

# COVID-19 Beliefs Matter: (Mis)information about COVID-19 changed the associations between well-being and engagement with sustainable development

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**Abstract:** The understanding of how individuals' beliefs, perceptions or (mis)information interact with other processes in shaping individuals' engagement is of great importance in contemporary societies. During the COVID-19 lockdown, adolescents were exposed to a huge amount of information through various channels. The formulated perceptions, beliefs and representations, including about the causes of the COVID-19, influence subjective experiences and functioning. This study aimed to examine the role that adolescents' perceptions and beliefs about COVID-19 played in the associations among well-being, satisfaction of basic psychological needs, and engagement with sustainable development. In total, 1,649 adolescents (51.2% girls) participated in two waves of data collection (before COVID-19 and during COVID-19 lockdown). The results showed that (1) well-being was positively associated with adolescent engagement with sustainable development, (2) satisfaction of basic psychological needs was also positively associated with engagement with sustainable development, and (3) satisfaction of basic psychological needs mediated the association between well-being and engagement with sustainable development. However, and the most significant result from this study, adolescents' perceptions of COVID-19 being a consequence of human-environment changed the direction of those associations. These results are consistent with research on misinformation and cognitive biases: in adolescents who had an understanding of COVID-19 as being a natural phenomenon, resulting from human-nature interaction, their engagement with sustainable development was less dependent on their subjective well-being and on their satisfaction of basic psychological needs. These results have important implications for research, political and educational practices and for Health-related Communication and Messages.

**Keywords:** COVID-19 perceptions, Misinformation, Well-being, Satisfaction of basic psychological needs, Engagement with sustainable development.

## Introduction

Engagement is one of the strong predictors of different processes and outcomes, in different functioning domains, including behavioral acts. For example, student engagement with school is one of the stronger predictors of academic performance and even school dropout (e.g., Moreira et

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al., 2018; Moreira & Lee, 2020). As sustainability and sustainable development are identified as a societal priority, including for science, the behavioral sciences are devoting more and more efforts to better understand individuals' attitudes towards sustainability and sustainable development. Consistently, the construct of engagement has been applied to the domain of sustainable development (Moreira, Inman, Hanel et al., 2022; Moreira, Ramalho et al., 2021). Unsurprisingly, substantial efforts have been made to identify and de-scribe the processes and mechanisms underlying engagement, and extensive research supports the importance of well-being and satisfaction of basic psychological needs to engagement, in its different expressions. On the one hand, there is strong evidence for the associations between the broad construct of engagement (such as engagement with school) and different indicators of subjective well-being (e.g., Faria et al., 2023). Consistently, recently there is growing evidence that also engagement with sustainable development is positively associated with positive indicators of subjective well-being and negatively associated with negative indicators of well-being (Moreira, 2021). On the other hand, satisfaction of basic psychological needs is also positively correlated with positive affect and with satisfaction with life and negatively correlated with negative affect (Inman et al., 2023).

However, besides subjective well-being and satisfaction of basic psychological needs, other processes and dimensions are involved in shaping engagement, including engagement with sustainable development. For example, the representations, beliefs or perceptions that individuals have about a specific phenomenon, naturally, play an important role in shaping attitudes towards that given phenomenon. Recently, several examples of how individuals' beliefs and perceptions about a given phenomenon have a marked impact on societal dynamics (such as attitudes towards COVID-19, misinformation, etc.). Consequently, there been a growing interest in better understanding how beliefs and representations interact with other processes (such as subjective well-being and satisfaction with basic psychological needs) underlying individuals' engagement. Thus, understanding of the psycho-logical context underlying engagement with sustainable development is of great importance both to sustainability and behavioral sciences. However, evidence about how subjective well-being interacts with the individuals' representations, perceptions or beliefs about a global crisis (such as COVID-19 pandemic) in shaping the individuals' engagement with sustainable development is scarce.

The COVID-19 pandemic lockdown resulted several challenges for everyone around the world, including on adolescents. Between March and June 2020, children and adolescents suddenly had to adapt to the physical distance of teachers, friends, colleagues, and family members, and to a new way of taking classes – classes at home (Bornardi et al., 2022; Francisco et al., 2020; Postigo-Zegarra et al., 2021).

The objective of this study was to evaluate the effect of beliefs about COVID-19 being a natural phenomenon on the associations between subjective well-being and engagement with sustainable development and between satisfaction with basic psychological needs and engagement with sustainable development.

### *Engagement and disengagement with sustainable development*

The construct of engagement has shown to be a strong predictor of several processes and outcomes in adolescents (from general well-being to academic performance among others) across ages and societies (Moreira & Dias, 2019; Virtanen et al., 2018). The concept of engagement with sustainable development emerged to understand how people react and think about sustainable development issues (Moreira, 2021). Engagement with sustainable development is defined as a dynamic process through which subjective experiences of connection and identification with sustainable development issues shape perceptions and information processing, in interaction with ecological influences, thus emerging internal states to maintain a pro-sustainable behavior (Moreira, Pedras et al., 2020; Moreira, Inman, Hanel et al., 2022). Pro-sustainable behaviors are a

manifestation of adaptive thoughts, feelings, and actions towards sustainable development. Perceptions and beliefs about sustainable development are cognitive indicators of engagement with SD; positive affective reactions towards sustainable development represent emotional indicators of engagement with SD, and finally, active participation and the effort to promote sustainable development constitute behavioral indicators of engagement with SD (Moreira, Inman, Hanel et al., 2022). As engagement and disengagement from sustainable development are independent dimensions interrelated in a two-dimensional circumplex model, individuals may, in turn, show disengagement from SD. Emotional disengagement includes disaffection and maladaptive affective reactions in relation to SD, cognitive disengagement consists of maladaptive beliefs about SD, and behavioral disengagement manifests itself in the withdrawal and absence of engaging behaviors with SD (Moreira, Inman, Hanel et al., 2022). Therefore, it is essential to promote the engagement of adolescents with SD to achieve Sustainable Development Goals (United Nations, 2014). The widespread of the COVID-19 pandemic raised awareness in many people of the misuse that humans are making of the natural resources, and about the special responsibility that humans have towards the environment. As Bates and colleagues pointed out, global COVID-19 highlighted humans as both threats and custodians of the environment (Bates et al., 2021). Awareness about the fact that “*Our humanity and planet Earth are under threat*” (International Commission on the Futures of Education, 2021) raised, as the pandemic affected our perception of sustainability (Bouman et al., 2021; Khalaf et al., 2023; Pham et al., 2022; Renzi et al., 2022).

