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The oneness IAT as a new assessment tool for sustainability research

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Abstract
Oneness is described as a unifying dimension of all existence, reportedly experienced by various demographics as a transcendence of self and connection with the universe. Its relevance in psychology and sustainability science stems from its positive link to pro-environmental lifestyles, emphasizing the need for accurate assessment. Most studies rely solely on self-report methods, despite concerns about their suitability. Scholars suggest implicit measures to access automatically activated mental associations. This study develops and validates a new Implicit Association Test (IAT) designed to analyse response latency to oneness-related words. Guided by two experts and literature in psychoanalysis and environmental psychology, the IAT integrates implicit and explicit measures adapted from previous research. This exploratory study consists of two phases: Study 1 ($n=31$) examines the reliability of the selected words, finding significant internal consistency and predicted IAT effects. Study 2 ($n=92$) explores the psychometric properties of the same IAT, assessing criterion-related and construct validity. Correlation tests indicate significant positive relationships with prior oneness measures and related variables. A multiple regression analysis identifies significant links between IAT scores and gender, religiousness, and spirituality, corroborating previous findings. Limitations arise due to the binary structure of the IAT, which may constrain its ability to fully capture oneness. Reliance on self-report measures in psychometric properties validation raises concerns about their ability to reflect nonconscious associations. This study contributes to discussions on oneness categorization and assessment by introducing an IAT-based measurement applicable across multiple fields.

Keywords Implicit association test, Oneness, Psychometric properties, Self-transcendence, Spirituality, Test validity

1 Introduction

Oneness has garnered growing interest from researchers amid the climate change emergency [1, 2]. In the face of humanitarian polycrises and insufficient collective action, the concept of spiritual oneness unveils a promising radicality for systemic transformation [3–6]. The acknowledgment of being one with the whole and of a "big We" [7, p.86] has been evoked in the speeches of environmental activists, Indigenous leaders, and often pleaded by scientists, economists, educators, and mental health physicians as a powerful

catalyst for radical change [3, 8–10]. Oneness is considered to make people care about the environment as nature "protecting itself" rather than as separate entities [10–12], even when that behaviour is inconvenient [13, 14]. This *self*-protection that includes the *other* and all of existence [15] has been linked to an intrinsic, intuitive motivation that differs from anthropocentric motivators such as personal wellbeing, human flourishing, economic benefits, or social approval [16, 17].

The experience of oneness has been, among other, related to the practice of meditation [5, 18], art-making [19–21], activism [2, 3, 22], mindfulness [23, 24], psychoanalysis [25–27], and engagement in mystical experiences [28–31], leaving room to question if oneness can be predicted and leveraged by controlled experiences. However, research on oneness and its impact on pro-environmental behaviour has been hindered by the absence of robust methods for measuring oneness. Moreover, oneness is framed by researchers as rooted in deeper societal structures, hence vulnerable to systemic oppression. Sociologists argue that embracing the inclusive oneness and wholeness of belonging has been compromised by an indoctrinated "inner diaspora" that has driven society to the brink of alienation and "spiritual departure from one's mediated self" [4, 7]. Some authors ascribe this to the colonizing identities of whiteness and patriarchy [4]. Others refer to the intertwined concepts of capitalism and disconnected individualism [33–35].

Considering the relevance of assessing oneness in climate action studies by identifying the potential for acting from a place of holistic self-preservation, this paper aims to thoroughly examine oneness by proposing refined methods for its assessment that can encompass its complexity and depth. Following the premise that oneness is more suitable to be assessed through automatically activated associations than with the existing self-reporting methods [36, 37], this study introduces a new implicit measure designed to assess the perceived ontology (PO) of oneness. It begins by establishing a theoretical framework that traces how oneness has been categorized and perceived across time. The paper then reviews existing assessment tools, ultimately narrowing its focus to the Implicit Association Test (IAT) as the core methodological approach. This study draws primarily from environmental psychology and psychoanalysis, while referencing adjacent disciplines to contextualize its conceptual framing. The subsequent chapters describe the results of two studies: the first details the design process, while the second evaluates the psychometric properties of the tool. The paper closes with a discussion and conclusion, addressing the studies' results, limitations, and future directions.

2 Assessing oneness

2.1 Oneness categorization

Various scientific disciplines, including psychology, ecology, sociology, neuroscience, and cognitive science, have framed oneness, specifically within religious and spiritual studies [15, 38–41]. Despite its pervasive presence, in empirical terms, the oneness concept has often been analysed rather superficially. It lacks adequate assessment tools with a more nuanced understanding of the spiritual experience and its full psychoanalytical dimensions [18].

Oneness references were brought from Sanskrit texts forming the philosophical basis of Hinduism, as *Brahman* (the universal soul), to ancient western literature. Pre-Socratic ideas were based on a unifying principle of all phenomena and Plato argued that "the one" must come before "the many", succeeded by Plotinus' first principle of "One" or

"The Good" as the ultimate source of all reality transcending all categories of being and non-being. Oneness is herein characterized by its ineffability, as it cannot be comprehended by human intellect or described by language. Instead, it can only be approached through a mystical union where the soul transcends the material world [2, 39, 42, 43]. Oneness was described similarly across religions, from Christian mysticism through the idea of "union with God", to the Buddhist concept of *Śūnyatā* (nothingness) [38, 44]. Oneness was absorbed by Islamic thought too, as *Tawhid* (oneness of God), and particularly within the Sufi mystical tradition, as *Wahdat al-Wujūd* (unity of existence), stating that all things are interconnected and derive their existence from the same divine source [42].

Freud (1930) laid the groundwork for oneness in twentieth century's psychoanalysis by introducing the term "oceanic feeling" (pp. 64–65, 72), describing it as a sense of limitlessness and of "being one with the external world as a whole" [2, 20, 45]. Developmental psychoanalysts that later built their theories on Klein's (1932) researched the fusional experience between the infant and its primary caregiver and the transition process to recognition of separate entities, ultimately fostering a cohesive sense of self [27, 46–50]. However, research findings from the late 1980s based on microanalysis of mother-infant interactions revealed that infants develop a sense of self much earlier than previously believed. Beebe and Lachmann's studies using frame-by-frame video recordings describe a dimension that is marked by the ability to feel both a sense of oneness and a distinct self [51]. Bion challenged oneness research by moving the field of study from children's development to intuitionistic and subjective science, such as spirituality and mysticism, referring to an ultimate, ineffable reality that is beyond human understanding and articulation, which he called "O" [29, 52, 53]. "O" is "the unknowable and the unreachable ultimate truth" that can be accessed through intuition and emotional resonance felt in psychoanalysis, but also poetry, music, painting, religion and philosophy, in a sense that these platforms are all engaged in the same search for truth [54]. Oneness was also observed in the analytic relationship, described by Bion as "at-one-ment" [29, 52, 55], manifested in the "analytic third", a co-created intersubjective space that emerges from the analyst-analysand interaction [27]. It is also referred to as the "black hole" of interpersonal psychic space [25], and as transposing non-dualistic approaches to mind-body and subject-object to tackle today's hyper-individualism [26]. Bion's work on oneness was also expanded to the realm of social group dynamics [56], paving the way for a sociological depiction of oneness, in addition to the spiritual and psychological dimensions.

