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The Engagement/Disengagement in Sustainable Development Inventory (EDiSDI)

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The Engagement/Disengagement in Sustainable Development Inventory (EDISDI): psychometric properties and validity-based studies

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Credit author statements:

Paulo Moreira: Conceptualization, Methodology, Supervision, Project administration, Funding acquisition, Writing – Review & Editing. **Sofia Ramalho**: Formal analysis, Writing – Original draft. **Richard A. Inman:** Formal analysis, Software, Data curation, Writing – Original draft, Writing – Review & Editing, Visualization

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Abstract

There is an urgent need to meet the goals outlined in the 2030 Agenda for Sustainable Development. Such advancements require people to adopt pro sustainable development behaviors. Research on engagement with sustainable development has the potential to provide a vital understanding of how individual differences and contextual factors interact to shape such behaviors. Our aim was to offer a theoretical framework for engagement, imported from Educational Psychology, and from it develop the Engagement/ Disengagement in Sustainable Development Inventory (EDiSDi). In Study 1 (n = 266; M_{age} = 38.6 years; 83% female) an exploratory factor analysis identified three engagement and three disengagement factors. In Study 2 (n = 510; M_{age} = 31.6 years; 58% female), confirmatory factor analyses supported a bifactor model with two negatively correlated general factors (engagement and disengagement). Using a bifactor model, engagement was positively (and disengagement negatively) correlated with nature relatedness, environmental identity, and environmental action. Item response theory analyses revealed good item discrimination. These results validate both the proposed framework and EDiSDI for use in research on engagement with sustainable development. Future research is needed to determine if engagement and disengagement in sustainable development are distinct constructs, or opposing ends of a continuum.

Keywords: sustainable development, engagement, disengagement, bifactor model.

A pressing challenge facing society is the need to facilitate development and prosperity while simultaneously protecting our planet's health for future generations (World Commission on Environment and Development, 1987). Given its importance, the global pursuit of sustainable development is directed by 17 goals to be met by 2030 including the eradication of poverty, achieving gender equality, fighting climate change, and promoting inclusive and equitable education, among others (UN General Assmbly, 2015). The adoption of these goals has been a pivotal first step toward sustainable development, although the recent 2019 Sustainable Development Goals Report (Sachs, Schmidt-Traub, Kroll, Lafortune, & Fuller, 2019) made it clear that "*a much deeper, faster, and more ambitious response is needed…to achieve our 2030 goals*" (p.2. United Nations Secretary-General António Guterres). Governments, organizations, scientists, and the public now all share the responsibility of responding to this urgent call.

Because changing peoples' behavioral patterns is a core aspect of promoting sustainable development, it is clear that research in the behavioral sciences has an important role to play. Understanding the factors that promote pro-sustainable development behaviors requires research guided by process-oriented frameworks (e.g. *Self-Determination Theory, SDT;* Ryan & Deci, 2017) that conceptualize behavior as a function of the interaction between people's internal experiences and contextual influences. As will be made clear in the following sections, the construct of engagement, which is grounded in SDT, is ideally suited to capturing this dynamic nature of behavior development. However, at present, there is no consistent conceptualization of this construct applied to sustainable development, and little attention has been given to its accurate and systematic measurement. The overarching objective of this report is to address this gap.

Engagement with Sustainable Development: A Theoretical Framework

Engagement is not a new concept in the context of research on sustainable development issues. Multiple past studies have referred to the concept of engagement (Alisat & Riemer, 2015; Milfont, Wilson, & Diniz, 2012; Wolf & Moser, 2011). However, a clear understanding of this construct is hampered by a lack of an explicit theoretical framework and no consensus

about its definition. In many studies, engagement has been used as a synonym for participation in pro-environmental behaviors or civic actions (Alisat & Riemer, 2015; Kaiser & Byrka, 2011; Theodori & Luloff, 2002). In other cases, this purely behavioral conceptualization of engagement has been broadened to include pro-environment attitudes (Milfont & Sibley, 2012; Milfont et al., 2012). In yet other studies, engagement has been conceptualized as a state of connection with an issue with affective, cognitive, and behavioral components (Lorenzoni, Nicholson-Cole, & Whitmarsh, 2007; Wolf & Moser, 2011). Without a clear consensus about the meaning of engagement in sustainable development, conclusions that can be reached across studies are limited. Without clear conclusions, practical applications of research findings for sustainable development cannot be maximized.

We propose that a robust theoretical framework for understanding engagement in sustainable development issues can be imported from the literature on student engagement with school. This body of work has advanced substantially over the last 20 years and continues to be a topic of high interest and practical relevance for promoting student educational success. It has, for example, been shown to be an important predictor of academic outcomes such as academic performance and school completion (Archambault, Janosz, Fallu, & Pagani, 2009; Lee, 2014; Li & Lerner, 2011; Wang & Fredricks, 2014; Wang & Holcombe, 2010). According to this framework, engagement has a number of characteristics: (1) it refers to subjective experience; (2) it is multidimensional; (3) it is malleable; and (4) it is conceptually distinct from disengagement.

There is now a general consensus that engagement is a multidimensional construct including cognitive, emotional, and behavioral dimensions (Appleton, Christenson, & Furlong, 2008; Fredricks, Blumenfeld, & Paris, 2004; Moreira, Cunha, & Inman, 2019). Thus, engagement broadly describes people's thoughts, feelings (i.e. subjective experiences), and behaviors toward a target topic/context. Thus, in the context of sustainable development, cognitive engagement reflects pro-sustainability representations (i.e. perceptions, beliefs, and attitudes). Emotional engagement refers to the emotional states relevant to involvement such as

interest and pride, and a sense of identification/connectedness with sustainable development issues. Finally, behavioral engagement refers overt indicators such as behaviors and actions concerning sustainable development (include active participation and effort in being sustainable).

