and encouraged the community to envision actionable paths toward sustainable change.

The second intervention in Driva leveraged the annual “Fjell & Fårikål” (mountain and mutton stew) festival to blend transformative and experiential learning with disruptive communication. The use of improvisational theatre during the mayor's opening speech provided an unexpected and engaging entry point for addressing local and environmental challenges, encouraging festival-goers to reflect on these issues from fresh perspectives. This creative approach disrupted conventional festival communication, fostering curiosity and critical reflection. By sharing a stand with Oppdal Municipality and the local organization of entrepreneurs, the intervention also highlighted collaborative action as a powerful driver of change, showcasing how partnerships between residents, businesses, and local authorities can address shared challenges. Through interactive performances and conversations, the intervention cultivated a sense of community agency, empowering residents to envision and embrace sustainable solutions collectively.

The third intervention in Driva focused on mountain farmers and local food production, employing transformative and experiential learning alongside disruptive communication to foster deeper engagement and reflection. The intimate lunch and dinner workshops, paired with immersive mountain farm visits, provided a platform for participants to critically reflect on the role of mountain farming in sustainability and community resilience. Sharing locally produced meals created a relaxed yet meaningful setting for open dialogue, allowing participants to challenge assumptions and build connections with local farmers. The mountain tour offered a hands-on experience, highlighting the realities and challenges of sustainable farming, which disrupted conventional narratives and encouraged a reimagining of the farmers’ contributions to the community.

By fostering trust and unity among farmers, stakeholders, and community members, the intervention enhanced collective efficacy. Participants developed a shared sense of purpose and agency, reinforcing their belief in their ability to influence perceptions, policies, and practices collaboratively. This intervention exemplified how focused, participatory activities can spark transformative shifts while empowering communities to envision sustainable futures together.

The first intervention in Myrsletta, designed as a probing group interview with local stakeholders, exemplified transformative and experiential learning while employing elements of disruptive communication. By creating a structured yet open environment for dialogue, the event encouraged participants to reflect critically on their values, assumptions, and priorities for the community. Exposure to diverse perspectives allowed participants to confront and reassess ingrained beliefs, fostering the kind of "disorienting dilemmas" central to transformative learning. This reflective process paved the way for new understandings of their roles and responsibilities within the community.

The group interview also strengthened collective efficacy by uniting stakeholders around shared concerns and goals. The dialogue revealed interconnected issues and inspired a sense of shared responsibility, empowering participants to envision collaborative solutions. Methodologically, the intervention disrupted traditional, hierarchical modes of communication by prioritizing horizontal, inclusive exchanges. This approach built trust and a shared sense of agency, enabling the group to collectively imagine and advocate for meaningful, sustainable changes in Myrsletta’s future development.

The second intervention in Myrsletta, “Myrsletta Mobility Day,” integrated transformative and experiential learning with disruptive communication to inspire sustainable change. Through activities such as free bike repairs, showcasing a car-sharing solution, and a children’s drawing competition on "Future Mobility," the event challenged traditional assumptions about

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transportation and fostered critical reflection. Participants were introduced to practical, alternative mobility solutions, encouraging them to reconsider reliance on private cars and explore sustainable options. The imaginative contributions of children further disrupted conventional perspectives, prompting residents to envision innovative, community-centred mobility futures.

The event also strengthened collective efficacy by demonstrating the community's ability to collaborate on sustainable initiatives. Accessible activities, positive engagement, and visible support from local businesses, the municipality, and the media fostered confidence in the community's shared capacity to address mobility challenges. The lively turnout and intergenerational involvement created a sense of pride and collective purpose, empowering residents to take ownership of their neighbourhood's transformation toward sustainable mobility solutions.

The third intervention in Myrsletta, "Myrsletta Environmental Day," expanded on the success of previous events by integrating transformative and experiential learning with inclusive, disruptive communication. Combining free bike repairs, a creative drawing competition for all ages, and active discussions with local politicians and researchers, the event provided a platform for residents to critically reflect on mobility and broader environmental issues. These activities encouraged participants to challenge entrenched beliefs about urban planning and sustainability, fostering transformative learning through exposure to diverse perspectives and institutional insights.

By involving local politicians and extending the invitation to nearby neighbourhoods, the intervention strengthened collective efficacy. Participants felt empowered to influence policies and address shared challenges, while researchers provided evidence-based approaches that reinforced confidence in sustainable solutions. The informal, neighbourly atmosphere—enhanced by refreshments, performances, and creative exercises like the "Environmental Crocodile" concept—cultivated trust and a sense of unity. This collaborative engagement inspired a collective ambition for a sustainable future, solidifying the community's belief in their ability to act together for meaningful change.

Evaluation methodology

To test changes in the key variables, we replicated the sections of the survey that measured the target variables what we were interested in and calculated the scores in the same way as described in [1]. Since the sample is very small, we do not assess reliability measures for the resulting scales in this study and rather refer to the corresponding assessments in our previous paper.

To be able to track changes within the same person, participants were asked in the first survey to generate an individual code based on for example the second letter of the maiden name of their mother, the third letter of their father's first name, the second digit in the mother's birthdate, etc. In the second round of survey after the interventions were finished, the same code generation instrument was used and answers were matched based on these codes. For 46 participants, matching codes in both surveys could be identified. Data in the first round before the interventions was collected between 03/06/2022 and 20/05/2023 (see [1] for more details), the second round of data collection was implemented between 01/06/2024 and 30/09/2024.

