



The Path to Sustainability Consciousness: The Role of Subjective Well-Being and Civic Engagement

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Abstract

This study examines how subjective well-being and civic engagement are statistically associated with Sustainability Consciousness, a multidimensional construct that encompasses knowingness, attitudes, and behaviours across environmental, social, and economic dimensions. Using structural equation modelling on data from 1040 Italian youths aged 12–25, we find that both factors play a significant role in shaping sustainability consciousness, particularly through the impact of personal well-being dimensions such as satisfaction with free time and health, as well as engagement with collective movements such as Fridays for the Future. Our findings underscore the importance of integrating psychological well-being and civic participation into sustainability education and policy, thereby reinforcing the role of both individual and collective agency in fostering sustainable mindsets.

Keywords Sustainability consciousness · Subjective well-being · Civic engagement · Pro-environmental behaviour · Structural equation modelling

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1 Introduction

Individual well-being and sustainability are two essential pillars for envisioning a future where economic development, social cohesion, and environmental protection converge into a model oriented toward the common good. While individual well-being is often perceived as a purely personal dimension, a growing body of literature highlights its potential link to sustainable behaviours, which have a significant and positive social impact. This relationship is particularly noteworthy: when personal well-being serves as a driver for sustainability, improving quality of life is not merely an end in itself but becomes a means to foster greater environmental orientation and encourage sustainable practices. Consequently, policies aimed at enhancing well-being assume a dual role: advancing individual quality of life and facilitating the transition toward a development model focused on the common good. The interaction between individual well-being and sustainable behaviours has been the focus of study in various disciplines, including environmental psychology, sociology, civic economy, and public policy analysis. These fields converge in emphasising that addressing global challenges requires integrated approaches that can simultaneously consider economic, social, and environmental dimensions. The United Nations' Sustainable Development Goals (SDGs), particularly Goals 3 (Good Health and Well-being) and 13 (Climate Action), exemplify the need to harmonise human well-being with environmental protection. Alongside these global frameworks, growing critiques of GDP as the sole indicator of progress have led to the adoption of alternative models that integrate quality of life and sustainability. Civic economy, in particular, offers an approach that places human dignity, solidarity, and the common good at its core, providing a perspective that not only values individual and collective well-being as objectives but also positions them as strategic tools to promote environmentally responsible behaviours and strengthen social resilience. This integrated vision underscores that sustainable development is not merely an issue of environmental policy but requires a paradigm shift that links human well-being, economic progress, and environmental protection.

Subjective Well-Being (SWB), which encompasses components such as life satisfaction, happiness, and mental health, has emerged as a key area of inquiry in relation to pro-environmental behaviours. The literature suggests that high levels of SWB can incentivise sustainable choices, creating a virtuous cycle in which improvements in quality of life enhance environmental responsibility, and vice versa. However, pro-environmental behaviours alone are insufficient to ensure sustainability. As also highlighted by IPCC (Creutzig et al. 2021), sustainability demands a systemic approach that balances economic, social, and environmental dimensions. Without such an equilibrium, efforts to achieve sustainable development risk remaining incomplete.

The concept of Sustainability Consciousness (SC), introduced by Gericke et al. (2019), provides a promising analytical framework for examining the interaction between SWB and sustainability. While existing studies have largely focused on the relationship between SWB and pro-environmental behaviours, this study shifts the focus to SC, a broader construct that integrates knowingness, attitudes, and behaviours across the environmental, social, and economic dimensions of sustainability. SC is assessed using the Sustainability Consciousness Questionnaire (SCQ), a set of 49 questions divided into nine subscales that cover the environmental, social, and eco-

conomic dimensions of what people think (Attitudes), know (knowingness), and do (Behaviour) in relation to sustainability. Following the framework of Gericke et al. (2019), the term “knowingness” refers to individuals’ self-perceived understanding of sustainability-related issues, rather than an objective assessment of factual knowledge. This distinction is relevant because self-perceived knowingness can influence sustainability attitudes and behaviours independently of actual knowledge levels.

To date, studies employing the SCQ have primarily focused on assessing SC across diverse populations, aiming to understand and enhance education for sustainable development in specific contexts. Among the most significant contributions are those exploring cultural differences, highlighting how cultural aspects influence SC among students from different countries, such as Taiwan and Sweden (Berglund et al. 2020), or between major cities in China, such as Beijing and Zhuhai (Chen et al. 2022). Another research strand focuses on the effects of educational policies in encouraging sustainable behaviours, demonstrating how targeted educational interventions can positively impact pro-sustainability practices, as observed in studies conducted in Spain, Belgium, and Sweden (Ariza et al. 2021), as well as in Swedish schools (Olsson 2014) and among university students in Spain (Vegel 2021). Other studies have examined the role of leadership and sex in promoting sustainability, analysing the relationships between gender, leadership skills, and SC, as in the case of working adults in Sweden (Tainio and Cameron 2019). A different approach is represented by a single study exploring the relationship between SC and a non-socioeconomic variable: the sociomotor component of sports practices. This study, conducted by Boned-Gómez et al. (2024), demonstrates how cooperative sports practices can positively influence social consciousness, suggesting an educational potential to promote a sustainable mindset through collaborative activities. In Italy, Bacci et al. (2024) validated the SCQ on a local sample.

In this contribution, we focus on the same Italian sample as in Bacci et al. (2024), which has been integrated with additional data collected on SWB. We also consider the role of perceived Civic Engagement (C-ENG) or predisposition toward it, exploring whether this factor additionally contributes to shaping SC.

By bridging a gap in the literature, this study aims to clarify the role of personal SWB and C-ENG in building an integrated approach to sustainability that encompasses all its fundamental dimensions.

This contribution is structured as follows. Section 2 provides a review of the relevant literature, focusing on the relationships between SC, SWB, and pro-environmental behaviours. Section 3 details the data and methodology, including the application of Structural Equation modelling (SEM) to investigate the links between SC, SWB, and C-ENG. Section 4 presents the empirical results, highlighting key findings related to the role of SWB and C-ENG in shaping SC. Section 5 discusses these findings in the context of existing theories and proposes implications for civic economy frameworks and sustainability policies. Finally, Sect. 6 addresses the limitations of the study and outlines directions for future research.

2 Literature Background

The relationship between SWB and pro-environmental behaviour is crucial to achieving the global sustainability goals outlined in the United Nations' 2030 Agenda. This policy framework emphasises the need to integrate environmental sustainability and human well-being as part of a holistic vision to transform the world towards equitable and sustainable development (United Nations, 2015). The concept of the 'double dividend' suggests that pro-environmental behaviour can not only reduce the ecological impacts of citizens' lives, but also improve individual quality of life. Understanding this relationship, in both directions, provides a basis for developing policies and interventions that promote a more sustainable and equitable future.

2.1 Interdisciplinary Theoretical Contributions

The theoretical contributions to the relationship between SWB and pro-environmental behaviour draw from psychology, sociology, and economics, each offering complementary perspectives to explain this intricate link. Psychology provides a robust foundation for understanding how positive emotions and values drive sustainable behaviours. The broaden-and-build theory posits that positive emotions expand cognitive and social resources, facilitating prosocial and pro-environmental actions (Fredrickson 2001). Similarly, Schultz (2002) demonstrated that ecocentric values and a deeper connection with nature enhance SWB while encouraging sustainable choices. Thiernann and Sheate (2020) extend these insights with their dual-pathway model, which integrates normative and relational dimensions to explain how internalized motivations, rooted in empathy, compassion, and nature connectedness, enhance SWB and foster sustainable behaviours. Their framework underscores the role of emotional and relational factors in transforming external motivations into intrinsic commitments, highlighting the reciprocal benefits for both individual well-being and environmental sustainability.

