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ORIGINAL RESEARCH

Exploring the association between growth mindsets and climate action with young people

Inkeri Rissanen[1] · Elina Kuusisto[1] · Essi Aarnio-Linnanvuori[1] · Rosamund Portus[2] · Sara-Jayne Williams[2] · Sophie Laggan[2] · Kathy Reilly[3] · Mari-Pauliina Vainikainen[1]

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Abstract

Decades of research has demonstrated the power of growth mindsets (i.e. belief in the malleability of the qualities of humans) to shape people's ways of making sense of their socio-cultural reality and influence their ways of thinking about and acting towards change. Yet, research which connects mindsets with climate action or sustainability behavior remains scarce. This study explores the association between mindsets and climate action among European young people. Our findings, based on statistical analyses of survey data from Tampere (Finland), Genoa (Italy), Galway (Ireland) and Bristol (United Kingdom) (N=1,814), indicate that growth mindsets about persons and groups are associated with some dimensions of climate action.[1] However, the results also showed that the dimensions of climate actions are understood in slightly different ways in different countries, possibly because of contextual differences. Developing and researching locally adapted approaches to cultivate growth mindsets in climate change education is recommended.

Keywords Growth mindset · Climate action · Value-action gap · Young people · Climate change education

✉ Inkeri Rissanen
inkeri.rissanen@tuni.fi

[1] Tampere University, Faculty of Education and Culture, Tampere, Finland

[2] University of the West of England Bristol, Faculty of Environment and Technology, Bristol, UK

[3] University of Galway, School of Geography, Archaeology & Irish Studies, Galway, Ireland

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1 Introduction

In addition to calls for behavioral change, the sustainability crisis has evoked views emphasizing the necessity of massive and widespread change in worldviews to promote sustainable climate action (Berzonsky & Moser, 2017; Van Egmond & Vriers, 2011; Rissanen et al. 2023). Views on the possibility of transformation, in general, might determine whether awareness of the necessity of these massive changes either motivates to act or, conversely, leads to apathy. Mindsets are personal networks of core beliefs about the fixed versus changeable nature of different targets. These beliefs are attributed to many different subjects such as towards individuals (Dweck, 2000), groups (Halperin et al., 2011; Rydell et al., 2007), and the world (Duchi et al., 2020; Soliman & Wilson, 2017), and they are known to powerfully shape motivation and persistence. Even brief mindset interventions, if carefully contextualized and adapted to target populations, can achieve powerful and long-lasting impacts on people's willingness to work towards both personal changes and to changes in the world (Dweck & Yeager, 2019; Goldenberg et al., 2018; Rattan & Georgeac, 2017).

Research which connects mindsets with climate action, pro-environmental behavior, and sustainability behaviour is beginning to emerge but remains scarce. According to recent studies, a growth mindset about the world is associated with a lower tendency to deny the severity of climate change, more favourable beliefs about its possible mitigation, as well as pro-environmental behavior (Duchi et al., 2020; Soliman & Wilson, 2017). However, there is still a lack of research that explores how mindsets about individuals and groups are associated with climate action. This is the focus of this research paper, which presents some of the research from the European Consortium CCC-CATAPULT (Challenging the Climate Crisis: Children's Agency to Tackle Policy Underpinned by Learning for Transformation). CCC-CATAPULT examined young people's experiences of, and learning around, the climate crisis in four European city regions: Tampere (Finland), Galway (Ireland), Genoa (Italy) and Bristol (UK).

Each of these city regions is distinct, serving a variety of urban and rural hinterlands. The impact of climate change and the reality of present and future vulnerabilities to climate impacts are experienced differently by those living in each city region. Bristol (UK), Galway (Ireland), and Genoa (Italy) are cities close to coastlines, where climate change is expected to cause more floodings, coastal storms, and water supply issues. There has been recent experience of major floodings in Genoa and Galway surroundings (Galway City, 2024; Comuna di Genova, 2021). Each three cities will also experience more erratic weather impacts with concerns such as heatwaves becoming increasingly prevalent (Harvey & E&E News, 2022). Tampere (Finland), on the other hand, is not a coastal city but is located between two lakes in the middle of Southern Finland. The local climate is expected to warm more during winter than summer, which will bring major challenges for species that are adapted to a cool climate (Ruosteenoja et al., 2016). However, the city region is not at high risk of major floodings, storms, or lethal heatwaves in the near future. Each city-region is characterised by diverse educational systems; despite this diversity there remain striking similarities between how climate change education (CCE) is delivered across each national setting. Where it exists, CCE is embedded across limited subject areas.

However, as education progresses these subjects that include CCE become optional and therefore opportunities to learn about CCE requires agency on the part of young people to choose to do so. Furthermore, more vocational courses or study strands often do not engage CCE to the same degree as academically focused courses. Without engagement with CCE, there is a danger that young people may not understand the necessity to act, adapt, and help mitigate the impacts of climate crisis (for further discussion on young people's views of climate change education see Reilly et al., 2024).