In the survey, we measured the following variables (see [1] for full details):

Self-reported **behaviour** was measured by providing people with a list of 19 behaviours, asking which of them they were doing already. We followed the same method of aggregating these into four categories as in the first paper: (a) Diet (3 items: eating a diet low on animal products, eating vegetarian, eating vegan as three steps of a increasing difficulty). (b) Travel

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behaviour (7 items, e.g., replacing short distance car trips by walking or cycling, avoid short flights, carpooling, etc.). (c) Protest behaviour (3 items, e.g., sign a petition, contact politicians). (d) general pro-climate action (6 items, e.g., reducing food waste, reduce energy use, buying second hand, etc.). Afterwards, the scores were standardized the average percentage of people doing the behaviours within each domain.

Individual and **collective intention** were measured with one item each ("I personally intend to contribute to local climate actions in the neighbourhood within the next year" and "We in the neighbourhood intend to take local climate action together within the next year"). **Individual** and **collective efficacy** were measured by three items each (e.g., "I think that I personally can manage to permanently lower my personal CO_2-emissions" and "I am capable to make a small but important contribution towards a climate neutral society together with other people in the neighbourhood"). **Attitudes** were measured by three items (e.g., "To act together against climate change in our neighbourhood would be good"). **Social norms** were measured by two items (e.g., "Most people in the neighbourhood expect me to take action against climate change"). **Social capital** was measured by four items (e.g., "We in the neighbourhood all draw in the same direction").

Identification with the neighbourhood was measured with four items (e.g., "I am very attached to the neighbourhood"). **Environmental identity** was measured with one item ("Acting pro-environmentally is an important part of who I am"). Perceived manifestation of **climate change in the neighbourhood** was measured with one item ("Have you perceived changes in your local area that you think are connected to climate change?"). Finally, **barriers** against climate action were measured by four items (e.g., "It is difficult in the neighbourhood to reach an agreement between the neighbours what to do against climate change"). All items were answered on a five-point Likert scale (with exception of climate change perception, which had five answers from "definitely not" to "yes, definitely").

Sample description

In the seven neighbourhoods participating in this longitudinal study, we received a total of 884 answers in the first round before the interventions were started (excluding the two Finnish neighbourhoods included in the first paper). In the second wave, we received a total of 161 answers. However, for only 46 of them we were able to match the first and the second survey, so these form the basis of our analyses presented in this paper.

Of these 46 participants, 13 indicated to have visited at least on of the intervention events, which were briefly described to them in the second survey. 33 of the participants were from the Austrian neighbourhoods, 12 from the Italian and 1 from one of the Norwegian neighbourhoods. 26 were identifying as females (56.5%), 19 as males (41.3%), and one as divers (2.2%). The age distribution is rather balanced with 10 in the age group 18-34 years, 14 in the group 35-49 years, 18 in the 50-65 years group, and 4 being older. Most of the participants have higher education (25 with a college or university degree), and most place themselves in the higher groups in social status (34 participants on level 7 or higher of 10, where 10 indicates the highest social status).

Results

Changes in climate mitigation behaviour

The first analysis conducted was to compare the self-reported frequency of climate change related behaviour on the individual level before and after the neighbourhood interventions compared between the participants who attended at least one of the three neighbourhood events in the respective neighbourhood during the project and those who did not. All 95% confidence intervals between the measurements overlap. Thus, no statistically significant effects could be detected. A visual inspection of the effects shows that in three out of four behavioural categories, the participants of the neighbourhood events increase their self-

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reported behaviour frequency, whereas the non-participants remain stable or reduce slightly (see Fig 1).

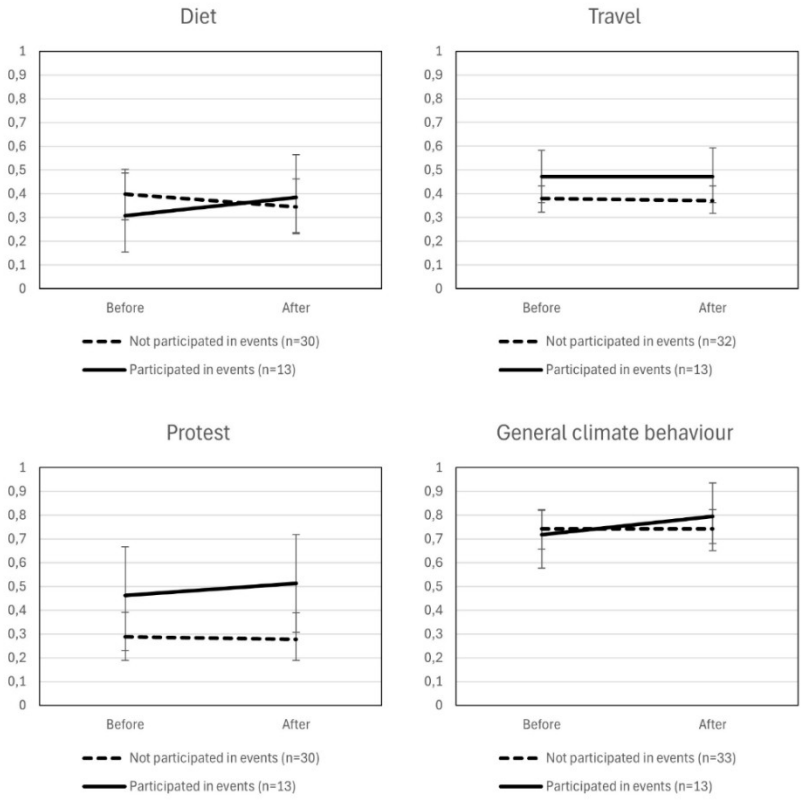

Fig 1: *Self-reported climate change mitigation behaviour in four behavioural domains before and after a series of neighbourhood interventions for participants and non-participants in the events.*