From a sociological perspective, the shift towards post-materialist values in economically secure societies has been associated with greater sensitivity to global challenges such as environmental protection (Inglehart 2020). In this context, SWB emerges not only as an individual aspiration but also as a key factor in reinforcing moral and social norms oriented toward the common good (Steg and Vlek 2009). Social capital plays a central role in this dynamic. Communities with robust social networks and effective institutions are better positioned to manage common resources sustainably, enhancing both collective SWB and environmental stewardship (Ostrom 2009). Furthermore, SWB has been associated with a stronger sense of community and increased C-ENG. Sociological theories suggest that higher levels of social capital and trust encourage collective action for the common good, including environmental sustainability (Dietz et al. 2017; Ostrom 1990). Empirical evidence supports these connections, showing that individuals with higher SWB are more likely to engage in social or environmental activism (Verhofstadt et al. 2016). In our context, perceived proximity to environmental movements, such as Fridays for Future, represents a contemporary manifestation of civic participation.

Economics provides an important perspective on the relationship between SWB and sustainability, tracing its evolution through key theoretical and empirical contributions. Early work by Jackson (2005) introduced the concept of the 'double dividend', highlighting that sustainable practices not only improve environmental outcomes, but also enhance individual and collective well-being. This idea was further developed by Jackson (2014), who emphasised the potential of sustainability to create synergies between environmental health and social prosperity. Building on these foundations, Layard (2011) emphasised the importance of public policies aimed at reducing stress and improving quality of life, arguing that such policies create favourable conditions for greater commitment to the common good, including environmental sustainability. The discourse gained further depth with the work of the Stiglitz-Sen-Fitoussi Commission (Stiglitz 2009), which advocated for a shift beyond GDP as the sole measure of progress, proposing metrics that integrate SWB with social and environmental dimensions, thereby laying the groundwork for holistic approaches to societal development. This vision was exemplified by the OECD's Better Life Index (Kerényi 2011), which explicitly links SWB and sustainability through indicators such as environmental quality and C-ENG. More recently, within the framework of civic economics, Becchetti et al. (2019) have highlighted SWB as a fundamental driver of collective action for the common good. Their model emphasises the interplay between human and social capital, integrating economic and cultural dimensions to promote equity and sustainability in contemporary societies.

2.2 Empirical Evidence on SWB and Pro-Environmental Behaviour: Direct, Reverse or Circular Relationship

Empirical research has consistently highlighted the intricate relationship between SWB and pro-environmental behaviour, underscoring how a deeper sense of well-being can inspire sustainable actions. Studies show that individuals with a strong connection to nature not only experience enhanced SWB, but are also more likely to engage in environmentally responsible behaviours such as energy conservation and recycling (Capaldi et al. 2015; Howell et al. 2011; Mayer and Frantz 2004). This interplay is evident even among adolescents, where life satisfaction and positive emotions have been shown to influence sustainable consumption choices (Voltmer and von Salisch 2023), suggesting that the influence of SWB on pro-environmental behaviour begins early in life (Otto et al. 2019). Beyond these individual behaviours, the eudaimonic dimension of SWB—rooted in purpose and personal fulfilment—plays a central role in driving more complex practices, including support for environmental policies (Krekel and Prati 2022). Meta-analytic evidence further supports the positive relationship between nature connectedness and eudaimonic SWB, suggesting that harmony with the environment fosters a sustainable ethos (Pritchard et al. 2020; Jacob et al. 2009). Factors such as mindfulness and the adoption of voluntary simplicity values have also been associated with increased SWB and commitment to ecological lifestyles, emphasising the interconnectedness of psychological well-being and sustainable practices (Brown and Kasser 2005; Dong et al. 2020; Rosa et al. 2018).

The benefits of this symbiosis are not unidirectional: engaging in pro-environmental behaviour has been found to significantly enhance SWB. For instance, environmental understanding and sustainable practices contribute positively to individual well-being, offering both affective and cognitive improvements (Suárez-Varela et al. 2016). This dynamic is particularly salient in educational contexts, as demonstrated by a study among university students in Granada, which revealed that a stronger connection with nature improved both affective and cognitive dimensions of SWB, thereby reinforcing pro-environmental choices such as recycling and energy conservation (Ibáñez-Rueda et al. 2020). Research also converges on the idea that pro-environmental behaviour is a pathway to well-being, integrating the pleasure derived from mindful actions with a sense of meaning and personal fulfilment. The relationship between pro-environmental behaviour and well-being involves different dimensions of SWB. On the one hand, pro-environmental behaviours may reduce hedonic well-being, which is associated with comfort and immediate pleasure, due to the personal sacrifices they often require. On the other hand, the same behaviours tend to increase eudaimonic well-being, which stems from a sense of purpose and personal accomplishment, especially when these actions are perceived as morally right and undertaken voluntarily (Venhoeven et al. 2013). Recent studies emphasise that believing in the benefits of sustainable behaviours for one's well-being promotes the adoption of such behaviours, thereby reinforcing the circular relationship between well-being and sustainable practices (Prinzing and Laffan 2024). The literature also suggests that sustainable consumption can serve as a direct source of personal satisfaction. Acting in accordance with one's values and contributing to the common good generates a sense of fulfilment that translates into greater life satisfaction (Xiao and Li 2011). Empirical studies confirm that sustainable behaviour can increase personal satisfaction: Schmitt et al. (2018) highlighted improvements in life satisfaction associated with such actions. From a temporal perspective, Kaida and Kaida (2016) showed that sustainable behaviours increase current well-being, while positive expectations about future well-being incentivise further pro-environmental behaviours. The impact of ecosystems on human well-being was explored by Costanza et al. (2017), who emphasised that ecosystems contribute not only through material resources, but also by providing emotional and spiritual benefits. Similarly, Verhofstadt et al. (2016) emphasises that respecting ecological limits enhances individual well-being, underscoring the importance of aligning personal values with sustainable practices to promote quality of life. Binder and Blankenberg (2017) examined the impact of ecological lifestyles and concluded that moderate practices oriented towards social sustainability improve well-being, especially in contexts that prioritise cooperation and mutual support.

This brief review highlights the complex relationship between SWB and pro-environmental behaviours, emphasising how SWB emerges both as a goal and a strategic tool for promoting sustainability. Integrating SWB and sustainability into public policies and economic models represents a critical challenge, with significant implications for promoting sustainable behaviours. To date, the literature has primarily focused on visible and measurable behaviours, such as recycling, adopting renewable energy, or making responsible consumption choices. However, these behaviours constitute only a fraction of the broader spectrum of factors that motivate and guide sustainable choices and pro-environmental behaviour, and in turn, represent only one

dimension of sustainability. The psychometric construct of SC integrates cognitive, affective, and behavioural components across the environmental, social, and economic pillars of sustainable development. By adopting this multidimensional perspective, SC offers a more comprehensive understanding of how SWB is associated with not only individual actions but also collective understanding and attitudes toward systemic change.

2.3 The Present Study

To fully understand the contribution of SWB to sustainability, it is useful to shift the focus from environmental behaviours to a more complex and multidimensional psychometric construct, such as Sustainability Consciousness (SC). Defined by Gericke et al. (2019), SC encompasses what individuals know (knowingness), believe (attitudes), and do (behaviours) regarding the three pillars of sustainability: environmental, social, and economic. Despite the growing interest in SWB and its implications for sustainability, to the best of our knowledge, no studies have examined its relationship with the multidimensional construct SC. Investigating this relationship not only broadens the theoretical perspective but can also provide insights into whether and how SWB shapes cognitive, attitudinal, and behavioural processes related to sustainability.

Building on the broaden-and-build theory (Fredrickson 2001), we hypothesise that the cognitive and social resources enhanced by life satisfaction deepen understanding of sustainability issues. Individuals with high SWB may better recognise the long-term implications of their decisions, develop empathy for future generations, and engage in collective initiatives to address global challenges in an integrated manner. We investigate how SWB and SC correlate, also examining the role of perceived proximity to environmental organisations as a form of C-ENG. This study shifts the focus from a limited correlation between SWB and sustainable behaviour to a broader perspective that positions SC at the centre of the analysis, considering SWB and civic participation as strategic levers for promoting cultural and value-driven engagement with sustainability. SC not only underpins sustainable behaviour but also shapes individual ability to understand and support policies and practices oriented towards the common good, ultimately contributing to the systemic and cultural shifts urgently needed to address global challenges.

3 Data and Methodology

The data used in this study were collected from a sample of 1,040 young individuals aged 12 to 25 years. This dataset builds on the foundation of the sample analysed in Bacci et al. (2024), which primarily included students. The current sample was expanded through successive waves of data collection, leveraging the networks of the initial participants to include a broader range of young individuals, while maintaining consistency with the demographic characteristics of the original cohort. Data collection followed a snowball sampling approach, initiated from the original cohort of university students and progressively extended through their social and educational networks.

