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Predictors of young people's anti-vaccine attitudes in the context of the COVID-19 pandemic

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Abstract

The objective of this research was to explore how attitudes to science and scientists may be related to anti-vax positions and whether the psychological trait known as Need for Closure may influence the relationship between any or all of these attitudes. A questionnaire was administered to a sample of 1128 young people aged 18–25 living in Italy during the COVID-19 health crisis. Based on the results of exploratory and confirmatory factor analyses, which allowed the extraction of a three-factor solution (scepticism about science, unrealistic expectations about science and anti-vax postures), we tested our hypotheses by means of a structural equation model. We found that anti-vax positions are strongly correlated with sceptical views of science, while unrealistic expectations about science affect attitudes to vaccination only indirectly. Either way, Need for Closure emerged as a key variable in our model, as it significantly moderates the effect of both factors on anti-vax positions.

Keywords

COVID-19, moderated mediation, need for closure, trust in science, vaccination hesitancy

The outbreak of the COVID-19 pandemic has highlighted the importance of science to society (Eichengreen et al., 2021), especially because relying on scientific research and expertise

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represents the main option in coming out of the pandemic more quickly. Even in the most dramatic moments of the pandemic, science has kept hope alive that the virus could be defeated. Confidence in science is well captured by the State of Science Index Survey (2021), which reported that global trust in science is high and that appreciation of science is stronger than in pre-pandemic times in all the countries included in the survey, increasing from a pre-pandemic average of 86% to over 90% (an increase also recorded by Gallup, 2020). In Italy, the country on which this research focuses, data prior to the pandemic already showed a high degree of confidence in science (European Commission, 2010; Gallup, 2018), and more recent data indicate a further increase (Pellegrini and Saracino, 2021; State of Science Index Survey, 2021, 2022).

However, the pandemic has also exposed a precarious equilibrium between two contrasting views, one presenting science as a source of definitive truth and certainties, the other conceiving science as providing just one opinion among many. Pioneering analyses by Nunn (1977) and Mazur (1981) showed that science has always been a target of criticism, generating doubts about its reliability and the usefulness of scientific evidence in normative decision-making. In fact, while scepticism in itself might be of value to science, based on the assumption that scientific progress is fostered by a rigorous and transparent scrutiny (Merton, 1973), it may also be converted into a generalized attitude that questions the effectiveness and impartiality of science and its ability to solve problems.

A crisis of confidence in science has arisen over the last few decades (Millstone and Van Zwanenberg, 2000; Rubin, 2020). A review of the literature shows that these attitudes are not only specific to particular domains, such as human evolution or anthropogenic climate change (Rutjens et al., 2021) but that they can also be a product of both individuals' particular backgrounds and miscommunication by the scientific community (Eichengreen et al., 2021). In Italy, evidence has been found of a possible relationship between opinions on science and attitudes about vaccines. Based on an online survey, the research conducted by Palamenghi et al. (2020) showed a trend that contrasted with international surveys (State of Science Index Survey, 2022): Italian citizens' trust of scientific research decreased between the first and second waves of the pandemic in Italy, leading many to question the benefits of vaccination as well. Aversion to vaccines is not new in Italy, and today it is among those countries with the highest rate of non-compliance with vaccination programmes in Europe (Gobo and Sena, 2019, 2022). Also, the so-called Lorenzin Law (L.119/2017), which introduced mandatory vaccinations for minors from 0 to 16 years old, has exacerbated the debate.

Against this background, our research addresses one of the most polarized scientific debates in Italian society by analysing the opinions of a sample of young people about science and vaccines in the context of the COVID-19 pandemic. To this end, we will use the term 'anti-vax postures' to refer to beliefs that vaccines do not work or are not safe and attitudes leading to a refusal of vaccination (Benoit and Mauldin, 2021). Although the younger age group (18–34) had a greater willingness to be vaccinated against coronavirus than the middle-aged group (Palamenghi et al., 2020), young people and adolescents are also the main users of social networks and are therefore more exposed to fake news and conspiracy theories (European Commission, 2018; Figueira and Oliveira, 2017; Herrero-Diz et al., 2020), thus justifying the relevance of studying this age cohort.

1. The relationship between sources of information and attitudes to vaccination

Even before the pandemic, scholars emphasized that attitudes to vaccination are shaped not only by health care professionals, but also by a number of other information providers, including online and social media sources (Nan and Madden, 2012; Yaqub et al., 2014). Exposure to online content

with a great deal of conflicting information can be a further activator of misconceptions. Research has found that online materials often provide misleading information about health issues, especially in user-generated platforms, such as YouTube videos and blogs (Keelan et al., 2010; Nan and Daily, 2015). Also, conspiracy theories are shared on social media about three times more often than information from official sources, which suggests that 'unsubstantiated rumours' are particularly pervasive on the Internet (Bessi et al., 2015; Rutjens et al., 2021).