A one-way MANOVA test with Pillai's Trace did not reveal a statistically significant multivariate effect of event participation on z-standardized before-after behavioural differences across all four domains ($F(4, 34)=.779$, $p=.546$, effect size $eta^2=.084$). Among the univariate results, differences between event participants and non-participants in changes of diet behaviour are the closest to statistical significance ($F(1, 37)=1.774$, $p=.191$, $eta^2=.046$), whereas the differences for travel ($F(1, 37)=.009$, $p=.924$, $eta^2=.000$), protest ($F(1, 37)=.040$, $p=.843$, $eta^2=.001$) and general climate behaviour ($F(1, 37)=.430$, $p=.516$, $eta^2=.011$) are smaller.

Changes in individual drivers of behaviour

In the next step, the effects of event participation on individual intentions to act against climate change and three drivers of that intention (attitudes, individual efficacy, and environmental identity) were tested. Visual inspection shows no changes in intentions in both groups, as well as small effects in the other variables (see Fig 2). Please be aware, that the effect on attitudes is opposed to what was expected.

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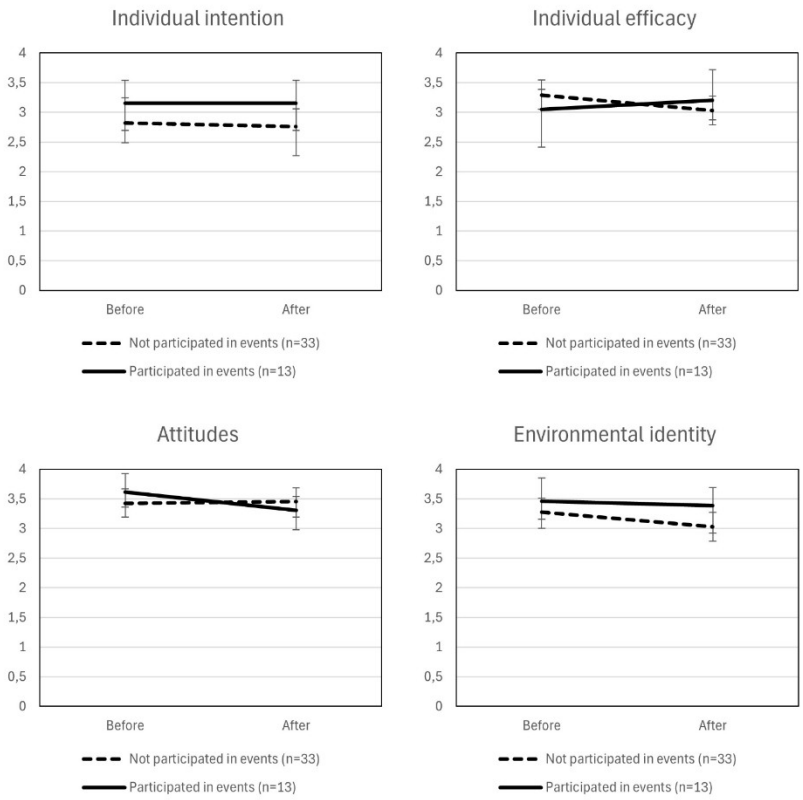

Fig 2: *Drivers of individual climate mitigation behaviour before and after a series of neighbourhood interventions for participants and non-participants in the events.*

This is confirmed by a one-way MANOVA test with Pillai's Trace which did not reveal a statistically significant multivariate effect of event participation on z-standardized before-after differences in these factors ($F(4, 41)=1.957$, $p=.119$, effect size $eta^2=.160$), but the multivariate effect is larger as for behaviours. Among the univariate results, differences between event participants and non-participants in changes of individual efficacy are the closest to statistical significance ($F(1, 44)=2.160$, $p=.144$, $eta^2=.048$), whereas the differences for attitudes ($F(1, 44)=1.789$, $p=.184$, $eta^2=.040$), individual intention ($F(1, 44)=.024$, $p=.879$, $eta^2=.001$) and environmental identity ($F(1, 44)=.341$, $p=.562$, $eta^2=.008$) are smaller.

Changes in collective drivers of behaviour

In contrast to the individual drivers of climate change behaviour, the collective drivers show stronger effects in a visual inspection (see Fig 3). In all four cases, the difference between participants and non-participants points to an improvement in the collective driver after the events relative to the development for the non-participants. However, 95% confidence intervals overlap also here.