1.1 Climate action– opportunities and barriers

By climate action, we refer to any environmental action that relates to anthropogenic climate change. According to the classic definition of Jensen and Schnack (1997), an action is something that participants actively decide to take part in to work towards solutions of the problem in question: in this case, climate change. Both these aspects are crucial: people taking part in actions have themselves chosen to do so, and the action(s) aims to mitigate and/or adapt to climate change. Actions can be individual or collective, and their impacts direct (e.g., directly diminishing carbon emissions in everyday choices such as taking public transport instead of a car) or indirect (e.g., informing community members about climate issues or aiming to change public regulations) (see Jensen, 2002).

In Europe, postmaterialist values, cosmopolitan attitudes, and engagement in environmental politics are closely connected to young people's decisions to engage with climate action (Henn et al., 2022). Moreover, feelings associated with climate anxiety, which many young people report feeling (Hickman et al., 2021), have also been positively linked to pro-environmental behaviour (Bouman et al., 2020; Ogunbode et al., 2022). It is also essential for young people to have a sense of hope to motivate them to take action (Ojala, 2012).

Despite increased reports of young people's involvement with climate action (Hohenhaus et al., 2023; United Nations, [n.d.]), a value-action gap has also been demonstrated among young people (Chung & Leung, 2007; Hitchings et al., 2015; Portus et al., 2024; Williams & Hodges, 2022). In order to narrow this gap, barriers to action need to be understood. An influential categorisation of psychological barriers to climate action comes from Gifford (2011) (see also Whitmarsh et al., 2021). These include limited cognition, ideological worldviews, comparisons with others, sunk costs and behavioural momentum, discredence towards experts and authorities, perceived risk of change, and positive but inadequate behaviour change. With a focus on younger people, Huoponen's (2023) meta-analysis identifies a lack of support from home or school, unpleasant emotions, lack of motivation, norms, lack of authoritative space, lack of concrete actions, and the media as significant barriers. Focusing specifically on reducing meat consumption, Graves and Roelich (2021) identify habit as the most significant psychological barrier, with values and attitudes acting as moderating variables.

When exploring the factors which contribute to the value-action gap it is paramount to recognise that, in addition to internal psychological factors, external factors also contribute (see Blake, 1999; Kollmuss & Agyeman, 2002; Stern, 2000). As

Gifford (2015, p. 28) considers, not everyone "can afford to buy solar panels, rural residents cannot commute by subway, and people who live in cold climates cannot go without heating". Put simply, there are restrictions upon people's choices which are a product of circumstances which they have a distinct lack of immediate control over. These include institutional, economic as well as social and cultural factors (Kollmus & Agyeman, 2002). This is why it is essential that the efforts to mitigate climate change and close the value-action gap include a wider focus on the promotion of economic, social, and cultural sustainability.

Where it exists, environmental and CCE often encourage people to engage in individual action: teachers and environmental education experts consider behaviour change to be an important goal of their work (Aarnio-Linnanvuori, 2019; Clark et al., 2020; Jorgenson et al., 2019). Yet, it is shown that frequently, educators do not promote efficient individual actions, such as flying less or choosing a vegetarian diet, but inefficient ones, such as recycling and changing lightbulbs - behaviours that have only limited impact on systemic change and personal emissions (Wynes & Nicholas, 2017). A rising number of researchers recommend that education should promote collective climate or environmental action (e.g. Ardoin et al., 2023; Chawla & Cushing, 2007; Clark, 2016; Cotton et al., 2016; Jensen, 2002). However, the line between individual and collective action is not always clear cut. For instance, discussing climate issues with family and friends is an essential element of engaging with climate action (Trott, 2020, 2021), and could be seen as a form of individual action taken to promote collective change.

Altogether, suggestions to promote climate action and close the value-action gap, based on findings on the barriers and incentives of climate action, typically include aspects of empowering and motivating individuals and supporting their agency for both individual and collective action (Burford et al., 2015; Gifford, 2011; Toivonen, 2022; Trott, 2021). Mindsets are powerful constructs affecting motivational processes as well as people's ways of thinking about and acting towards change (Dweck & Yeager, 2019), yet their role in hindering or supporting climate action is under-studied, which implies a lack of attention to them in the field of environmental and CCE.

1.2 Mindsets about individuals and groups

People have different beliefs concerning the extent to which the qualities of humans (e.g. intelligence, giftedness, personality) and human groups (e.g. norms and values) are static or malleable. These beliefs are referred to as mindsets, implicit theories, or lay theories; they form meaning systems which influence cognitive and affective processes in multiple ways (Burnette et al., 2013; Dweck, 2000; Molden & Dweck, 2006). Decades of research have brought evidence of the broad effects of mindsets for self-regulation, motivation as well as for social meaning making, and through these to behaviour, learning, achievement, and intergroup-phenomena (Burnette et al., 2013; Carr et al., 2012; Dweck, 2000; Dweck & Yeager, 2019). A growth mindset (i.e. incremental theory) is a construct used to refer to a high belief in the possibility of individuals to change, whereas a fixed mindset (i.e. entity theory) implies viewing human qualities as static and non-malleable (Dweck & Yeager, 2019). A growth mindset predicts mastery-orientated behavioural patterns (prioritizing learning over

performance), whereas a fixed mindset is associated with passive and avoidance-orientated behaviour and helpless responses (giving up in front of failures and setbacks) (Dweck, 2000). People with a growth mindset tend to put more emphasis on contextual factors when interpreting the behaviour of other people, whereas a fixed mindset is associated with a tendency to make trait-focused interpretations, and to regard many aspects in people's lives as determined by unchanged and global qualities (Molden et al., 2006; Rissanen et al., 2023).