This strategy allowed for a diversified yet coherent sample, representative of the same age group and socio-educational context.

The dataset mainly includes answers to the Sustainability Consciousness Questionnaire (SCQ), developed by Gericke et al. (2019). The SCQ is a psychometric instrument consisting of 49 items measured on a Likert scale 1–5 representing manifestations of latent dimensions of SC, which are structured according to a hierarchy. Overall SC results from the concurrence of three dimensions, that is, knowingness (K-SUS), attitudes (A-SUS), and behaviours (B-SUS), which in turn are composed of three further sub-components: environmental (ENV), social (SOC), and economic (ECO). Thus, a total of nine latent sub-dimensions result: A-ENV, A-SOC, A-ECO that load on A-SUS; K-ENV, K-SOC, K-ECO that load on K-SUS, and B-ENV, B-SOC, B-ECO that load on B-SUS. For further details, see Gericke et al. (2019).

For this study, we employed the short form of the SCQ (SCQ-S), which was validated and adapted to the Italian context (Bacci et al. 2024). The SCQ-S retains the multidimensional approach of the full instrument but reduces the number of items to 27 for improved practicality in larger samples; the list of items is reported in Appendix A.1. The validation confirmed its psychometric reliability and suitability for young individuals, making it an effective tool for assessing SC in this demographic. The goodness-of-fit indices indicated an excellent fit to the data, supporting the psychometric robustness of the instrument ($CFI > 0.95$, $RMSEA < 0.05$).

In addition to the SCQ items, the survey included seven items directly taken from ISTAT's Multiscopo surveys to measure the SWB (see Appendix A.2). These items assess satisfaction across specific life domains, such as health, relationships, and living standards, using a scale of 0–10. This inclusion ensures comparability with official national data on well-being in Italy.

Furthermore, respondents were asked to indicate on a scale 0–10 their closeness to two environmental activist movements, Fridays For Future and Extinction Rebellion that concur to measure dimension C-ENG, allowing to explore how external influences and identification with activism relate to sustainability-related attitudes and behaviours. The survey also included basic demographic variables, such as sex and age, to contextualise the analysis and account for potential individual-level determinants of SC.

The data under investigation are analysed using Structural Equation Models (SEM; Duncan, 1975; Bollen, 1989; Hox and Bechger, 1998; Bollen et al., 2008) to account for the latent nature of the primary variables involved. The measurement component of the model builds on the structure validated by Bacci et al. (2024) for assessing SC (27 indicators). This framework is further expanded to include components for measuring SWB (7 indicators) and C-ENG (2 indicators). The resulting model is a hierarchical confirmatory factor model featuring multiple latent variables: SC, with its hierarchical components (A-SUS, B-SUS, K-SUS, each addressing environmental, social, and economic dimensions); SWB; and C-ENG. This hierarchical confirmatory factor model is subsequently extended into an SEM by incorporating structural relationships between the latent variables and controlling for individual characteristics. A detailed technical specification of the measurement and structural components of the SEM is provided in Appendix Appendix B.

4 Empirical Analysis and Results

The SEM framework adopted in this study is designed to model the latent associations between subjective well-being, civic engagement, and sustainability consciousness. Given the non-experimental nature of the data, we invite the reader not to interpret the results of the model in a strictly causal sense, but rather to limit their interpretation to correlations between latent constructs and between latent constructs and observed variables.

As outlined in Sect. 3, to investigate how the cognitive, affective, and behavioural dimensions contribute to the construction of SC and how this latent variable interacts with SWB and C-ENG, we develop an SEM based on the basic hierarchical structure of SC validated by Bacci et al. (2024) using similar data. The model fit is evaluated using the Tucker and Lewis Index (TLI; Tucker and Lewis, 1973), the Comparative Fit Index (CFI; Bentler, 1990), and the Root Mean Square Error of Approximation (RMSEA; Steiger, 1990). The selected model demonstrates satisfactory values for these indices, with TLI equal to 0.90125, CFI equal to 0.90871, and RMSEA equal to 0.04659.

The path diagram of the selected SEM is shown in Fig. 1, including the estimated standardised values of the factor loadings (for the measurement component) and the regression coefficients (for the structural component). The estimated factor loadings and regression coefficients with related standard errors and limits of confidence interval at 95% are displayed in Tables 2, 3 and 4 in Appendix C.

The path diagram presents the measurement structure of the SEM, along with part of the structural relations. The squared nodes represent the observed variables corresponding to individual questionnaire indicators and exogenous variables (i.e., age and gender), whereas circles denote the latent constructs involved in the study.

As outlined in Sect. 3, SC is conceptualised in a hierarchical way, with first-order constructs converging into second-order latent traits (K-SUS, A-SUS, and B-SUS) that represent the three main dimensions of SC. Their construction reflects a hierarchical process in which each second-order construct synthesises information related to specific dimensions of knowingness, attitudes and behaviours. The estimated factor loadings (Table 2) illustrate how each sub-dimension contributes to the construction of the overall construct; for further details, see Bacci et al. (2024). For example, the node K-SUS comprises three first-order constructs: K-ENV (environmental knowingness), K-SOC (social knowingness) and K-ECO (economic knowingness). Each dimension contributes to K-SUS with a specific weight that reflects its relative importance. Specifically, economic knowingness (K-ECO) has the highest weight (0.91), followed by social knowingness (K-SOC) with a weight of 0.83 and environmental knowingness (K-ENV) with a weight of 0.81. This indicates that in the sample analysed, economic and social aspects play an important role in defining the overall level of sustainability knowingness. A similar process applies to A-SUS and B-SUS. For example, A-SUS, which synthesises attitudes towards sustainability, is composed of A-ENV (environmental attitudes), A-SOC (social attitudes), and A-ECO (economic attitudes). Again, the relative weights vary according to the contribution of each dimension: economic attitudes (A-ECO) have the strongest contribution (weight 1.019), followed by social attitudes (A-SOC) with a weight of 0.942, and environmental attitudes (A-ENV),

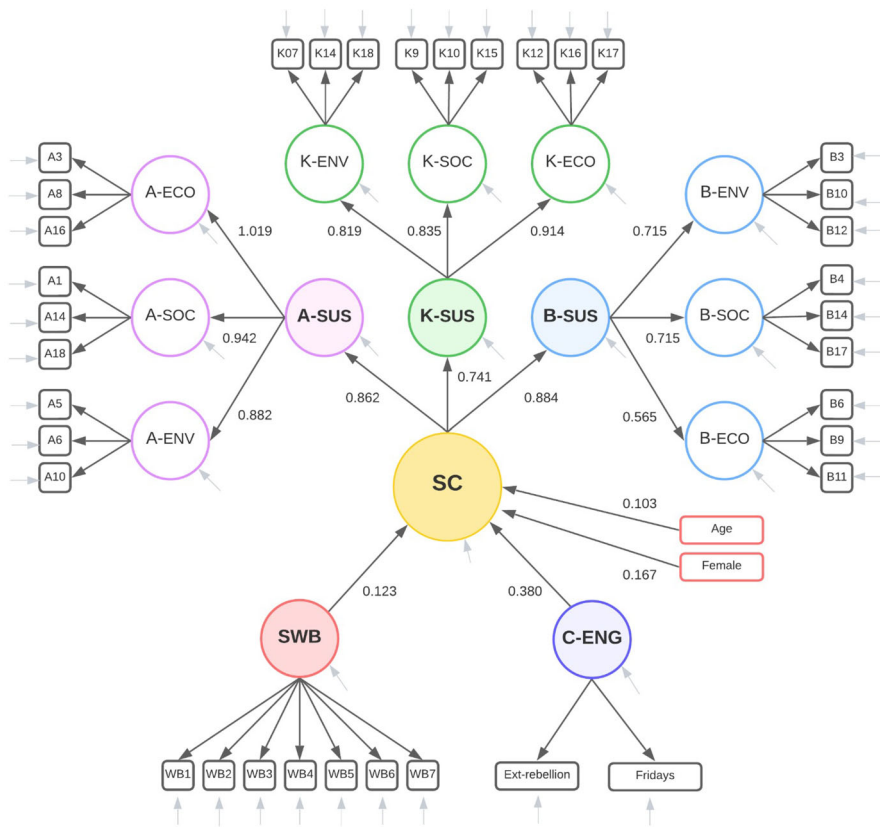


Fig. 1 Graphical representation of the SEM model structure, illustrating the relationships between observed nodes, first-order latent constructs, second-order latent constructs, and the final SC node, along with regression paths connecting SC to SWB, C-ENG, and demographic variables

which contribute less (weight 0.882). Similarly, B-SUS, which represents sustainable behaviours, receives contributions from B-ENV (environmental behaviours), B-SOC (social behaviours) and B-ECO (economic behaviours). In this case, environmental and social behaviours (B-ENV, B-SOC) have the highest weight (0.715), followed by economic behaviours (B-ECO, 0.565).