### *Satisfaction of basic psychological needs*

The school strives to meet the three basic psychological needs of any adolescent, according to the Self-Determination Theory (SDT; Ryan & Deci, 2000): autonomy, competence, and relationship/connectivity, which are of great importance for the general subjective well-being (Eryilmaz, 2012). The possible negative impact on the well-being of adolescents, the necessary changes in their daily routine, physical distance, and the prohibition to go out into the street can be understood as a threat to the satisfaction of their basic psychological needs (Šakan et al., 2020). Not surprisingly, during the COVID-19 outbreak, higher levels of meeting basic psychological needs were associated with greater well-being (Cantarero et al., 2020) and meeting these needs had a positive impact on the regulation of emotional skills (Benita et al., 2020).

Self-determination theory posits that satisfaction of basic psychological needs “*buffer in times of stress, reducing both initial appraisals of stress and encouraging adaptive coping after stress-related events occur*” (Weinstein & Ryan, 2011, p. 12). Consistently, studies developed during the COVID-19 pandemic confirmed that satisfaction of basic psychological needs buffered the impact of stress on mental health (Cantarero et al., 2020; Šakan et al., 2020).

Some studies found that the COVID-19 had a negative impact on satisfaction of basic psychological needs, including in the youth. In a study developed in Germany, comparing satisfaction with basic psychological needs before COVID-19 and during the lockdown, Schwinger and colleagues (2020) found that satisfaction with psychological need of autonomy and relatedness decreased over time. A strong effect was found for autonomy and a small effect was found for relatedness (Schwinger et al., 2020).

### *Beliefs about the nature of COVID-19 and misinformation*

Cognitive, and attributional research has shown that the perceptions, representations, and attributions that individuals have about events and situations are crucial for understanding individuals' subjective experiences and functioning. Thus, having a representation of COVID-19 as a “logical” phenomenon allows adolescents to understand causal relationships, contributing to having a rational and, ultimately, predictable understanding of the phenomenon.

The social relevance of misinformation has been highlighted in the context of COVID-19, where it has been shown to undermine life or death positioning and behaviors, such as confinement, and vaccination (Greene & Murphy, 2021; Van Lange & Rand, 2022). As revealed by meta-analytic research, observations, representations, and beliefs about the cooperation of others are the strongest predictors of cooperative behaviors themselves (Balliet & Van Lange, 2013). Uncertainty and misinformation are at the heart of the COVID-19 pandemic – uncertainty not only about the economic and social repercussions but also about health dimensions (how the virus will mutate, will vaccines be effective, will they have side effects). However, situational characteristics do not act by themselves: their effect happens through the individuals' information processing, such as personality characteristics underlying psychological reactance (Moreira, Cunha, & Inman, 2020; Moreira, Inman, & Cloninger, 2022). People selectively seek information that is consistent with their previous beliefs or motives (Fiske & Taylor, 2020). Analytic thinking appears to be positively related to the perceived accuracy of true news and insight into true and false news (Pennycook & Rand, 2021). Finally, an emerging research trend concerns the description of associations between the well-being of individuals and beliefs in misinformation. Surprisingly, this line of research is still in its embryonic stage, considering the relevance that (especially emotional) well-being has in information processing. Trust in emotion promotes belief in false news, acute psychosocial stress affects information processing and levels of mental abstraction (Felt et al., 2021). Also, low well-being (depression) was associated with beliefs in misinformation about COVID-19 (De Coninck et al., 2021). Anxiety-related emotions, including uncertainty and avoidance, impair executive functions (Moons & Shields, 2015; Shields et al., 2016), and there is well-documented evidence of an association between negative affect and system impairment attentional (Keller et al., 2019); in turn, executive functions are aimed at information processing, including analytical thinking, which has been found to be an indicator of disbelief in misinformation. Thus, situational uncertainty has a strong effect on various psychobiological phenomena, from sensory experience (Rauwolf et al., 2021) to information processing (Felt et al., 2021).

### *This study*

Previous empirical works have described the associations between subjective well-being and the phenomenon of engagement (e.g., Faria et al., 2023), including engagement with sustainable development (e.g., Moreira, Pedras et al., 2021). Also, several studies have described the significant associations between subjective well-being and satisfaction with basic psychological needs in adolescents (e.g., Inman et al., 2023). However, the role that satisfaction of basic psychological needs has on the association between subjective well-being and engagement with sustainable development in adolescents requires empirical evidence. Additionally, recently there has been a growing consensus about the need of better understanding how beliefs and (mis)information that people have about specific societally relevant phenomena influence peoples' attitudes (including engagement or disengagement) towards those phenomena. Despite this, evidence about the role that representations, beliefs or (mis)information that individuals had about COVID-19 being a “natural” phenomenon play on the associations between subjective well-being and engagement with sustainable development and between satisfaction of psychological needs and engagement with sustainable development is scarce. The main objective of this study was to describe the effect of beliefs about COVID-19 being a natural phenomenon on the associations between subjective well-being and engagement with sustainable development and between satisfaction of basic psychological needs and engagement with sustainable development.

Consistently, we tested the following hypotheses, as displayed in the diagram below (Figure 1) describing our tested moderated mediation model:

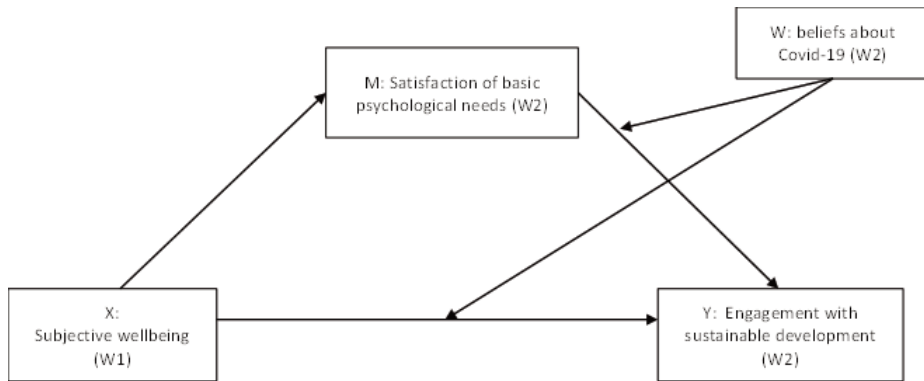


Figure 1. The moderated mediation model

- H1:* Subjective well-being at Wave 1 is positively associated with engagement with sustainable development at Wave 2;
- H2:* Satisfaction of basic psychological needs at Wave 2 is positively associated with engagement with sustainable development at Wave 2;
- H3:* Satisfaction of basic psychological needs at Wave 2 *mediates* the association between *subjective well-being* at Wave 1 and *engagement with sustainable development* at Wave 2;
- H4:* Adolescent beliefs of COVID-19 at Wave 2 *moderates* the associations between *subjective well-being* at wave 1 and *engagement with sustainable development* at Wave 2;
- H5:* Adolescent beliefs of COVID-19 Wave 2 moderates the associations between satisfaction of basic psychological needs at Wave 2 and engagement with sustainable development at Wave 2.