Rather than being an outcome itself, engagement can be understood as the process through which outcomes develop over time (Skinner et al., 2009, Wang et al., 2017). Specifically, engagement manifests as the interaction between contextual factors and outcomes (Appleton, Christenson, Kim, & Reschly, 2006; Connell & Wellborn, 1991), meaning engagement is malleable and can, therefore, be influenced by external influences and targeted interventions (Fredricks et al., 2004). Furthermore, researchers have argued that engagement and disengagement correspond to related yet distinct continua. This is because disengagement is not just expected to represent the absence of engagement, but instead the presence of maladaptive processes and states (Skinner, Kindermann, & Furrer, 2009). This is similar to how positive mental health is more than the absence of illness (Wang, Fredricks, Ye, Hofkens, & Linn, 2017). This logic is consistent with current conceptualizations of affect, where positive affect and negative affect are considered independent dimensions (Watson, Clark, & Tellegen, 1988). Research on achievement goals also suggests that the levels of processing implied in engagement and disengagement are independent constructs (Elliot, Gable, & Mcgregor, 1999). Indeed, a thematic analysis of semi-structured interviews has supported the assumption that student engagement and disengagement in school have qualitatively different features that cannot easily be placed at opposing ends of a continuum (e.g. the absence of 'goofing off' in class is not an indication of behavioral engagement as it does not imply persistence and effort in tasks; Fredricks et al., 2019). Empirical evidence also supports this conceptual distinction, with engagement and disengagement predicting relevant student outcomes, such as average GPA and school absence, differently (Skinner, Furrer, Marchand, & Kindermann, 2008; Wang et al., 2017).

The Current Study

Given the urgent need to promote pro-sustainability action, it is important that attention is given to the accurate and systematic measurement of people's engagement (and disengagement) in sustainable development. There are presently no dedicated measures for this purpose in adults, and only one instrument exists for the measurement of engagement, but not disengagement, in adolescents (the Youth Engagement in Global Sustainability Inventory; Moreira, 2021). In short, researchers currently do not have access to a validated measure of the cognitive, emotional, and behavioral components of engagement and disengagement with sustainable development that can be used in adult samples. Considering this barrier to the study and promotion of sustainable development action, we aimed to develop and then validate such an instrument using data from two studies conducted in Portugal. Study 1 was conducted to define the factorial structure of our proposed measure using exploratory methods. Study 2 was then run to confirm this structure and to test the measure's psychometric properties.

Study 1

Method

Participants and Procedures

We used a snowball sampling method to recruit adults (≥ 18 years) for the study. Specifically, undergraduate psychology students were invited to participate in the study, accessed via a link to online (Google Docs) version of an informed consent form and the study measures, and then to share this link with family, friends, and colleagues via email or social media. Participants could only partake in the study if they gave their informed consent. Participants could not submit their responses unless they had responded to all items (ensuring no missing data). Given the purpose of the study was to conduct an exploratory factor analysis (EFA), the number of participants to recruit was guided by a ratio rule of thumb of five participants per variable (Kyriazos, 2018). Assuming our instrument would have roughly 30-40 items, we anticipated that a sample of at least 200 adults was required.

In total, a sample of 266 adults were recruited. The majority of these respondents were women (83%), and all but one were Portuguese (the other individual was Brazilian). The mean age of these individuals was 38.6 years (*SD* = 14.14). The bulk of participants were aged between 49.0 and 25.0 years (interquartile range). Most individuals (81%) had an undergraduate or postgraduate degree. A small number were full-time students (17%), unemployed (8%), or retired (7%), but the majority were employed (77%).

Measures

The Engagement/Disengagement in Sustainable Development Inventory (EDiSDI). To develop the EDiSDI, first we determined that it should provide a relatively short self-report measure of current engagement and disengagement with sustainable development in adults. We determined that the items would be rated on a scale from 1 (*completely false*) to 5 (*completely true*) and that no items would require reverse-coding. Based on a general review of the engagement literature and past research (to which the authors have contributed), we determined that engagement and disengagement should be conceptualized as distinct multi-dimensional constructs. We then generated an initial pool of items that capture the emotional, cognitive, and behavioral aspects of engagement and disengagement with sustainable development. When developing this item pool, we referred to validated measures of engagement, including the Youth Engagement with Global Sustainability Inventory (Moreira, 2021), and strove to create items that capture the broad nature of each engagement/disengagement dimension (see introduction). For example, for emotional engagement we aimed to generate items that capture peoples' affective reactions to sustainable development as well as and their sense of connectedness with these issues. In total, 99 items were formulated distributed as follows in the six dimensions: Behavioral engagement (25 items), behavioral disengagement (15 items), cognitive engagement (20 items), cognitive disengagement (18 items), emotional engagement (14 items), and emotional disengagement (7 items).

Having generated the initial pool of items, items were subjected to a process of revision and refinement by the study authors (who have published research on student engagement).

When authors agreed that an item had a weaker theoretical alignment with an engagement or disengagement dimension, or was redundant, this item was removed from the pool. There was generally a high degree of consensus, although we did not calculate kappa coefficients as evidence of this. We determined that each dimension should have no fewer than three items but also that broader constructs could have more items if deemed necessary. This process resulted in a preliminary 30-item version of the EDiSDI designed to capture Cognitive Engagement (3 items), Emotional Engagement (5 items), Behavioral Engagement (5 items), Cognitive Disengagement (8 items), Emotional Disengagement (4 items) and Behavioral Disengagement (5 items).