Social networks have a fundamental role in building and maintaining confidence in vaccination (The Lancet Haematology, 2021), but they can also amplify extreme anti-scientific and anti-vax positions. For example, a recent analysis of a hundred million profiles on Facebook found that, whereas anti-vax individuals represent a minority, without intervention, they are projected to dominate mainstream discourse on this social media platform within the next decade (Johnson et al., 2020).

As for COVID-19, its media narrative, when not adequately accompanied by the health education and engagement of the population, can expose people to misunderstandings about the role of science and health institutions (Garfin et al., 2020; Germani and Biller-Andorno, 2021). This applies especially to young people, for whom vaccine-critical websites resonate strongly (Betsch et al., 2010), and sentiments can travel quickly across 'fertile' social networks (UNICEF, 2013). In this regard, the World Health Organisation (2014: 7) has stated that the situation is 'complex and contextual; varies over time, place and between vaccines; and it is influenced by numerous factors, such as complacency, convenience and trust'. It thus highlights the need to collect evidence on the factors that influence anti-vaccine attitudes, anti-science views and the possible connections between them.

2. Unrealistic expectations about science and the need for cognitive closure

Debates and controversies among reputable scientists are integral components of the scientific method. Science advances randomly through trial and error, particularly evident under strong social pressure and in the absence of consolidated evidence, conditions that occurred during the pandemic. Moreover, while science usually provides its public with finished products, the health emergency caused by the spread of the COVID-19 virus opened up a pandora's box (Knorr-Cetina, 1989; Latour and Woolgar, 1979) in which scientific progress was uncertain and conflicts between scientists became extreme. This is what some authors called a post-normality situation (Funtowicz and Ravetz, 1997; Waltner-Toews et al., 2020) in which the exposure of science is at its maximum, and scientific disputes are sharpened by the disintermediation of social media.

Prior research shows that, when the pressure to produce and disseminate scientific findings quickly is intense, miscommunication occurs that has an impact on citizens' ideas about science (Eichengreen et al., 2021). In the face of conflicting statements by different experts, or when scientific evidence is uncertain and often discordant, public perceptions of scientific knowledge in general may change (Provenzi and Barello, 2020). Thus, unrealistic expectations and erroneous ideas about science proliferate, a pseudoscientific culture spreads, along with the idea that debates undermine science (Tipaldo, 2019).

These conceptual misunderstandings lead to paradoxes and conflicts (National Research Council, 1997), as well as to the desire for certainty that is inherent in all people. Indeed, several studies indicate that there is an aversion to ambiguity (Han et al., 2009, 2018; Hillen et al., 2017) that characterizes science's 'lay' public, or those whom Fleck (1980) called 'the exoteric circles of science' and that this aversion is amplified precisely in the presence of debates or other risk factors that increase uncertainty (Vraga et al., 2018). Faced with a flood of news items and information (a so-called infodemic), people voice the need to be given clear answers. In other words, what is

activated at the micro-level is a mechanism psychologists call 'the Need for Cognitive Closure' (NFC) (Kruglanski and Fishman, 2009). This corresponds to the desire to obtain definite knowledge on some issues in contexts of indeterminacy, confusion and ambiguity. This is a crucial issue because the intensity of the need for cognitive closure is established early in life and is hard to shift. To respond to the need for certainty, people can invoke different sources: in addition to epistemic authority, there may be preconceived notions drawing on tradition, including religious or mythical teachings (Campbell and Kay, 2014), which can result in 'seizing and freezing' and a consequent closing of the mind (De Grada et al., 1999; Kruglanski and Webster, 1996).

3. Objectives and hypotheses

The aim of this research is to analyse opinions about science and attitudes towards vaccination among a sample of young people living in Italy aged between 18 and 25 in the context of the COVID-19 health crisis. The research proposes the following hypotheses:

Hypothesis 1 (H1). Sceptical views (H1a) and unrealistic expectations about science (H1b) are correlated with anti-vax positions.

Hypothesis 2 (H2). The effect of unrealistic expectations on scepticism about science depends on different individual levels of the need for closure.

Hypothesis 3 (H3). Scepticism (H3a), unrealistic expectations about science (H3b) and anti-vax positions (H3c) vary as a function of the sources of information that young people use to acquire and share information about science.

These hypotheses have been tested by means of a structural equation model with a test for moderated mediation.

4. Data and methods

In this research, we use a cross-sectional quantitative study and a survey design. The questionnaire was designed and validated by experts (two professors of research methodology) prior to its administration through the CATI (Computer-Assisted Telephone Interviewing) system, in April 2021, when the national vaccination campaign in Italy was still in its start-up phase. The spread of infections began to decline from this point. In the previous month, daily infections exceeded 25,000 cases; in the second part of April, they amounted to about 13,000 cases on average.