## Methods

### *Participants*

The current study used data from two waves of data collection from three-year longitudinal research on engagement with SD in Portuguese adolescents. For this study, were considered 51 schools from different regions of Portugal (37 schools were from the north of Portugal, 13 from the center, and 2 from the south). Of the 51 schools, 49 were from the public system, one was a professional school, and one was a private school. Thirty schools offered basic and high levels of school (from 5<sup>th</sup> to 12<sup>th</sup> grade), and 21 schools offered only a basic level of school (5<sup>th</sup> to 9<sup>th</sup> grade). The adolescent sample comprised 1649 students (48.8% male and 51.2% and female) with a mean age of 12.77 years ( $SD=.77$ ) at wave 1 (W1) and 13.79 years ( $SD=0.791$ ) at wave 2 (W2). All those students were enrolled at 7<sup>th</sup> grade in wave 1 and in the 8<sup>th</sup> grade in wave 2. Participants were balanced in terms of gender (51.2% female, and 48.8% male). Parents marital status was largely married. About 12% of parents were divorced and single or widow parents were residual. Most parents were employed (both father and mother), but unemployment amongst mothers (14.2%) was substantially higher than amongst fathers (4.2%). Finally, parental education was normally distributed with the extremes for fathers [lower level of education (4 years:13.8%) and upper level (University degree or higher: 13.9%)] being equivalent. However, reflecting the growing tendency registered in the Portuguese Population, having a University degree or more was more frequent amongst mothers (19.7%). Similarly, most of fathers had 9 years of education (26.6%) whilst most of the mothers had 12 years of education (27.5%). Table 1 presents participants' characteristics.

Table 1

*Participants characteristics (N=1649)*

Variables	<i>M (SD)</i>	
Age at Wave 1	12.77 (.77)	
Age at Wave 2	13.64 (.77)	
	% (n=)	% (n=)
Adolescents gender	51.2 (n=825, female)	
School retention (W1)	14.4 (n=228, yes)	
Parents marital status (W1)	Father	Mother
Single	2.9 (n=44)	4.2 (n=66)
Married	84.7 (n=1295)	82.8 (n=1287)
Divorced	11.8 (n=181)	12.2 (n=190)
Widow	.4 (n=6)	.8 (n=12)
Parents occupation status (W1)		
Student	0.7 (n=10)	1. (n=15)
Employed	93.5 (n=1374)	84.1 (n=1223)
Unemployed	4.2 (n=62)	14.2 (n=206)
Retired	1.6 (n=24)	.7 (n=10)
Parental education (W1)		
4 years of education	13.8 (n=186)	8.4 (n=115)
6 years of education	24.1 (n=325)	20.9 (n=287)
9 years of education	26.7 (n=359)	23.6 (n=324)
12 years of education	21.5 (n=290)	27.5 (n=378)
University degree	10.3 (n=139)	14.9 (n=205)
Master/Doctoral degree	3.6 (n=48)	4.8 (n=62)

Note. W1=Wave 1.

Sociodemographic questionnaire – Socio-demographic characteristics such as gender, age, parent’s education level, occupation, and marital status were collected.

### *Measurements*

*Satisfaction of Basic Psychological Needs (W1-W2).* The Satisfaction of Basic Psychological Needs Scale (Tian et al., 2014) composed of 15-items assessed adolescents’ satisfaction of autonomy (5 items), competence (5 items), and relatedness (5 items). Example items include “*I can decide for myself how to do things at school*” (autonomy), “*I am capable of learning new knowledge at school*” (competence), and “*I get along well with my teachers and classmates at school*”. All items were scored on a 5-point-Likert scale (1=Totally Disagree to 5=Totally Agree). The indicator about “*The Satisfaction of Basic Psychological Needs Scale*” was used as a composite indicator of the three scales. The adequacy for this analytical option was supported the article describing the psychometric properties of the scale (Inman et al., 2023). The Cronbach’s alpha of the composite indicator was .72.

*Beliefs about COVID-19 (W2).* The Beliefs about COVID-19 Questionnaire (COVID-19-Q; Moreira, Pedras, Faria et al., 2020) included 4 items (e.g., “*The COVID-19 pandemic is a sign that we need to respect more the planet*”) scored on a 5-point-Likert scale (1=Totally disagree to 5=Totally agree). Higher scores indicate higher levels of beliefs about COVID-19 as natural and logical consequence of environment-human interactions. The Cronbach’s alpha was .81.

*Cognitive well-being* (W1-W2). Cognitive well-being was calculated as the mean score across satisfaction with social support (SSSSCA), satisfaction with life (BMSLSS), and quality of life (KIDSCREEN). This index was already used in similar samples. The methodology of estimating composite cognitive well-being is consistent with the evidence that well-being is multidimensional, and aligns with recent studies that capture different indicators of cognitive engagement, and use a composite indicators analytical methodology (e.g., Faria et al., 2023; Moreira, Pedras, & Pombo, 2020; Moreira et al., 2023; Moreira, Pedras et al., 2021).

The *Brief Multidimensional Student's Life Satisfaction Scale* (BMSLSS; Costa et al., 2022; Huebner et al., 2006) was used to assess students' satisfaction with life. This instrument includes 6-items (e.g., "My satisfaction with myself is..."), scored on a 7-point-Likert scale (1=*Terrible* to 7=*Delighted*). In this sample, the measure presented good levels of reliability ( $\alpha=.84$ ). Higher scores indicate higher levels of global satisfaction with life.