The increase of oneness conceptualizations within environmental science led researchers to disambiguate and categorize oneness terms as they became increasingly scattered. A recent typology study suggests that oneness—defined as "a sense of profound unity with some other entity" that transcends the self—is categorized across psychology literature according to scope, manifestation and perceived ontology [15]. Five scopes are specified, within which the "other entity" can range: (1) one another, (2) a social group; (3) humanity; (4) nature; and (5) "everything". Apart from the one included in the latest scope, "everything" [15], the selected literature understates the all-inclusive, unabridged nature of oneness originally described in ancient texts. Whereas, for example, the *inclusion of other in the self* (IOS) [13, 57] addresses inclusion of other people or another individual into one's self-concept, literature explicitly mentioning oneness portrays "other" as a presence that goes beyond a person or entity. It is referred to as "an Other" with

a capital "O", emphasizing the symbolic presence [19] or as "the many" or the material world described in nondual texts [2, 5]. Part of Coomber and Harré's selected literature—including the fifth scope ("everything")—also misses the fundamental mystical dimension of oneness. Oneness has been mentioned interchangeably as *metapersonal self-construal* [58], *mystical experiences* [59, 60], *spirituality* [61], *spiritual transcendence* [62], *self-expansiveness* [63], *self-transcendent experience* [30, 64], *nondual awareness* [5, 65, 66], and *ego-dissolution* [41]. Oneness is also categorized according to how it manifests [15]: as an experience of boundlessness, self-transcendence, nothingness, timelessness or wholeness [18, 19, 25, 28]; as an intuition or "sense" beyond the cognitive realization that one's self and everything else is one [65, 66]; or as a belief in the fundamental interconnectedness and unity of all existence [1, 2, 44, 67]. The perceived ontology (PO) of oneness is divided into three basic categories: expansion, in which the other is included in the self, thereby expanding the self; interdependence, in which the self is part of a greater whole; and essential, in which the self and the other are seen as sharing some fundamental essence [15]. Reinterpretations and deviations of the concept of oneness from its unboundedness and mystical dimension may compromise the applicability of the assessment tools [18, 38, 44]. Therefore, correctly framing oneness is crucial to its assessment.

2.2 Oneness assessment tools

The assessment tools used to examine oneness reliably vary across different fields of study. In the realm of psychoanalysis, oneness is analysed with the psychoanalytical method, in in-depth clinical case studies [25, 50, 52, 68], and non-clinical case studies [19]. In a particular case for a set of developmental psychology studies, a microanalytic observational method was applied by analysing videotaped mother-infant interactions and measuring their nonverbal attunement [51]. Oneness is also assessed through *interactive management* (IM) in psychology, a collective intelligence method that collects participatory insight through structured dialogue with experienced meditators [18]. In the great majority of cases, oneness is assessed with self-report questionnaires in which participants are asked the degree to which they agree with a list of statements, some of which integrating oneness measurement scales, namely the *oneness beliefs scale* (OBS) with physical oneness and spiritual oneness subscales [1] and the *belief in oneness scale* (BOS) [67]. These instruments treat oneness as a belief system, but recent contributions from personality psychology suggest that such beliefs may also reflect stable individual traits [2, 67]. Oneness has also been measured as a behaviour with the *oneness behaviors scale* [23, 40], although oneness behaviours are not acknowledged by self-transcendence studies, which caution against conflating oneness with its "antecedents or outcomes" [15, 64].

Regarding variables that are interchangeable with oneness, similar assessment measures using self-reporting questionnaires have been applied in transpersonal psychology and religion studies. The *metapersonal self-construal scale* (SCS) [58], based on Bragg's constructionist self-theory [69], the transpersonal scale of the *self-expansiveness level form* [63], the *spiritual transcendence scale* [62], the phenomenological dimension of the *expressions of spirituality inventory* [61], the ego quality and unifying quality subscales of the mysticism scale of *reported mystical experience* [59], the external and internal unity sub-scales of the *mystical experience questionnaire* [70], the *revised mystical*

experiences questionnaire [60], the *mysticism scale* [71], the connectedness factor of the *awe experience scale* (AWE-S) [72], and the transpersonal self cluster of the *meditation depth index* [73]. Neuroscience studies on meditative states of consciousness, in which oneness is experienced, measure the brain activity of participants by generating detailed images with magnetic resonance imaging scanners [64, 74–76], in which an "enlightenment state, where time and place limits have disappeared, and a great feeling of love/unity is experienced" is reported and analysed [75]. Table 1 lists the assessment tools used to evaluate oneness and other interchangeable variables in scientific studies since the 1960s.

In addition to divergences in oneness categorization discussed above, the reliance on self-report questionnaires for assessing oneness further raises concerns about oneness' measurability. While metaphysical claims of oneness posit an ultimate, indivisible reality, psychological perceptions of oneness reflect how individuals subjectively experience interconnectedness with the whole. Given its ineffable nature, oneness is assessed through psychological representations rather than assertions about metaphysical truth [29, 52]. Self-report measures are considered to be limited in accurately capturing complex psychological constructs because they can be biased by social desirability, lack of self-awareness, and their very abstract nature [77]. Researchers argue that a person's beliefs or intuitions are either unconscious or at least not "readily available for retrieval" and thus not suitable to be self-reported, but rather likely to be assessed through non-conscious automatic associations [78, 79]. Implicit measures are argued to be a more

Table 1 Oneness-related assessment and measurement tools

Terminology	Assessment tool		References
Oneness	Psychoanalytical method	Clinical case studies	[25, 50, 52, 68]
		Non-clinical case studies	[19]
	Scale with self-report questionnaire	Oneness beliefs scale	[1, 2]
		Belief in oneness scale	[67]
		Oneness behaviours scale	[23]
	Interactive management		[18]
Metapersonal self	Scale with self-report questionnaire	Metapersonal self-construal scale	[58]
Self-expansiveness	Scale with self-report questionnaire	Transpersonal scale of the self-expansiveness level form	[63]
Spiritual transcendence	Scale with self-report questionnaire	Spiritual transcendence scale	[62]
Spirituality	Scale with self-report questionnaire	Phenomenological dimension of the expressions of spirituality inventory	[61]
Mystical experience	Scale with self-report questionnaire	Ego quality and unifying quality subscales of the mysticism scale of reported mystical experience	[59]
	Scale with self-report questionnaire	External and internal unity subscales of the mystical experience questionnaire	[70]
	Scale with self-report questionnaire	Revised mystical experiences questionnaire	[60]
Mysticism	Scale with self-report questionnaire	Mysticism Scale	[71]
Awe experience	Scale with self-report questionnaire	Connectedness factor of the awe experience scale	[72]
Meditation depth	Scale with self-report questionnaire	Transpersonal self cluster of the meditation depth index	[73]
Meditative state	Magnetic Ressonance Imaging		[75]

reliable methodological approach to overcome this research gap and provide observable data.

2.3 The implicit association test

In psychology, the term implicit refers to mental processes or representations that operate without conscious awareness or intentional control. Implicit measures are defined as performance-based assessment tools that infer mental content from tasks responses, rather than relying on self-report. The implicit association test (IAT) is an implicit measure using a response latency technique's (RTL), designed to measure the speed, hence the strength, of associations between two concept representations in a person's memory. The IAT involves organizing words, or images representing concepts, into a pair of categories. Participants are asked to sort these concepts appearing in the middle of a computer screen into attributes on the left and on the right, as fast as they can, using two keyboard keys. Faster responses indicate stronger implicit associations between the paired concepts and attributes [80, 81]. Greenwald first developed the test in 1998, measuring "pleasant" vs. "unpleasant" cognitive associations, later applied in psychology, social sciences and marketing studies. The IAT is mainly used to unveil social biases (e.g., race, gender, age) and consumers' underlying cognitive processes. However, it has been recently applied and recommended to measure participants' connectedness with nature [79, 82, 83], which anticipates the potentiality for oneness assessment as well, considering that both oneness and connectedness are a sense of unity, transcending the boundaries of self or expanding the concept of *me* to include an external entity [15].

The IAT enables a broad applicability, sensitivity to subtle differences, cost-effectiveness, promptness, effortless engagement process, and ability to uncover unconscious biases that individuals may not be aware of [84]. However, there is currently no compelling evidence that the IAT reveals attitudes or self-concepts of which individuals are genuinely unaware [85, 86]. The data collected from the Implicit Association Test (IAT) is synthesized into a key metric known as the D-score, which can be quantitatively related to other variables [84].