Even though it is typical to have a general tendency towards a fixed or growth mindset, mindsets should not be seen as a dichotomy, but as a continuum, and they are also known to be dimension specific - i.e. a person can hold a growth mindset about artistic talent, but a fixed mindset about mathematical ability (Chan et al., 2022; Haukås & Mercer, 2021). People who fall in the middle of the mindset continuum are sometimes referred to as having a mixed mindset (see e.g., Claro et al., 2016). Malleability of personality is a much researched mindset dimension (Levy et al., 1998). Belief in the ability of individuals to change "the kind of person" they are, is associated, for instance, with feeling less threatened about acknowledging responsibility of one's actions (Schumann & Dweck, 2014), as well as with being less prone to making shortsighted choices when faced with environmental uncertainty (Geng et al., 2022). Mindsets tend to activate and influence behaviour particularly strongly during difficult times: for example, growth mindsets have been reported to influence preparedness and prevention behaviours during the Covid-19 pandemic (Zhang et al., 2021). In general, people with a tendency towards a growth mindset are more persistent when they face setbacks and challenges (Yeager & Dweck, 2012).

Beliefs about the malleable and situated or static and innate nature of the characteristics of human groups (i.e., group mindsets) have been researched in intergroup contexts: a growth mindset about groups is associated with positive intergroup attitudes, lesser tendency to stereotype and willingness to work towards improvement (e.g., Carr et al., 2012; Dweck, 2000; Rattan & Georgeac, 2017). Interventions that target mindsets about groups by demonstrating the malleability of cultural groups have been able to increase positive emotions towards outgroups and enhance cooperation (Goldenberg et al., 2018). Group mindsets are also related to political identity and ideas of social justice (Kahn et al., 2018); people with a growth mindset tend to acknowledge and accept the responsibility of their in-group's actions, and hence feel more group-based guilt– however, they also see challenging situations as opportunities for individuals and groups to change (Schumann & Dweck, 2014; Weiss-Klayman et al., 2020).

Some studies have explored implicit theories about the world (whether the social world and its institutions have malleable characteristics) and about climate change (whether climate change can be mitigated), which are statistically independent from other mindset dimensions (Cuadrado et al., 2023; Soliman & Wilson, 2017). Soliman and Wilson (2017) explored the link between mindsets about the world and willingness to engage in pro-environmental behaviour and found that fixed mindsets decrease pro-environmentalism through two factors– they increase climate skepticism and decrease belief in the possibility of society to change. Cuadrado et al. (2022) focused on growth mindsets about climate change and found a link between growth mindsets, pro-environmental intention, and behaviour.

Research reviewed above demonstrates that growth mindsets about the qualities of humans and human groups powerfully shape motivation and behaviour, and they also might be of relevance when considering the climate crisis. Yet, to our knowledge, these mindset dimensions have not been previously researched in relation to climate action specifically. High belief in the capacity of humans to change could be associated with higher intentions to influence the actions of other people. Moreover, individuals who recognize the necessity for lifestyle changes in climate crisis mitigation might be inclined to take action themselves only if they believe in their own and others' capacity for change. Therefore having a sufficient sense of hope for change is essential for motivating action (Ojala, 2012; Sangervo et al., 2022). Thus, in the present study, we hypothesize that growth mindset about individuals and groups are associated with intentions and behaviour relevant for climate action. Earlier research shows that people who believe in the changeability of their own sustainability behavior, also report more sustainability related behaviour (Schutte & Bhullar, 2017). We predict growth mindsets to be associated with young people's individual climate actions, but in addition to that, we hypothesize that these are related to their intentions to influence other people. In this cross-cultural study we are also interested in also in seeing whether these possible correlations significantly differ across the countries. First, however, we need to start with exploring the feasibility of using identical instruments for assessing mindsets and climate action across diverse national contexts. Our research questions and hypotheses are:

RQ1 Can mindsets and climate action be measured with the same instruments in different countries?

RQ2 What kind of mindsets do European young people have about the malleability of persons and groups?

RQ3 How do young people self-evaluate their climate action?

RQ4 How are mindsets associated with young people's climate action? In particular, how are mindsets about the malleability of persons and groups associated with (a) a willingness to build a sustainable world, (b) an inclination to discuss climate change, as well as (c) individual and (d) collective climate action?

H1: Growth mindset (GM) about individuals is associated with higher levels of climate change action and fixed mindset (FM) is associated with lower levels.

H2: GM about groups is associated with higher levels of climate action and FM with lower levels.

