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How Should We Teach Nature Protection? Self-Determination and Environmental Attitudes

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Abstract: Environmental attitudes are supportive for learning about the environment and for pro-environmental engagement. The question, then, is how to strengthen and establish environmental attitudes. Based on a sample of 429 middle and high school students, we investigated the effect of self-determination-based motivation on environmental attitude. While high levels of self-determination (i.e., intrinsic motivation) positively affected pro-environmental attitude ($\beta = 0.40$), low levels of self-determination (i.e., external regulation) negatively affected attitude ($\beta = -0.31$). Our data further pointed to a distinct trajectory of self-determination and inclusion of nature throughout adolescence (high scores for 12-year-olds that decline to a minimum around 15–16-years old); a trend that has already been shown for environmental attitude. Such a dip might help derive teaching recommendations in environmental education, e.g., by supporting high scores in time to attenuate a decline. Further teaching recommendations include strengthening students' self-determination through their basic needs (autonomy, competence, and relatedness).

Keywords: environmental attitude; motivation toward the environment; science motivation; self-determination; basic needs; autonomy; relatedness; competence

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1. Introduction

Human impact on Earth can be seen all around the globe, in biodiversity loss, climate change consequences, resource depletion, and other consequences of pollution. Reports such as the IPCC [1] synthesize some of those consequences, while providing solutions to mitigate them; as such, the IPCC issues recommendations regarding how to change human behavior on a political and individual level in order to live a more sustainable life, or at least how to slow down negative human impact on Earth. So how come there is such a discrepancy between what people (could) know and how they behave?

What people do, or fail to do, to protect the environment seems to be reflected by both their environmental attitude, and situational constraints that either facilitate or undermine environmental behavior. While situational constraints such as infrastructure (e.g., availability of recycling options or access to public transportation) mainly affect pro-environmental engagement for only as long as those external factors are prevalent, environmental attitude is a more consistent antecedent that is influenced, but not exclusively dependent on external factors. Environmental attitude is thus relevant for engagement in nature preservation and conservation behavior. There are of course other factors that affect pro-environmental engagement, such as socioeconomic status, childhood experiences, gender, norms, or age [2]. While we do acknowledge such contributing factors, we want to focus on those factors that can be supported through teaching or other educational initiatives; this means we want to study how educational programs can be improved in such a way as to guide people toward living a more sustainable life. Here, literature points to the supportive role played by environmental attitudes in learning about the environment (i.e., acquiring knowledge such as that provided by the IPCC report), and for pro-environmental engagement (i.e., making use of one's knowledge) [3]. Environmental attitude is seen as a mental entity—a fairly persistent, internal factor—that shows in peoples' commitment to nature protection and conservation, and helps overcome situational constraints such as spending more money or time on more sustainable behaviors [3,4].

It is therefore reasonable to look at parameters influencing environmental attitude in order to derive guidelines for program and curricular development. There are again both external factors and also those that are rooted in the past, such as outdoor childhood experiences, that might positively contribute to establishing one's environmental attitude [2]. Age also seems to play a critical role: the literature point to an early plateau in environmental attitude around ages 11–12, that drops throughout adolescence, to only slowly recover in late adolescence and early adulthood [3,5]. This trend might help derive curricular recommendations which align environmental education topics with certain age groups. As such, we focus on school students, because they seem to go through a sensitive age period during which the formation of environmental attitudes might primarily occur, and because schools are platforms for distributing such knowledge and competencies as are necessary in daily life. Another aspect relevant to strengthening environmental attitudes might be to give students power in the classroom [6], an argument that is related to Deci and Ryan's [7] well-established self-determination theory. The theory talks about the basic needs that comprise personal autonomy (i.e., giving people choices), competence (i.e., helping people to feel competent and successful in what they do), and relatedness (i.e., feeling accepted and acknowledged). Those three domains help to internalize external factors, such that they become part of one's self-definition, thus changing an attitude. Pelletier et al. [8] specifically applied the theory to people's self-determination toward pro-environmental engagement, which they termed motivation toward the environment [8].

Grounded in Deci and Ryan's [7] self-determination theory, Pelletier et al. [8] defined people's motivation to engage pro-environmentally according to their level of self-determination. They defined six stages of increasing self-determination: amotivation, external regulation, introjected regulation, identified regulation, integrated regulation, and intrinsic motivation. Those levels reflect how much people feel they can autonomously regulate their behaviors, in this case, toward nature protection. Amotivation is the lowest level of self-determination, as it indicates an absence of motivation to engage pro-environmentally. This might stem from a lack of appreciation, purpose, knowledge, or skills toward an activity. Amotivation could also stem from perceived incapability to achieve the desired outcome, or to make a change. If a person believes that all endeavors to protect the environment were in vain hope, chances to engage pro-environmentally are low. External regulation is at the lower end of self-determination, which means an action originates from perceived external pressures (e.g., penalties, constraints, or bad grades), and incentives (e.g., rewards, praise, or career opportunities). Introjected regulation goes a step further, through external pressures having become somewhat internalized, to form feelings of obligation, guilt, anxiety, or shame, if the intended goal cannot be met. External motivators have thus been taken in without having been truly integrated. Identified regulation reflects a further step toward self-determination, by showing a higher degree of autonomy. It refers to things that are consistent with somebody's values, and part of one's self-concept. Since people consciously identify with and endorse the value of something, so there is a certain degree of willingness in an action. Integrated regulation relates to inherent values, where a person not only identifies with an action, but also perceives it as congruent with one's core values and part of one's self-definition. Those stages (external, introjected, identified, and integrated) are on a continuum of being externally motivated, whereas the most self-determined and autonomous motivation, which is intrinsic motivation, reflects doing things for pure pleasure, satisfaction, or an inherent appeal that arises from the activity itself. In contrast to intrinsic motivation, identified and integrated regulation are associated with a lack of enjoyment; it shows in the difference between an activity being worthwhile vs. being enjoyable [9].