The second-order latent traits converge on the third-order node, which represents the overall SC. This node integrates the contributions of K-SUS, A-SUS, and B-SUS, providing a global measure of the individual's SC. The relationship between the second- and third-order nodes is also weighted to reflect the relative contribution of each dimension. B-SUS contributes the most to total SC with a weight of 0.884, followed by A-SUS with a weight of 0.862 and K-SUS with a weight of 0.741. This indicates that, within the model, the behavioural dimension plays the most prominent role in the definition of overall SC, while the affective dimension (attitudes) also shows a substantial contribution, exceeding that of the cognitive dimension (knowingness).

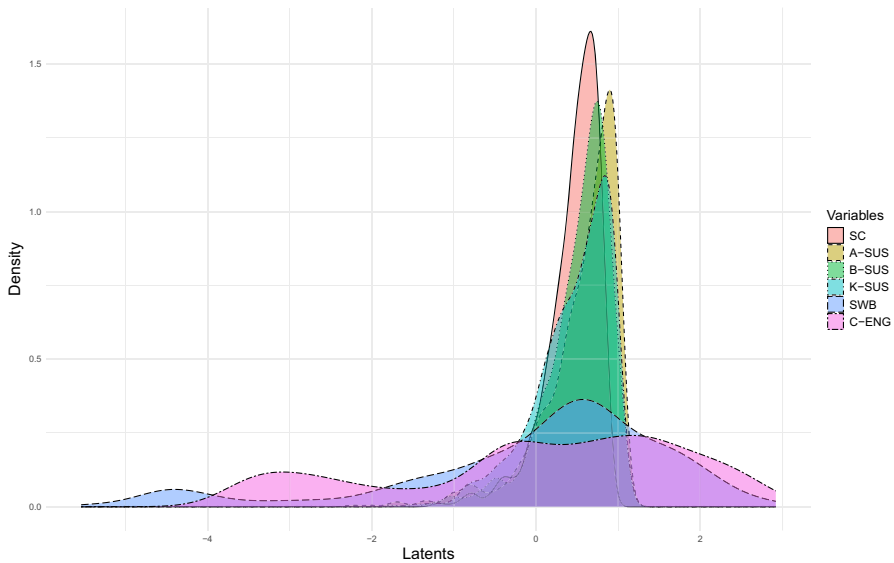


Fig. 2 Marginal density distributions of standardized latent variables

The latent construct SWB is a multidimensional measure of individuals' SWB, constructed from seven observed indicators (WB1 - WB7), each reflecting a specific dimension of quality of life. These indicators capture aspects such as satisfaction with health, personal relationships, and other relevant components of perceived well-being. The standardised weights associated with the indicators (Table 3), ranging from 0.669 to 0.816, indicate that each element consistently and significantly contributes to the definition of the latent construct.

The latent construct C-ENG is defined by two indicators, denoting proximity to two environmental movements: Fridays for Future and Extinction Rebellion. Looking at factor loadings displayed in Table 3, we observe that the identification with the movement Fridays for Future is strongly associated with greater SC (factor loading equal to 0.953). A similar relation emerges for the proximity to Extinction Rebellion (factor loading 0.677), although its effect is less pronounced. This result may reflect differences in the visibility and degree of diffusion of the two movements during the data collection period. Fridays for Future, with its strong focus on young people and extensive international media coverage, may have achieved greater popularity and recognition than Extinction Rebellion, which may have been less well known or perceived as more radical.

The marginal density distributions of the latent variables SWB, C-ENG, SC and its components K-SUS, A-SUS, B-SUS, resulting from the measurement part of the selected SEM, are plotted in Fig. 2; a synthesis of these distributions is provided in Table 1.

SWB and C-ENG display skewed distributions with local maxima for low values of SWB and C-ENG, respectively. In comparison with SC and its components, both SWB and C-ENG present a substantially higher variability. Concerning SC and its

Table 1 Summary of marginal density distributions of latent variables

	SWB	C-ENG	SC	K-SUS	A-SUS	B-SUS
min	-5.54	-3.73	-1.23	-1.55	-2.23	-1.75
first quartile	-0.65	-1.00	0.30	0.21	0.37	0.33
median	0.39	0.28	0.53	0.57	0.69	0.61
third quartile	1.08	1.34	0.69	0.82	0.89	0.79
max	2.92	2.80	0.92	1.03	1.06	1.13
mean	0.00	0.00	0.45	0.45	0.55	0.51
sd	1.69	1.78	0.33	0.46	0.49	0.41

components, we observe a strong overlap in the distributions, with similar mean values and standard deviations, as well as similar medians and modal values. In light of this result, SC summarises well the components K-SUS, A-SUS, and B-SUS.

Concerning the structural relationships investigated through the SEM (Fig. 1 and Table 4), SWB is significantly related to SC with a standardised coefficient equal to 0.123, highlighting that individuals with higher SWB tend to have higher SC. Also C-ENG presents a significant and positive effect on SC, with a coefficient equal to 0.380.

The socio-demographic variables also provide interesting insights. Gender emerges as a significant predictor, with a coefficient of 0.167, indicating that women have higher SC levels than men, a finding consistent with the existing literature. Previous studies have often highlighted women's greater sensitivity to social and environmental issues, due to both cultural factors, such as traditionally more caring and protective social roles, and psychological traits, such as greater empathy (Tainio and Cameron 2019; Berglund et al. 2020; Chen et al. 2022). This finding confirms the result that gender plays an important role in shaping attitudes and behaviour towards sustainability. Age, with a coefficient of 0.103, also shows a positive effect on SC. Increasing age is associated with higher SC, a result that can be interpreted as the result of a progressive accumulation of experience, knowledge and orientation related to sustainability. However, the limited effect suggests that SC does not depend solely on age, but is the product of a more complex interaction of factors, including media exposure, education and participation in social or activist networks.

To provide an overview of the observed dynamics complementary to the one depicted in Fig. 1, Figures 3 and 4 illustrate age- and sex-related patterns in pro-environmental behaviour (B-ECO), SWB, and SC. To challenge stereotypes, we reversed the colours typically associated with men and women.