2 Data & methods

2.1 Participants

Participants ($N=1{,}814$) of the study were young people between the ages of 15–18 from four European city-regions, Tampere (Finland) ($n=553$), Genoa (Italy) ($n=392$), Galway (Ireland) ($n=507$) and Bristol (United Kingdom) ($n=352$). In all countries about half of the young people identified themselves as females, just under half (44%) males, and a minority as non-binary or third gender (see Table 1).

Table 1 Age and gender of participants in four countries

				Finland		Italy		Ireland		UK	
		n = 1,814	%	*n* = 553	%	*n* = 392	%	*n* = 507	%	*n* = 352	%
Age	15	359	20	46	8	3	1	213	42	95	27
	16	900	50	340	62.5	130	33	282	56	147	42
	17	381	21	112	20	187	48	10	2	71	20
	18	158	9	54	10	67	17	1		36	10
	PNTS* /missing	16		1		5	1	1		3	1
Gender	Female	916	50.5	273	49	199	51	261	51.5	181	51
	Male	796	44	252	46	177	45	213	42	152	43
	Non-binary /third gender	39	2	8	1	4	1	15	3	12	3
	PNTS /missing	63	3	20	4	12	3	18	4	7	2

*Prefer not to say

2.2 Procedure

The CCC-CATAPULT research project involved young people working as co-researchers, a process which was facilitated by the creation of Youth Action Partnerships (YAPs) (for more information see ccc-catapult.org, see also Portus et al., 2024). The survey formed one of the projects methods and was co-designed (by researchers and YAPs) to examine young people's experiences of and learning about the climate crisis. The survey was translated into four languages, piloted, iterated, and administered through a Qualtrics link. It was disseminated through lessons at colleges and schools in each of the European partner cities (as well as through other platforms such as college newsletters). Survey introduction was locally tailored, and there was either a teacher or researcher present when participants completed the survey in order to answer questions and encourage survey completion. In addition to the survey link, a guide for teachers was produced for disseminating the survey. Guidance was also offered at the end of the survey for participants who wanted to learn more about climate issues or who needed some extra support after having engaged with these topics.

2.3 Measures

The CCC-CATAPULT survey included several existing scales, some original and some adapted. In this study we present an analysis of mindset scales as well as scales through which we operationalize climate action. All scale items can be found in Table 2.

Mindsets were measured with two scales. Levy et al.'s (1998) four items were utilized to study mindsets (i.e., implicit theories) about persons (ITP) and Halperin et al.'s (2011) four items to study mindsets about groups (ITG). All these items had negative wordings which meant that on Likert type of scale (1 = strongly disagree, 6 = strongly agree) lower scores indicated growth mindset tendencies and higher

Table 2 Instruments

Factors and items
MINDSET
Mindset about persons (ITP, Levy et al., 1998)
26.1 The kind of person someone is, is something basic about them, and it can't be changed very much
26.2 People can do things differently, but the important parts of who they are can't really be changed
26.3 Everyone is a certain kind of person, and there is not much that they can do to really change that
26.4 You can't teach an old dog new tricks, People can't really change their deepest attributes
Mindset about groups (ITG, Halperin et al., 2011)
26.5 Groups can do things differently, but the important parts of who they are can't really be changed
26.6 Groups can't really change their basic ways of thinking.
26.7 Groups that are characterised by indifference towards nature will never change their ways
26.8 Every group or nation has basic moral values and beliefs that can't be changed significantly
CLIMATE ACTION
Willingness to build a sustainable world (Colebrook-Claude, 2019)
22.1 Helping other people
22.2 Helping to make the world a better place
22.3* Giving time and money to make life better for other people
22.4 Helping to reduce hunger and poverty in the world
22.5 Helping to make sure all people in the world are treated fairly
22.6 Speaking up for equality (everyone should have the same rights and opportunities)
Inclination to discuss climate change (DISC, Youth Climate Justice Survey, 2020, 2021)
19.1 With parents/guardians
19.2 With siblings
19.3 With extended family members or relatives
19.4 With teachers as part of a lesson
19.5 With friends at school
19.6 With friends outside school
Individual climate action (IND, Youth Climate Justice Survey, 2020, 2021)
11.1* Reducing, reusing, recycling
11.3 Energy saving initiatives
11.4 Choosing a climate friendly diet (i.e., plant-based)
11.5 Choosing climate friendly transport options
Collective climate action (COL, Youth Climate Justice Survey, 2020, 2021)
11.7 Involvement in local environmental action groups/projects
11.8 Organising or participating in petitions or protests
11.9** Writing to politicians or companies about climate change issues
11.10 Involvement in school/youth group/college/workplace environmental initiatives

*Item removed from the models. **Item removed from the Finnish and Irish models

scores fixed mindset tendencies. For the analysis, we reversed the scales of mindset items, higher scores referring to a growth mindset and lower scores to a fixed mindset.

We analysed young people's climate action through four dimensions. Firstly, a measure taken from the Adolescent Internal Environmental Locus of Control Scale (Colebrook-Claude, 2019) was adopted to measure *willingness to help to create a sustainable world*. Six items were evaluated on a four-point scale 1 = not at all impor-

tant, 4 = very important. Secondly, participants were asked to evaluate how often they *discuss climate change* with their family, friends and teachers with six items (*Climate Justice Survey 2020*, 2021). Participants reported climate action was measured with four items referring to *individual action* and four items describing *collective action* (*Climate Justice Survey 2020*, 2021). These scales used a six-point scale (1 = never to 6 = daily).