The attribute exemplars (i.e., the pair of words conveying the positive category and the negative category) used in an implicit association test must be "easy for subjects to sort" and common sense is suggested to be enough in this selection process because the specific words chosen for the evaluative stimuli do not significantly impact the results. A wide range of attribute words can be effectively used in the IAT without compromising its reliability. However, the selection of target exemplars is rather critical. Each one of the exemplars should differ from those for its contrasted target category in one primary feature. This recommendation is suggested to be crucial in avoiding ambiguity and succeeding at the pilot test validation [84, 87] that is further described in Study 1. Given the previously mentioned complexity in defining oneness across the literature, this study assimilates an insight that has been overlooked in recent oneness assessment tools: the integrative view of oneness that includes not only blissful feelings, but also dreadful ones. Ofra Eshel delves into the "unfathomable depths of deadness and emptiness" of the "black hole" that lies in the interpersonal psychic space [25], confirming the "suffering" dimension of oneness reported by experienced meditators [18] that traces back to the mystical path of loss towards the unity of existence [42]. Oneness scales that are

one sided with a list of pleasant premises only might reinforce bias in self-reporting and compromise overall measurement efficacy.

3 Study 1: IAT development and pilot testing

The first study consists of developing an implicit association test (IAT) to assess oneness. For content validity, the design phase identifies relevant sets of target words, attribute words (positive and negative), and respective stimuli words, with the input of two expert interviews. A subsequent pilot testing uses the category classification tasks, following the recommended practices for administering IAT measures, to verify if the words are easy enough to classify [84] and examines the internal consistency-reliability of the selection of words [88].

3.1 Method

3.1.1 Participants

Participants in this study were selected through unrestricted convenience sampling, appropriate for pilot studies and preliminary research [89]. A total of 35 subjects completed the online test by following a hyperlink provided via email. The initial email included a brief introduction to the study's aim, test format, language (English), estimated duration, and a request to forward the email to others, creating a snowball sampling effect. No recruitment services nor incentives were used. The link was shared informally through the first author's personal and professional contacts, who then circulated it within their own networks. This open distribution likely contributed to a relatively diverse sample in terms of age, religion, and education. Although most participants were Portuguese, English proficiency was inferred from their voluntary engagement with the English-language test, as outlined in the introductory explanation. No demographic filters were applied, and participation was unrestricted to anyone with access to the link. All methods were carried out in accordance with relevant guidelines and regulations and were approved by the Ethics Committee of the NOVA School of Science and Technology with the Ref. CE_FCT_017-2025. Informed consent was obtained through a consent declaration embedded in the online form before the actual test. Four participants were removed from the data set due to error rates above 20%, following Greenwald's assumption that participants might have either misunderstood the instructions or responded too rapidly in these cases [6, 80], and no participants were discarded for having mean latency below 300*ms*. A final sample size of 31 participants was retained. The age range varied from 17 to 59 years old (M = 34.23; SD = 9.07). 20 participants identified as women, 10 as men, and 1 as other. The sample size was determined based on a power analysis conducted using G*Power version 3.1.9.7 [90]. With an expected Cronbach's alpha value of at least 0.5, an alpha level of 0.05, and a desired power of 0.95, the analysis indicated that the sample size meets the required conditions for internal consistency [91, 92].

3.1.2 Design

In an implicit association test, participants are asked to sort words into positive and negative attributes that have to be defined in the design phase, as well as a set of two target words and respective stimuli exemplars [80, 93]. This study collected recommendations from two experts in semi-structured interviews (see Appendix A): (i) a social

psychologist based in the United States who pioneered the use of IAT in environmental psychology and developed several IAT studies measuring connectedness with nature—which is categorized as oneness in sustainability studies [15]—and (ii) a psychoanalyst specialist based in Portugal developing research work in oneness studies. The experts were selected based on their respective qualifications—one for developing an IAT from the ground up to measure connectedness with nature, and the other for expertise in oneness studies—with both demonstrating willingness to engage in a one-hour online interview. The selection of words was guided by the interviewees' responses and supported by referred literature, following the recommended practices for selecting categories and exemplar stimuli [84]. The exploratory nature of this study prompted integrating diverse perspectives coming from the experts' inputs and literature, while acknowledging potential limitations in construct validity and category coherence. Table 2 summarizes the stimuli words for each target and attribute used for the IAT.

The test replicates Schultz's (2004, 2007, 2010, 2017) self-referential valence framework, with the attributes "Me" (positive) and "Not-me" (negative) and their respective five related words. "Me" represents personal identification and "Not-me" signals psychological distance. The use of "Not-me" is supported by Greenwald's recommendation A6 "negations can be satisfactory in category labels" [84]. Although the "Me" vs. "Not-me" categorization may blur nuances of oneness perception—since it can ambiguously reflect either inclusion in a larger whole or separation from it—it provides a pragmatic structure for exploring implicit associations related to perceived ontology and for testing construct validity. Because the oneness experience is perceived as a fundamental *unboundedness* or a sense of dissolved boundaries [18], target words were set to be "Bounded" and "Unbounded". Two groups of seven stimuli words were selected for each target, ensuring both target groups were balanced in terms of pleasant and unpleasant words. For example, the "Unbounded" group of words includes terms like "cosmos" and "transcendence", integrated with an extended perception of self [67]; "infinity" because of the consistent reporting of a sense of being "infinite" [18]; and "unknown", due to Winnicott's [48, 94, 95] and Bion's [52, 96] embracement of the unknown and of the unthinkable to be in oneness [18, 25]. Conversely, words like "darkness", "void" and "death" are also part of the "Unbounded" target to counterbalance the essentiality of "suffering" in the oneness experience [18]. Oneness literature pictures the self-other overlap in the interpersonal psychic space as a "black hole" experience [25, 96, 97]. Oneness or "at-one-ment" is described as the "bottomless void of primary meaninglessness, nothingness, chaos, and dread" [25], and ultimately an acceptance of "death" [18], or the feeling of "deadness" itself and "going through annihilation and death" [25]. The "Bounded" group of words includes terms of Shalom Schwartz's [98] theory of values conveying the self-centred conceptualization of restraint "power" as opposed to "self-transcendence". The

Table 2 Words used for oneness assessment on the IAT of study 1

Target		Attribute	
Unbounded	**Bounded**	**Me (positive)**	**Not me (negative)**
Cosmos	Authority	I	Another
Darkness	Control	Me	It
Death	Dominance	My	Other
Infinity	Power	Myself	Them
Transcendence	Prestige	Self	They
Unknown	Status		
Void	Wealth		

inclusion of the words "domination" and "control" in the "Bounded" target group is reinforced by the negative relation between spiritual oneness and dominion beliefs [1] and the definition of oneness experience as a feeling of "no longer needing to control" [18]. The interviews were additionally useful to sharpen details about the software used for conducting the IAT (see next section), used both for the test and data analysis, the desirable setting, procedures and limitations.

3.1.3 Materials

IAT. A modified version of Greenwald's IAT was used to assess automatic associations [80, 84]. A computerized test was developed online in Testable.org with a default setting of an implicit association test, which was later adapted to the number of blocks, trials, and stimuli words of Harvard's Project Implicit, applying the words above, and also according to Greenwald's directives on structure [84]. This test measures the reaction time (in milliseconds) participants take to sort words into categories and target-concepts. Figure 1 presents four samples of the computerized test.