Additional measures. Alongside the original pool of 99 EDiSDI items, participants completed a battery of other questionnaires that are not considered in the present study. This included measures of character strengths, values, comic style markers, affect, and quality of life.

Data Analysis

All data were analyzed using the statistical program R (R Core Team, 2019). Given the exploratory nature of Study 1, we conducted a series of separate exploratory factor analyses (EFAs) to test a range of models. Each of these EFAs used an oblimin rotation and maximum likelihood factoring method. Given our *a priori* theoretical expectations about the factor structure, we tested 3-, 4-, 5-, and 6- factor models. We selected the optimal number of factors to retain by comparing two factor retention criteria (BIC and RMSEA; Preacher et al., 2013), and evaluating the theoretical meaning of the extracted factors.

Results and Discussion

From the four models tested, the factor-retention criteria supported the 6-factor model. Specifically, BIC was lowest for this model (-1116.94) and RMSEA fell below the threshold of .05 (.046) (see Table 1). Three items from the full set of 30 had factor loadings less than .40 (items 18, 26, and 30), and were subsequently excluded.

An examination of the factors and their associated items (see Table 2) revealed that they were theoretically consistent with three distinct dimensions of engagement and three distinct dimensions of disengagement:

- Cognitive Disengagement (8 items): negative/pessimistic thoughts about one's ability to influence sustainable development "My influence in protecting the planet is so small that it doesn't matter", or about others who are engaged in these issues "I think people who care a lot about the future of the planet are fanatics (or a little crazy)".
- Behavioral Engagement (5 items): active involvement in pro-sustainability behaviors "In my daily life, I strive to do things that protect the planet and environment".
- Behavioral Disengagement (4 items): acknowledgement that one's actions are mostly inconsiderate of sustainable development "I don't normally consider how my habits and behaviors affect the planet of environment".
- Cognitive Engagement (3 items): positive thoughts about the summative influence of humans on sustainable development "If each of us does little things in our daily lives, it will have a big influence on the planet"
- Emotional Engagement (4 items): positive emotions about one's involvement in sustainable development "I feel proud of the things I do to make the world better", adaptive affective reactions to sustainability issues "I feel concerned about the future of the planet", and a sense of connectedness with the environment "I often feel that other people and I are a part of nature".
- Emotional Disengagement (3 items): negative affective reactions to sustainability issues "Global sustainability issues are annoying".

The factor correlations presented at the end of Table 2 confirmed that engagement and disengagement dimensions were negatively correlated, and that all factors were related yet mostly distinct dimensions (*r* values ranging from -.51 to .65).

These findings support a prevalent idea in the engagement literature that emotional, cognitive, and behavioral engagement are components of a higher-order multi-dimensional

engagement construct (Fredricks et al., 2004; Moreira et al., 2019; Wang et al., 2017). These findings also align with past studies that have highlighted a conceptual distinction between general engagement and disengagement factors (Wang et al., 2017).

Study 2

Having identified the basic underlying structure of the EDiSDI in Study 1, our next objective was to test structural and convergent validity using an independent sample of adults. Indirect evidence of validity can be obtained by testing whether scale scores are related to other instruments that measure theoretically related constructs (Cronbach & Meehl, 1955). We therefore sought to establish convergent validity by assessing the associations between engagement/disengagement with sustainable development and three constructs for which we expected conceptual overlap: nature relatedness (Nisbet, Zelenski, & Murphy, 2009), environmental action (Alisat & Riemer, 2015), and environmental identity (Clayton, 2003). Nature relatedness and environmental identity are constructs that capture people's relationships with the natural world. People high in nature relatedness have been found to display more environmental behaviors, such as buying more organic and fair trade products (Nisbet et al., 2009), and environmental concern (Nisbet & Zelenski, 2013). Those high in environmental identity have also been shown to present more environmental behaviors and ecocentric values (Clayton, 2003). Environmental action, as measured by Alisat and Riemer's environmental action scale, captures behavioral involvement (engagement) in pro-environmental civic actions (e.g. using platforms to raise awareness about environmental issues) (Alisat & Riemer, 2015). As such, we anticipated engagement with sustainable development would be linked to increased nature relatedness, environmental identity and environmental action, while disengagement would present the reverse pattern.

Method

Participants and Procedures

The sampling method and data collection procedures for this online study were the same as Study 1. Based on a series of CFA sample size recommendations (Kyriazos, 2018), we determined that a sample of at least 500 adults was necessary for this study. The sample comprised 510 Portuguese adults, of which 294 were women (57.6%) and 216 were men (42.4%). The mean age of these adults was 31.6 years (*SD* = 10.98) with the majority of individuals aged between 23.0 (1st quartile) and 38.0 (3rd quartile). The majority were employed (60.0%) or full-time students (32.2%). Most had at least a high-school level of education (88.8%) and 54.1% had completed tertiary education.

Measures

The EDiSDI. The participants responded to the pool of 99 items used to develop the EDiSDI, although we only analyzed the 27 items derived from the EFA in Study 1 (see Electronic Supplementary Table 1 for items). Inter-item correlations are available in Electronic Supplementary Table 2.

The Nature Relatedness (NR-21) Scale. To assess individual levels of connectedness with the natural world, participants completed the Nature Relatedness Scale (Nisbet et al., 2009), which we had translated into Portuguese. The items of the NR-21 are scored using a five-point Likert scale from 1 (*strongly disagree*) to (*strongly agree*). The NR-21 has three subscales that capture internalizing identification with nature, a nature-related worldview, and physical familiarity/comfort with nature, although we calculated and used a composite mean score for analysis. In the study sample, the NR-21 scale reliability was excellent ($\omega = .94$).