The left panel of Fig. 3 shows that pro-environmental behaviour (B-ECO) is constant for men, whereas it increases with age for women, peaking in the 24–25 age group. Furthermore, women systematically show higher average B-ECO scores than men across all age groups. This finding is consistent with the literature that links greater female environmental sensitivity to intrinsic values and prosocial attitudes. The overall trend in the graph confirms that age and sex are significant factors in shaping pro-environmental behaviour, particularly during the transition to adulthood. The

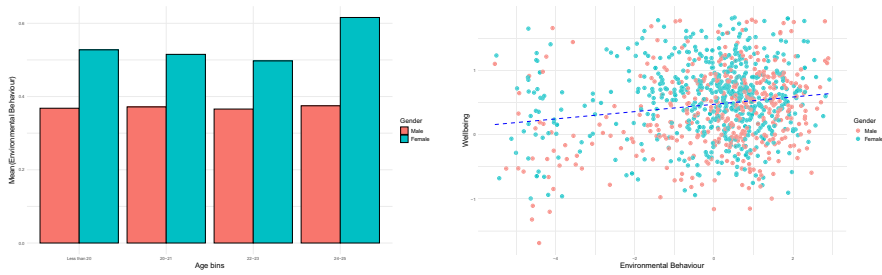


Fig. 3 Pro-environmental behaviour by sex and age (left) and SWB and pro-environmental behaviour (right)

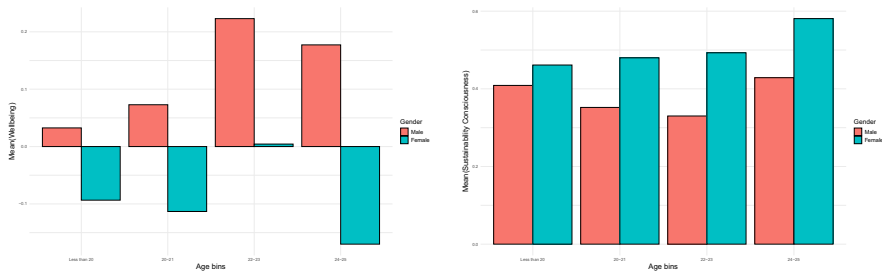


Fig. 4 Average SWB by age and sex (left) and Average SC by sex and age (right)

right panel of Figure 3 explores the direct relationship between SWB and B-ECO. The observed positive correlation indicates that, at the individual level, an increase in SWB corresponds to an increase in pro-environmental behaviour. This relationship appears to be similar for men and women, with no notable sex differences.

The left panel of Fig. 4 shows the average SWB values by sex and age group. Males report higher average SWB values than females independently of the age group. The literature on SWB often finds that women report higher levels of SWB on dimensions related to social relationships and community connections, often attributed to greater empathy and an orientation towards intrinsic values (Diener 2021). However, it also finds that women's well-being is more vulnerable to contextual factors and social pressures, particularly during periods of transition (ISTAT 2023). The relative decline in SWB observed among women in the 24–25 age group may reflect this dynamic, as this period often coincides with important transitions, such as completing formal education or entering the labour market, moments when social pressures may intensify. In contrast, men tend to show a more stable trajectory in their average SWB scores, in line with findings from studies such as (Stevenson and Wolfers 2009), which suggest that men are less affected by fluctuations related to social contexts and role expectations.

The right panel of Fig. 4, related to SC, shows a similar trend to the pro-environmental behaviour shown in the left panel of Fig. 3. Specifically, SC scores are generally higher for women than for men across all age groups. Furthermore, in women, SC scores tend to increase with age, whereas they remain relatively constant in men. This finding supports the idea that, like pro-environmental behaviour, SC is positively associated with age and shows a significant gender difference, with women

scoring higher, consistent with existing literature. The two figures provide complementary evidence that reinforces findings from the existing literature: pro-environmental behaviour and SC increase with age, mainly for women, while women's SWB is, on average, lower than men's, despite greater individual variability. Age emerges as a contributing factor to both SBW and sustainable behaviour, within an overall framework that integrates sex differences and personal maturation.

The relationship between SC and C-ENG, age, and gender provides significant results that are consistent with the existing literature and highlight the mechanisms through which personal and social factors contribute to sustainable consciousness. Propensity to C-ENG, here proxied by the perceived proximity to environmental movements, results as an important predictor of SC.

These findings highlight how SC is shaped by a combination of personal, social and contextual influences. Activism propensity is particularly central, highlighting that perceived proximity to environmental movements can sensibilise individuals and promote greater internalisation of sustainable values and practices. At the same time, socio-demographic variables such as sex and age further enrich the understanding of how SC develops in different segments of the population.

5 Discussion

This study contributes to the scientific debate on sustainability by exploring the relationship between subjective well-being (SWB), sustainability consciousness (SC) and perceived closeness to environmental movements, which can be interpreted as a form of civic engagement (C-ENG). It offers new insights that extend the existing knowledge in the literature. The relationship between SWB and pro-environmental behaviour has been addressed in previous research, particularly in relation to the 'double dividend' theory, which emphasises how sustainable practices can enhance both individual well-being and pro-environmental behaviour. Our study shifts the focus to the broader construct of SC, which encompasses cognitive, attitudinal, and behavioural dimensions across the three pillars of sustainability (environmental, social, and economic). This multidimensional approach enables a more nuanced and comprehensive understanding of the relationship between SWB and SC compared to studies that focus solely on individual pro-environmental behaviours. From a theoretical perspective, the integration of the concept of SC with SWB is consistent with the broaden-and-build theory, which suggests that positive states of well-being expand individuals' cognitive and social resources, thereby promoting prosocial and sustainable behaviours. The findings also support the sociological perspective of post-materialist value theory, which emphasises how economic and social well-being can lead to increased sensitivity to global issues, such as sustainability in its broadest sense. In this context, SWB emerges not only as a desirable goal, but also as a strategic lever to promote sustainable practices and attitudes. This study confirms and builds upon several existing findings in the literature, while also providing new insights into SC. One of the most significant findings is the role of the latent variable C-ENG, which represents the perceived closeness to environmental movements, such as Fridays For Future (Fridays) and Extinction Rebellion (Ext-Rebellion). This variable proves to be a sig-

nificant predictor of SC, highlighting how youth-led activism can promote not only greater consciousness but also stronger commitment to sustainability values. What is interesting about this finding is that even the simple perception of proximity—and not just active participation—can have a significant impact on SC. This indicates that the visibility and communication strategies employed by these movements are effective in disseminating their message. For example, the narrative and public image of Fridays For Future can attract people who share its goals, even if they are not directly involved. This demonstrates how modern environmental movements can utilise digital media and global networks to reach and influence a broader audience beyond those already engaged. Our research establishes a clear link between perceived closeness to activism and SC as a multidimensional concept, expanding on previous studies that have examined how activism affects well-being (Klar and Kasser 2009). This finding suggests that closeness to activism can be a crucial lever to promote a consistent alignment between knowledge, values, and attitudes, thereby strengthening the ability to adopt a critical and systemic view of sustainability. At a time when systemic change is needed, this link could support educational and policy strategies aimed at promoting a deeper and more conscious culture of sustainability. Young females show significantly higher SC scores than young males, a finding consistent with previous studies, which is further elaborated here through the analysis of cognitive, attitudinal, and behavioural components. The stronger association between females and traits such as empathy and caring, highlighted in psychological and sociological studies, may explain this difference. These traits are present in all individuals to varying degrees. However, their greater relevance for women may provide an interpretative key to understanding the observed gap. In addition, the finding that satisfaction with free time (WB1) and health (WB2) have the highest weight in defining SWB is interesting. This suggests that the ability to balance responsibilities with meaningful leisure time, as well as maintaining good health, is central to individual well-being. At the same time, other dimensions, such as social relationships and a sense of belonging, also contribute significantly, reinforcing the idea that well-being is a multidimensional construct. These results align with the broader principles of the civic economy, which emphasises how both personal and relational factors shape collective well-being and sustainability.

Building on the SCQ previously validated in the Italian context by Bacci et al. (2024), this study extends its application by integrating new dimensions such as SWB and perceived closeness to environmental activism, thus enhancing its potential for future cross-cultural and regional comparisons. Our findings highlight how social capital, such as a sense of belonging to a community, and human capital, including sustainable knowingness and attitudes, can be integrated into public policies that promote the transition to more equitable and sustainable development models. In interpreting these findings, it is important to avoid reductionist approaches. The complex interplay between SWB and SC, in the context of factors such as civic participation, sex, and community ties, highlights the need to move beyond linear interpretations. Linking these findings to the framework of civic economy offers a vision of development that places individual values and social relationships at the centre of public policy design.