A large-scale pilot study was conducted with 185 young adults recruited through the sampling criteria described in the following section. Subjects signed an informed consent form prior to their engagement in the survey. Data collection was anonymous by design.

Instrument

The questionnaire included 23 statements, evaluated on a 4-point Likert-type scale (strongly agree; agree; disagree; strongly disagree), on the representation of science, scientific inquiry, and attitudes towards vaccines and vaccination (the items are listed in Table 1). Statements about general views on science and positioning in relation to current debates in science were drawn from two instruments – the Credibility of Science Scale or CoSS (Hartman et al., 2017) and the Test of Science-Related Attitudes or TOSRA (Fraser, 1978, 1981) – adapted to match the specific

Table 1. CFA-generated factorial structure: Standardized solution.

Latent variables	Observed variables	λ
Scepticism about science	Scientific discoveries are doing more harm than good	.664
	I am concerned by the amount of influence that scientists have in society	.685
	Our society places too much emphasis on science	.651
	People trust scientists a lot more than they should	.628
	Too much money is being spent on science which could be put to better use	.617
	A lot of scientific theories are dead wrong	.533
	Scientific research only serves to make pharmaceutical companies richer	.530
	Science lessons are a waste of time	.463
	Science helps to make life better [REVERSE CODED]	.528
Unrealistic expectations about science	In times like these, science should only give people certainties	.558
	Public debates between scientists who have different ideas on the same topic are bad for society	.606
	Listening to scientists who have different ideas on the same subject puts me off	.555
	Science cannot have uncertainties, otherwise it is not science	.591
	On television, scientists should only communicate sure results	.456
	Science should not debate but offer solutions	.658
	Scientists should communicate the results of their research only when there is the consent of the entire scientific community	.461
	It is bad that scientists have different ideas about the vaccines' effectiveness	.424
Anti-vax postures	Research has shown that vaccines are completely safe and effective [REVERSE CODED]	.491
	The diffusion of vaccines serves only to enrich those who produce them	.541
	We must leave the individual to decide on vaccines, because only he or she knows what is good for his or her health	.612
	The benefits of vaccines outweigh the potential risks [REVERSE CODED]	.661
	All doctors and health professionals should be required to be vaccinated against some serious medical conditions [REVERSE CODED]	.692
	In some cases, it is right to make a vaccine mandatory to protect the community and the most vulnerable [REVERSE CODED]	.794

CFA: confirmatory factor analysis.

objectives of our research. To investigate attitudes towards vaccines, a seven-item instrument developed by the non-profit research centre *Observa – Science in Society* was used.

In addition, the instrument included the 15-item instrument of the need for closure (Roets and Van Hiel, 2011), which investigates the extent to which individuals develop cognitive closure to respond to the needs for predictability and order and intolerance of ambiguity (the items are listed in Table 2). The NFC scale was initially presented in a longer 42-item version by Kruglanski (1990), as validated in Italian by Pierro et al. (1995), to identify the desire of some people to avoid situations with uncertain outcomes. In the words of Kruglanski (1990: 337), the NFC is a cognitive

Table 2. The 15 items of NFC scale.

Items	Mean	Variance
I don't like situations that are uncertain	3.05	0.45
I dislike questions that could be answered in many different ways	2.17	0.59
I find that a well-ordered life with regular hours suits my temperament	2.60	0.72
I feel uncomfortable when I don't understand the reason why an event occurred in my life	2.93	0.53
I feel irritated when one person disagrees with what everyone else in a group believes	2.10	0.62
I don't like to go into a situation without knowing what I can expect from it	2.56	0.58
When I have made a decision, I feel relieved	2.97	0.50
When I am confronted with a problem, I'm dying to reach a solution very quickly	2.65	0.67
I would quickly become impatient and irritated if I would not find a solution to a problem immediately	2.63	0.64
I don't like to be with people who are capable of unexpected actions	2.40	0.62
I dislike it when a person's statement could mean many different things	2.63	0.55
I find that establishing a consistent routine enables me to enjoy life more	2.66	0.66
I enjoy having a clear and structured mode of life	2.70	0.57
I do not usually consult many different opinions before forming my own view	2.02	0.61
I dislike unpredictable situations	2.53	0.57

NFC: Need for Closure.

mechanism based on the need to obtain 'an answer on a given topic, any answer [. . .] compared to confusion and ambiguity'.

Finally, questions on how young people acquired and shared scientific information are included. These items are detailed in the 'Structural model' section.