The Environmental Action Scale (EAS). The EAS (Alisat & Riemer, 2015) measures individual involvement with civic activities aiming to address environmental issues. Participants completed a version that we had translated into Portuguese. This 18-item scale has two subscales that capture two types of action: leadership and participatory. However, we calculated and used a composite mean score for analysis. Items are scored using a five-point Likert scale

from 0 (*never*) to 4 (*frequently*). In the study sample, the EAS reliability was excellent (ω = .97).

The Environmental Identity (EID) Scale. Participants completed the 24-item EID scale (Clayton, 2003), which we had translated into Portuguese, to assess the extent to which the natural environment plays an important part in their self-definition. Items are scored using a seven-point Likert scale from 1 (*never true*) to 7 (*almost always true*). In the study sample, the EID scale reliability was excellent (ω = .99).

Data Analysis

We used confirmatory factor analysis (CFA) to test the factor structure of the EDiSDI. Specifically, we tested three models. Model 1 was a first-order model with six correlated factors. Model 2 was a second-order model in which two correlated higher-order factors – representing engagement and disengagement -- account for the relationships among the six first-order factors. Model 3 was a bifactor model in which two correlated general factors (engagement and disengagement) account for the relationships between individual items, and specific factors capture systematic variance not explained by the general factors. Because specific factors are not equivalent to first-order factors, they were given alternative labels. All CFAs were conducted using a robust maximum likelihood estimator (MLR). We considered the following indices and thresholds for good model fit: TLI ≥ .95 (Hu & Bentler, 1999), RMSEA ≤ .05 (Browne & Cudeck, 1992), and SRMR < .05 (Hu & Bentler, 1999).

Bifactor models and their associated fit indices are useful for testing scale dimensionality. We evaluated the reliability of the general factors by calculating omega (ω). ω is an estimate of variance attributed to the general and specific factors. We calculated omega hierarchical (ω_H) to measure the extent to which total engagement and disengagement scores can be interpreted as a measure of single constructs. ω_H represents the proportion of variance in total scores accounted for by a general factor isolated from variance accounted for by specific factors (Reise, Moore, & Haviland, 2010). Total scale scores can be interpreted as a measure of

a single construct when $\omega_H > .75$ (Reise, Scheines, Widaman, & Haviland, 2013). We assessed the extent to which multidimensional data are unidimensional by calculating the Explained Common Variance (ECV) index and Percentage of Uncontaminated Correlations (PUC) (Rodriguez, Reise, & Haviland, 2016). The combination of both ECV and PUC > .70 indicates a scale is essentially unidimensional.

We used structural equation modelling (SEM) to estimate the associations between the bifactor model and composite indicators of nature relatedness, environmental identity, and environmental action, each in individual models. Using this method describes the associations between external variables and the general engagement and disengagement factors isolated from the effects of specific factors. External variables were modelled as a latent factor with a single composite indicator, for which the unstandardized error variance was calculated using the following equation: $(1-r_{xx}) \times \text{var}(x)$. r_{xx} corresponds to Cronbach's alpha for the composite score and var(x) is its variance (Yost & Finney, 2018). In each model, the external latent factor was allowed to correlate with the two general factors and the specific factors.

Finally, we assessed the properties (discrimination and difficulty) of the EDiSDI items and scale informativeness using item response theory (IRT) analyses. Because the items of this measure are ordered and polytomous (i.e. Likert scales), we used a graded response model (Samejima, 1969).

Results

Scale descriptive statistics for Study 2 are presented in Electronic Supplementary Table 3 and scale correlations are presented in Electronic Supplementary Table 4. Participants generally scored high for the engagement dimensions and low for the disengagement dimensions.

Confirmatory Factor Analysis

The bifactor model had the best fit to the data ($\chi^2(296) = 581.66$, TLI = .966, RMSEA = .044 [.039, .048], SRMR = .027) with statistically, albeit marginally, better fit than the second-

order model ($\chi^2(317) = 714.98$, TLI= .956, RMSEA = .050 [.045, .054], SRMR = .033, $\Delta\chi^2 = 118.05$, $p < .001$) and the first-order model ($\chi^2(309) = 673.40$, TLI = .959, RMSEA = .048 [.044, .052], SRMR = .031, $\Delta\chi^2 = 80.72$, $p < .001$). An unexpected finding from the bifactor model (see Table 3 for standardised factor loadings) was that the two general factors were very highly correlated ($r = -.92$, $p < .001$). As such, we tested an ancillary bifactor model where all items loaded on one, rather than two, general factors (specific factors remained the same). This model had marginally, albeit statistically, worse fit than the original bifactor model ($\chi^2(297) = 651.83$, TLI = .958, RMSEA = .048 [.044, .053], SRMR = .032, $\Delta\chi^2 = 16.27$, $p < .001$). Overall, these findings support modelling the EDiSDI as a bifactor model with two general factors that share a strong negative correlation.

Reliability and Unidimensionality

For the engagement general factor, ω was .98 and ω_H was .93. For the disengagement general factor, ω was .98 and ω_H was .90. These combination of omega coefficients indicated these scales had good internal consistency. The small numerical differences between ω and ω_H coefficients (.05 and .08) suggested that the specific factors accounted for a limited amount of items variance. For the engagement general factor, ECV was .87 and PUC was .71. For the disengagement general factors, values ECV was .78 and PUC was .65. Despite PUC values lower than .80, the high ECV (>.60) and ω_H values (>.70) allow these general factors to be interpreted as being essentially unidimensional (Reise et al., 2013).