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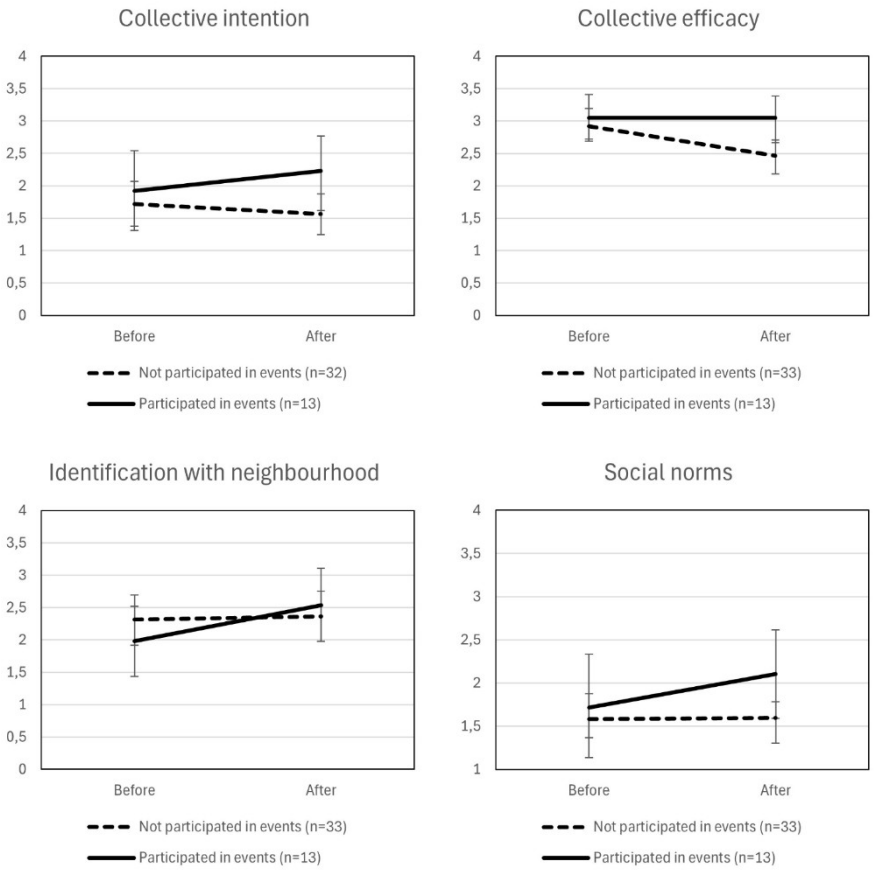

Fig 3: *Drivers of collective climate mitigation behaviour before and after a series of neighbourhood interventions for participants and non-participants in the events.*

Furthermore, a one-way MANOVA test with Pillai's Trace did not reveal a statistically significant multivariate effect of event participation on z-standardized before-after differences in these factors ($F(4, 40)=1.387$, $p=.256$, effect size $eta^2=.122$), and the multi-variate effect is a bit smaller as for the individual factors. Among the univariate results, differences between event participants and non-participants in changes of social norms are the closest to statistical significance ($F(1, 43)=2.977$, $p=.092$, $eta^2=.065$). Also the difference for identification with the neighbourhood are close to statistical significance ($F(1, 43)=2.810$, $p=.096$, $eta^2=.063$), whereas the differences for collective intention ($F(1, 43)=1.358$, $p=.250$, $eta^2=.031$) and collective efficacy ($F(1, 43)=2.552$, $p=.117$, $eta^2=.056$) are smaller. Effect sizes in the collective drivers are higher than for the individual drivers, and two of the univariate results are statistically significant for one-sided testing (as positive effects were expected).

Other drivers of behaviour

Finally, an inspection of effects on perceived barriers to climate action in the neighbourhood, local indications of climate change in the neighbourhood, and perceived social capital in the neighbourhood indicate that the only effect seems to show in that barriers are perceived less high (see Fig 4).

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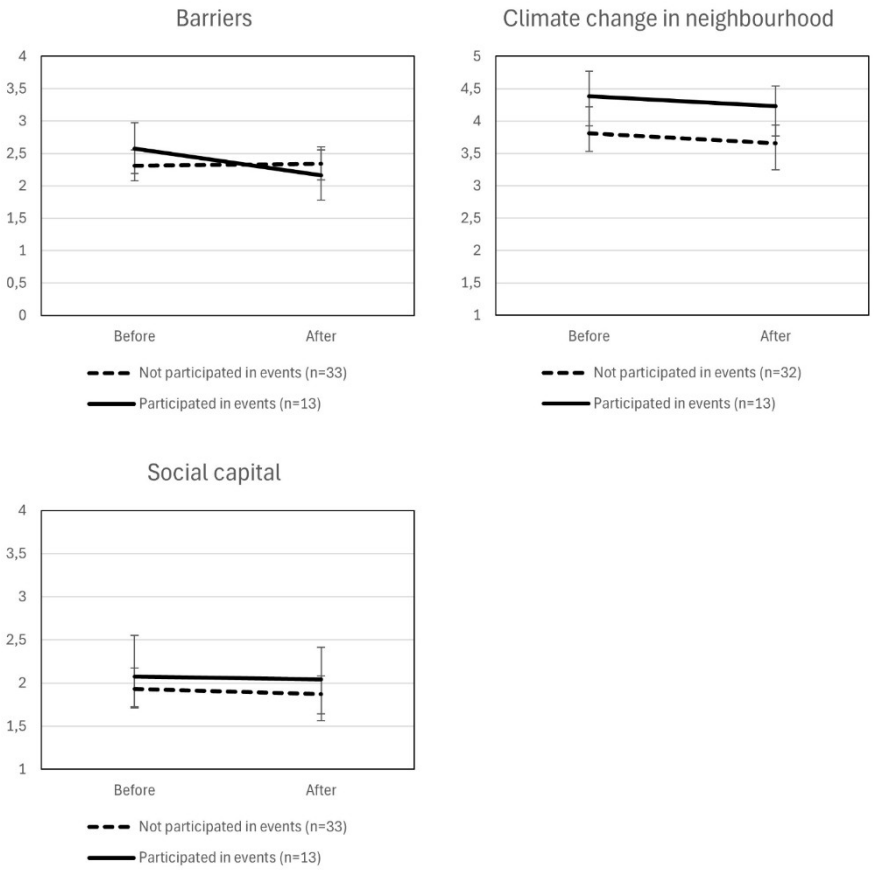

Fig 4: *Other influences on climate mitigation behaviour before and after a series of neighbourhood interventions for participants and non-participants in the events.*

Also here, the one-way MANOVA test with Pillai's Trace did not reveal a statistically significant multivariate effect of event participation on z-standardized before-after differences in these factors ($F(3, 31)=1.258$, $p=.301$, effect size $eta^2=.084$). Among the univariate results, differences between event participants and non-participants in changes of barrier perception are the closest to statistical significance ($F(1, 43)=3.862$, $p=.056$, $eta^2=.082$), whereas the differences for climate change perception in the neighbourhood ($F(1, 43)=.000$, $p=.996$, $eta^2=.000$) and social capital ($F(1, 43)=.135$, $p=.715$, $eta^2=.003$) are non-existent.