6 Limitations and Future Research

This study provides valuable insights into the relationship between SWB, C-ENG and SC. However, it is essential to acknowledge certain limitations and outline potential avenues for future research to further develop and refine these findings. A limitation lies in the sample composition, which is dominated by individuals aged 12–25, with a focus on students. While this demographic is crucial for understanding the development of sustainability attitudes, it limits the generalisability of the findings to other age groups, particularly adults in working or post-retirement life. Future research could benefit from a more diverse sample that includes older populations and individuals from different socio-economic backgrounds, allowing for a broader exploration of how SC develops across the lifespan. In addition, the study relies on self-reported measures of both SWB and propensity for activism. While these instruments provide important subjective insights, they are susceptible to biases such as social desirability and individual interpretation. The use of a mixed-methods approach, combining self-report data with objective measures (e.g. behavioural observations or third-party ratings), may increase the robustness of the findings. The cross-sectional design of this study limits the ability to infer causal relationships between SWB, C-ENG, and SC. While the broaden-and-build theory supports the hypothesis that higher SWB may foster greater SC, the directionality of these relationships remains speculative. Future research should consider longitudinal designs to track how changes in SWB influence the development of SC and vice versa over time. Such an approach could also identify potential feedback loops between SWB, SC and sustainable behaviours, providing a richer understanding of their interactions. This study highlights the role of perceived proximity to environmental organisations as a form of C-ENG. However, it does not fully address how this proximity translates into active participation or measurable outcomes. Future research could investigate the mechanisms by which perceived proximity fosters actual engagement, such as activism, policy advocacy, or community initiatives. Furthermore, exploring the quality and depth of C-ENG - for example, by distinguishing between passive support and active leadership roles - could provide more nuanced insights into its interplay with SWB and SC. While this study focuses on SWB and C-ENG as predictors of SC, additional variables could enrich the analytical framework. For example, factors such as exposure to media narratives about sustainability, digital engagement with environmental campaigns, and access to education about sustainability issues may significantly influence SC. Future studies could adopt a multi-layered analytical model that integrates these contextual factors to better capture the complexity of SC. By addressing these limitations and pursuing these lines of inquiry, future research can build on the foundation laid by this study and advance both theoretical understanding and practical strategies for promoting a collective and comprehensive consciousness about sustainability.

Appendix A Measurement of Latent Traits

In this appendix, we list the indicators used to measure SC and SWB, respectively.

A.1 Short-FORM Questionnaire (SCQ-5)

K18: Sustainable development requires a shift to renewable natural resources. Lo sviluppo sostenibile richiede una conversione alle risorse naturali rinnovabili.

K14: Preserving the variety of living creatures is necessary for sustainable development (preserving biological diversity). Difendere la biodiversita' e' necessario per uno sviluppo sostenibile.

K07: Sustainable development demands that we humans reduce all sorts of waste. Lo sviluppo sostenibile richiede che gli esseri umani riducano ogni sorta di rifiuto.

K10: Respecting human rights is necessary for sustainable development. Lo sviluppo sostenibile richiede il rispetto dei diritti umani.

K09: Reinforcing girls' and women's rights and increasing equality around the world is necessary for sustainable development. Lo sviluppo sostenibile richiede un rafforzamento dei diritti delle ragazze e delle donne e una maggiore uguaglianza tra i paesi nel mondo.

K15: Having respect for other cultures is necessary for sustainable development. Lo sviluppo sostenibile richiede rispetto per le altre culture.

K17: Wiping out poverty in the world is necessary for sustainable development. Eliminare la poverta' nel mondo e' condizione necessaria per lo sviluppo sostenibile.

K16: Sustainable development requires a fair distribution of goods and services among people in the world. Lo sviluppo sostenibile richiede una equa distribuzione di beni e servizi tra la popolazione mondiale.

K12: Sustainable development requires that companies act responsibly towards their employees, customers, and suppliers. Lo sviluppo sostenibile richiede che le aziende agiscano responsabilmente nei confronti dei propri dipendenti, acquirenti e fornitori.

A10: I think that it is important to take measures against problems which have to do with climate change. Penso che sia importante adottare misure contro i problemi che riguardano il cambiamento climatico.

A06: I think that we need stricter laws and regulations to protect the environment. Penso che siano necessarie leggi e regolamenti piu' stringenti in materia di protezione ambientale.

A01: I think that everyone ought to be given the opportunity to acquire the knowledge, values, and skills that are necessary to live sustainably. Penso che a ciascuno debba essere data l'opportunita' di acquisire le conoscenze, i valori e le capacita' per vivere in modo sostenibile.

A14: I think that it is important that people in society exercise their democratic rights and become involved in important issues. Penso che sia importante che i cittadini esercitino i propri diritti democratici e che diventino parte attiva sui temi sociali piu' importanti.

A18: I think that women and men throughout the world must be given the same opportunities for education and employment. Penso che nel mondo uomini e donne dovrebbero avere accesso alle stesse opportunita' di istruzione e lavoro.

A03: I think that companies have a responsibility to reduce the use of packaging and disposable articles. Penso che le imprese abbiano la responsabilita' di ridurre l'uso di imballaggi e articoli usa e getta.

A16: I think that people who pollute land, air or water should pay for the damage they cause to the environment. Penso che la gente che inquina la terra, l'aria o l'acqua dovrebbe pagare per il danno che causa all'ambiente.

A08: I think that companies in rich countries should give employees in poor nations the same conditions as in rich countries. Penso che le imprese dei paesi ricchi dovrebbero assicurare ai propri lavoratori nei paesi poveri lo stesso trattamento economico di quello garantito ai lavoratori nel proprio paese.

B11: I avoid buying goods from companies with a bad reputation for looking after their employees and the environment. Evito di acquistare prodotti di aziende con una cattiva reputazione sul rispetto dei lavoratori e dell'ambiente.

B09: I often purchase second-hand goods over the internet or in a shop. Acquisto spesso beni di seconda mano su internet o in negozio.

B06: I do things which help poor people. Compio azioni che aiutano le persone povere.

B12: I have changed my personal lifestyle in order to reduce waste (e.g., throwing away less food or not wasting materials). Ho cambiato il mio stile di vita personale per ridurre i rifiuti (per esempio butto via meno cibo o non spreco materiali).

B03: I recycle as much as I can. Riciclo quanto piu' possibile.

B19: I never waste water. Non spreco mai l'acqua.

B14: I treat everyone with the same respect, even if they have another cultural background than mine. Tratto tutti con lo stesso rispetto, indipendentemente dalla loro estrazione culturale.

B04: When I use a computer or mobile to chat, to text, to play games and so on, I always treat others as respectfully as I would in real life. Quando utilizzo il computer o il telefono per chattare, scrivere, giocare, e cosi' via, tratto gli altri con lo stesso rispetto che riserverei loro nella vita reale.

B17: I show the same respect to men and women, boys and girls. Mostro lo stesso rispetto a uomini e donne, ragazzi e ragazze.

A.2 Subjective Well-Being (SWB) Survey

WB1 How satisfied are you with your free time

WB2 How satisfied are you with your health

WB3 How satisfied are you with what you usually do in your life

WB4 How satisfied are you with your personal relationships

WB5 How satisfied are you with how appreciated you feel by the people close to you

WB6 How satisfied are you with feeling part of the community where you live

WB7 How satisfied are you with the safety of the area where you live

Appendix B Structural Equation Model Specification

This appendix provides a formal description of the SEM employed in the empirical analysis. We outline the motivation and scope of the model, the measurement component, the structural relations among latent constructs, and the identification and estimation strategy.

B.1 Model motivation and scope

The SEM framework represents a particularly suitable methodological instrument for analysing relationships among latent constructs measured through multiple observed indicators. Sustainability Consciousness (SC), Subjective Well-Being (SWB), and Civic Engagement (C-ENG) are all inherently latent concepts that cannot be directly observed and therefore require an explicit measurement model.

The SEM framework allows us to jointly model (i) the measurement structure of these latent variables (Sect. B.2) and (ii) the structural associations among them (Sect. B.3) within a unified system. In particular, the hierarchical structure of SC follows the framework originally proposed by Gericke et al. (2019) with the Sustainability Consciousness Questionnaire (SCQ) and validated for the Italian context by Bacci et al. (2024).

It is essential to emphasize that, due to the cross-sectional nature of the data and the absence of exogenous sources of variation, the SEM estimated in this study does not identify causal effects. Rather, it captures associations among latent constructs that are theoretically motivated by the existing literature on well-being, civic engagement, and sustainability-related attitudes and behaviours, discussed in Sect. 2. The results should therefore be interpreted as correlations rather than causal relations.

B.2 Measurement Model

The measurement component of the SEM explicitly links the observed indicators to the latent constructs through a hierarchical confirmatory factor structure. The model comprises three measurement levels: first-order, second-order, and third-order latent variables. All measurement errors and disturbance terms are assumed to have zero mean and finite variance, to be mutually uncorrelated, and to be uncorrelated with the latent variables.