Convergent Validity

Table 4 presents correlations between the bifactor model and the theoretically-related constructs. The main finding was that nature relatedness, environmental actions and environmental identity had correlations with engagement and disengagement that were directionally consistent (positive for engagement, negative for disengagement) and practically significant in terms of magnitude (ranging from $r = .344$ to $r = .889$). With one exception (see

inconsiderate actions and environmental action), the correlations between specific factors and the external variables were weak ($r < .30$) and often not statistically significant.

Item Response Theory

We used IRT to test the discrimination and difficulties of the engagement and disengagement scales separately (see Table 5). Item discrimination (a) reflects the ability of an item to discriminate between individuals varying in engagement or disengagement. Higher values indicate items are more discriminative (Baker, 2001). All items were 'very highly' discriminative ($a > 1.7$), and it was notable that the most discriminative items were from the cognitive dimensions. Regarding item difficulty scores (β) – the levels of engagement/disengagement at which the next Likert response has 50% of being endorsed -- values at each category were similar across engagement items. These values indicated it was relatively easy for participants to endorse the higher response categories; that is, participants did not need to be very high in the latent construct to give a strong response. In contrast, for disengagement it was generally more difficult to endorse the higher response categories: participants needed to have a high level of disengagement to give a strong response. Figure 1 presents Test Information Curves (TIC). The TIC for engagement indicates that the engagement items yield the greatest information about respondents that vary between roughly -2 and 1 (θ) on the engagement scale. The TIC for disengagement indicates the disengagement items yield the greatest information about respondents that vary between roughly 0 and 3 (θ) on the disengagement scale.

General Discussion

The overall objective of this multistudy report was to present a new measure of engagement/disengagement in sustainable development and to provide psychometric evidence of its adequacy. Items for this measure were developed considering past research on the construct of student engagement in school, but with an acknowledgement that engagement may have different meanings in different contexts.

In Study 1, EFA was used to identify the underlying factorial structure of the proposed measure. In accordance with our expectations, we identified six latent factors: three engagement (cognitive, emotional, and behavioral), and three disengagement (cognitive, emotional, and behavioral). This finding was consistent with a robust and heavily supported framework, imported from educational psychology, that conceptualizes engagement as a multi-dimensional construct with emotional, behavioral, and cognitive components (Fredricks et al., 2004; Moreira et al., 2019). However, our study highlights that the specific content of these distinct dimensions when applied to sustainable development differs from when applied to school. Such findings imply that the presented engagement framework may be usefully applied to describing human behavior in various relevant contexts (e.g. engagement in healthy living), but that research is necessary to understand how this construct differs in each.

In Study 2, we used CFA to confirm the factorial structure uncovered in Study 1 with an independent sample of adults. We found that a bifactor model with two general factors had the most adequate fit with the data. Specifically, engagement with sustainable development was modelled as one global engagement factor and a second global disengagement factor, each with three specific factors. The loadings observed in this model combined with bifactor indices suggested that composite engagement and disengagement scores could be interpreted as measures of essentially unidimensional constructs, despite some multidimensionality. This finding is consistent with several psychometric studies that have supported modelling engagement instruments with bifactor models (Inman, Moreira, Cunha, & Castro, 2020; Moreira et al., 2019; Wang, Fredricks, Ye, Hofkens, & Linn, 2016; Wang et al., 2017). By using a bifactor model, it was possible to assess the extent to which the engagement and disengagement general factors were associated with theoretically-related constructs *isolated* from the effects of specific factors. This approach provides an accurate model for testing convergent validity. Given the theoretical framework, we anticipated that engaged individuals would have higher scores on two measures describing environmental-self connections and would be more involved in civic activities promoting sustainable development. We also expected the opposite pattern of

results for individuals who were disengaged with sustainable development. Our results, which were consistent with these expectations, provide evidence (albeit indirect evidence) that the EDiSDI measures what it claims to measure (Borsboom, Mellenbergh, & Van Heerden, 2004).

Finally, we complemented tests using the bifactor model with IRT analyses. These indicated that the 27 EDiSDI items were very good at differentiating between individuals that are high and low in engagement and disengagement. Those wishing to use this measure can, therefore, be confident that this measure is sensitive to individual differences in engagement/disengagement. Users should also be aware that the EDiSDI is most precise at the lower levels of engagement and higher levels of disengagement (which is suitable, if not ideal, in the current context of promoting global sustainable development).

Do Engagement and Disengagement Lie on the Same Continuum?

A noteworthy finding was that the latent factor correlation between the engagement and disengagement general factors in Study 2 was particularly high ($r > -.90$). This result implies that engagement and disengagement do not reflect distinct constructs, but rather the opposing ends of the same underlying continuum. This contrasts with past studies that identified weaker latent correlations in bifactor models (e.g. Wang et al., 2017) and also with the weaker latent factor correlations identified in Study 1 (see Table 2). One explanation is that specific methodological features of the study augmented this correlation. For example, participants completed the original pool of 99 items alongside 62 further conceptually related items. It is possible that the large exposure to similar item content led participants to make their responses using more generalized heuristics (e.g. items that are pro- vs. anti-sustainable development) rather than considering the precise content of individual items. Alternatively, of course, this result may reflect the underlying reality of the engagement in sustainable development construct and hint at fundamental differences in the engagement construct when applied across contexts. Direct replications and studies applying only the reduced items derived from EFA are required to determine if this is the case.