Discussion

Table 2 below presents an overview of the results of our hypotheses testing. As our sample size is extremely small, we base our interpretation on a combination of three criteria: (1) We inspected the plots of the effects for the two groups visually and checked if the observed effects appear to be in the expected direction and of a visual size big enough to justify the assumption that the hypothesis is met. (2) We used traditional significance testing (here univariate tests in conjunction with MANOVA multi-variate tests) to test if the difference in differences before-after intervention between participants and non-participants is significantly different from 0. As the sample is small and we had directed hypotheses (see Table 1), we used one-sided testing. (3) We inspected the effect sizes of the differences in differences between the two groups. Using the rules-of-thumb as for example outlined in Adams and Conway [34], we interpret values of eta^2 below .01 as small effects, values around .06 as

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medium sized effects, and values around or above .14 as large effects. Based on a combination of these criteria, we come to the following conclusions.

Table 2: *Confirmation of hypotheses*

	Aspect	Expected effect	Direction (visual inspection)	Statistically significant	Effect size (eta²)
H1	Diet	+	Confirmed	Not significant	Medium
H2	Travel	(+)	Confirmed	Not significant	Very small / zero
H3	Protest	+++	Partially confirmed	Not significant	Very small
H4	General climate behaviour	+	Confirmed	Not significant	Small
H5	Individual intention	0	Confirmed	Not significant	Very small
H6	Attitudes	(+)	Opposite direction	Not significant	Small to medium
H7	Individual efficacy	(+)	Confirmed	Not significant	Small to medium
H8	Environmental identity	0	Partially confirmed	Not significant	Small
H9	Collective intention	++	Confirmed	Not significant	Small
H10	Collective efficacy	+++	Confirmed	Not significant	Small
H11	Identification with neighbourhood	+	Confirmed	Significant (one-sided)	Medium
H12	Social norms	+++	Confirmed	Significant (one-sided)	Medium
H13	Perceived barriers	-	Confirmed	Significant (one-sided)	Medium
H14	Climate change perception	(+)	Partially confirmed	Not significant	Very small / zero
H15	Social capital	0	Confirmed	Not significant	Very small

For the self-reported behaviours all four results point in the expected directions: We see a medium size effect for changes in diet behaviour, and a small effect for general climate behaviour. Against our expectation the effect on protesting behaviour is very small, which seems to indicate that protesting behaviour is per-se uncommon in the studied neighbourhoods and that the neighbourhood action may have rather opened for local action than protesting against the authorities (which often were involved in the interventions). Effects on travel behaviour were as expected extremely small, which indicated that travel choices are mostly determined by external conditions rather than internal motivational factors [35].

As expected, the effects of the neighbourhood interventions on the individual factors were small to absent. Individual environmental identity and individual intentions seem to be mostly unaffected by the interventions, which underlines that these processes still mostly happen on the individual level, unaffected by the interventions aiming at strengthening the collective capacity to act. We found a small to medium size effect for increased individual efficacy, though, which might indicate that the interventions might have indirectly strengthened the participants' perceived individual efficacy also by making the effects of one's actions in the larger context more salient. However, we found also an unexpected small to medium size effect on attitudes to act. Participants of the intervention events seem to have less positive attitudes to individual climate action after the event than before which might indicate that especially very motivated people adjust their attitude levels to the lower average level of the group.

As expected, the strongest effects were found for collective factors, here in particular social norms and identification with the neighbourhood (both achieve one-sided significance in spite of the small sample size). Our intervention events seem to be successful in making social norms salient and create a stronger identification with the neighbours. Effects of collective intention and efficacy point in the same direction, but they are weaker than expected.

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Finally, among the other factors, climate change perception in the neighbourhoods and perceived social capital were apparently not affected by the interventions, whereas perceived barriers to action seem to have been reduced, probably because the interventions focused on concrete climate actions in the neighbourhoods and the barriers were phrased in terms of social barriers. Also this effect was significant in one-sided testing and of medium effect size.

Limitations of the study

The main limitation of the presented study is obviously the very small sample size, which prevents us from following conventional significance testing of the effects and puts a large degree of uncertainty on the presented results. It is possible that what we found has been caused by just random variations in people's assessments and the (self-)selection of participants. However, we consider the combination of three criteria (visual inspection, significance testing, inspection of effect sizes) as reasonably robust, in conjunction with that the overall pattern of results further underlines our narrative.

A second limitation is that participation in the events is of course not randomly assigned. We organized the events in the neighbourhoods and invited all neighbours to participate, but far from all did. Thus, the group of participants was strongly self-selected, which indicates that they might have been particularly receptive for the interventions. However, self-selection should have worked in the direction of climate interested people (and thereby already more active people) being more motivated to attend the events, which would rather under- than overestimate the effects of the intervention. Another dimension of self-selection is more critical, though: It is likely that people who are interested in social interaction with neighbours and are identified with the neighbourhood are more likely to participate in the events than other people. This might lead to an overestimation of the effects on collective factors as people less connected to the social environment of the neighbourhood may respond less positively.