The IAT of this study consisted of 180 trials distributed in five parts—three blocks for practice and two parts containing a practice block with a critical block—summarizing a total of seven blocks. Practice blocks are designed to help participants become familiar with the task and the categories they will be using. The two critical blocks - one *combined and congruent*, where the categories that are typically associated together for oneness (e.g., "me" and "transcendence") share the same response key, and one *combined*

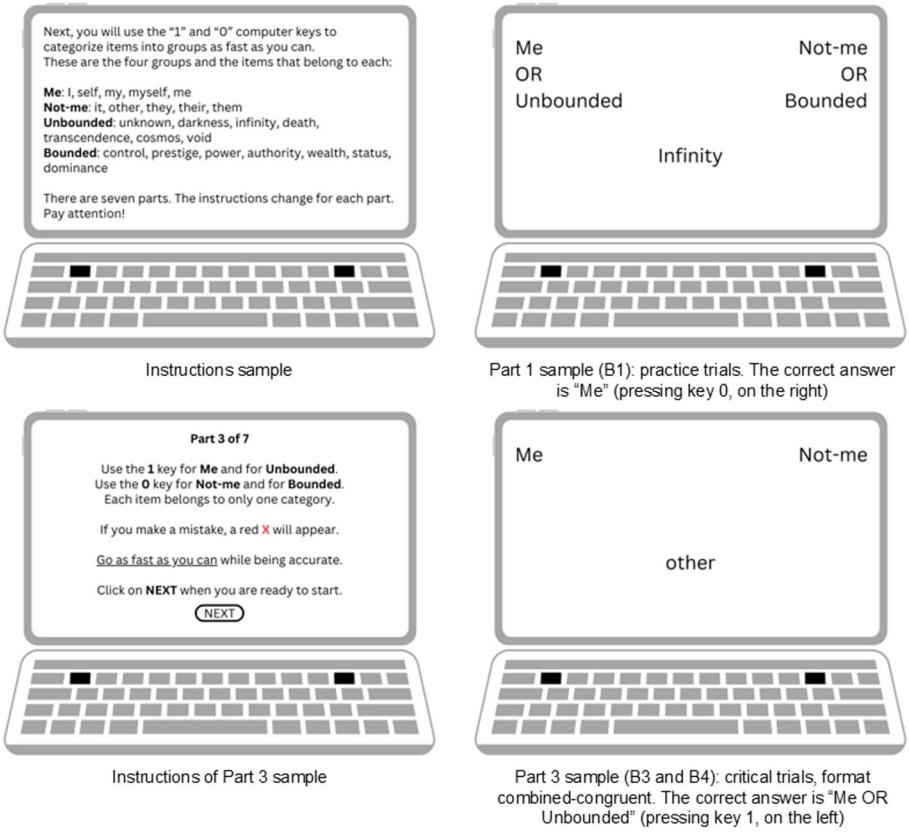

Fig. 1 Sample screenshots of the IAT in Testable: the initial instructions, a trial of part 1, the introduction to part 3, and a trial of part 3

and incongruent, where the categories that are typically associated together correspond to different response keys—issue the reaction times that will further generate the D-score by standardizing the differences between both means.

The D-score is a standardized measure derived from response latencies in the IAT. It quantifies the relative strength of one pair of associations compared to another by comparing response times across task blocks. Testable randomizes the order in which stimuli words appear on screen but also ensures that repetitions on both attributes and targets are counterbalanced. Table 3 shows the schematic description of the implicit measure of the IAT.

Demographics of the IAT include age, gender, education level, and two yes-or-no questions about whether participants considered themselves religious and whether they considered themselves spiritual. This study acknowledges gender as socially constructed roles and behaviours, following SGBA best practices [99], including a non-binary option "other" that allows participants to self-identify. The demographics of this test were chosen based on previous research, which indicates that respondents identifying as women have significantly higher oneness, that oneness increases with age and decreases with education level [2], and positive relations between oneness and spirituality and between oneness and religiosity [1, 28, 67] .

3.1.4 Procedure

Participants used individual computers to follow the hyperlink that was sent to them by email along with a brief written explanation of the aim of the study. The hyperlink took them to a computerized test (in Testable.org) in which they were invited to read and sign a consent form to assure their understanding of the IAT procedure, followed by a demographic form of compulsory filling. Before initiating the actual implicit measure, subjects were asked if they agreed to be contacted further on to be part of the next research phase that would follow the present study. Subjects were then prior presented with the list of words and categories that they were supposed to put together in the sorting task (see Table 1) and were also advised to do it as accurately and as fast as they could, keeping their left and right fingers on top of the "1" and "0" keys of the keyboard at all times. The test automatically records the reaction time (RT) in milliseconds for each of the 180 trials and notes whether each response was correct or incorrect, which is used for calculating the error rate. Once the last submit button is hit, the test is complete and Testable.org automatically generates a file per participant, which can be immediately accessed and downloaded by the authors for further analysis. The data is then organized into a single table or data frame, including the D-score, demographics, average reaction times (RT), and error rates. This data frame is designed to be accessed and analysed using R version 4.3.2 [100]. The analysis utilizes various function: *lm* for linear multiple regression, *cor.*

Table 3 Schematic diagram of the IAT in testable

Part	Block	Type	Trials	Format	Left attribute/target(1)	Right attribute/target(0)
1	B_1	Practice	20	Simple	Me	Not me
2	B_2	Practice	20	Simple	Unbounded	Bounded
3	B_3	Practice	20	Combined–congruent	Me OR Unbounded	Not me OR Bounded
	B_4	Critical	40	Combined–congruent	Me OR Unbounded	Not me OR Bounded
4	B_5	Practice	20	Simple	Bounded	Unbounded
5	B_6	Practice	20	Combined–incongruent	Me OR Bounded	Not me OR Unbounded
	B_7	Critical	40	Combined–incongruent	Me OR Bounded	Not me OR Unbounded

test for correlation tests, *alpha* for Cronbach's alpha test and *splitHalf* for split-half test. The latter two are intended to evaluate the reliability of the implicit measure.

3.2 Results

The first study yielded an average D-score of 0.18 (*SD* = 0.63), ranging from – 1.17 to 1.28. The D-score for each participant is calculated using the formula below, after neutralizing responses with reaction times (RT) over 10,000*ms*, and replacing the RT of incorrect responses with the respective block's average RT plus a penalty of 600*ms*, following the protocol recommended by Greenwald [84, 93, 101] (Eq. 1).

$$d = \frac{M_{incongruent} - M_{congruent}}{\text{SD}} \tag{1}$$

In a preliminary analysis, *p*-values were calculated with a linear multiple regression in R version 4.3.2 [100], relating the D-score and participants' demographics like age, gender, education, religiousness and spirituality (the latter two are yes-or-no questions). The multiple regression delivered no noteworthy relations between the D-score and the predictors referred above. However, a correlation test yielded a marginally significant negative correlation between the subjects' age and their D-score (r = – 0.362; p = 0.046).

The data analysis procedure to evaluate whether the words used were easy enough to classify consists of calculating the participants' average response latency of the first two practice blocks (see B_1 and B_2 in Table 2) and error rates. The majority of the subjects should range their average time, measured in milliseconds, between 600 and 800, while also presenting error rates below 10% [84]. The first 52 percentile of participants in this study scored between 600 and 800 milliseconds, and 97% of participants had error rates below 10%. These results configure favourable outcomes for a positive pilot testing and the content validity of the test. Reaction times ranged from 650.3ms to 1261.4 ms, with a median of 784.1 ms (M = 854.1; SD = 154.8). Figure 2 shows the density of participants' average reaction time (RT) and error rates in both block 1 and block 2. Both histograms reveal positively skewed distributions. As expected in typical reaction time histograms [102], most reaction times are clustered towards the lower end, with a few outliers extending the distribution towards higher values, as most reactions happen quickly, but a few outliers take much longer (Fig. 2).

A split-half reliability test delivered excellent internal consistency, with an average of 0.95 across the 80 trials of the implicit association test's critical blocks, both congruent and incongruent (see B_4 and B_7 in Table 3), with a sample size of 31 respondents. The Cronbach's alpha analysis indicates excellent internal consistency of the IAT as well, with a raw alpha of 0.94 and a standardized alpha of 0.95, which is considered to indicate excellent levels of reliability [103]. The average inter-item correlation is 0.2, suggesting moderate relationships between items. By taking out specific stimuli words, consistency did not significantly increase or decrease the coefficient of the Cronbach's alpha analysis. Table 4 shows the summary of split-half reliability and Cronbach's Alpha results of the IAT.