This stepwise progression toward self-determination delineates how things gradually become internalized until they are fully endorsed. Some people might start with refusing plastic bags at grocery stores in order to avoid extra fees, or because it's socially proscribed to use them. Later on, such a rising awareness, prompted by external motivators, might turn into realizing the importance of avoiding plastic bags for nature protection. In this way, socially approved behaviors can become personally approved ones [10]. During this process of internalization, something becomes a stronger part of a person's identity [9]. While the behavior (e.g., avoiding plastic bags) is still the same, the underlying motivation based on one's self-determination varies and shows in the persistence of pro-environmental behaviors over time. Externally motivated behaviors usually cease without external motivators, whereas intrinsically motivated behaviors usually persist over time, rendering intrinsic motivation a goal of environmental education [11]. On the other hand, amotivation (i.e., lack of intentionality, perhaps through a lack of perceived competence or purpose) is regarded as a negative predictor of engagement and cognitive achievement [9]. Self-determined forms of motivation have been found to be correlated with pro-environmental behaviors, while external regulation and amotivation are shown to be either unrelated or inversely related to environmental engagement [8,12,13]. The relationship is more pronounced with difficult behaviors, such that those that are more demanding require more resources (e.g., money, time, energy) to be performed [14,15]. Several studies suggest the supportive role of self-determination on behavioral outcomes, and chances to engage pro-environmentally increase if people believe they can either achieve the desired outcome, or experience pleasure or satisfaction (e.g., [8]). This suggests a positive effect of people's self-determination-based types of motivation—their autonomous regulation—on attitude, which in turn prompts nature protection behaviors. We therefore investigate the role of self-determination (i.e., motivation to engage pro-environmentally) on environmental attitude, which might allow us to derive teaching recommendations.

Research objectives: Given the supportive role of environmental attitude in learning and nature protection, we investigated the effect of a promising parameter in environmental education research that might strengthen environmental attitude: a person's degree of self-determination, which is termed motivation toward the environment. To do so, we first validated an established scale [8] with our Irish school sample by (1) investigating the scale's factor structure, and (2) relating it to further constructs, i.e., *Science Motivation* [13] and *Inclusion of Nature in Self* [16]. We further investigated age-related patterns that might resonate with the typical U-shaped growth curve of environmental attitude throughout adolescence (i.e., high attitude levels until aged 11 to 12 years, followed by a decrease and a subsequent recovery in late adolescence: [3]). Our research questions were thus:

- How does motivation toward pro-environmental engagement that relies on the degree of self-determination affect environmental attitude?
- Which age-related trends may underlie motivations toward acting pro-environmentally?

2. Materials and Methods

2.1. Participants & Procedure

The data was collected at several schools in central Ireland. The data collection was coordinated with teachers, who filled in the paper-and-pencil questionnaires with their complete classes during regular school times in their classrooms. Students were informed about the data collection, and parents or guardians gave their written consent. The sample (N = 429) covered an age range from 11 to 18 years ($M \pm SD$ = 14.65 ± 1.89). Gender was unevenly distributed with 67.1% males (n = 288) and 32.9% females (n = 141), because of Ireland's co-educational approach.

2.2. Measures

We applied the Motivation Toward the Environment Scale (MTES; [8]) and the Science Motivation scale [17]. We further assessed Inclusion of Nature in Self [16] and environmental attitude [3]. While the MTES—a reflection of people's level of self-determination toward environmental engagement—and environmental attitude, are at the focal point of this study, we use the Science Motivation scale and Inclusion of Nature in Self scale to validate the MTES; the Science Motivation scale is an established instrument that contains items to test people's level of self-determination in the science domain, which should resonate with the MTES. The Inclusion of Nature in Self scale is a robust instrument in environmental education research, which we also expect to correlate with the MTES.

The **Motivation Toward the Environment Scale** (MTES; [8]) measures motivation towards pro-environmental engagement, based on Deci and Ryan's [7] self-determination theory. Guided by the question "Why are you doing things for the environment?", people responded to 24 items on a 5-point frequency scale that indicates their degree of agreement: strongly disagree, disagree, not sure/ neutral, agree, and strongly agree. Those items covered six types of motivation toward pro-environmental engagement grounded in peoples' self-determination: amotivation, external regulation, introjected regulation, identified regulation, integrated regulation, and intrinsic motivation (see Introduction).

Science Motivation [17] as a scale, was designed to assess motivational forces of students in the science domain. It covers five subscales, ranging from extrinsic motivation (grade and career motivation) to rather intrinsic motivation (self-determination, self-efficacy, and intrinsic motivation), with five items each. The response pattern ranged from strongly disagree, to disagree, not sure/ neutral, agree, and strongly agree. A confirmatory factor analysis represented the data well, reflecting the instrument's proposed structure of five subscales (see Appendix A; Chi-square in relation to the degrees of freedom: CMIN/DF = 2.689, Comparative Fit Index: CFI = 0.938, Root Mean Square Error of Approximation: RMSEA = 0.063). All factor loadings were well above the threshold, so the manifest variables significantly contributed to their latent factors.

Inclusion of Nature in Self [16], as a one-item scale, indicates the extent to which nature is incorporated in one's self-concept, thus giving an idea of a person's relationship with nature. Students have to choose one graphic out of seven graphics, each depicting two approaching circles, which are labelled *Self* and *Nature*. The first graphic depicts a set of circles that are clearly separate, while the last graphic depicts two completely overlapping circles. The scale is headed by the question "Please circle the picture below that best describes your relationship with the natural environment. How interconnected are you with nature?"

Environmental attitude (derived from the item-pool of [3]), as people's commitment to nature protection is demonstrated in self-reports of engagement in past behaviors that were aimed at preserving the environment, and in expressions of support for preserving the environment, i.e., opinions about nature preservation. For our sample, we used 12 items, such as "Humankind will die out if we don't live in tune with nature", that must be answered using a 5-point response-format to indicate the degree of agreement (strongly disagree, disagree, not sure/ neutral, agree, and strongly agree). Six items were negatively formulated, such as "Our planet has unlimited resources", and reverse coded prior to the analysis. Environmental attitude was calibrated as a unidimensional Rasch scale. The separation reliability (*rel*. = 0.62) estimates that the scale was fairly accurate in distinguishing between the students. Student parameters ranged from –2.54 to 2.59, and the higher a score, the more pronounced the attitude is;negative scores point at rather weak attitudes. Item-fit values reflect the discrepancy between the model's prediction and the observed data, with mean square values (MS: $0.80 \leq MS \leq 1.20$) weighted by the item variance that covered a reasonable range from 0.88 to 1.21 [18,19].