The *Brief Version of the Satisfaction with Social Support Scale for Children and Adolescents* (SSSSCA; Gaspar et al., 2009) includes 11-items (e.g., "I am satisfied with the number of friends I have"), scored on a 5-point-Likert scale (1=*Totally Agree* to 5=*Totally Disagree*). Higher results indicate higher satisfaction with social support. For this sample, the instrument showed a good level of reliability ( $\alpha=.81$ ).

The *KIDSCREEN-10* (Erhart et al., 2009; Matos et al., 2012) was used to assess students' quality of life. This measure includes 10-items (e.g., "Did you feel sad?"), scored on a 5-point-Likert scale (1=*nothing* to 5=*totally*). Higher scores indicate higher quality of life (feeling happy, fit, and satisfied with family, school, and peers' group) and Cronbach's alpha was .81.

*Emotional well-being* (W1-W2). Emotional well-being was assessed through *The Positive and Negative Affect Scale* (PANAS; Galinha & Pais-Ribeiro, 2005; Watson et al., 1988) that includes 20 items, scored on a 5-point-Likert scale. Participants indicate the extent to which they experienced specific affective states indicative of Positive Affect (e.g., proud) and Negative Affect (e.g., guilty) during the previous week. Individuals responded to each item on the following scale (1=*very slightly or not at all* to 5=*extremely*). Positive Affect (PA) scale presented a Cronbach's alpha of .82 and the Negative Affect (NA) Scale presented a Cronbach's alpha of .88. A single indicator of emotional well-being was calculated by subtracting the sum of the NA items from the sum of the PA items.

*Subjective well-being* (W1-W2). An index of subjective well-being was calculated using the average of cognitive well-being and emotional well-being. As the aim of this study was to explore the role of well-being in engagement with SD and not the differential role of emotional and cognitive well-being, the subjective well-being index was used.

*Engagement and Disengagement with Sustainable Development* (W2). *Engagement and Disengagement with Sustainable Development Scale* (EDiSDI; Moreira, Ramalho et al., 2021) comprises 27 items with six sub-dimensions and was used to assess emotional engagement (indicators include positive affective reactions towards sustainable development: e.g., "I feel proud of the things I do to help make the world better"), cognitive engagement (adaptive beliefs about sustainable development: e.g., "If each of us does little things in our daily lives, it will have a big influence on the planet"), behavioral engagement (behavioral involvement with sustainable development: e.g., "Even if changing behavior is difficult, I will continue to try my best"), emotional disengagement (disaffection and maladaptive affective reactions towards sustainable development: e.g., "Global sustainability issues are annoying"), cognitive disengagement (e.g., "I think that people who care a lot about the future of the planet are fanatics (or a little crazy)"),

maladaptive beliefs about sustainable development), and behavioral disengagement (withdrawal of behavioral involvement with sustainable development: e.g., “*I don’t do anything to protect the planet*”). A psychometric investigation of the EDiSDI supported a bifactor model comprising two general factors (engagement and disengagement) and six specific factors (Moreira, Ramalho et al., 2021). The Cronbach’s alpha was .84 for engagement with sustainable development and .78 for disengagement with sustainable development.

### *Procedure*

Ethical approval was granted by the Ethics Committee of the Centro de Investigação em Psicologia para o Desenvolvimento (CIPD) where this study was developed and by the Portuguese General Education Board, an entity responsible to evaluate research projects which sample is constituted by students. Ninety-seven schools were contacted by the research team members and invited to participate in the study. Those schools who accepted to participate (51) named a teacher to be responsible for the data collection that took place between April and June of 2019 at wave 1 (W1) and between May and July of 2020 for wave 2 (W2) (Figure 2). In the W1, questionnaires were filled through the pen and paper method at schools. Each responsible teacher received the paper protocols at school and the informed consent to parents’ students. After the teacher have had received the informed consent, he/she divided them between the class headteachers. Students filled the instruments while at class, supervised by teachers. At W2, the questionnaires were administered online, via Google Forms, to the students whose parents signed the informed consent and authorized their participation in the W1 of data collection. The link to the questionnaire was sent to students through professors with the indication to fill the questionnaires during online home classes.

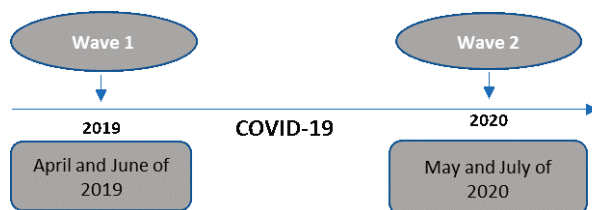


Figure 2. Timeline of data collection

### *Data analysis plan*

Regarding missing values, including attrition between the two waves, we highlight that this data was collected during a period of severe restrictions, including classes at home, which impacted in the degree to each participant could had timely access to the questionnaires. In regular times, attrition rates between the moments of data collection may represent meaningful information to a better understanding of the data, including the nature of the questionnaires, the procedures, and also about the sample. However, that information is only valid for inferences about those indicators, when the attrition rates were affected by those variables. In the case of the present study, it is very likely that the eventual attrition rates between waves would be strongly dependent on the specific characteristics of the moment when the data was collected (for example, if collected in a specific time where the Pandemic restrictions were more severe, then the odds participants being at home and not at school would raise, and consequently, the odds of the participants have different type of access to the questionnaires). Therefore, depending on the specific situation of the pandemic in each community, the conditions to access the data would be different. And we



know that in different countries, and in different regions and communities of the same country (including Portugal) different restrictions in different time moments were made depending on the pandemic situation in the specific regions/communities. Considering the complexity of this question, especially for the understanding of the meaning of the attrition rates (for example, because of the restrictions, it is very likely that attrition rates would have varied accordingly to the region/community of the participants) we choose only to include in the analyses data from participants that had answered the questionnaires in the two moments. We consider that this was the option that better controlled for the effect that belonging to different regions/communities would have in the attrition rates and its meaning to the interpretation of the attrition rates. In sum, we only included in the analysis data from participants that participated in the two moments. And from these participants, the Missing Values were residual, because the participation was online, and the completion of all the answers to all the items was required to the system to move to the next section. In the few exceptions, the missing values were replaced by the mean. But these missing values were lower than 1%.