An additional exploratory analysis revealed a significant difference in reaction times (RT) between participants with the highest and lowest D-scores on the IAT. A Pearson correlation analysis revealed a highly significant negative correlation between the variables ($r = -0.731$; $p = 3.071 \times 10^{-6}$). Participants with higher D-scores demonstrated

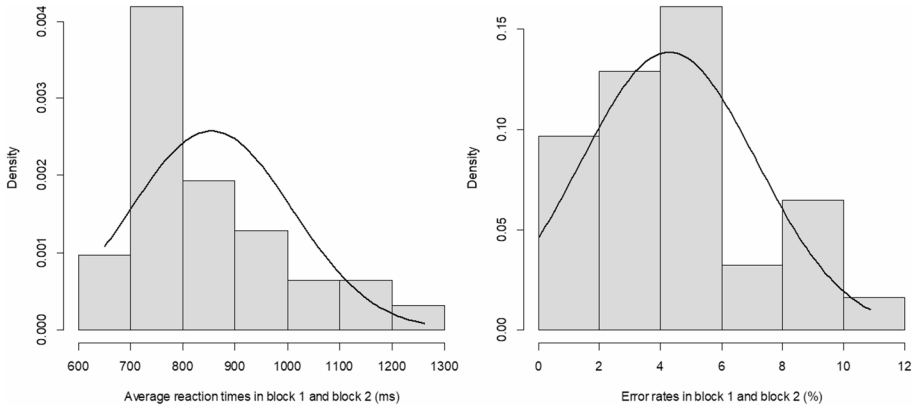

Fig. 2 Histogram of reaction times (RT) in the pilot testing of the implicit association test (on the left) and histogram of participants' error rates in the implicit association test (on the right). The density of the average RT between 600 and 800 milliseconds and the density of participants responding incorrectly to more than 10% of trials shows that the words used in the test are easy enough to classify, which configures a positive result for a valid pilot testing

Table 4 Summary of the analysis of internal consistency of the IAT

Trials	Split-half reliability	Cronbach's alpha	Std.alpha	G6 (smc)	Average *r*	Median *r*
80	0.95	0.94	0.95	0.99	0.2	0.17

n = 31. std.alpha = standardized alpha median; G6 = Guttman's lambda 6; average r = average inter-item; median r = median inter-item correlation

significantly lower RTs than those with lower D-scores, indicating they were faster at sorting words in the critical blocks (which included an equal number of congruent and incongruent trials).

The first study concludes that the IAT developed is suited to be applied in the oneness assessment of the following study without any further adaptations except for an adequate sample size according to the required correlations for psychometric properties analysis.

4 Study 2: IAT psychometric properties

The second study consists of examining the psychometric properties of the oneness IAT developed in study 1 (see previous chapter) and analysing relationships between implicit oneness and demographics. The psychometric properties ascertain the instrument's construct validity, criterion-related validity and consistency-reliability, by checking for correlations between implicit oneness and former oneness scales and between implicit oneness and variables that have been correlated in previous research.

4.1 Method

4.1.1 Participants

Participants were recruited from school of science and technology of a university in Portugal. The recruitment process involved obtaining permission from the university to administer the test to students in a set of classes held in the university's computer lab, as well as during the seminar of a doctoral program and an open day event for high school students, happening within a period of ten months from July 2023 to May 2024. This study was conducted in accordance with the ethical guidelines of NOVA School of Science and Technology. A total of 95 subjects completed the online test by following the hyperlink provided via email. However, three participants were removed from the data

set due to error rates above 20%, and one participant was discarded for having a mean latency below 300 ms. This resulted in a final sample size of 92 participants. The age range of the participants varied from 16 to 52 years old (M = 23.18; SD = 8.42). Among the participants, 57 identified as women, and 35 identified as men. Also in this study, no recruitment services or incentives were used for participant recruitment. Informed consent was obtained through a consent declaration embedded in the online form before the actual test. In order to determine an adequate sample size for a correlation test and multiple linear regression, a power analysis was conducted using G*Power version 3.1.9.7 [90]. With an anticipated medium effect size, an alpha level of 0.05, and a desired power of 0.90, the analysis indicated that the minimum sample size is comfortably below the number of collected responses.

4.1.2 Materials

IAT. The same implicit measure of the IAT developed in the previous study to assess oneness was used in study 2 (see Chap. 3.1.3), with the same structure and words listed in Table 2. The IAT was complemented with the three explicit measures described below, in English.

Oneness beliefs scale (OBS). The oneness beliefs scale [1] is designed to assess individuals' beliefs in oneness. The scale consists of two subscales: spiritual oneness (SO), including premises that reflect the interconnectedness of all things on a spiritual level, and physical oneness (PO), with premises that reflect the psychical interconnectedness of all things. Participants are asked to respond to a series of statements that reflect these beliefs, indicating their level of agreement or disagreement on a Likert scale. The Oneness Beliefs Scale has been tested across multiple studies, demonstrating internal consistency, convergent and discriminant validity, and temporal stability (ibid.). This study uses the OBS to validate the Oneness Implicit Association Test (IAT) psychometric properties by running a correlation test between the OBS results—i.e., of an existing and previously validated oneness measure—and the D-score.

Oneness experience. The oneness experience is a Likert-scale questionnaire designed using statements from Van Lente and Hogan's collective intelligence study [18]. The selected statements were those that ranked highest among the most voted categories, making them the most commonly used by the five groups of experienced meditators to describe the experience of oneness. This resulted in a total of 15 sentences for participants to indicate their level of agreement or disagreement. The oneness experience serves as an alternative oneness predictor, allowing for further analytical comparison between experience and belief, as established in Coomber and Harré's categorization study [15].

New environmental paradigm (NEP). The NEP scale [78] measures individuals' environmental attitudes and beliefs. It assesses the extent to which people recognize the ecological limits of growth and the need for sustainable practices. The questionnaire consists of a series of statements to which participants respond on a Likert scale, indicating their level of agreement or disagreement (ibid.). The NEP scale was validated through extensive testing for reliability and consistency and has become the most widely used measure of environmental concern in the world, employed in hundreds of studies in dozens of nations [104]. This study uses this scale to validate the Implicit Association Test (IAT) psychometric properties by running a correlation test between the results of

the NEP questionnaire—i.e., a validated assessment tool that yielded a positive correlation test with oneness in past research—and the D-score. Previous correlations between the NEP scale and the oneness beliefs scale (OBS) yielded a moderate positive relationship ($p < 0.01$) with a Pearson coefficient of 0.22 [1].

4.1.3 Procedure

Participants completed the test by clicking on a hyperlink provided via email, which directed them to a Testable.org computerized test, similar to the procedure in Study 1. Participants had to read and sign the same consent form to start the test, ensuring they understood the study's aim, the anonymity of their responses, and what was expected of them. The demographics were also the same, and the test followed the exact same structure, number of blocks, and respective trials. The order of stimuli words might differ, as Testable.org randomizes the order in which the exemplars appear on the screen for sorting. After hitting the submit button at the end of the implicit part, participants were required to complete the three Likert-scale questionnaires described above. A file was generated for each participant, containing all reaction times and responses.

4.2 Results

The second study yielded an average D-score of – 0.04 (*SD* = 0.44), ranging from – 1.17 to 0.84. The D-score is calculated following the same protocol as in Study 1. The average percentage of error in the test was 7.3% (*SD* = 5.63). 68% of participants delivered a test with error rates below 10% and half of participants were quick enough to configure favourable results for content validity. Cronbach's alpha and split-half analysis in R version 4.3.2 [100] were used once again to evaluate the internal-consistency reliability of the implicit measure, as well as of all the questionnaire measures. McDonald's omega was additionally computed for the questionnaires to provide a more robust estimate of reliability. The implicit association test yielded an alpha value of 0.94 and an average split-half reliability of 0.94, indicating excellent internal consistency across the 80 trials of the test's critical blocks, with a sample size of 92 respondents. All questionnaires yielded high to very high levels of reliability: OBS ($\alpha = 0.85$; $\lambda = 0.84$; $\omega = 0.9$), OE ($\alpha = 0.79$; $\lambda = 0.78$; $\omega = 0.83$), NEP ($\alpha = 0.69$; $\lambda = 0.74$; $\omega = 0.82$) (Table 5).