2.3. Statistical Analyses

For basic analyses, we used the Statistical Program for Social Sciences (SPSS, 24 version, IBM Corporation, Armonk, NY, USA). We used the program for Pearson correlations and regression analyses.

We further used IBM SPSS AMOS 24 (version 3.6, IBM Corporation, Armonk, NY, USA) (Analysis of Moment Structures: [20]), to calculate confirmatory factor analyses (CFA). Factor analyses investigate a scale's dimensionality based on correlating the observed variables to form higher order variables (latent factors). CFA figures in the results display standardized values and rely on the Maximum Likelihood solution. Single-headed arrows represent regression weights, while double-headed arrows estimate correlations. Among the better-known fit indices is the chi-square (χ^2), which tests whether the model is consistent with the observed data, i.e., whether the model matrix truly reflects the population matrix. The χ^2, however, is vulnerable to sample sizes at both ends (too many or too few participants), and assumes multivariate normality [21,22]. Alternatively, the relative chi-square (χ^2 divided by the degrees of freedom: CMIN/DF) minimizes such effects, and should be less than 5.0 [23]. We report the CMIN/DF and absolute and incremental fit indices to estimate the adequacy of our postulated models. The Root Mean Square Error of Approximation (RMSEA) is an absolute index, while the Comparative Fit Index (CFI) is an incremental index. The RMSEA indicates the deviation between the hypothesized and the perfect model [24]. It is challenging to draw cutoff values [25], though the RMSEA should be lower than 0.08 [21]. The CFI, in contrast, relates the fit of the hypothesized to the baseline model, and its value should be above 0.9 [24]. We further report the Tucker-Lewis Index, which compares the chi-square to the null model, since it has been frequently used in the literature for the Motivation Toward the Environment Scale (see Results). Like the CFI, the TLI (Tucker-Lewis Index) is normed, and ranges from 0 to 1.0, while a good model fit is indicated by values above 0.9.

For the dichotomous Rasch model, we used the software ConQuest [26]. We report person scores (the higher the score, the stronger or more positive the attitude) and item-fit indices (relating the model fit to the observed data, with adequate indices ranging from 0.80 to 1.20 [18]).

3. Results

3.1. Assessing the Quality of the Motivation Toward the Environment Scale (MTES)

Confirmatory factor analyses reflected the MTES structure as reported in the literature (e.g., [8,11,27]). The data fit the model best when cutting the four lowest loading items (see Table 1), a procedure that has been reported in earlier studies (e.g., [28]). For amotivation, we dropped "I don't know. I can't see what I'm getting out of it", which was only slightly above Steven's [22] threshold of 0.5 in the original study [8]. For external regulation, the item "To avoid being criticized", was excluded. For introjected regulation, the lowest loading item in the original study was "I'd regret not doing something" (β = 0.36), while with our younger participants "Because I would feel bad if I didn't do anything for the environment" revealed a low factor loading (β = 0.36). For integrated regulation, we excluded "Because being environmentally-conscious has become a fundamental part of who I am".

Table 1. Confirmatory factor analyses of the Motivation Toward the Environment Scale [8]; fit statistics of the basic model, with its six subscales, are contrasted to modified model versions.

Model	CMIN/DF	CFI	TLI	RMSEA
6 subscales	4.375	0.793	0.738	0.099
5 subscales (excluding amotivation)	3.959	0.855	0.810	0.083
6 subscales (excluding 4 items, see text)	**2.493**	**0.932**	**0.905**	**0.059**

Note: CMIN/DF = Chi-Square divided by the degrees of freedom, CFI = Comparative Fit Index, TLI = Tucker-Lewis Index, RMSEA = Root Mean Square Error of Approximation.

Construct validity builds on convergence and discriminant validity [29]. It indicates that intrinsic motivation, identified, integrated, and introjected regulation, were too similar to form distinct categories, as well as external regulation and amotivation. It points at two opposite ends, with intrinsic motivation reflecting high levels of self-determination, and external regulation reflecting low levels of self-determination (Average Mean Extracted: intrinsic motivation = 0.59, integrated regulation = 0.46, identified regulation = 0.35, introjected regulation = 0.49, extrinsic regulation = 0.51, amotivation = 0.47; discriminant validity: intrinsic motivation = 0.77, integrated regulation = 0.59, identified regulation = 0.68, introjected regulation = 0.70, extrinsic regulation = 0.71, amotivation = 0.68).

For further validation, we correlated the motivation scale to the Inclusion of Nature in Self scale [16], environmental attitude [3], and the Science Motivation's subscale of Self-Determination [17]. The Inclusion of Nature in Self scale [16] indicates a person's relationship to nature, how much one perceives nature as part of one's identity, such that the stronger the score, the stronger a person's interconnection with nature can be expected to be. Pearson correlations met our expectations, so the more inherent and self-determined the motivation toward pro-environmental engagement, the stronger the correlation with each scale was (see Table 2). Inclusion of Nature in Self correlated lowest with external regulation, and not at all with amotivation. For environmental attitude, the flip occurred earlier, with negative correlations with both extrinsic regulation and amotivation.

Table 2. Pearson correlations of the Motivation Toward the Environment Scale's [8] latent factors with Inclusion of Nature in Self [16], environmental attitude [3], and a subscale of Science Motivation, i.e., Self-Determination [17].