Implications

To promote pro-sustainable behavioral patterns, having a clear understanding of what it means to be engaged with sustainable development is paramount. To achieve this, it is necessary to have a validated theoretical framework from which to define the concept of engagement. The present study has addressed this issue via the application of a well-supported framework of engagement with school to the context of sustainable development. By supporting a tridimensional characterization of engagement and disengagement, our findings imply that promoting engagement with sustainable development requires interventions that go beyond encouraging participation in behaviors. Adaptive subjective experiences of sustainable development (pro-sustainability beliefs/attitudes/perceptions and emotions) need to be fostered and, simultaneously, maladaptive processes linked to disengagement need to be tackled. Fortunately, evidence indicates engagement is malleable (Fredricks et al., 2004), meaning that it is responsive to interventions and other external/social influences. Using the proposed framework, interventions can be targeted at enhancing engagement (and tackling disengagement) with sustainable development, such as interventions aimed at creating positive attitudes and positive emotional experience linked to sustainable development, and thus contribute to a progression in society toward more sustainable living. Future studies using the EDiSDI as a psychometrically adequate measure will then be necessary to evaluate the efficacy of such interventions on developing engagement in sustainable development over time.

Limitations

In addition to the methodological issue raised above, we acknowledge several limitations of the studies. First, both used a snowball sampling method to recruit participants. This non-probability method suffers from a number of biases that make it difficult to generalize between the sample and target population (i.e. the general adult population). For example, the nature of the sample would have been influenced by the initial referring participants, which in this case were mainly female students at a private university. Future studies testing the EDiSDI should endeavor to use more sophisticated probability sampling techniques to acquire adult

samples that are more representative of the general adult population. A second limitation concerns our exclusive use of self-report instruments. This form of data collection lends itself to biased responses due to issues such as social desirability, which may be particularly salient for sustainable development, although this problem may have been reduced by collecting data anonymously online.

Conclusion

We offer a framework, imported from Educational Psychology, for conceptualizing engagement with sustainable development, and from it the EDiSDI. This measure is intended for measuring engagement and disengagement in sustainable development, and can be used in adult samples. In two studies, we provide evidence that the Portuguese version of this measure has adequate structural validity, reliability and convergent validity. Our results suggest that those choosing to use the EDiSDI can have confidence calculating and interpreting separate composite engagement and disengagement scores as indicators of essentially unidimensional constructs, although further research is needed to elucidate whether these fall on the same continuum, or should be measures as distinct constructs. We suggest that researchers with an interest in specific engagement/disengagement dimensions should adopt a bifactor approach to isolate effects of these dimensions from those of the global factors.

Electronic Supplementary Material

ESM 1. Electronic Supplementary Tables 1-4 **(**ESM1.docx)

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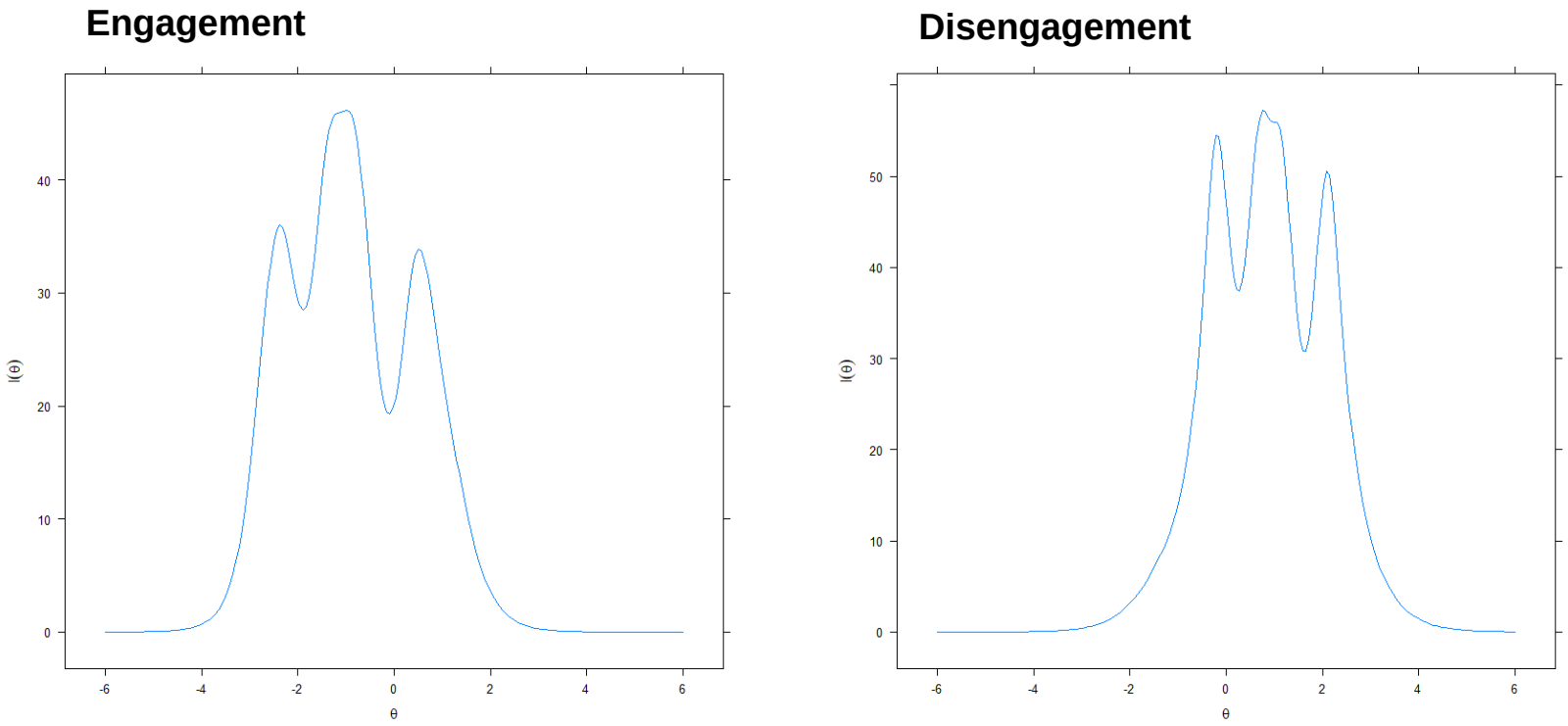