A Pearson coefficient was used to test the relationships among variables. To explore the mediator role of satisfaction of basic psychological needs, in the relationship between subjective well-being (W1) and engagement with SD (W2) a mediation analysis was performed. To determine whether this mediational process is conditional on other variables, a moderated mediation was performed (Calantone et al., 2017). Hayes' PROCESS macro (2013) incorporates a variety of model specifications that allows testing the effects (both direct and indirect) of X on Y, conditional on a moderator (Model 15). Process's model 15 allows examining the mediating effect of satisfaction of basic psychological needs in the association between subjective well-being (W1) and engagement with SD (W2) and the moderating effect of beliefs about COVID-19 on this mediation effect and in the relationship between satisfaction of basic psychological needs and engagement with SD. This study employed 5000 bootstrap samples to obtain estimates for the conditional relationships through PROCESS software, which is a computational tool for estimating and probing interactions and the conditional indirect effects of moderated mediation models (Hayes, 2013; Preacher et al., 2007). The Index of moderated mediation of X on Y is reflected in an omnibus test of the conditional indirect effect (Preacher et al., 2007), reflected in the If the null of 0 does not fall between the lower and upper limit of the 95% confidence interval, we infer that the indirect effect is conditional on the level of the moderator variable (W).

## Results

### *Descriptive analysis and correlations*

Associations between beliefs about COVID-19, satisfaction of psychological needs, subjective well-being in wave 1 and wave 2, and engagement and disengagement with SD in wave 1 and wave 2, showed Pearson coefficients ranging from -.07 to .49.

Engagement with SD at wave 1 was positively and strongly correlated with Engagement with SD at wave 2 ( $r=.460$ ). Moreover, Disengagement with SD at wave 1 was positively and strongly correlated with Disengagement with SD at wave 2 ( $r=.451$ ), confirming the stable nature of these phenomena across time.

The same tendency of positive correlations was registered also between well-being at wave 1 and well-being at wave 2 ( $r=.355$ ). Interestingly, subjective well-being at wave 1 registered positive correlations with Engagement with SD at wave 1 ( $r=.388$ ) and with engagement with SD at wave 2 ( $r=.277$ ), but (although also positive correlations) the strength of the association between well-being at wave 1 ( $r=.388$ ) and Engagement with SD at wave 2 ( $r=.277$ ) was lower. The positive

correlation between well-being at wave 2 and engagement with SD also at wave 2 ( $r=.337$ ) was similar to the correlation between well-being at wave 1 and engagement with SD also at wave 1 ( $r=.388$ ), suggesting that the nature and strength of association between well-being and engagement with SD is stable across this time period.

Satisfaction with basic psychological needs at wave 2 was positively associated with Engagement with SD at Wave 1 ( $r=.251$ ), with Engagement with SD at Wave 2 ( $r=.479$ ), with well-being at Wave 1 ( $r=.308$ ) and with well-being at wave 2 ( $r=.496$ ). As expected, positive associations between satisfaction with basic psychological needs at wave 2 and Engagement with SD and with well-being were stronger at wave 2. Consistently, Disengagement with SD at wave 2 and Satisfaction with basic psychological needs at wave was negatively correlated ( $r=-.234$ ).

Beliefs about COVID-19 being a natural phenomenon (wave 2) was positively correlated with satisfaction with basic psychological needs ( $r=.221$ ), with engagement with SD at wave 1 ( $r=.125$ ), with engagement with SD at wave 2 ( $r=.298$ ). Beliefs about COVID-19 being a natural phenomenon correlated negatively with Disengagement with SD at wave 2 ( $r=-0.69$ ), but did not register statistically significant correlations with Disengagement with SD at wave 1, which is interesting precisely because at wave 1 COVID-19 had not emerged yet.

Finally, and similarly to what happened with Disengagement with SD, beliefs about COVID-19 (at wave 2) correlated positively with well-being at wave 2 ( $r=.098$ ), but not correlated with well-being at wave 1.

Descriptive statistics and correlation coefficients of the variables under study are presented in Tables 2 and 3.

Table 2

*Descriptive statistics (N=1649)*

Variables	Min-max	Mean (SD)
Satisfaction of basic psychological needs W2	1 - 5	3.909 (.530)
Beliefs about COVID-19 W2	1 - 5	3.681 (.859)
Subjective wellbeing W1	.01 - 4.43	2.414 (.691)
Subjective wellbeing W2	.68 - 4.08	2.620 (.574)
Engagement with sustainable development W1	1.33 - 5	4.113 (.552)
Engagement with sustainable development W2	1.60 - 5	4.126 (.599)
Disengagement with sustainable development W1	1 - 5	2.292 (.741)
Disengagement with sustainable development W2	1 - 5	2.208 (.784)

Note. W1=Wave 1, W2=Wave 2.

Table 3

*Correlations among variables*

	1.	2.	3.	4.	5.	6.	7.	8.
Satisfaction with basic psychological needs W2	-							
Beliefs about COVID-19 W2	.221***	-						
Engagement with SD W1	.251***	.125***	-					
Disengagement with SD W1	-.133***	-.030	-.466***	-				
Engagement with SD W2	.479***	.298***	.460***	-.279***	-			
Disengagement with SD W2	-.234***	-.069**	-.307***	.451***	-.445	-		
Subjective well-being W1	.308***	.011	.388***	-.353***	.277***	-.286***	-	
Subjective well-being W2	.496***	.098***	.168***	-.074***	.337***	-.205***	.335***	-

Note. \* $p<.05$ , \*\* $p<.01$ , \*\*\* $p<.001$ ; SD=Sustainable development; W1=Wave 1, W2=Wave 2.

*Moderated mediation effects*

The moderated mediation means that mediating effect that intervenes between subjective well-being at W1 and engagement with SD at W2 is different at different values of beliefs about COVID-19 as a “logical” phenomenon and as a message and a “wake-up call” from the planet (Figure 3).