First-Order Measurement Equations

Let $i = 1, \dots, n$ denote individuals. Each observed indicator is assumed to be a linear function of a first-order latent construct plus a measurement error. The general measurement model can be written as:

$$\mathbf{y}_i = \mathbf{\Lambda} \boldsymbol{\eta}_i + \boldsymbol{\varepsilon}_i, \quad (\text{B1})$$

where $\mathbf{y}_i$ is the vector of observed indicators, $\boldsymbol{\eta}_i$ is the vector of latent variables, $\mathbf{\Lambda}$ is the matrix of factor loadings, and $\boldsymbol{\varepsilon}_i$ is a vector of measurement errors. Equation (B1) is detailed as follows.

For latent construct SC, the first-order latent variables correspond to the environmental, social, and economic dimensions of knowingness (i.e., K-ENV, K-SOC, K-ECO), attitudes (i.e., A-ENV, A-SOC, A-ECO), and behaviours (i.e., B-ENV, B-SOC, B-ECO). Thus, for the measurement of the knowingness, we have:

$$y_{ij}^{K-ENV} = \lambda_j^{K-ENV} K-ENV_i + \varepsilon_{ij}^{K-ENV},$$

where y_{ij}^{K-ENV} denotes the j -th observed indicator measuring environmental knowingness for individual i , λ_j^{K-ENV} is the corresponding factor loading, and ε_{ij}^{K-ENV} is a measurement error, and with a similar interpretation,

$$\begin{aligned} y_{ij}^{K-SOC} &= \lambda_j^{K-SOC} K-SOC_i + \varepsilon_{ij}^{K-SOC}, \\ y_{ij}^{K-ECO} &= \lambda_j^{K-ECO} K-ECO_i + \varepsilon_{ij}^{K-ECO}. \end{aligned}$$

Analogous equations define the measurement of attitudes:

$$\begin{aligned} y_{ij}^{A-ENV} &= \lambda_j^{A-ENV} A-ENV_i + \varepsilon_{ij}^{A-ENV}, \\ y_{ij}^{A-SOC} &= \lambda_j^{A-SOC} A-SOC_i + \varepsilon_{ij}^{A-SOC}, \\ y_{ij}^{A-ECO} &= \lambda_j^{A-ECO} A-ECO_i + \varepsilon_{ij}^{A-ECO}, \end{aligned}$$

and behaviours:

$$\begin{aligned} y_{ij}^{B-ENV} &= \lambda_j^{B-ENV} B-ENV_i + \varepsilon_{ij}^{B-ENV}, \\ y_{ij}^{B-SOC} &= \lambda_j^{B-SOC} B-SOC_i + \varepsilon_{ij}^{B-SOC}, \\ y_{ij}^{B-ECO} &= \lambda_j^{B-ECO} B-ECO_i + \varepsilon_{ij}^{B-ECO}. \end{aligned}$$

The 27 indicators ($j = 1, \dots, 27$) used to measure the first-level latent dimensions of SC are listed in Appendix A.1.

Moreover, latent construct SWB is measured as

$$y_{ik}^{SWB} = \lambda_k^{SWB} SWB_i + \varepsilon_{ik}^{SWB}, \quad k = 1, \dots, 7,$$

where the indicators y_{ik}^{SWB} are listed in the Appendix A.2.

Finally, C-ENG is measured by

$$y_{im}^{C-ENG} = \lambda_m^{C-ENG} C-ENG_i + \varepsilon_{im}^{C-ENG}, \quad m = 1, 2,$$

where the two indicators refer to perceived proximity to Fridays for Future and Extinction Rebellion.

Second-Order Measurement Equations

First-order dimensions defined above aggregate on second-order latent constructs, that is, K-SUS, A-SUS, and B-SUS, as follows:

$$\begin{aligned} K-ENV_i &= \lambda_{\cdot}^{K-ENV} K-SUS_i + \varepsilon_{i\cdot}^{K-ENV}, \\ K-SOC_i &= \lambda_{\cdot}^{K-SOC} K-SUS_i + \varepsilon_{i\cdot}^{K-SOC}, \\ K-ECO_i &= \lambda_{\cdot}^{K-ECO} K-SUS_i + \varepsilon_{i\cdot}^{K-ECO}, \end{aligned}$$

$$\begin{aligned}A-ENV_i &= \lambda^{A-ENV} A-SUS_i + \varepsilon_i^{A-ENV}, \\A-SOC_i &= \lambda^{A-SOC} A-SUS_i + \varepsilon_i^{A-SOC}, \\A-ECO_i &= \lambda^{A-ECO} A-SUS_i + \varepsilon_i^{A-ECO},\end{aligned}$$

$$\begin{aligned}B-ENV_i &= \lambda^{B-ENV} B-SUS_i + \varepsilon_i^{B-ENV}, \\B-SOC_i &= \lambda^{B-SOC} B-SUS_i + \varepsilon_i^{B-SOC}, \\B-ECO_i &= \lambda^{B-ECO} B-SUS_i + \varepsilon_i^{B-ECO}.\end{aligned}$$

Third-Order Measurement Equation

At the highest level, overall SC is defined as:

$$\begin{aligned}K-SUS_i &= \lambda^K SC_i + \varepsilon_i^K, \\A-SUS_i &= \lambda^A SC_i + \varepsilon_i^A, \\B-SUS_i &= \lambda^B SC_i + \varepsilon_i^B.\end{aligned}$$

B.3 Structural Model

The structural component of the SEM specifies the relationships among the latent constructs. In particular, SC is modelled as an endogenous variable explained by SWB, C-ENG, and a set of observed control variables.

The structural equation for individual i can be written as:

$$SC_i = \beta_1 SWB_i + \beta_2 C-ENG_i + \beta_3 Age_i + \beta_4 Woman_i + \zeta_i,$$

where ζ_i is a disturbance term capturing unobserved factors affecting SC.

SWB and C-ENG are treated as exogenous latent variables, while age and gender are included as observed controls. The model is recursive and does not allow for feedback effects or reciprocal relationships among latent constructs.

B.4 Identification and Estimation Strategy

To estimate the model, we use the function `sem` of the R package `Lavaan` (Rosseel 2022).

Model identification follows standard practices in confirmatory factor analysis and structural equation modelling. In particular, we adopt the default identification constraints adopted by *Lavaan*. Specifically, for each latent construct, the scale is defined by fixing one factor loading (the first one) to unity and allowing the variances of the latent variables to be free. The estimated loadings are then standardised to make them comparable (see Tables 2 and 3). The structural model is identified by the recursive specification and by the presence of sufficient variation in the exogenous variables. No equality constraints are imposed across structural coefficients.

Estimation is performed using maximum likelihood. Namely, although questionnaire items are measured on ordinal Likert-type scales, they are treated as continuous variables, as the number of response categories is sufficiently large (five or more), a common practice in SEM applications.

The model involves the estimation of a large number of free parameters (more than fifty), including factor loadings, latent variances and covariances, residual variances of indicators, and regression coefficients. Simulation studies have shown that, in the presence of continuous indicators and moderate or high factor loadings, complex SEM models can be reliably estimated with sample sizes of about 400 cases, ensuring stability of estimates and correctness of standard errors (Wolf et al. 2013). Therefore, a sample size of $n = 1041$ is definitely adequate for the complexity of the estimated SEM.

As is common practice in structural equation modeling, the final model specification is obtained through an iterative process informed by modification indices. Modification indices quantify the expected decrease in the overall model chi-square statistic that would result from freeing a fixed or constrained parameter, conditional on all other model parameters remaining unchanged. Large modification index values, therefore, indicate parameters whose omission contributes substantially to model misfit and whose inclusion may improve model fit (Saris et al. 2009).

Model fit is assessed using the Comparative Fit Index (CFI), the Tucker–Lewis Index (TLI), and the Root Mean Square Error of Approximation (RMSEA). Values of CFI and TLI equal to or greater than .90 are considered indicative of acceptable model fit, with values above .95 indicating good fit, whereas RMSEA values below .08 are considered acceptable and values below .06 indicative of good model fit (Hu and Bentler 1999). As outlined in Sect. 4, the estimated final model achieves a satisfactory goodness of fit, with values of CFI and TLI greater than 0.90 and an RMSEA lower than 0.05.