Figure 1. Test Information Curves (TIC) for the engagement (left-hand panel) and disengagement (right-hand panel) scales of the EDSD inventory.

Table 1.

BIC and RMSEA values for EFA models. (Study 1, n = 266)

Solution	BIC	TLI	RMSEA, 90% CI
3-factor	-1125.679	.878	.073 [.064, .077]
4-factor	-1139.691	.905	.065 [.056, .069]
5-factor	-1134.927	.930	.056 [.046, .060]
6-factor	-1116.941*	.954	.046 [.035, .051]

Note. *Minimum value

Table 2.

EFA with oblimin rotation and maximum likelihood factoring method. (Study 1, n = 266)

Item (English translation of original Portuguese item)	CD	BE	BD	CE	EE	ED
I think people don't have the power to protect the planet in their daily lives [I-1]	**.84**	.04	.06	-.03	-.01	-.03
I think the daily lives of ordinary people are irrelevant for the future of the planet [I-2]	**.69**	.07	-.03	-.16	-.02	.12
The future of the planet is entirely in the hands of people in positions of leadership [I-3]	**.64**	.03	.09	-.06	.01	-.05
People are deluded if they think they can do anything to protect the planet [I-4]	**.57**	-.02	.12	-.14	.09	.10
The environment has to be destroyed a little to meet people's needs [I-5]	**.57**	-.01	.13	.06	-.07	-.03
Striving for global sustainability is very expensive: rich people can worry about it, but poor people don't have that luxury [I-6]	**.55**	-.08	-.03	.09	-.09	.14
I think that people who care a lot about the future of the planet are fanatics (or a little crazy) [I-7]	**.54**	-.01	.03	-.04	.00	.14
My influence in protecting the planet is so small that it doesn't matter [I-8]	**.54**	-.07	-.03	-.11	-.10	.26
I am helping to make the planet a better place [I-9]	.03	**.75**	-.10	.05	.00	-.02
I strive to make life on our planet more sustainable [I-10]	-.07	**.67**	-.02	-.02	.10	-.09
In my daily life, I strive to do things that protect the planet and environment [I-11]	.06	**.64**	-.08	.12	.11	-.03
I always try my best to respect the planet [I-12]	.11	**.53**	-.19	.13	.09	-.04
Even if changing behavior is difficult, I will continue to try my best [I-13]	.04	**.42**	-.27	.07	.07	.03
I don't normally consider how my habits and behaviors affect the planet or environment [I-14]	.02	.06	**.91**	-.03	-.04	.00
When I do something, I rarely think about how it will affect the environment or planet [I-15]	.09	-.14	**.72**	.06	.02	.10
I don't do anything to protect the planet [I-16]	.09	-.14	**.66**	.09	-.08	-.02
I don't pay much attention to whether what I do is good for the planet [I-17]	.03	-.21	**.52**	-.12	.05	.16
Even if I'm told that what I'm doing is bad for the planet, if it is good for me I do it anyway.†	.00	-.17	.20	-.18	-.13	.19
If each of us does little things in our daily lives, it will have a big influence on the planet [I-18]	-.04	-.01	.09	**.83**	.06	-.03
I know I'm only a small part of the world, but small actions make a difference [I-19]	-.13	.08	-.07	**.78**	-.07	.05
Although I know global sustainability isn't just up to me, I think I can help [I-20]	.02	.11	-.09	**.47**	.32	-.08
I am interested in the protection of the planet [I-21]	-.08	.17	-.09	.01	**.69**	-.04
I often feel that other people and I are a part of nature [I-22]	.09	-.13	-.18	.19	**.63**	-.14
I feel concerned about the future of the planet [I-23]	-.12	.20	.02	.03	**.55**	-.14
I feel proud of the things I do to make the world better [I-24]	-.19	.35	-.01	-.03	**.49**	.19
I have a perfect idea of what is good and what is bad for the planet. †	-.13	.16	.03	.21	.26	.07
Global sustainability issues are annoying [I-25]	.13	-.06	.05	.04	.01	**.81**
I think sustainability issues are boring [I-26]	-.02	.02	.11	-.08	-.13	**.67**
I would like people to talk less about climate change (it's so annoying!) [I-27]	.29	.05	.01	-.05	-.11	**.40**
Global sustainability issues frustrate me.†	.22	-.29	-.11	-.02	.20	.35

Factor Correlations:						
CD	1.00					
BE	-.26	1.00				
BD	.40	-.62	1.00			
CE	-.51	.34	-.31	1.00		
EE	-.25	.54	-.48	.43	1.00	
ED	.65	-.31	.44	-.37	-.29	1.00

Note. † = item excluded after EFA due to factor loading < |.40|; CD = cognitive disengagement; BE = behavioral engagement; BD = behavioral disengagement; CE = cognitive engagement; EE = emotional engagement; ED = emotional disengagement. I-1, I-2 etc. refer to new item numbers after EFA and used in Study 2.