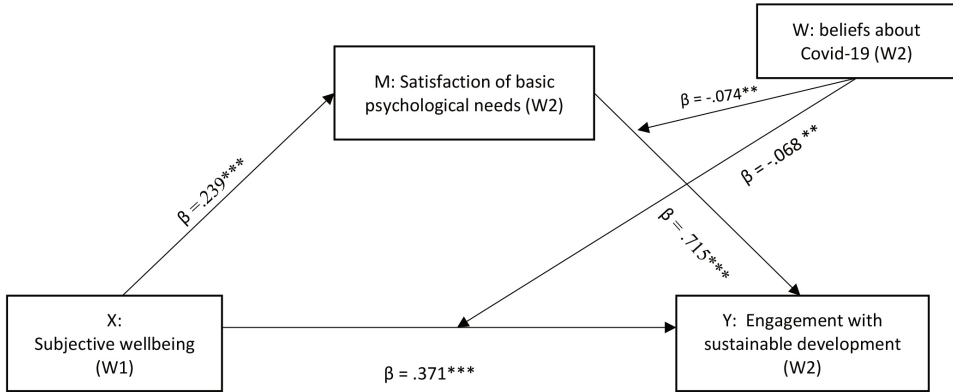


Figure 3. Moderated mediation using process macro (Model 15), direct and indirect relationships between wellbeing and engagement with sustainable development through the indirect effect of satisfaction of basic psychological needs. COVID-19 beliefs as a moderator on the relationship between satisfaction of basic psychological needs and engagement with sustainable development and on the relationship between wellbeing and engagement with sustainable development

Note. \*\*\* $p < .001$ , \*\* $p < .01$ ; W1=Wave 1, W2=Wave 2.

Table 4 presents the main results consisting of conditional direct effect, mediating model, and conditional indirect effect analysis. Analyzing the mediating model, results show that subjective well-being at W1 positively predicts satisfaction of basic psychological needs at W2 ( $\beta = .239$ , 95% CI=[.201; .275]), and satisfaction of basic psychological needs predicts engagement with SD at W2 ( $\beta = .715$ , 95% CI=[.524; .905]). In turn, subjective well-being at W1 positively predicts engagement with SD at W2 ( $\beta = .371$ , 95% CI=[.206; .536]). These results indicate a significant indirect effect of satisfaction of basic psychological needs at W2 in the relationship of subjective wellbeing at W1 and engagement with SD at W2.

Besides, the interaction of subjective well-being at W1 and beliefs about COVID-19 had a significant effect on engagement with SD at W2 ( $\beta = -.068$ , 95% CI=[-.111; -.024]), and the interaction between satisfaction of basic psychological needs and beliefs about COVID-19 had a significant effect on engagement with SD at W2 ( $\beta = -.074$ , 95% CI=[-.124; -.024]). These results indicate that both relationships between subjective well-being at W1 and engagement with SD at W2 and the relationship between basic psychological needs and engagement with SD at W2 were moderated by beliefs about COVID-19 (see Figures 4 and 5). The index of moderated mediation was significant ( $\beta = -.018$ , 95% CI=[-.033; -.004]), confirming the moderated mediation model. Analyzing both a conditional direct effect and conditional indirect effect, all of the three conditional direct effects (based on the moderator values at the mean and at -1 standard deviation) and all of the three conditional indirect effects were positive and significantly different from zero. Namely, the effect of subjective well-being at W1 on engagement with SD at W2 and the indirect effect of subjective well-being at W1 on engagement with SD at W2 through the satisfaction of basic psychological needs were observed when beliefs about COVID-19 were low and high.

Table 4

*Moderated mediation analysis: COVID-19 beliefs moderate the direct and the indirect relationship between subjective wellbeing (W1) and engagement with sustainable development (W2)*

Consequent (M=Mediator) Satisfaction of basic psychological needs						
Antecedents	<i>B</i>	<i>SE</i>	<i>t</i>	<i>p</i>	<i>LLCI</i>	<i>ULCI</i>
Subjective wellbeing (X)	.239	.019	12.572	<.001	.201	.275
<i>R</i> <sup>2</sup> =.087 <i>F</i> =158.056; <i>p</i> <.001						
Conditional direct effect of COVID-19 beliefs	Effect		<i>SE</i>		<i>LLCI</i>	<i>ULCI</i>
Mean - 1SD (2.815)	.181		.028		.127	.235
Mean (3.675)	.123		.020		.085	.162
Mean + 1SD (4.535)	.065		.027		.012	.119
Consequent (Y=Dependent variable) Engagement with sustainable development (Y)						
Antecedents	<i>B</i>	<i>SE</i>	<i>t</i>	<i>p</i>	<i>LLCI</i>	<i>ULCI</i>
Subjective wellbeing (X)	.371	.084	4.403	<.001>	.206	.536
Satisfaction with basic psychological needs	.715	.097	7.350	<.001>	.524	.905
COVID-19 Beliefs (W)	.600	.102	5.864	<.001>	.400	.801
X*W (Int. 1)	-.068-	.022	-3.038-	.002	-.111-	-.024-
M*W (Int. 2)	-.074-	.025	-2.889-	.004	-.124-	-.024-
<i>R</i> <sup>2</sup> =.298 <i>F</i> =140.474; <i>p</i> <.001						
Conditional indirect effect of COVID-19 Beliefs	Effect		<i>Boot SE</i>		<i>Boot LLCI</i>	<i>Boot ULCI</i>
Mean - 1SD (2.815)	.139		.016		.109	.173
Mean (3.675)	.121		.012		.098	.146
Mean + 1SD (4.535)	.103		.012		.079	.128
Index of moderated mediation	-.018-		.007		-.033-	-.004-

Note. W1=Wave 1, W2=Wave 2.

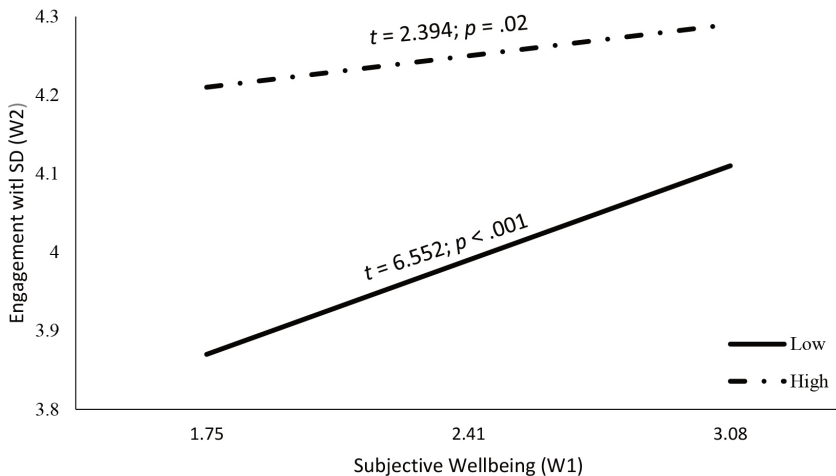


Figure 4. Graphical representation of the moderator role of beliefs about COVID-19 as a “logical” phenomenon on the mediated effect of wellbeing at wave 1 and engagement with SD at wave 2