		IM	**INTEG**	**IDEN**	**INTRO**	**ER**	**AMO**
	n	417	409	417	417	417	417
Inclusion of Nature in Self	*r*	0.353	0.350	0.340	0.288	0.123	*ns*
	p	<0.001	<0.001	<0.001	<0.001	0.012	
Environmental attitude	*r*	0.336	0.161	0.345	0.360	−0.217	−0.342
	p	<0.001	0.001	<0.001	<0.001	<0.001	<0.001
Self-Determination	*r*	0.305	0.206	0.299	0.289	*ns*	−0.164
	p	<0.001	<0.001	<0.001	<0.001		0.001

Note: IM = Intrinsic motivation, INTEG = Integrated regulation, IDEN = Identified regulation, INTRO = Introjected regulation, ER = External regulation, AMO = Amotivation; *ns* = not significant

3.2. Degrees of Self-Determination on Peoples' Environmental Attitudes

A multiple regression analysis revealed effects of self-determination on environmental attitude. To avoid multicollinearity (see, e.g., Figure 1, which shows strong correlations among the latent factors, or see construct validity in the text above), we tested the effect of external regulation and intrinsic motivation on environmental attitude, as those depict extremes of being extrinsically vs. intrinsically motivated to act pro-environmentally (i.e., the scale's least to strongest dimension of self-determination). While both effects were significant (*ps* < 0.001), the effect of intrinsic motivation ($\beta = 0.40$) was stronger than the effect of external regulation ($\beta = -0.31$): $F(2, 417) = 52.68$, $p < 0.001$, $R^2 = 0.20$. The second motivation scale [17] contains one latent factor that covers self-determination toward learning science. It reflected a positive, yet weaker, effect of self-determination on environmental attitude ($\beta = 0.25$): $F(1, 418) = 27.41$, $p < 0.001$, $R^2 = 0.062$.