The examination of construct validity was performed in R, by conducting a correlation test between the IAT's D-score and the oneness beliefs scale (OBS)—a scale of the same construct. The Pearson analysis yielded a moderate positive correlation with OBS ($r = 0.265$; $p = 0.011$) and a marginally significant correlation with OE ($r = 0.197$; $p = 0.06$). The examination of criterion-related validity was conducted through a correlation test between the IAT's D-score and the new environmental paradigm (NEP)—a measure that

Table 5 Summary of the analysis of internal consistency reliability of all measures

Measure	Items	Split-half reliability	Cronbach's alpha	Std.alpha	G6 (smc)	ω_t	Average *r*	Median *r*
IAT	80	0.94	0.94	0.94	1	–	0.17	0.16
OBS	11	0.84	0.85	0.84	0.88	0.90	0.33	0.31
OE	15	0.78	0.79	0.78	0.82	0.83	0.19	0.19
NEP	15	0.74	0.69	0.71	0.84	0.82	0.16	0.18

$n = 92$. Items = number of analysed trials/questions; std.alpha = standardized alpha median; G6 = Guttman's lambda 6; ω_t = McDonald's omega; average r = average inter-item; median r = median inter-item correlation.

Table 6 Summary of the analysis of construct validity and criterion-related validity

Response variable	Predictor	*r*	*p*-value	CI (95%)
D-score	OBS	0.265	0.011**	[0.064, 0.446]
	OE	0.197	0.06■	[– 0.008, 0.386]
	NEP	0.254	0.015**	[0.052, 0.436]

r = Pearson's correlation coefficient; CI (95%) = confidence interval; D-score = IAT metric; OE = oneness experience; OBS = oneness beliefs scale; NEP = new environmental paradigm; ■/*Marginally significant; **Significant; ***Highly significant.

Table 7 Categorization of the demographics of the test

Demographic	Categorization	Description	*n*
Age	< 18	Participants who typed their age as being less than 18 years old	7
	18–27	Participants who typed their age as being between 18 and 27years old	64
	28–37	Participants who typed their age as being between 28 and 37years old	11
	38+	Participants who typed their age as being over 38 years old	10
Gender	Woman	Participants who identified themselves as women	57
	Man	Participants who identified themselves as men	35
	Other	Participants who selected "other"	0
Education level	Less	Participants who selected "Less than high school"	7
	High-school	Participants who selected "High school or equivalent"	57
	College	Participants who selected "College or technical school"	6
	Bachelor	Participants who selected "Bachelor degree"	7
	Master/Doc	Participants who selected "Master/Doctorate"	15
Religiousness	Religious	Participants who replied "yes" to "Do you consider yourself religious?"	24
	Non-religious	Participants who replied "no" to "Do you consider yourself religious?"	68
Spirituality	Spiritual	Participants who replied "yes" to "Do you consider yourself spiritual?"	42
	Non-spiritual	Participants who replied "no" to "Do you consider yourself spiritual?"	50

n = 92.

Table 8 Results of the reduced multiple regression model. The regression coefficients indicate the positive or negative relationship between the IAT results and gender, religiousness and spirituality

Response variable	Predictor	Beta	SE	t value	*p*-value
D-score	(intercept)	– 0.208	0.081	– 2.573	0.012*
	Woman	0.245	0.090	2.726	0.008**
	Religious	– 0.166	0.098	– 1.691	0.094■
	Spiritual	0.129	0.088	1.457	0.149

n = 92. D-score = IAT metric; Beta = estimate/regression coefficient; SE = standard error; ■/*Marginally significant; **Significant; ***Highly significant.

is positively related to OBS. The test delivered a moderate positive correlation ($r = 0.254$; $p = 0.015$) (Table 6).

Additionally, a linear multiple regression was performed in R, relating the D-score with a group of five predictors, which are the demographics collected in the initial part of the implicit association test, also included in Study 1. The words used to categorize each of the demographics are described in Table 7, along with the count of participants corresponding to each category.

The *step* function [100] identified the most efficient model for explaining the variability in the D-score in relative to the initial group of five predictors by calculating and comparing the models' AIC (Akaike Information Criterion), a measure of the relative quality of a statistical model given the data. The final step regression model includes gender, religiousness and spirituality (Table 8). The overall model was statistically significant, $F(3, 88) = 5.37$, $p = 0.002$, $R^2 = 0.15$, Adjusted $R^2 = 0.13$, indicating that gender,

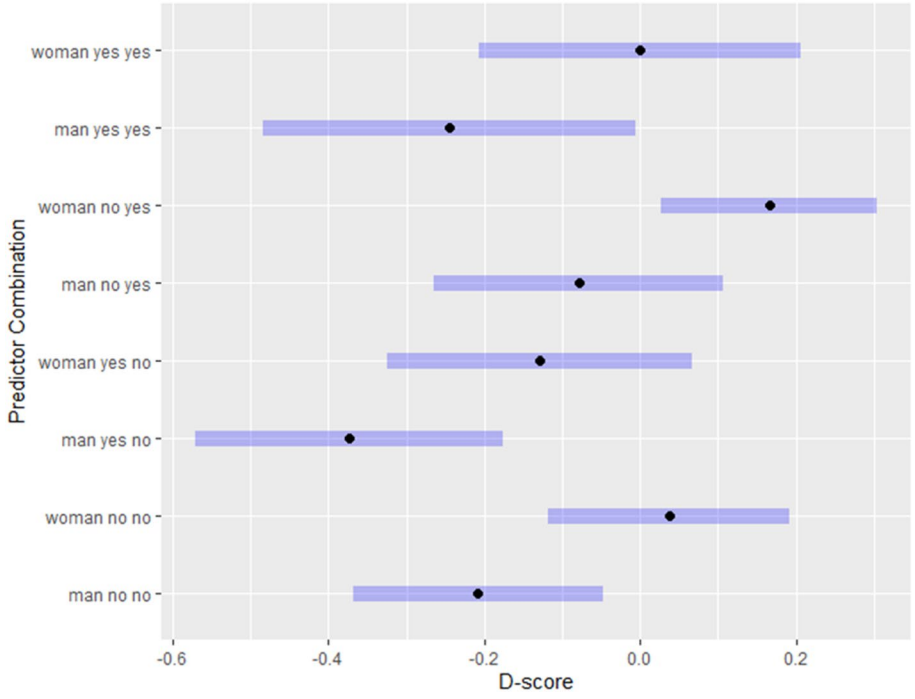

Fig. 3 Estimated marginal means from the final simplified regression model, depicting D-scores on the x-axis across combinations of gender, religiousness, and spirituality on the y-axis. Each point on the plot represents an estimated mean score for a specific combination of predictors. The confidence intervals (95%) provide a range within which the true mean score is expected to fall

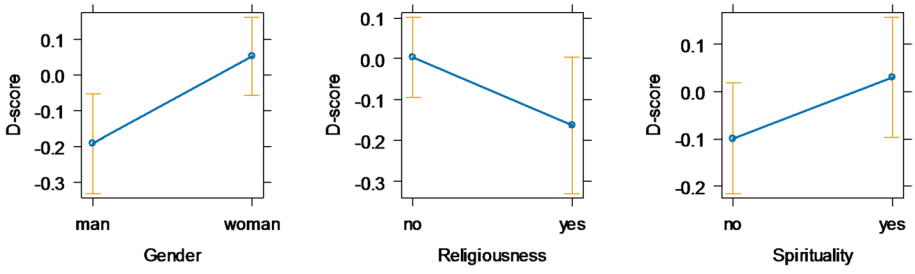

Fig. 4 Partial effects of the multiple regression model relating the participants' D-score with their gender, religiousness and spirituality. The D-scores for women are significantly higher than those for men. The light vertical lines represent confidence intervals of 95%, showing the range within which the true effect is likely to fall

religiousness, and spirituality explain 15% of the variance in D-scores. Participants identifying as women and spiritual show an increase in the D-score. Religiousness is associated with a slight decrease in the D-score, indicating a marginally significant negative effect. The *emmeans* function [105] validated the final model by estimating marginal means for the remaining predictors and providing a clear understanding of the effect of each predictor (Fig. 3). The *effect* function [106] supported the creation of the plots in Fig. 4, which display the estimated D-scores for each predictor category, with 95% confidence intervals.