Table 3.

Fully standardized factor loadings and unstandardized error terms for the bifactor models tested in Study 2 (n = 510).

Item	$\lambda_{GEN-ENG}$	$\lambda_{GEN-DISENG}$	λ_{AER}	λ_{AI}	λ_{POS}	λ_{PES}	λ_{IA}	λ_{NAR}	Error Variance
I-21	1.00 (.88)		1.00 (.34)						.12
I-22	0.85 (.78)		0.62 (.22)						.35
I-23	0.96 (.86)		0.62 (.22)						.22
I-24	0.84 (.72)		1.14 (.39)						.36
I-9	0.79 (.77)			1.00 (.42)					.20
I-10	0.81 (.72)			0.80 (.31)					.39
I-11	0.86 (.80)			0.69 (.28)					.27
I-12	0.89 (.83)			0.86 (.34)					.18
I-13	0.89 (.81)			0.84 (.33)					.22
I-18	0.85 (.89)				1.00 (.42)				.03
I-19	0.95 (.88)				0.93 (.36)				.09
I-20	0.96 (.90)				0.75 (.16)				.15
I-1		1.00 (.85)				1.00 (.42)			.13
I-2		0.98 (.87)				0.93 (.40)			.09
I-3		0.97 (.76)				0.75 (.29)			.50
I-4		1.03 (.84)				0.67 (.27)			.30
I-5		0.82 (.69)				0.25 (.11)			.63
I-6		1.02 (.77)				0.42 (.15)			.61
I-7		1.02 (.81)				0.26 (.10)			.48
I-8		1.02 (.88)				0.75 (.32)			.14
I-14		0.82 (.67)					1.00 (.67)		.14
I-15		0.78 (.65)					1.01 (.69)		.13
I-16		0.80 (.61)					0.88 (.55)		.47
I-17		0.88 (.70)					0.89 (.59)		.23
I-25		0.92 (.85)						1.00 (.42)	.10
I-26		0.86 (.75)						0.96 (.38)	.36
I-27		0.99 (.84)						0.47 (.18)	.33

Note. Values on the left of the / represent standardized loadings from the bifactor model tested in Study 2. Values on the right of the / represent standardized loadings from the bifactor model tested in Study 3. GEN-ENG = general engagement factor; GEN-DISENG = general disengagement factor; AER = adaptive affective reactions; AI = active involvement; POS = positive thoughts; PES = pessimistic thoughts; IA = inconsiderate actions; NAR = negative affective reactions.

Table 4.

Standardized latent factor correlations between the bifactor model and external variables (Study 2, n = 510).

	Nature Relatedness	Environmental Action	Environmental Identity
General Factors			
Engagement	.889*	.344*	.679*
Disengagement	-.878	-.371*	-.653*
Specific Factors			
Positive Thoughts	.052	.034	.155
Adaptive Affective Reactions	.275	.044	.288*
Active Involvement	-.056	-.015	.056
Pessimistic Thoughts	-.000	.100	.023
Negative Affective Reactions	-.043	.137	-.029
Inconsiderate Actions	-.105*	-.360*	-.114*

Note. *$p < .05$.

Table 5.

Item parameters for the EDSD Inventory (Study 2, n = 510).

Dimension	Item	Discrimination	Difficulty			
			≥2	≥3	≥4	=5
Engagement						
Emo	I-21	4.31	-2.29	-1.20	-0.70	0.58
	I-22	2.61	-2.73	-1.34	-0.60	0.81
	I-23	3.83	-2.36	-1.28	-0.75	0.63
	I-24	2.51	-2.38	-1.35	-0.45	0.85
Beh	I-9	2.88	-2.35	-1.46	-0.71	1.10
	I-10	2.24	-2.22	-1.25	-0.69	1.45
	I-11	3.10	-2.22	-1.24	-0.70	1.14
	I-12	3.48	-2.11	-1.30	-0.71	1.01
Cog	I-13	3.25	-1.98	-1.32	-0.73	1.09
	I-18	4.76	-2.79	-1.36	-0.86	0.35
	I-19	4.97	-2.51	-1.38	-0.89	0.36
	I-20	5.01	-2.36	-1.35	-0.82	0.56
Disengagement						
Cog	I-1	5.36	-0.20	0.72	1.14	2.05
	I-2	5.83	-0.19	0.73	1.21	2.17
	I-3	2.77	-0.54	0.46	1.01	1.97
	I-4	4.67	-0.24	0.47	1.01	2.14
	I-5	1.92	-0.49	0.57	1.33	3.14
	I-6	2.64	-0.29	0.42	1.11	1.92
	I-7	3.27	-0.29	0.51	1.05	2.11
	I-8	6.93	-0.17	0.71	1.13	2.07
Beh	I-14	2.48	-1.12	-0.08	0.48	2.62
	I-15	2.25	-1.36	-0.09	0.48	2.52
	I-16	2.03	-1.35	-0.26	0.12	2.21
	I-17	2.59	-0.97	0.04	0.59	2.39
Emo	I-25	3.59	-0.30	0.88	1.31	2.52
	I-26	2.44	-0.58	0.76	1.18	2.61
	I-27	3.08	-0.30	0.74	1.19	2.20

Note. Discrimination = alphas. Difficulty = betas. All items were analysed in a single model. We indicate the subscales to which items belong to help with the interpretation of parameters. CD = cognitive disengagement; BE = behavioural engagement; BD = behavioural disengagement; CE = cognitive engagement; EE = emotional engagement; ED = emotional disengagement