Finally, the presented results are based on seven European neighbourhoods. These are divers on many criteria, but nonetheless a very particular selection. In addition, response rates in the Italian neighbourhoods were higher than in the Austrian and Norwegian, which means that the results are stronger impacted by the conditions in the two Italian neighbourhoods than in the other five.

Conclusion

Thus, it appears that overall our neighbourhood interventions were successful, and with a larger sample we would have been able to demonstrate this with traditional significance testing also for more of the tested hypotheses. With all caution that the small sample warrants, the results seem to indicate that neighbourhood interventions as a means of stimulating to collective climate action should be studied further as they may be a promising alternative to over-individualized action appeals. Further research is necessary to consolidate the presented effects, but we consider the results interesting enough to justify more research in this new arena of climate communication and action.

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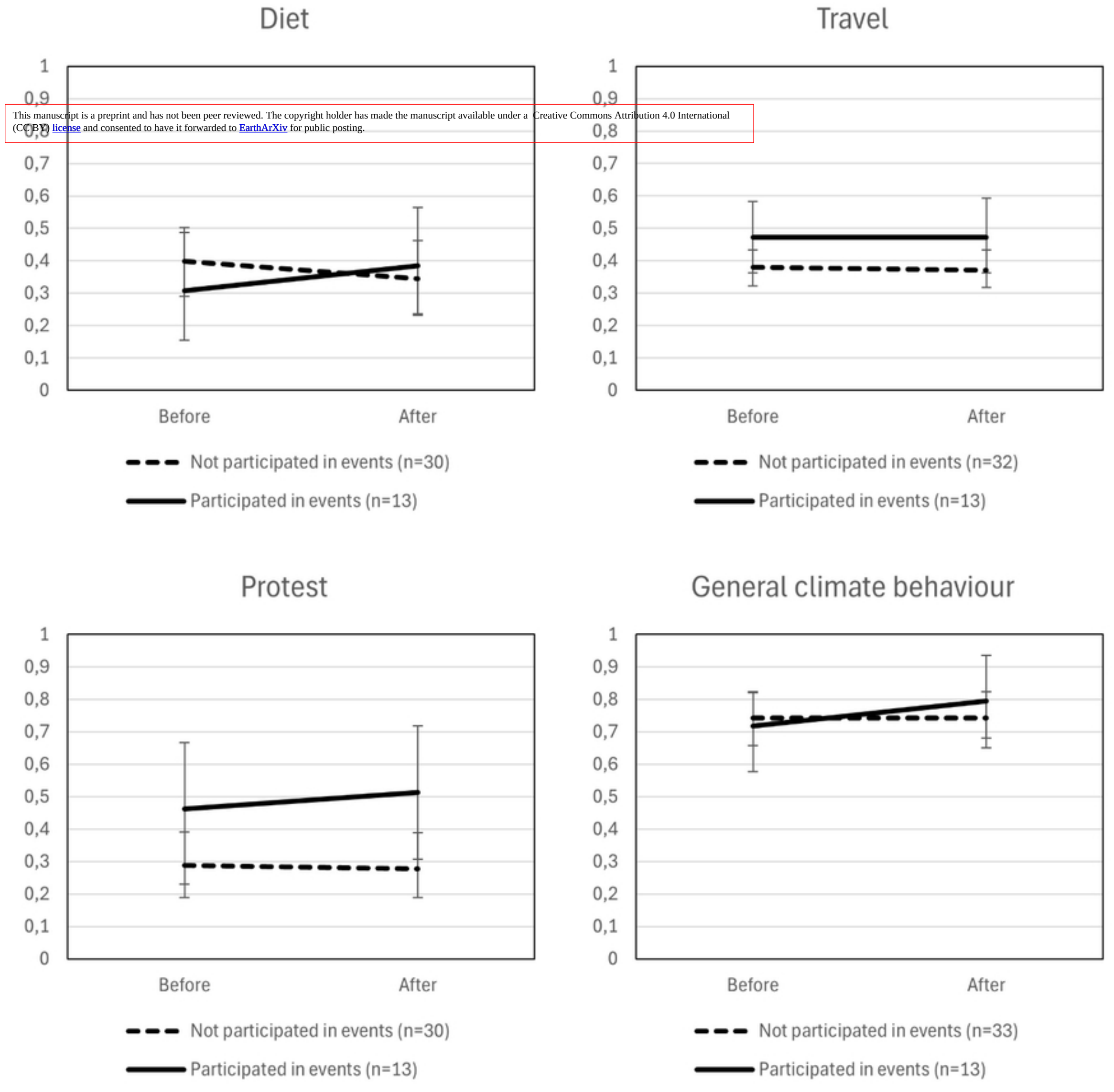