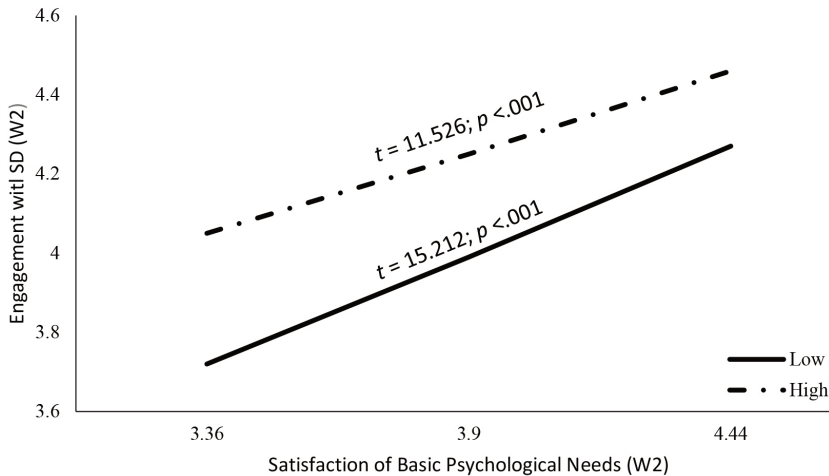


Figure 5. Graphical representation of the moderator role of beliefs about COVID-19 as a “logical” phenomenon on the relationship between satisfaction of basic psychological needs at wave 2 and engagement with sustainable development at wave 2

Testing the same moderated mediation model but with Disengagement with SD as the dependent variable, the index of moderated mediation was ( $\beta=.018$ , 95% CI=[-.006; .044]), passing the null, thus not being significant.

## Discussion

In the present study, a moderated mediation model was constructed to analyze the mechanisms underlying the relationship between adolescents’ well-being before COVID-19 (W1) and engagement with SD during COVID-19 lockdown (W2).

Generally, results confirmed our hypotheses. First, subjective well-being (at Wave 1) was positively associated with adolescent engagement with sustainable development (at Wave 2). Second, satisfaction of basic psychological needs (at Wave 2) was also positively associated with engagement with sustainable development (at Wave 2). Third, satisfaction of basic psychological needs (at Wave 2) mediated the association between well-being (at Wave 1) and engagement with sustainable development (at Wave 2). Moreover - and the novelty of this study – hypotheses testing the moderating effect of beliefs about COVID-19 were also confirmed. Beliefs about COVID-19 as a “logical” phenomenon and as a message and a “wake-up call” from the planet, had a moderating effect in the relationship between subjective well-being (W1), and engagement with SD (W2). Finally, beliefs of COVID-19 being a natural and logical phenomenon had a moderating effect also in the relationship between satisfaction of basic psychological needs (W2), and engagement with SD (W2). Specifically, as adolescent beliefs about COVID-19 being a natural and logical phenomenon increase, the correlations changed from positive to negative; and as the adolescent beliefs about COVID-19 being a natural and logical phenomenon decrease, these correlations become positive.

Broadly, two sets of results emerged from our study: (1) well-being and satisfaction of basic psychological needs are positively associated with engagement with sustainable development; and (2) those associations are moderated by beliefs about COVID-19 being a natural phenomenon.

The first set of results is consistent with other studies: pre-pandemic well-being contributed to increasing adolescent engagement in sustainable development. It was the adolescents who were happier and healthier before the COVID-19 pandemic who registered cognitions, affective responses, and behaviors more pro-sustainable development (Brown & Kasser, 2005) and had more expanded thought-action resources to meet their autonomy, competence, and relationship needs during the lockdown due to the COVID-19 pandemic. These results are consistent not only with Basic Psychological Needs Theory (e.g., Deci & Ryan, 2000), but also with results from experimental studies demonstrating that interventions were efficient in promoting the satisfaction of needs of autonomy, competence and relatedness during the COVID-19 pandemic (e.g., Behzadnia & FatahModares, 2020). Additionally, our study goes a step further by demonstrating that subjective well-being has a positive effect on engagement with SD through meeting basic psychological needs.

According to the Broaden-and-Built Theory (Fredrickson, 2001), positive emotions such as joy, interest, or enthusiasm broaden individuals' thought-action repertoires, leading to a wider and more unusual range of perceptions, thoughts, and actions that, in turn, promote more flexible and creative cognitive and behavioral actions. In addition, believing in misinformation depends on analytical thinking, which tends to be hampered by low well-being (including negative emotionality and anxiety), which tends to increase in times of uncertainty – as is the case with the COVID-19 pandemic – where uncertainty about the evolution of the pandemic, the effectiveness of vaccines, and the side effects were very evident. Thus, it seems that the role of well-being is undisputed: (1) for promoting beliefs, affective responses, and sustainable development behaviors and ecological behaviors in adolescents (even when well-being is reported before the pandemic; (2) for contributing to the development of lasting physical, psychological, intellectual and social resources and to the satisfaction of basic psychological needs; and (3) for negatively influencing analytical thinking when it is low (including negative emotionality and anxiety).

The second set of results evidence that beliefs about COVID-19 being a natural phenomenon moderated the associations between subjective well-being and engagement with sustainable development and between satisfaction of basic psychological needs and engagement with sustainable development.

In adolescents who had an understanding of COVID-19 as being a natural phenomenon, resulting from human-nature interaction, their engagement with sustainable development was negatively correlated with subjective well-being and satisfaction with basic psychological needs. These results are consistent with research on misinformation and cognitive biases: in adolescents who had an understanding of COVID-19 as being a natural phenomenon, resulting from human-nature interaction, their engagement with sustainable development was less dependent on their subjective well-being and on their satisfaction with basic psychological needs. These results are consistent with research on cognitive biases and misinformation: having beliefs about COVID-19 being a natural phenomenon makes the engagement less dependent on more spontaneous states (such as subjective well-being and satisfaction of basic psychological needs), and more dependent on other processes and resources such as executive processes, and analytical processing of the information. In fact, information processing characterized by analytical thinking (rather than mostly emotionally driven), is a predictor of disbelief in misinformation (Felt et al., 2021).