2.4 Analyses

Psychometric properties were computed in SPSS and all other analyses in Mplus 8.0 (Muthén & Muthén, 1998–2017). Addressing the first research question, we specified confirmatory factor models (CFA) and started the analysis process by testing measurement invariance for each scale across countries by constraining factor loadings and then intercepts equal and studying changes in fit indices (Chen, 2007). As measurement invariance was not reached with the original models with all items of the scales included, the models were adjusted (see Table 3). First, we omitted poorly functioning items (e.g., items with almost no variance), but we also had to allow some of the residuals to correlate within scales or have items to cross-load on two factors. For most scales, metric invariance held, and the goodness-of-fit indices of the models were on a good level (CFI > 0.95, TLI > 0.95, RMSEA < 0.80) (Byrne, 2012). However, scalar invariance was reached only for the mindset scales, whereas for the climate action scales we either had to release intercepts of individual items in some countries, or to conclude that the scales were not measurement invariant to conduct country comparisons. With those scales (individual and collective climate action, IND and COL), we continued with country-specific structural equation models that cannot be directly compared, which should be kept in mind when interpreting the results (Table 4).

Regarding models with sufficient measurement invariance, the latent means between the countries were compared by bootstrapping 95% confidence intervals for estimates of ITP, ITG, CARE and DICS in Mplus. Means of every country were compared with confidence intervals: if the mean could be located between the low and high confidence intervals the difference was not statistically significant. For the country-specific models for IND and COL, we utilized paired sample t-test in SPSS with country specific mean variables (see Tables 4 and 5) to identify whether there were statistically significant differences between individual and collective actions within the countries. Associations between mindsets and climate action were investigated with structural equation models. Again, for ITP, ITG, CARE and DISC we were able to compare countries, while for IND and COL the regression analyses were computed separately for each country.

Table 3 Measurement invariance of the scales

		CFI	TLI	RMSEA	χ2	df	*p*
MINDSETS							
Mindset about persons (ITP, modifications: items 4with3)	No grouping	1.000	1.000	0.000	1325.301	6	0.000
	Baseline model	0.999	0.993	0.032	1324.254	24	0.000
	Factor loadings constrained equal	0.994	0.988	0.042	1324.254	24	0.000
	Intercepts constrained equal	0.984	0.982	0.051	1324.254	24	0.000
Mindset about groups (ITG, in grouping FI 6with5**)**	No grouping	0.991	0.973	0.064	1348.125	6	0.000
	Baseline model	0.997	0.989	0.042	1395.331	24	0.000
	Factor loadings constrained equal	0.993	0.989	0.041	1395.331	24	0.000
	Intercepts constrained equal	0.986	0.986	0.047	1395.331	24	0.000
CLIMATE ACTION							
Willingness to build a sustainable world (CARE, item 3 removed, 1with2, 6with5, in grouping also: IT 6with4, 4with5,[6], [4])	No grouping	0.998	0.994	0.026	1865.979	10	0.000
	Baseline model	0.997	0.989	0.037	1949.665	40	0.000
	Factor loadings constrained equal	0.995	0.990	0.035	1949.665	40	0.000
	Intercepts constrained equal	0.985	0.981	0.048	1949.665	40	0.000
Inclination to discuss climate change (DISC, 6with5, 5with4,6with1, in grouping also: FI[4][1][6], IR[1][4])	No grouping	0.999	0.997	0.017	2465.877	15	0.000
	Baseline model	0.997	0.991	0.031	2673.248	60	0.000
	Factor loadings constrained equal	0.987	0.980	0.048	2673.248	60	0.000
	Intercepts constrained equal	0.985	0.981	0.046	2673.248	60	0.000
Individual climate action (IND)	No grouping	0.906	0.719	0.126	578.813	6	0.000
	Baseline model	0.931	0.794	0.120	725.281	24	0.000
	Factor loadings constrained equal	0.909	0.871	0.095	725.281	24	0.000
	Intercepts constrained equal	0.500	0.539	0.180	725.281	24	0.000
Collective climate action (COL)	No grouping	0.967	0.902	0.116	1362.028	6	0.000
	Baseline model	0.957	0.872	0.133	1378.220	24	0.000
	Factor loadings constrained equal	0.948	0.927	0.100	1378.220	24	0.000
	Intercepts constrained equal	0.877	0.886	0.125	1378.220	24	0.000

with = residuals of the mentioned items are allowed to correlate, FI[4] = in Finnish data the mean of item 4 is utilized

Table 4 Separate confirmatory factor analyses of individual (IND) and collective (COL) climate action

	INDIVIDUAL and COLLECTIVE CLIMATE ACTION						
Country	Modifications	CFI	TLI	RMSEA	χ2	df	*p*
Finland	items 1 and 9 removed	0.950	0.974	0.074	842.140	15	0.000
Italy	item 1 removed; 10 with 3	0.990	0.983	0.029	402.307	21	0.000
Ireland	items 1 and 9 removed	0.994	0.990	0.028	554.910	15	0.000
UK	item 1 removed; IND by 7	0.967	0.943	0.070	564.284	21	0.000

with = residuals of the mentioned items are allowed to correlate, by = cross loading is allowed