Figure 1

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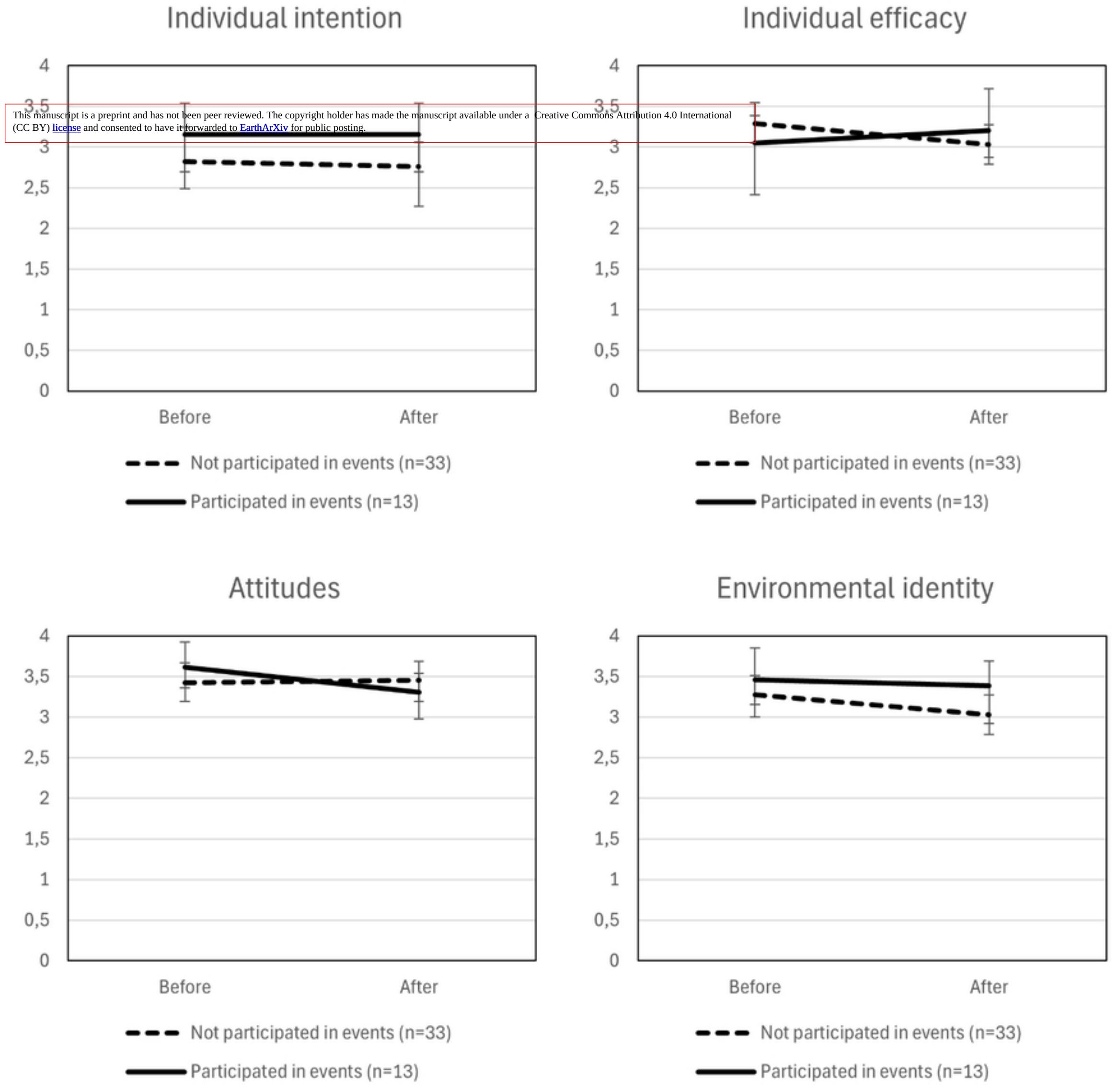

Figure 2

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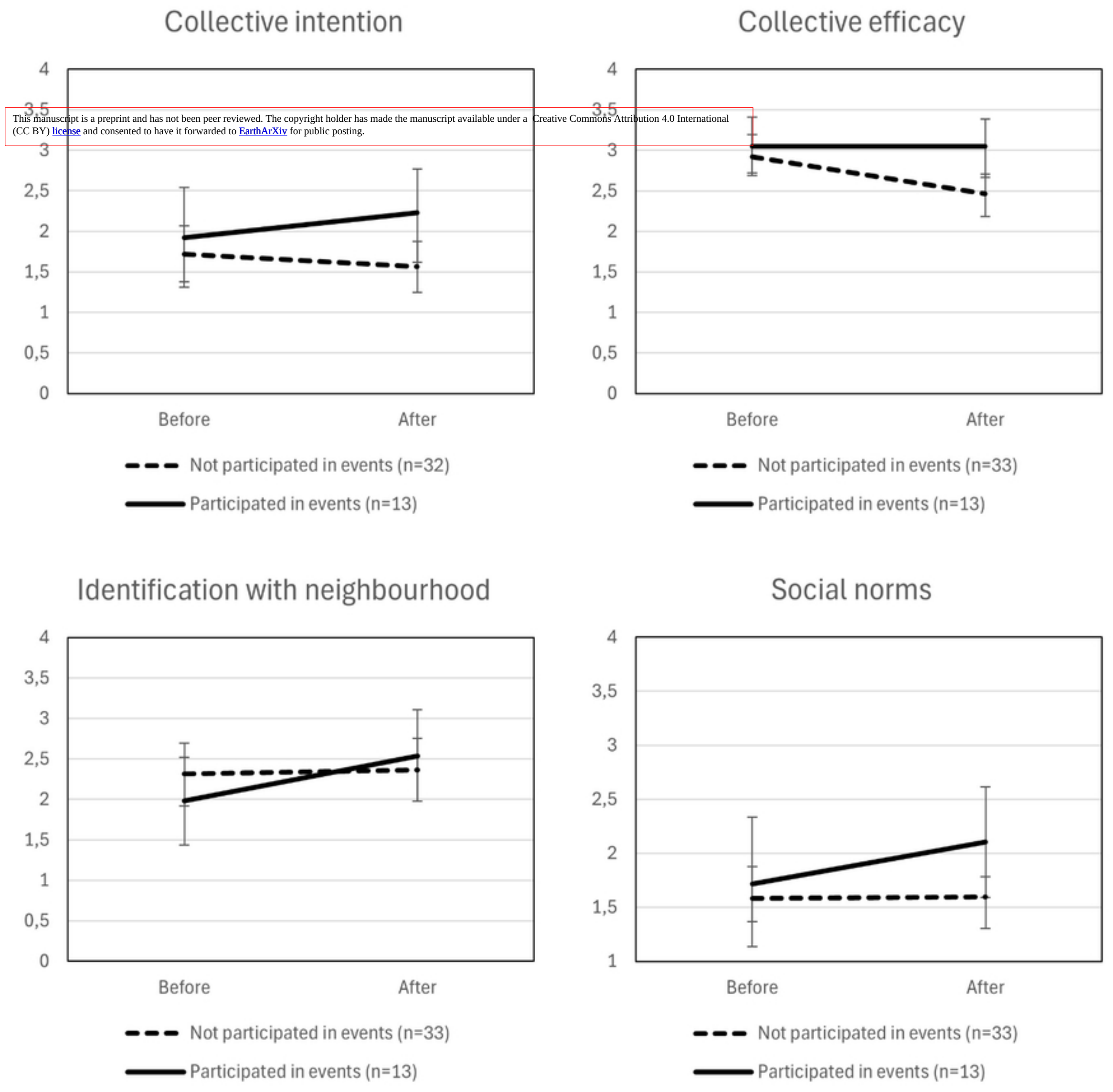