These results showing that the beliefs in COVID-19 being a natural phenomenon moderate the associations between subjective well-being and engagement with sustainable development suggest two important conclusions. On the one hand, it suggests that there is – at least – two profiles of adolescents' engagement with sustainable development. One type of engagement emerging from high well-being and high satisfaction of basic psychological needs, but low awareness of the complexity of COVID-19 as being a natural phenomenon. This is a type of engagement essentially dependent on emotional and more spontaneous processes, such as subjective well-being, which

is consistent with Broad-and Build Theory and with evidence that subjective well-being favors the mobilization of resources allowing for higher engagement. However, in this type of engagement the information processing seems to be more superficial, not involving analytical thinking and rational understanding of the phenomenon, that as it is implied when having an analytical understanding the complexity of the causes and dynamics involved in COVID-19 pandemic. And this refers to the second profile of engagement. In adolescents having an understanding that COVID-19 was a complex phenomenon, a result also from human interaction with nature, their engagement with sustainable development was less dependent from emotional and more spontaneous processes and very likely to be more dependent on executive processes and analytical thinking. This result is consistent with research suggesting that analytic thinking prompts accuracy in the information processing, especially in complex situations (Pennycook & Rand, 2021).

### *Practical implications*

This work has important implications for behavioral sciences (especially educational sciences), but also for political sciences. Contemporary societies are facing the challenges that misinformation and information processing biases posit to societal functioning. The understanding of the dynamics involving the representations/ perceptions/ believes about facts and the processes involved in energizing actions (such as well-being, satisfaction of basic psychological needs or engagement with sustainable development) are crucial for informing policies and practices fostering positive development.

By demonstrating that engagement with sustainable development informed by accurate information (beliefs of COVID-19 being a natural phenomenon) is dependent on more complex psychological resources (such as executive processes and analytical thinking), our study highlights the importance of schools and families offer systematic interpersonal and emotional support (especially with more vulnerable populations, such as children and adolescents) in order to insure that individuals are able to cope well and with the processing of complex events and situations.

### *Study limitations and future directions*

Despite some methodological strengths, such as the size of the representative sample and the longitudinal design, it is important to recognize that the study also has some limitations.

First, cognitive well-being was considered as a composite indicator calculated as the mean score of the raw scores of scales with different response scales. Satisfaction with social Support (SSSSCA) and KIDSCREEN both have a rating scale of 5 points, but the satisfaction with life scale (BMSLSS) has a rating scale of 7 point-likert-scale. Making a composite index from the mean of dimensions with different rating scales, results in a bias on the compositive indicator, as the scale with a higher rating scale will have a higher weight in the total index. In the case of this study, the fact that the satisfaction with life scale has a 7 point-likert-scale and the other 2 have 5 point-likert-scales resulted in a composite index where the dimension of satisfaction with life had a higher weight than the other two. Although the construct of life satisfaction is one of the stronger predictors of the construct of subjective well-being (Pavot & Diener, 2008), a note of caution is needed in the interpretation of the composite indicator of subjective well-being. A way of overcoming this limitation is to use standardized scores (e.g., z-scores) of the different dimensions rather than the raw scores. Future studies should overcome this limitation by using standardized scores to generate the composite indicator of cognitive well-being using the scales used in our study.

Second, the methodological data collection procedure was different in the two waves: at school in wave 1 and at home in wave. On the one hand, the students in wave 2, filled data at home without the chance to clarify possible doubts. On another hand, it is very likely that the different participants at wave 2 had answered to the questionnaires in different contextual and individual circumstances. This is a limitation common to all studies describing data from adolescents which was collected during COVID-19 lockdown periods.

Future studies need to deepen our understanding about the interactions between individual characteristics (e.g., personality) and states (e.g., well-being) and contextual conditions (e.g., educational practices) that promote youth's positive development and functioning in adapting to information- and knowledge-based societies.

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The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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## **Authors contribution**

Conceptualization: PASM; Data curation: SP, SF, JL, RI; Formal analysis: SP; Methodology: SF, JL, RI, PASM; Visualization: SP; Software: SP; Supervision: PASM; Funding acquisition: PASM; Project Administration: PASM; Writing – Original draft: SP, PASM; Writing – Review and edit: SP, PASM.

All the authors read and approved the final manuscript.

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### **As crenças acerca da COVID-19 são importantes: A (des)informação sobre a COVID-19 alterou as associações entre bem-estar e envolvimento com o desenvolvimento sustentável**

**Resumo:** A compreensão de como as crenças, percepções ou (des)informações dos indivíduos interagem com outros processos na moldagem do envolvimento dos indivíduos é de grande importância nas sociedades contemporâneas. Durante o confinamento da COVID-19, os adolescentes foram expostos a uma enorme quantidade de informação através de vários canais. As percepções, crenças e representações formuladas, inclusive sobre as causas da COVID-19, influenciam as experiências e o funcionamento subjetivos.

O objetivo deste estudo foi examinar o papel que as percepções e crenças dos adolescentes sobre a COVID-19 desempenharam nas associações entre bem-estar, satisfação com as necessidades psicológicas básicas e envolvimento com o desenvolvimento sustentável. Um total de 1.649 adolescentes (51,2% sexo feminino) participaram em duas fases de recolha de dados (antes da COVID-19 e durante o confinamento da COVID-19).

Os resultados mostraram que (1) o bem-estar esteve positivamente associado ao envolvimento dos adolescentes com o desenvolvimento sustentável, (2) a satisfação com as necessidades psicológicas básicas também esteve positivamente associada ao envolvimento com o desenvolvimento sustentável, e (3) a satisfação com as necessidades psicológicas básicas mediou a associação entre o bem-estar e o envolvimento com o desenvolvimento sustentável.

No entanto, e o resultado mais significativo deste estudo, a percepção dos adolescentes de que a COVID-19 é uma consequência da interação entre o *Ser Humano – Natureza* mudou a direção dessas associações. Estes resultados são consistentes com a investigação sobre desinformação e enviesamentos cognitivos: em adolescentes que entendiam a COVID-19 como sendo um fenómeno natural, resultante da interação entre o *Ser Humano – Natureza*, o seu envolvimento com o desenvolvimento sustentável era menos dependente do seu bem-estar subjetivo e da satisfação com as necessidades psicológicas básicas.

Estes resultados têm implicações importantes para a investigação, para as práticas e políticas educativas e para a Comunicação e Mensagens relacionadas com a Saúde.

**Palavras-chave:** Percepções sobre a COVID-19, Desinformação, Bem-estar, Satisfação com as necessidades psicológicas básicas, Envolvimento com o desenvolvimento sustentável.

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