Appendix C Results of the Selected SEM

The following tables report the estimated coefficients of the selected SEM: Tables 2 and 3 refer to the measurement part, whereas Table 4 displays the regression coefficients. The detailed equations are shown in Appendices B.2 and B.3, respectively.

Table 2 Measurement part of the selected SEM for latent variable SC: estimates of factor loadings (Est.), standard errors (S.E.), z-values, p-values and lower (Low) and upper (Up) limits of confidence intervals at 95%

	Est	S.E	z-value	p-value	Low	Up
<i>Environmental Knowingness</i>						
K18 (λ_1^{K-ENV})	0.710	0.024	29.138	< 0.0001	0.662	0.758
K14 (λ_2^{K-ENV})	0.651	0.025	25.696	< 0.0001	0.602	0.701
K07 (λ_3^{K-ENV})	0.414	0.031	13.167	< 0.0001	0.353	0.476
<i>Social Knowingness</i>						
K10 (λ_4^{K-SOC})	0.867	0.012	71.031	< 0.0001	0.843	0.891
K09 (λ_5^{K-SOC})	0.774	0.016	49.447	< 0.0001	0.744	0.805
K15 (λ_6^{K-SOC})	0.795	0.015	53.686	< 0.0001	0.766	0.824
<i>Economic Knowingness</i>						
K17 (λ_7^{K-ECO})	0.732	0.019	38.810	< 0.0001	0.695	0.769
K16 (λ_8^{K-ECO})	0.787	0.017	46.243	< 0.0001	0.754	0.821
K12 (λ_9^{K-ECO})	0.665	0.021	31.150	< 0.0001	0.623	0.707
<i>Environmental Attitudes</i>						
A10 (λ_{10}^{A-ENV})	0.797	0.017	45.770	< 0.0001	0.763	0.832
A06 (λ_{11}^{A-ENV})	0.766	0.018	42.250	< 0.0001	0.731	0.802
A05 (λ_{12}^{A-ENV})	0.120	0.034	3.512	< 0.0001	0.053	0.187
<i>Social Attitudes</i>						
A01 (λ_{13}^{A-SOC})	0.774	0.017	45.164	< 0.0001	0.740	0.808
A14 (λ_{14}^{A-SOC})	0.631	0.022	28.320	< 0.0001	0.587	0.674
A18 (λ_{15}^{A-SOC})	0.701	0.020	35.666	< 0.0001	0.662	0.740
<i>Economic Attitudes</i>						
A03 (λ_{16}^{A-ECO})	0.704	0.020	34.809	< 0.0001	0.664	0.743
A16 (λ_{17}^{A-ECO})	0.564	0.024	23.096	< 0.0001	0.517	0.612
A08 (λ_{18}^{A-ECO})	0.613	0.023	26.763	< 0.0001	0.568	0.658
<i>Environmental Behaviors</i>						
B12 (λ_{19}^{B-ENV})	0.603	0.026	23.008	< 0.0001	0.551	0.654
B03 (λ_{20}^{B-ENV})	0.727	0.023	31.258	< 0.0001	0.682	0.773
B10 (λ_{21}^{B-ENV})	0.708	0.024	29.964	< 0.0001	0.662	0.755
<i>Social Behaviors</i>						
B14 (λ_{22}^{B-SOC})	0.811	0.017	46.537	< 0.0001	0.777	0.845
B04 (λ_{23}^{B-SOC})	0.626	0.023	27.243	< 0.0001	0.581	0.671
B17 (λ_{24}^{B-SOC})	0.812	0.017	46.645	< 0.0001	0.778	0.846

Table 2 continued

	Est	S.E	z-value	p-value	Low	Up
<i>Economic Behaviors</i>						
B11 (λ_{25}^{B-ECO})	0.601	0.039	15.492	< 0.0001	0.525	0.677
B09 (λ_{26}^{B-ECO})	0.495	0.038	13.090	< 0.0001	0.421	0.569
B06 (λ_{27}^{B-ECO})	0.445	0.038	11.726	< 0.0001	0.371	0.520
<i>Knowingness</i>						
K-ENV ($\lambda_{\cdot}^{K-ENV}$)	0.819	0.026	31.420	< 0.0001	0.768	0.870
K-SOC ($\lambda_{\cdot}^{K-SOC}$)	0.835	0.019	44.278	< 0.0001	0.798	0.872
K-ECO ($\lambda_{\cdot}^{K-ECO}$)	0.914	0.019	48.423	< 0.0001	0.877	0.951
<i>Attitudes</i>						
A-ENV ($\lambda_{\cdot}^{A-ENV}$)	0.882	0.018	49.112	< 0.0001	0.847	0.917
A-SOC ($\lambda_{\cdot}^{A-SOC}$)	0.942	0.016	59.528	< 0.0001	0.911	0.973
A-ECO ($\lambda_{\cdot}^{A-Eco}$)	1.019	0.018	56.540	< 0.0001	0.984	1.054
<i>Behaviors</i>						
B-ENV ($\lambda_{\cdot}^{B-ENV}$)	0.716	0.031	22.948	< 0.0001	0.654	0.777
B-SOC ($\lambda_{\cdot}^{B-SOC}$)	0.715	0.029	24.602	< 0.0001	0.658	0.772
B-ECO ($\lambda_{\cdot}^{B-ECO}$)	0.565	0.044	12.914	< 0.0001	0.480	0.651
<i>Sustainability Consciousness</i>						
K-SUS ($\lambda_{\cdot}^{K_{\cdot}}$)	0.741	0.026	28.916	< 0.0001	0.691	0.791
A-SUS ($\lambda_{\cdot}^{A_{\cdot}}$)	0.862	0.023	38.052	< 0.0001	0.818	0.907
B-SUS ($\lambda_{\cdot}^{B_{\cdot}}$)	0.884	0.030	29.079	< 0.0001	0.824	0.943

Table 3 Measurement part of the selected SEM for latent variables SWB and C-ENG: estimates of factor loadings (Est.), standard errors (S.E.), z-values, p-values and lower (Low) and upper (Up) limits of confidence intervals at 95%

	Est	S.E	z-value	p-value	Low	Up
<i>Subjective Well-Being</i>						
WB1 (λ_1^{SWB})	0.816	0.012	66.499	< 0.0001	0.792	0.840
WB2 (λ_2^{SWB})	0.811	0.013	64.693	< 0.0001	0.786	0.835
WB3 (λ_3^{SWB})	0.811	0.013	64.651	< 0.0001	0.786	0.835
WB4 (λ_4^{SWB})	0.799	0.013	60.822	< 0.0001	0.773	0.824
WB5 (λ_5^{SWB})	0.792	0.013	58.796	< 0.0001	0.765	0.818
WB6 (λ_6^{SWB})	0.779	0.014	55.306	< 0.0001	0.751	0.806
WB7 (λ_7^{SWB})	0.669	0.019	35.246	< 0.0001	0.632	0.706
<i>Civic Engagement</i>						
Extinction Rebellion (λ_1^{C-ENG})	0.677	0.031	21.872	< 0.0001	0.616	0.738
Fridays for Future (λ_2^{C-ENG})	0.953	0.036	26.206	< 0.0001	0.882	1.024

Table 4 Structural part of the selected SEM (dependent variable: SC): estimates of regression coefficients (Est.), standard errors (S.E.), z-values, p-values and lower (Low) and upper (Up) limits of confidence intervals at 95%

	Est	S.E	z-value	p-value	Low	Up
(β_1)	0.123	0.037	3.308	0.001	0.050	0.195
C-ENG (β_2)	0.380	0.037	10.186	< 0.0001	0.307	0.453
Woman (β_3)	0.167	0.033	5.126	< 0.0001	0.103	0.230
Age (β_4)	0.103	0.033	3.136	0.002	0.039	0.167

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Code Availability Code and scripts for data analysis are available from the authors upon request.

Declarations

Conflict of interest The authors have no conflict of interest to declare that are relevant to the content of this article

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