Figure 3

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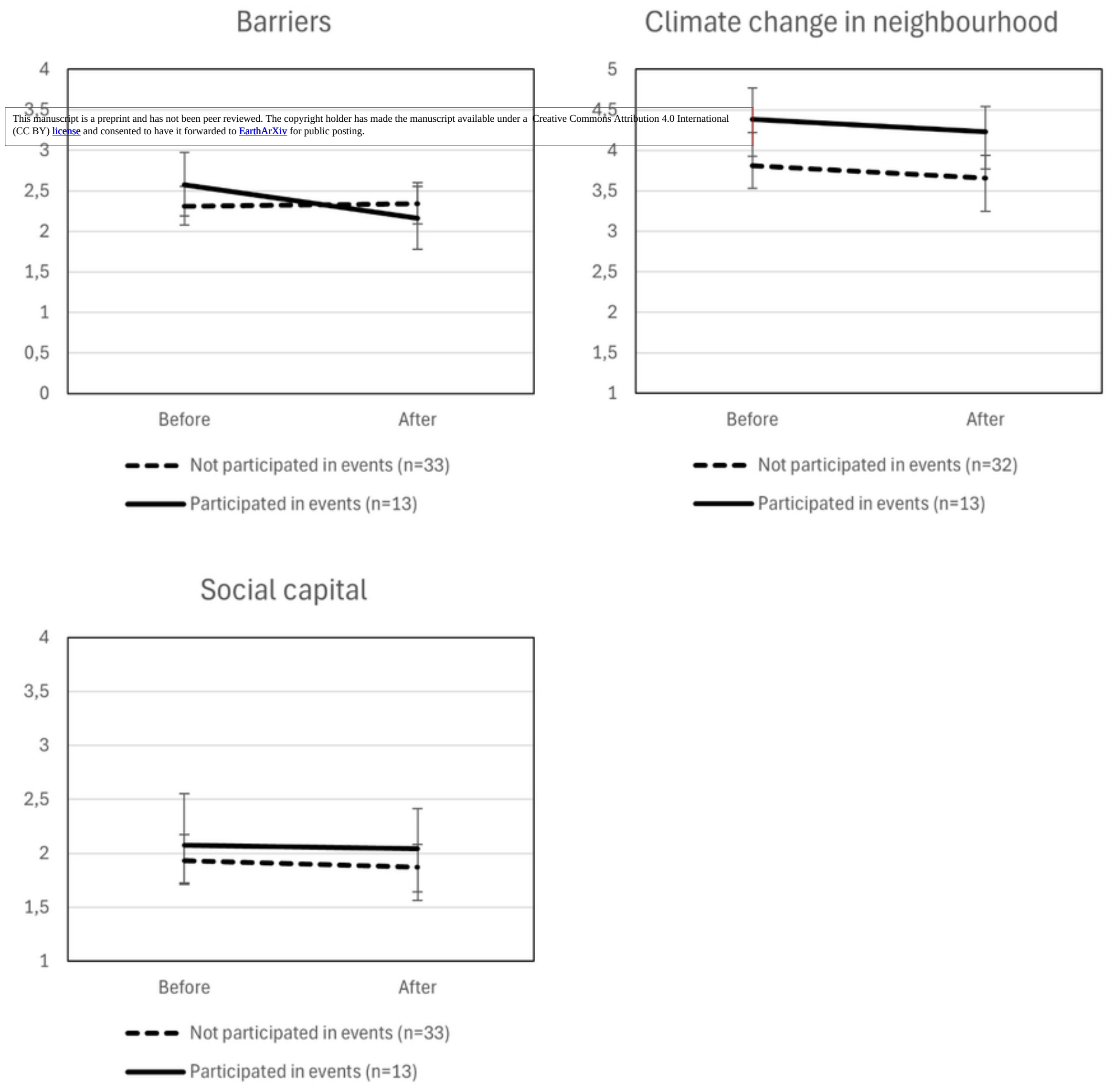

Figure 4