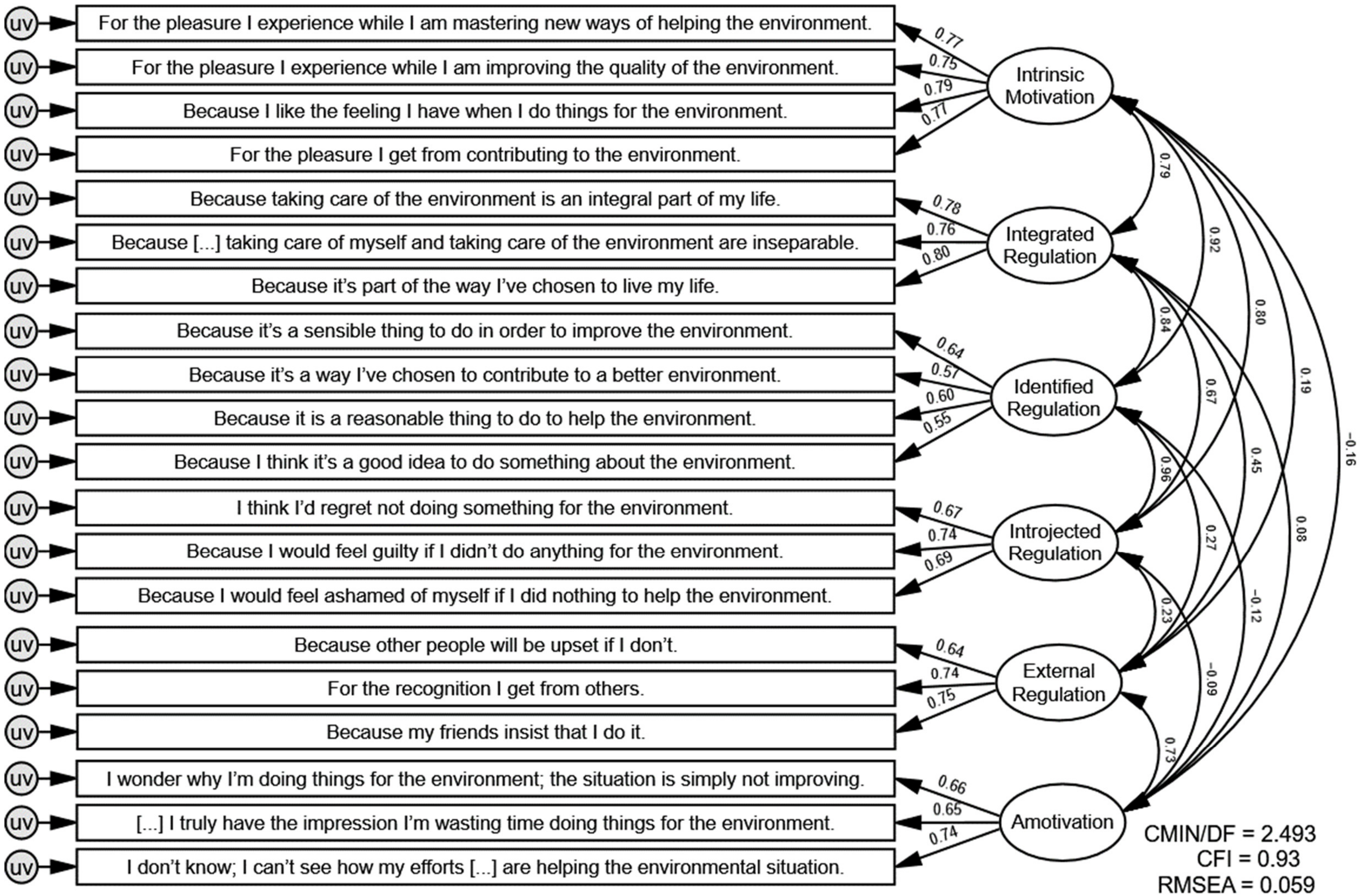


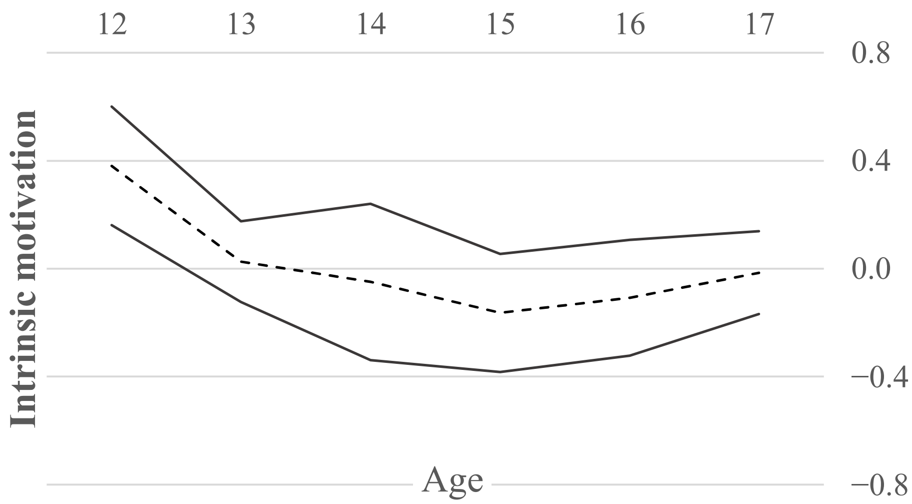
Figure 1. Confirmatory factor analysis of the Motivation Toward the Environment Scale [8] with its six latent factors. Single-headed arrows reflect beta regression weights, while double-headed arrows reflect correlations. uv = unobserved variables/error term.

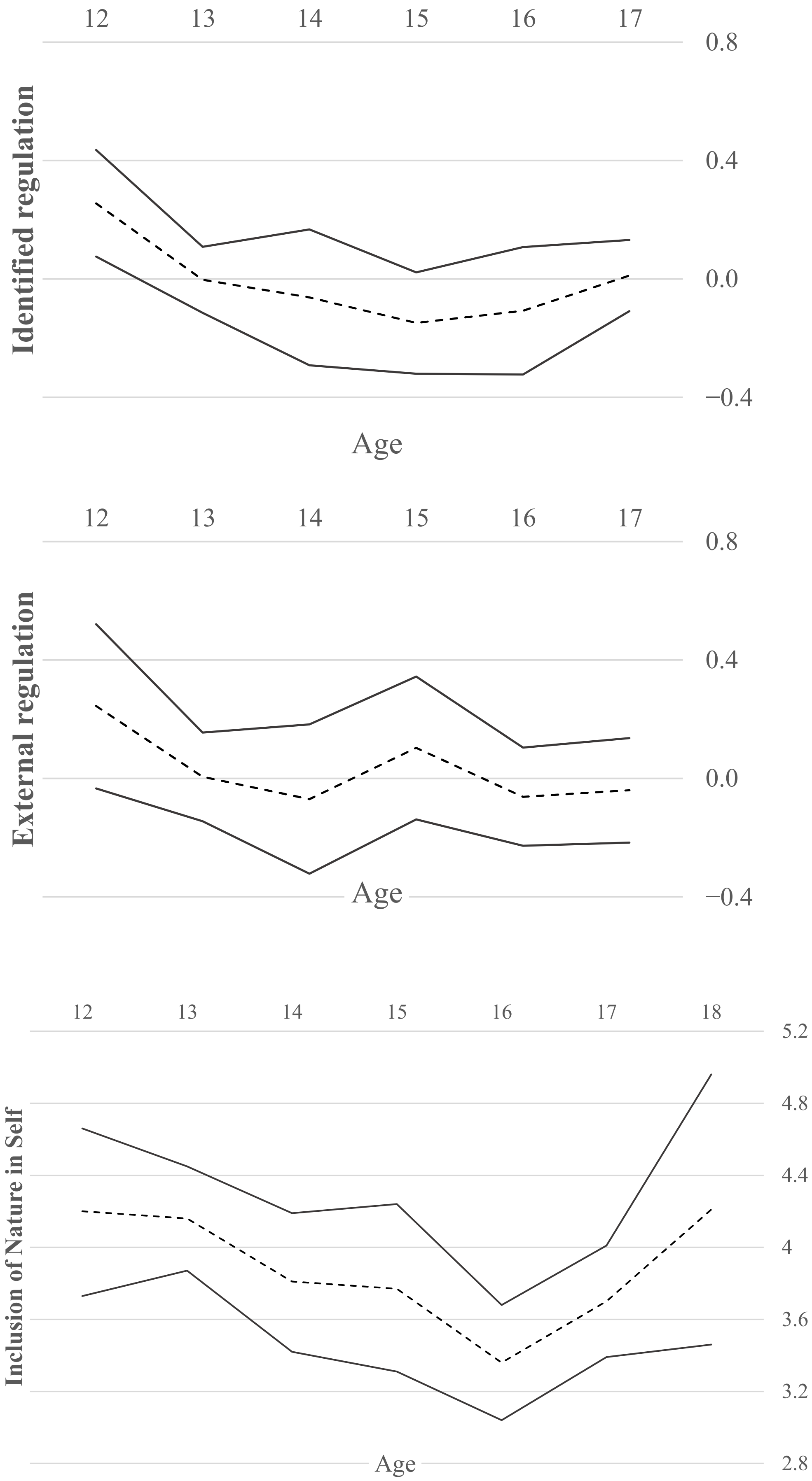
3.3. Trajectory of Self-Determination and Inclusion of Nature in Self throughout Adolescence

Differences in mean scores of motivations toward pro-environmental behaviors seem to relate to age. Our fairly young sample ($M_{Age} \pm SD$ = 14.65 ± 1.89, *N* = 429) scored highest in intrinsic motivation, while identified regulation scored highest in a slightly older Flemish student sample (17–18 years, *N* = 1730 [27]), and amotivation in an older Dutch-speaking one (17–19 years, *N* = 779 [28]). This points to a dip, with pro-environmental scores increasing in late adolescence and adulthood, e.g., identified regulation scoring highest in two Canadian samples (M_{Age} = 20.9, *N* = 168: 10; M_{Age} = 48.6, *N* = 544 [5]). Grønhøj and Thøgersen [30] compared the motivation scales' mean scores of adolescents (M_{Age} = 18.4, *n* = 448) with their parents (M_{Age} = 49, *n* = 448), and revealed the same pattern, with adolescents scoring higher in external regulation and amotivation than their parents.

Such a dip has been identified for environmental attitude (e.g., [3]), and we therefore looked for age-related patterns in self-determination-based motivation to act pro-environmentally. There were indeed age differences, in external regulation, identified regulation, and intrinsic motivation (see in Figure 2). Due to multicollinearity, we looked at those factors selectively, instead of clustering all factors with their stepwise progression toward self-determination.