Table 5 Means and standard deviations of individual and collective climate action separately in four countries

	Finland			Italy			Ireland			UK		
Scale 1–6	*M*	*SD*	α	*M*	*SD*	α	*M*	*SD*	α	*M*	*SD*	α
Individual climate action*	4.14	1.50	0.779	4.23	1.47	0.571	4.00	1.48	0.631	3.93	1.63	0.662
Collective climate action*	1.75	1.25	0.909	1.78	0.86	0.717	2.18	1.30	0.807	1.79	1.14	0.883
t(df), *p, d*	30.636(465), <0.001, 1.68			30.046(376), <0.001, 1.58			25.128(473), <0.001, 1.54			21.283(280), <0.001, 1.68		

*See Table 4 for utilized factor structures in each country, however, in the mean variables does not include the information related to correlating residuals or allowing cross-loadings

3 Results

3.1 Measurement invariance testing

We tested each scale separately for their measurement invariance between four countries. Mindsets were studied with two instruments: *mindset about persons* (ITP, 4 items) and *mindset about groups* (ITG, 4 items). Climate action was studied through *willingness to build a sustainable world* (CARE, 6 items), *inclination to discuss climate change* (DISC, 6 items), *individual climate action* (IND, 4 items) and *collective climate action* (COL, 4 items). By removing one item from CARE, allowing within-scale residual correlations for ITP, ITG, CARE and DISC, and by freeing the intercepts of some of the items in some countries, the fit indices of ITP, ITG, CARE and DISC improved considerably (see Table 3). Thus, we were to some extent able to compare youth from four studied countries in their ITP, ITG, CARE and DISC. For IND and COL, we were not able to establish measurement invariance with fit indices on an acceptable level even with big modifications. Therefore, we could not compare the countries with individual or collective climate actions but computed confirmatory factor analyses (CFA) and structural equation models separately for each country (Table 4).

3.2 What kind of mindsets do European young people have about persons and groups?

Table 6 shows the latent means and their 95% confidence intervals of mindsets in the other countries compared to the reference country, Finland. Italian youth scored statistically significantly lower than youth from other countries meaning that Italians had more tendencies towards fixed *mindset about persons* (ITP). The scores of Ireland and the UK did not differ from the Finnish scores, but the UK had a slightly higher score than Ireland. For *mindsets about groups* (ITG) Italian young people were statistically significantly less growth oriented than students in Ireland and UK. The Italian, Irish or British participants did not differ from their Finnish peers.

3.3 How do young people self-evaluate their climate action in four European countries?

Climate action was studied with four dimensions (1) *Willingness to build a sustainable world* (CARE), (2) *Inclination to discuss climate change* (DISC), (3) *Individual climate action*, and (4) *Collective climate action*. However, the tests of measurement invariances (Table 3) allowed us to conduct country comparisons only for CARE and DISC variables. We tested the statistical significance of the differences between the countries by bootstrapping 95% confidence intervals for estimates. The latent means and their confidence intervals are displayed in Table 7.

Even though all studied European youth were quite *willing to build a sustainable world*, the Finnish youth differed statistically significantly from other countries since they self-evaluated their willingness the lowest (Table 7). Italian, Irish and British young people did not differ from each other in their interest for helping the world.

Table 6 Latent means of ITP and ITG and their confidence intervals compared to the baseline level (0) of Finland

	ITP CFI 0.989 TLI 0.988 RMSEA 0.055				ITG CFI 0.989 TLI 0.990 RMSEA 0.054			
	M	*p*	CI low	CI upper	*M*	*p*	CI low	CI upper
Finland	0.000				0.000			
Italy	−0.274	0.001	−0.435	−0.098	−0.134	0.074	-2.81	−0.013
Ireland	−0.100	0.202	−0.250	0.058	0.015	0.829	−0.120	0.149
UK	0.070	0.474	−0.127	0.259	0.144	0.098	−0.022	0.305

p=statistically significant difference with Finnish sample; CI=95% confidence interval

Table 7 Latent means of CARE and DISC and their confidence intervals compared to the baseline level (0) of Finland

	CARE CFI 0.989 TLI 0.987 RMSEA 0.066				DISC CFI 0.986, TLI 0.983, RMSEA 0.053			
	M	*p*	CI low	CI upper	*M*	*p*	CI low	CI upper
Finland	0.000				0.000			
Italy	0.204	0.000	0.097	0.317	0.059	0.553	−0.128	0.230
Ireland	0.162	0.002	0.063	0.277	−0.236	0.019	−0.436	0.071
UK	0.141	0.027	0.014	0.262	−0.169	0.163	−0.405	0.032

CI=95% confidence interval

However, participants rarely *discussed climate change* with their family, friends, and teachers. In this domain Italian youth discussed statistically significantly more than their British peers and Irish students discussed less than Finish students.