5 Discussion

5.1 Summary of results and findings from study 1 and study 2

The development of an implicit association test to assess oneness considered the complexity of the construct and the exploratory character of this research work. The literature review and expert interviews highlighted the importance of framing oneness correctly, taking into account its unbounded nature, its mystical dimension, and its dreadful angle beyond the blissful one. The first study showed that the implicit association test had excellent internal consistency reliability. The pilot testing using exemplars sourced from literature and the interviews configured a valid set of words that were easy to classify. A preliminary analysis did not show significant relations between implicit oneness and any of the five demographics (age, gender, education level, religiousness, and spirituality). However, a correlation test indicated a marginally significant negative relation between implicit oneness and age, countering previous research [2]. Exploratory findings showed that participants with stronger implicit associations with oneness were faster, i.e., more efficient in performing the task. While not part of this study's initial hypotheses, these results substantiate previous findings in neuroscience that high-scoring participants tend to have better cognitive control, enabling them to respond faster even in incongruent trials [107]. The second study repeated the same implicit measure with a wider sample and yielded similar results in terms of internal consistency reliability. The psychometric analysis of the oneness IAT configured valid, positive results. Correlations with a measure of the same construct and with a related measure were significant, highlighting the construct validity and criterion-related validity of the IAT. All explicit measures (questionnaires) showed significant levels of internal consistency as well. A predictive model relating the IAT scores with demographics indicated that women and spiritual participants scored higher while religious participants scored lower.

All relationships between oneness and the analysed variables align with previous research [1, 2, 28, 67], except for the negative relation between oneness and religiousness. In this study, religiousness is categorized by participants' affirmative responses to the question "Do you consider yourself religious?". This raises concerns about the adequacy of this construct. While previous research indicates that oneness and spiritual well-being are positively related to *intrinsic* religiosity, it shows no significant correlation with *extrinsic* religiosity [59, 108]. Further scrutiny about the nature of religiosity and employment of religiosity scales will likely generate more comprehensive insights.

5.2 Limitations and future directions

The prior involvement of experts in the selection of words likely contributed to the instrument's content validity. However, although the pilot test results established a valid set of words, the number of participants responding quickly enough was arguably close to the threshold. Confidence levels could increase with a subsequent expert review of the words and further refinement of the categorization [88].

A key limitation of study 2 is the sample size, which hinder the ability to provide robust empirical evidence for the validation of the proposed assessment tool. Small to moderate correlations, as the ones in this study, require larger samples to yield reliable estimates and power analyses can become insufficient in addressing this concern [109]. Future research should focus on increasing sample sizes and conducting multiple well-articulated studies to enhance the measure's reliability and validity. The psychometric

properties of the IAT provided evidence of reliability in terms of internal consistency. However, both studies fail to ascertain the instrument's consistency over time. Administering the same test to the same sample of participants at two different points in time would contribute to predictive analysis as well. Furthermore, it would likely benefit future research if participants were asked whether they have previously taken an implicit association test. This would help control for reaction times, which are expected to be lower for repeat participants [107], and enable the detection of potential test faking and the necessary adjustments [110].

Although the pilot testing protocol and exploratory nature of the studies did not require representative samples, fairness and diversity in sampling are still crucial for ethical integrity and reducing the risk of bias, ensuring that conclusions are objective and reliable. The sampling of this study over-relied on a single source, albeit from multiple channels within the same school of the university. This likely limited the sample to specific age groups and individuals with access to higher education, potentially excluding minority groups. Participation in this test also discriminates against individuals with limited computer literacy. While this study countered Eurocentric bias by diversifying the literature review, it likely reinforced the overrepresentation of European research in the web of science by conducting the studies among Portuguese participants.

Although the majority of participants were native Portuguese speakers, the study relied on the assumption that all had sufficient English proficiency, based solely on their prior acceptance of an English-language test via the introductory email. This may have affected comprehension and reaction times in a linguistically sensitive task like the IAT. Future studies should either use participants' native language or include language proficiency in demographics.

The appeal to design an implicit association test emerges from a need to outperform self-report methods. A response latency technique would overcome the biased responses of questionnaires and access participants' subconscious associations. However, in order to subject a new IAT to a validity test, scale questionnaires had to be integrated into its design, and the self-report responses had to be related to the IAT results. This fundamental paradox raises questions about accurately answering the research question: How is it possible to ascertain if this new IAT is a valid measure compared to existing scales, and to what extent are both compatible?

Regarding the measurability of oneness, another fundamental chasm remains unsettling. Unlike implicit association tests for measures whose binary categorizations are enabled by opposite concepts, such as self-esteem (e.g., Me—Successful, Not-me—Failure) [80] and connectedness with nature (e.g., Me - Trees, Not-me—Building) [79], setting paired concepts to determine whether each attribute dimension is associated with a person's self-concept was arguably challenging in the case of oneness. Whereas the natural world can be separated from the artificial world as its opposite, oneness—or the "everything" [15]—cannot be set apart from anything else. Expert interviews—and certainly expert reviews—are critical to navigate the conceptualization of oneness towards an assessment construct without losing sight of its radical dimension and significance. Another layer of complexity is the fact that the IAT is not measuring oneness, but participants' reaction time in associating their concept of self with transcendental unbounded concepts—most accurately, with an expanded self or self-transcendence. The possibility

that this is interfering with the idea of "Me" and "Not-me" is yet to be unravelled in future research.

Future studies could also empirically compare the Oneness IAT with the Connectedness with Nature IAT to examine their convergence and divergence, specifically the extent to which they predict overlapping or distinct constructs. Testing whether stimuli like "bounded" and "unbounded" generalize across languages would also strengthen cross-cultural applicability.

6 Conclusion

The present study aimed to develop an implicit measure to assess oneness and to examine its psychometric properties, driven by the need to evaluate the implicit bias potentially concealed by self-report questionnaires. The study was conducted in two phases. In a first study, an implicit association test was developed with input from expert interviews, followed by a pilot-test. In a second study, the test's psychometric properties were analysed. The implicit association test demonstrated content validity, construct validity, criterion-related validity, and internal consistency reliability, according to the psychometric analysis it underwent. However, larger samples are suggested to yield reliable estimates. Additional predictive analysis to assess consistency over time is recommended for future studies, such as test–retest and inter-rater reliability. Greater diversity and fairness in sampling are suggested. The IAT's internal structure and alignment with previous research establish it as a valid assessment tool applicable across fields of research integrating oneness studies. Nonetheless, the necessity of integrating scale questionnaires to validate the IAT posed conflictual conclusions, questioning the accuracy of comparing the new IAT with existing scales: if the implicit measure overcomes a fundamental hindrance of self-reporting that compromises results reliability, (A) why are scales based on self-report questionnaires used as references for the implicit measure's validity testing, and (B) should the IAT results not differ from previous research?

Measuring oneness is challenging due to its complex, non-binary nature. This study highlights these difficulties and contributes to a better understanding of oneness and its potential—though still limited—methods of measurement. Expert reviews are crucial to navigate this complexity.