In Figure 2, identified regulation and intrinsic motivation resonate with environmental attitude's age dip [3], with a decrease until 15- to 16-years old, and a successive recovery in late adolescence. Quadratic regressions explained the trajectory throughout adolescence by 19% better than linear ones: identified regulation $F(2, 403) = 4.702$, $p = 0.01$, $R^2 = 0.023$; intrinsic motivation $F(2, 403) = 6.236$, $p = 0.002$, $R^2 = 0.03$. Inclusion of Nature in Self [16] reflected a related pattern. As such, a cubic regression explained the trajectory throughout adolescence 10% better than a linear, and 1% better than a quadratic one: $F(2, 414) = 5.201$, $p = 0.006$, $R^2 = 0.025$. External regulation seemed to be congruent: an increase in 15-year-olds opposed intrinsic motivation's decrease, while it is the other way round for 17-year-olds, with an overall decline throughout adolescence. Though there is a recovery, intrinsic motivation also revealed a general decline. Identified regulation showed the strongest increase, which has been reported to have the highest mean scores for 17- to 18-year-olds (e.g., [27,30]).




Identified regulation
Age
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External regulation
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−0.4
Inclusion of Nature in Self
Age
12
13
14
15
16
17
18
5.2
4.8
4.4
4
3.6
3.2
2.8

Figure 2. The trajectory of intrinsic motivation, external and identified regulation [8], and Inclusion of Nature in Self [16], throughout adolescence. Mean scores are depicted by the dashed line, while their 95% confidence intervals are in solid lines (participants in years of age for the MTES: $n_{12} = 44$, $n_{13} = 122$, $n_{13} = 48$, $n_{15} = 51$, $n_{16} = 49$, and $n_{17} = 92$, and for Inclusion of Nature in Self: $n_{12} = 43$, $n_{13} = 121$, $n_{13} = 47$, $n_{15} = 48$, $n_{16} = 47$, $n_{17} = 90$, and $n_{18} = 19$).

4. Discussion

We validated the Motivation Toward the Environment Scale [8] through factor analysis, and its consistency with further scales, such as Inclusion of Nature in Self [16], and Science Motivation [17]. Our data then revealed significant effects of motivation toward pro-environmental engagement that are based on self-determination and self-regulation on environmental attitude. Finally, we delineated an age dip in motivation to act pro-environmentally that has already been shown for environmental attitude: a dip around 15-years old, with a successive, slow recovery in late adolescence [3].

4.1. Self-Determination on Peoples' Environmental Attitude and Teaching Recommendations

Self-determination toward the environment—that is, the motivation to act in an environmentally friendly way—affects environmental attitude. While external regulation showed a negative effect on environmental attitude, intrinsic motivation showed an even stronger positive one. In this way, extrinsic and intrinsic motivation do not complement, but rather they oppose each other, meaning that extrinsic motivators can undermine intrinsic motivation [31]. This is in line with previous studies, e.g., that people with a stronger perception of autonomy were more likely to show positive environmental attitudes and behaviors, and to sustain such attitudes over time [13]; strong self-determination relates to nature preservation behaviors (e.g., [12,32]). The relationship between motivation and attitude suggests that the more self-determined a person is toward pro-environmental engagement, the more positive the attitude score. The more people feel capable and skilled to reach the desired outcome, and the stronger the internal drive to succeed for the sake of the activity or the goal itself, the higher the attitude scores. Environmental attitude is thus a lever for learning about the environment, and for engaging pro-environmentally [3].

For teaching, this implies strengthening students' self-determination to support pro-environmental attitudes. The self-determination theory relies on the belief in peoples' inherent curiosity and interest in learning, which is often undermined in a controlling, evaluative, classroom [33]. It incorporates what are thought to be peoples' basic needs: autonomy, competence, and relatedness, which can help internalize extrinsic motivators so that pro-environmental engagement meets personal relevance and is thus sustained over time. Each basic need is important to people's self-determination, and each can be strengthened in the classroom setting.

Autonomy is supported if students feel they have a choice, and that their choice matters [33]. In a more recent study, Činčera et al. [6] called it power distribution, indicating that giving students power in decision-making about classroom learning supported overall learning outcomes. In practice, this can be met by: (1) rather open teaching formats (1a) that provide several resources to teach the same matter (e.g., students can choose whether to read a text, search the internet, or work with a model to elaborate on the same topic), (1b) that allows for choosing the social setting (e.g., students can choose whether they want to work on their own, with a partner, or in small groups for some activities), or (1c) allowing one to devote individual time slots to certain activities which could be met by organizing workstations or completing work sheets; when no such choice is possible, a rationale can suffice [15]; (2) acknowledging student responses (e.g., when completing worksheets in plenary, students may feel more acknowledged if teachers use student contributions instead of pre-defined responses); (3) integrating student suggestions in lessons (e.g., if topics allow one to dive into examples such as life cycle assessments, students can vote for topics); (4) role-playing games in which students have to find a consensus (e.g., discussing scenarios such as whether to build solar panels, how many, and where exactly); and (5) using several grading systems (e.g., portfolios which document the learning progress). Over two decades, studies have been reporting the positive effects of autonomy-support in various domains, including on: well-being (e.g., [34,35]), cognitive achievement (e.g., [36,37]), conceptual learning (e.g., [38]), academic performance (e.g., [34,39]), health-related behaviors (e.g., [40]), STEM-engagement (e.g., [41]), and—most importantly, in this context—engagement in environmentally friendly behaviors (e.g., [15]).