We were not able to study statistical differences between the countries in relation to *individual* (IND) and *collective* (COL) *climate action* due the lack of measurement invariance. Nevertheless, the means and paired t-tests (see Table 5) indicate that young people in every country estimated their individual climate activity higher than their collective climate actions.

3.4 How is growth mindset associated with young people's climate action?

Table 8 shows that *mindset about persons* (ITP) was associated with *willingness to build a sustainable world* (CARE) only among Finnish young people while *mindset about groups* (ITG) predicted CARE in Finland, Ireland, and UK. Mindsets about persons and groups were linked in all countries with *discussion about climate change* (DISC). Even though these associations were statistically significant, all effect sizes were rather small (Table 8).

When SEM models were specified separately in four countries to study the associations of mindsets for *individual* (IND) and *collective* (COL) *climate action* using country-specific measures, the only country where these associations were identified was Finland: *Individual climate action* was associated with growth *mindset about persons and groups*, while collective action was linked only with mindset about persons. The effect sizes were also very low in these analyses (Table 9).

Table 8 Associations of mindsets with CARE and DISC - standardized estimates and their confidence intervals

					Standardized		
CARE		B	B	R^2	CI low	CI high	
Finland	ITP	0.301***	0.207***	0.091	0.109	0.299	CFI 0.981, TLI 0.979, RMSEA 0.053
Italy	ITP	.022ns	.014ns	0.000	−0.090	0.137	
Ireland	ITP	.125ns	.096ns	0.016	−0.013	0.218	
UK	ITP	.095ns	.070ns	0.009	−0.084	0.226	
Finland	ITG	0.352***	0.259***	0.124	0.234	0.456	CFI 0.987, TLI 0.985, RMSEA 0.045
Italy	ITG	.116ns	.098ns	0.013	−0.057	0.269	
Ireland	ITG	0.218**	0.172**	0.048	0.071	0.350	
UK	ITG	0.188*	.156ns	0.035	0.005	0.365	
DISC							
Finland	ITP	0.291**	0.315***	0.085	0.153	0.406	CFI 0.985, TLI 0.984, RMSEA 0.037
Italy	ITP	0.194**	0.240**	0.038	0.072	0.333	
Ireland	ITP	0.170**	0.222**	0.029	0.042	0.294	
UK	ITP	0.223**	0.299**	0.050	0.048	0.370	
Finland	ITG	0.202**	0.233**	0.041	0.078	0.322	CFI 0.989 TLI 0.988, RMSEA 0.033
Italy	ITG	0.234**	0.373**	0.055	0.087	0.364	
Ireland	ITG	0.131*	0.177*	0.017	0.011	0.238	
UK	ITG	0.276**	0.416**	0.076	0.096	0.422	

Table 9 Associations of mindset on IND and COL

	INDIVIDUAL and COLLECTIVE CLIMATE ACTION									
		CFI	TLI	RMSEA	χ2	df	*p*	β	B	R^2
Fin	IND on ITP	0.982	0.969	0.049	863.801	21	0.000	0.288***	0.241***	0.083
land	IND on ITG	0.997	0.995	0.020	948.658	21	0.000	0.161*	0.145*	0.026
	COL on ITP	0.984	0.972	0.052	1074.944	21	0.000	0.163*	0.148*	0.027
	COL on ITG	0.997	0.995	0.023	1176.369	21	0.000	–.013ns	–.014ns	0.000
Ita	IND on ITP	1.000	1.000	0.000	448.695	21	0.000	.036ns	.031ns	0.001
ly	IND on ITG	1.000	1.000	0.000	317.116	21	0.000	–.164na	–.125ns	0.016
	COL on ITP	0.998	0.997	0.013	616.300	28	0.000	.107ns	.084ns	0.011
	COL on ITG	0.987	0.980	0.029	488.113	28	0.000	.001ns	.001ns	0.000
Ire	IND on ITP	1.000	1.000	0.000	577.511	21	0.000	.056ns	.044ns	0.003
land	IND on ITG	0.991	0.986	0.030	691.074	21	0.000	.079ns	.064ns	0.006
	COL on ITP	1.000	1.000	0.000	770.764	21	0.000	.029ns	.030ns	0.001
	COL on ITG	0.996	0.993	0.024	862.792	21	0.000	–.004ns	–.004ns	0.000
UK	IND on ITP	0.988	0.979	0.034	374.307	21	0.000	.129ns	.168ns	0.017
	IND on ITG	0.985	0.975	0.039	414.599	21	0.000	.174ns	.239ns	0.030
	COL on ITP	0.982	0.972	0.045	659.217	28	0.000	.134ns	.158ns	0.018
	COL on ITG	0.983	0.975	0.045	706.011	28	0.000	. 196*	0.239*	0.038

4 Discussion

In this study, we presented some of the results from data collected through the CCC-CATAPULT survey, conducted in four city regions in European countries, to investigate young people's mindsets, climate action, and the associations between these

constructs. We started by exploring whether mindsets and climate action can be measured with the same instruments in these four city regions. M*indset about individuals (ITP) and groups (ITG)*, as well as *willingness to build a sustainable world (CARE)* and *inclination to discuss climate change (DISC)*, were able to establish measurement invariance that allowed for a comparison of responses from youth from different countries. However, *individual (IND) and collective climate action* (COL) scales seemed to be measuring slightly different things in our different contexts, meaning that country comparisons were not possible. We also found some evidence to support our hypothesis that there is an association between growth mindsets and some dimensions of climate action: most strongly manifested in the Finnish data.