This study serves as an initial attempt to assess the implicit associations with spiritual oneness, laying the ground for researchers to explore the potential of redefining the self in climate action. Rather than perceiving the world as a separate entity to be saved, the oneness perspective considers life itself—as one—resisting and thriving. It provides a foundation for methodological advancements and sets the stage for future discoveries.

Appendix A: script of the semi-structured interviews

Introduction

Thank you for taking the time to participate in this interview for CENSE, FCT-NOVA—Center for Environmental and Sustainability Research & CHANGE—Global Change and Sustainability Institute, NOVA School of Science and Technology. We are working on developing a new Implicit Association Test (IAT) to measure oneness.

This interview should not take more than one hour. The purpose of this interview is to gather your expert opinions and insights to support the development of a reliable and

valid IAT for oneness. The information you provide will be used to inform the design and implementation of the test. Your responses will be kept confidential and will only be used for the purposes of this research. Do you have any questions before we begin?

Questions for the expert in measuring connectedness with nature with IAT

1. Can you describe your background and expertise in the field of implicit measures?
2. What are the key components or dimensions of an implicit association test?
3. What are the main challenges in developing an implicit association test?
4. How do you address these challenges in your work?
5. Are you familiar with the concept of oneness?
6. What are the strengths and limitations of using implicit measures to assess variables like oneness (e.g. interconnectedness, self-transcendence)?
7. What design considerations should we keep in mind when developing an implicit association test for oneness?
8. If you were to develop an implicit association test to assess oneness, what target and attribute words would you consider using?
9. Are there any specific methodologies or best practices you recommend?

Questions for the expert in oneness

1. Can you please describe your background and expertise in the field of oneness?
2. How would you define oneness?
3. How would you define the opposite of oneness?
4. What are the key components or dimensions of oneness?
5. What are the main challenges in assessing oneness?
6. How would you define oneness as a construct that can be assessed and compared with other measures?
7. What are the most important aspects to consider when analysing oneness?
8. How does oneness compare with other related constructs?
9. What are the key differences and similarities?
10. What is your experience with implicit measures or response latency techniques?
11. If you were to develop an implicit measure to assess oneness, what concepts would you consider using to differentiate oneness from what it is not?
12. What literature on oneness do you recommend for this purpose?

Appendix B: questionnaires of the iat's explicit measures

Oneness beliefs scale (OBS) [1]

Statement	Response
1. There is a unifying force (in the universe) through which all life is brought together in one great whole	1; 2; 3; 4; 5
2. There is a mysterious link, beyond the purely physical, that connects all human beings with each other and with the entire natural world	1; 2; 3; 4; 5
3. A vital thread of life joins all objects and beings in the universe	1; 2; 3; 4; 5
4. Human beings and nature are both part of a vast symphony of life directed by a single life-force	1; 2; 3; 4; 5
5. The peace and happiness of humankind is founded on being in harmony with the rhythm of the universe	1; 2; 3; 4; 5

Statement	Response
6. All existence in the universe forms one great unified life system	1; 2; 3; 4; 5
7. The natural world does not consist merely of physical phenomena but contains spiritual and emotional elements as well	1; 2; 3; 4; 5
8. Every living and nonliving thing is an expression of the fundamental life-force of the entire cosmos	1; 2; 3; 4; 5
9. The entire cosmos is linked together by complicated and intricate physical laws	1; 2; 3; 4; 5
10. All parts of the universe—both living and nonliving—are composed of the same fundamental materials	1; 2; 3; 4; 5
11. All living beings are connected because they are produced and nourished by the same diverse forces, such as the pull of gravity in the universe, the flow of energy from the sun, and the web of life in the natural world	1; 2; 3; 4; 5

1 = Strongly disagree; 2 = Disagree; 3 = Neither agree nor disagree; 4 = Agree; 5 = Strongly agree

Oneness experience [18]

Statement	Response
1. A sense of being boundless or infinite	1; 2; 3; 4; 5
2. A sense of "me" dissolving	1; 2; 3; 4; 5
3. A feeling of inner peace and stillness	1; 2; 3; 4; 5
4. No longer feeling superior or inferior to others	1; 2; 3; 4; 5
5. A sense of no longer needing to control	1; 2; 3; 4; 5
6. A feeling of being connected to something greater	1; 2; 3; 4; 5
7. A sense of no longer having a fear of death	1; 2; 3; 4; 5
8. A sense of seeing that our nature is kindness	1; 2; 3; 4; 5
9. A recognition that suffering is part of oneness	1; 2; 3; 4; 5
10. An awareness that all of my actions have an impact on the universe	1; 2; 3; 4; 5
11. A feeling of love	1; 2; 3; 4; 5
12. A sense of being a conduit rather than a doer	1; 2; 3; 4; 5
13. A sense of the world being one energy field	1; 2; 3; 4; 5
14. Knowing that I am ultimately not separate from others	1; 2; 3; 4; 5
15. A sense of timelessness	1; 2; 3; 4; 5

1 = Never; 2 = Rarely; 3 = Sometimes; 4 = Often; 5 = Always

New environmental paradigm (NEP) [78]

Statement	Response
1. We are approaching the limit of the number of people the earth can support	1; 2; 3; 4; 5
2. Humans have the right to modify the natural environment to suit their needs*	1; 2; 3; 4; 5
3. When humans interfere with nature it often produces disastrous consequences	1; 2; 3; 4; 5
4. Human ingenuity will insure that we do NOT make the earth unliveable	1; 2; 3; 4; 5
5. Humans are severely abusing the environment	1; 2; 3; 4; 5
6. The earth has plenty of natural resources if we just learn how to develop them	1; 2; 3; 4; 5
7. Plants and animals have as much right as humans to exist	1; 2; 3; 4; 5
8. The balance of nature is strong enough to cope with the impacts of modern industrial nations*	1; 2; 3; 4; 5
9. Despite our special abilities humans are still subject to the laws of nature	1; 2; 3; 4; 5
10. The so-called "ecological crisis" facing humankind has been greatly exaggerated*	1; 2; 3; 4; 5
11. The earth is like a spaceship with very limited room and resources	1; 2; 3; 4; 5
12. Humans were meant to rule over the rest of nature*	1; 2; 3; 4; 5
13. The balance of nature is very delicate and easily upset	1; 2; 3; 4; 5
14. Humans will eventually learn enough about how nature works to be able to control it	1; 2; 3; 4; 5
15. If things continue on their present course, we will soon experience a major ecological catastrophe	1; 2; 3; 4; 5

1 = Strongly disagree; 2 = Disagree; 3 = Neither agree nor disagree; 4 = Agree; 5 = Strongly agree;

*Statement with reverse scoring

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Author contributions
Salomé Areias led the conceptualization, methodology development, software implementation, validation, formal analysis, investigation, resource provision, data curation, and project administration. Salomé also authored the original draft and contributed to the review, editing, and visualization processes. Antje Disterheft, João P. Gouveia, and Daniel Fischer provided supervision and contributed to writing, reviewing, and editing of the manuscript.

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Data availability
Data and additional online materials are openly available at the project's Zenodo page (DOI [10.5281/zenodo.17831270] (https:/doi.org/10.5281/zenodo.17831270)). We have no conflicts of interest to disclose.

Declarations

Ethical approval
Ethical approval for this study was obtained from the Ethics Committee of the NOVA School of Science and Technology with the Ref. CE_FCT_017-2025, considering that data were collected through a voluntary questionnaire, fully anonymized. All procedures were carried out in accordance with relevant guidelines and regulations.

Consent to participate
All participants were provided with detailed information about the study's aims, and procedures. They gave their informed consent in a form, to participate voluntarily, with the understanding that they could withdraw at any time.

Consent to publish
Consent for publication was not required as the manuscript does not contain any individual person's data in any form.

Clinical trial number
Not applicable.

Competing interests
The authors declare no competing interests.

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