Competence is embraced if students feel they can achieve the desired outcome, so their action matters. Competence is likely to be strengthened by providing students with the right level of task difficulty [33]. In practice, this could be met by: (1) checking students' pre-lesson conceptions (e.g., testing their prior understanding by letting them draw concept maps (see, e.g., [42]), or completing quizzes, so teachers can build their lessons on their students' pre-knowledge; examples in [43,44]); (2) providing tasks with varying difficulty levels, so there is always a task for each student to succeed in; (3) providing learning aids, so if students are stuck, they can get subtle help (e.g., information cards or hints that help solving tasks); (4) providing constructive feedback, while conveying an understanding that mistakes are chances to learn, and thus are part of learning [33]; and (5) subtle organization (e.g., if there is collaborative group work, students with different strengths could work together, so that every student has a chance to contribute and to experience success). If people do not feel competent in environmental protection, then the chances that they volitionally and persistently engage pro-environmentally, are low. In this regard, competence is related to its relevance in daily life.

Relatedness is about positive social interactions among peers and with teachers, inducing a sense of belonging and feeling accepted [33]. For teachers, this shows in caring for their students, and paying them respect. Strengthening relatedness thus goes hand-in-hand with previous recommendations, such as giving constructive feedback or acknowledging student interest. For classroom settings, relatedness is supposed to be supported by (1) clear social rules which the students define with their teacher at the beginning of term, so autonomy is acknowledged, too; (2) friendly and respectful interactions [33]; (3) transparency and structure (e.g., defining goals, so students know their teachers' expectations; this also refers to transparent grading systems); and (4) giving real praise, as too little or too much praise undermines competence and good relationships. There is proof of the positive effect of relatedness for classroom learning (e.g., [45]). In Benware and Deci's [46] experiment, for example, peer teaching induced stronger intrinsic motivation and better learning outcomes compared to those who studied for a typical exam.

Intrinsic motivation as an absence of external motivators, entails deep engagement in activities for fun, curiosity, or excitement [33]. Such an inherent drive provides a powerful resource for classroom learning, and in the face of people's basic needs, it meets topics relevant to the students' lives. Autonomy might be better experienced through common issues that are in the media, such as developing recycling concepts or energy saving strategies for their school. Feeling competent can be supported through competencies beneficial in real life, including broad abilities such as problem-solving skills, and more topic-specific skills, such as a scientist's approach to work (e.g., hands-on and inquiry-based, with use of experiments or models). Feeling related might be stronger if students discuss real life issues using a multi-perspective approach. In general, such approaches do not follow pre-defined lessons, but rather embrace open teaching formats that are not only for, but with, students.

There is a long tradition of curricular contents being supposed to meet personal relevance so that students will perceive science as relevant to their lives (e.g., [47]); this way, as opposed to external goals such as grades, internal ones should initiate long-lasting, cumulative learning. It is therefore useful to convey each topic's relevance by giving reasons why curricular contents are important (e.g., [33,48]); they should meet personal relevance, provide autonomy, and allow for competence, so students feel they can make a change. This is embraced by relatedness, since people are more likely to endorse information when they feel respected, acknowledged, and safe. According to self-determination theory, things that are essential to the management of life are of inherent importance. So if environmental issues are communicated in such a way that they are fundamental to people's well-being, they become gradually internalized [10].

4.2. Trajectory of Motivation to Act Pro-Environmentally throughout Adolescence

The literature point to an age-related pattern in environmental attitude: a dip around 15- to 16-years old, followed by a slow recovery in late adolescence (e.g., [3]). Motivation to act pro-environmentally that represents the degree of people's self-determination [8], affected environmental attitude, and revealed a similar pattern. This raises two questions: which parameters affect the trajectory of pro-environmental motivation and attitude throughout adolescence, and which teaching recommendations can be derived from such a trajectory?

There are several explanations for age-dependent differences, which cover physiological factors, such as cognitive development; social factors such as culture, that provide a normative framework; and educational factors, such as time spent outdoors. More than 50 years ago, Buttel [49] had already pointed to the negligence of age in attitude research, and recognized a drop in adolescence. This pattern has been reaffirmed over time [5,50–52]. Some argue environmental attitude was mostly formed in early years, and harder to generate in older students [53,54]. Krettenauer and colleagues [5] reported younger students felt a stronger attachment to nature and stronger (moral) obligations to act in an environmentally friendly way. Wray-Lake and colleagues [50] identified an age-dependent decrease in social responsibility, and Nucci and Turiel [55] argue that moral standards shift as adolescents develop a better understanding of moral concepts applied in individual contexts, which places more importance on personal evaluation than on societal obligation. The resulting ambiguity, fueled by a conflation of personal choice and moral right, leads to more variability and more non-moral choices. This ambiguity levels off in adulthood, resonating in a U-shaped growth curve. The trend might be fostered by media through inducing disconnectedness with nature [5], which in turn might result in less nature protection behaviors (e.g., [56]), also because children spend less time outdoors [57]. Since renegotiating of moral standards and personal evaluation seem to be driving forces throughout adolescence, it might be sensible to strengthen people's environmental attitudes in time, while acknowledging their basic needs.

For educational settings, this suggests focusing on environmental education in late elementary and early middle school (see also [58]), through providing authentic learning experiences that meet personal relevance. If adolescents re-define their moral standards and rely on personal evaluation, a school setting should allow for reflective practices that meet their basic needs (see, e.g., [59]). In this regard, environmental issues can be prompted with external motivators that can become internalized [9]. Teaching then benefits from bringing environmental issues close to everyday life, while allowing for discussion (i.e., autonomy), and experiencing success (i.e., competence). Accordingly, the trajectory of environmental motivation and attitude throughout adolescence suggests the need to capture and strengthen motivation and attitude before they meet a decline that only slowly re-establishes in late adolescence.

4.3. Study Limitations and Prospects

First, overall assumptions regarding age-patterns require some caution. Though our findings are supported by the literature and align with trends for environmental attitude, we rely on a small sample-size and cross-sectional data. As such, our data point to an age-related dip in motivation toward pro-environmental engagement that requires further investigation. Second, the correlation matrix (Table 2) shows numbers for integrated regulation that deviate from a continuum from external regulation to intrinsic motivation. There have been some inconsistencies in previous studies [60], where intrinsic motivation was more closely related to introjected regulation than to identified regulation (e.g., [61,62]). Those findings resonate with ours, yet we have to acknowledge that our sample size is not overly representative, so inconsistencies might exist in our sample. Third, we gave several examples to strengthen students' basic needs; yet some of those arose from experience, and thus await further approval.