According to our results, European youth are willing to build a sustainable world and take individual climate action but are less likely to act collectively or to discuss climate change with people close to them. Our finding regarding the tendency of Finnish young people to have a lower willingness to act for sustainability than respondents from the UK, Ireland, and Italy challenges some previous comparative European studies in which Finnish people expressed high climate awareness (Baiardi & Morana, 2021) and pro-environmental behaviour (Ogunbode et al., 2022). However, some earlier comparative studies found that climate change has little impact on the functioning of Finnish young people (Clayton et al., 2023), and that they prefer individual climate action that does not require influencing others (e.g. peers, school staff or the local community) (Hokkanen et al., 2021). Furthermore, although growth mindsets were evident in young people in all the countries in our study, young people in Italy had a stronger tendency towards fixed mindset thinking than respondents from the other countries. This finding confirms findings from 2018's PISA (Programme for International Student Assessment) which found that Irish, British, and Finnish young people scored higher, and Italian students lower than the OECD average in growth mindsets (Gouëdard, 2021).

The association between growth mindsets and climate action also manifested differently in our different study contexts. Association between ITP and ITG with DISC was consistently found in all countries – yet effect sizes were very low. Finland was the only country, where the association between all measured dimensions of climate action and growth mindset were found. The effect sizes were also a little larger in Finland– mindset about persons explained approximately 8–12% of the variance in CARE, DISC and IND in Finland. Even though these effect sizes still are low, taking into account the complexity of the phenomenon of climate action and the numerous factors previously identified as its predictors or barriers, they indicate an association that is worth noting and should be explored further in future studies.

Our findings highlight the need to pay attention to the contextual differences in investing climate action among European youth. Contemporary research with children and young people acknowledges, and is sensitive to the fact, that young people and young lives are experienced differently depending on where a person lives in the world, and therefore growing up is experienced differently (Reilly & Hughes, 2021; Katz, 2004). Such differences present young people not as a homogeneous group, but as multifarious, impacted by considerations beyond their age (e.g. social class, race, gender to mention but a few), as well as context dependent factors. In our study, measurement variance with respect to individual and collective climate action was

found, indicating that when investigating climate action among young people measures should be more sensitive to local differences in, for example climate change impact, educational approaches and opportunity structures, and designed to identify the context invariant aspects of climate action.

Our results give some support to the hypothesis that growth mindsets - the core beliefs concerning the ability of individuals and groups to change– motivate several relevant aspects of climate action. However, more research and methodological development is needed to gain a better understanding of this phenomenon. A growth mindset is a prominent concept in motivation and education research (Dweck & Yeager, 2019), but it is currently a missing construct in the field of CCE. In experimental studies, mindsets have been successfully manipulated by short texts concerning the neuroplasticity of the brain, or historical examples of fast and significant changes in human groups that have typically occurred with the help of strong leaders (Dweck & Yeager, 2019; Halperin et al., 2011; Rattan & Georgeac, 2017). Educational interventions, which include this fact-based approach, but also work to evoke personal level reflections, have successfully induced rather long-lasting changes to motivation, learning and behaviour (Goldenberg et al., 2018; Yeager et al., 2019). Research in which these interventions are applied and contextualised to local approaches of CCE could lead to a better understanding of the possibilities of a growth mindset pedagogy as an approach for motivating young people to climate action. In the context of CCE, growth mindsets could be supported through concrete examples of individual and group-level changes, but also by creating opportunities to experience change personally through collective active learning processes (e.g., nature conservation, volunteering, public speaking, role playing/taking part in climate decision making processes, etc.) and combining these with deep-level reflections of individual and group changes, as well as of the beliefs concerning the prospects of change.

However, there are limits to the interpretations that can be made based on the findings presented in this paper. Purposive sampling was used in the study, which means the findings are not generalisable to the populations in the studied city-regions and countries: this is why we have concentrated on the associations between the constructs under study, rather than making far reaching interpretations on their levels in our data. All analyses are based on self-reported data, and the constructs we have studied are likely to evoke some levels of social desirability bias in the answers. However, social desirability is unlikely to exaggerate the findings concerning the association between mindsets and climate action. Nevertheless, more research with diverse measures and methods and in different contexts is needed. Qualitative approaches could deepen the understanding of young people's mindsets and how they shape their willingness to act for climate, as well as the contextual differences in possibilities for climate action and experiences of its importance. This paper points towards the impact of place, as linked to location as well as social and cultural contexts, engaging research on the development of growth mindset and climate action among young people. Ultimately, this highlights the need to further engage multi-method research, sensitive to different contexts in the pursuit of understanding and supporting young people's engagement with climate action.

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Declarations

Competing interests The authors have no competing interests to declare that are relevant to the content of this article.

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