Fourth, although motivation toward the environment appeared to be relevant to environmental attitude, further factors, such as social and contextual ones, also contribute to the formation of environmental attitude (e.g., [31,63]). According to the self-determination theory, parents and peers either strengthen or weaken behaviors on their way from extrinsic to intrinsic motivation, so they can speed up or slow down the process of internalization. This is because people are more likely to incorporate knowledge, attitudes, or behaviors, that seem commonly accepted, as reflected by the basic need of relatedness [33]. Parental and peer support (i.e., being interested in environmental topics, or allowing for making decisions) positively affect people's environmental motivations and engagement [13]. Grønhøj and Thøgersen [30], for instance, pointed to parents as role models to positively affect their children's motivations, through communicating clear expectations (e.g., desired behaviors) and setting directions (e.g., giving small prompts and reminders), while communicating in a way that allows for choices (autonomy-support). In this way, teachers' intrinsic motivation strongly relates to their students' levels of intrinsic motivation in learning experiences [64].

5. Conclusions

Most pro-environmental behaviors require energy, effort, and cost, so there needs to be an internal drive that overcomes such obstacles in order for persistent pro-environmental engagement to be performed: environmental attitude [3]. Environmental attitude, in turn, seems to be affected by people's level of self-determination, with intrinsic motivation supporting, and external regulation undermining pro-environmental attitude. For the classroom-setting, this implies strengthening students' basic needs (i.e., autonomy, competence, and relatedness), in order to promote pro-environmental attitude and behavior. The trajectory of motivation toward the environment (based on people's level of self-determination) and environmental attitude, with an early plateau at around 11-years old, and a subsequent drop to a minimum, suggests focusing on environmental education in upper elementary and early middle school, through rather open teaching formats. This might mitigate the drastic decline in motivation and attitude toward the environment throughout adolescence. Though people's self-determination appears relevant to environmental attitude, further factors contribute to pro-environmental engagement (e.g., [31]). Although social constraints and demographic factors keep playing a role, it is important to consider variables that can be affected through teaching, and strengthening people's self-determination toward environmental behaviors might be a promising step to guide students toward more environmentally friendly behaviors.

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Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: Data available on request due to restrictions eg privacy or ethical The data presented in this study are available on request from the corresponding author.

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Appendix A

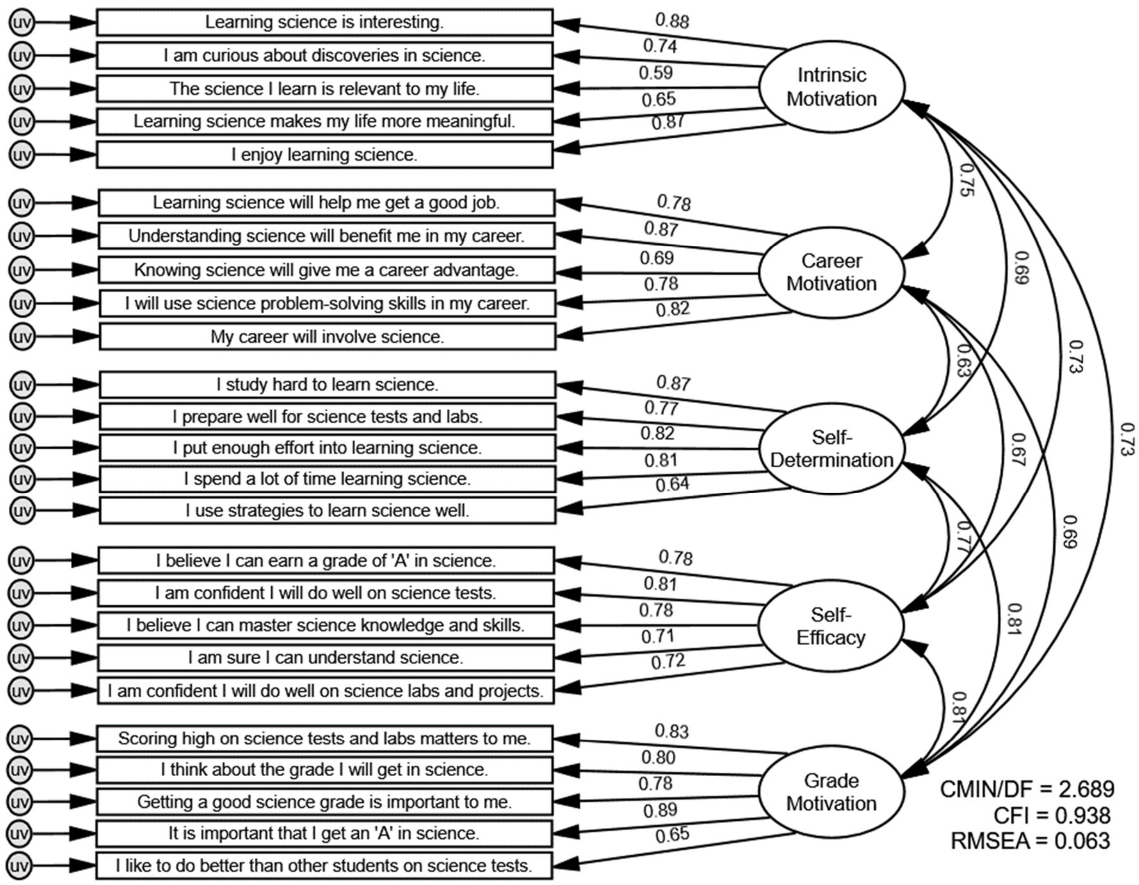

Figure A1. Confirmatory factor analysis of the Science Motivation scale [17], which reflects its proposed structure of five subscales. Those latent factors are assessed with five manifest items each. *Uv* are error terms, and include all disturbances that are not reflected by the model; this allows a more accurate measurement. Double-headed errors are correlations, and single-headed errors are beta-regression weights. Fit indices are good with the Chi-square, in relation to the degrees of freedom (CMIN/DF), the Comparative Fit Index (CFI), and the Root-mean-square Error of Approximation (RMSEA), within their thresholds.

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