Sample and sampling

The questionnaire was addressed to a non-probabilistic quota sample of 1128 18–25 years old living in Italy, selected according to biological sex (48.8% of men, 51.2 of women), age (18–21 vs 22–25 years old; mean = 21.3 years old) and place of residence (53.5% living in urban areas vs 46.4% in non-urban areas), the latter defined according to the Degurba classification in Eurostat (2019). The sampling method was snowball sampling. That is, recruitment was through researchers' contacts and the latter's acquaintances. Each research trainee recruited 21 people (on average), whose participation was purely voluntary. Researchers in charge of carrying out the survey were students from the Faculty of Psychology of the University of Rome La Sapienza. They followed the same written script, and they were trained to conduct the survey by means of the CATI system prior to collecting data.

Analytical approach

Structural equations were used to model our data with the *Mplus 8.5* statistical package. Structural equation modelling is a method that combines factor analysis with regression analysis to explore the relations between latent variables and observed (single) variables within the framework of the structural model. Our model (Figure 1) is made up of three latent variables (or factors), which were

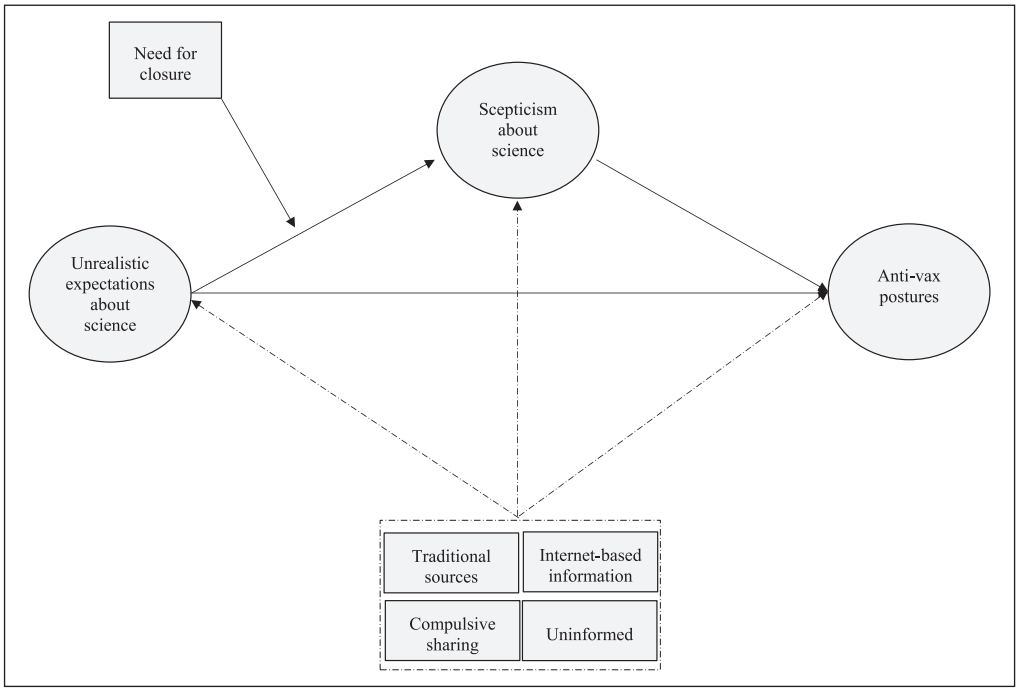

Figure 1. The conceptual model, integrated by latent variables (ellipses), observed variables (boxes), and the direct and mediated relations (single-headed arrows) among them.

extracted and confirmed using the procedures detailed in the following section, together with five observed variables.

Measurement model

As a first step in our analysis, a principal components analysis (PCA) with varimax rotation was carried out to reduce the dimensionality of 23 variables identifying to what extent the respondents agreed or disagreed with three different blocks of statements, referring, respectively, to their general views on science, their positioning in current debates in science, and their opinions about vaccines and vaccination. In line with our initial expectations, the PCA extracted three components showing eigenvalues greater than 1 (Kaiser–Meyer–Olkin (KMO) = .919; $\chi^2 = 7146.8$; $df = 253$; $p \leqslant .001$), with a cumulative percentage of variance explained of 45.7. The extracted components overlap with the three blocks of statements. However, the results also identified a cross-loading variable (i.e. 'the diffusion of vaccines serves only to enrich those who produce them'), showing high loadings on two components (scepticism about science and anti-vax posture).

To confirm the three-factor solution, we ran a confirmatory factor analysis (CFA). We assigned the cross-loading variable to the factor gathering opinions about vaccines and vaccination but specifying a relation of covariance with another variable (i.e. 'scientific research only serves to make pharmaceutical companies richer'), so as to align with the indications of the PCA and the modification indices. The output of the CFA is presented in Table 1.

The first factor (Cronbach's $\alpha = .739$) identifies a generalized *scepticism about science*. Respondents who score high on this factor are more likely to take positions against what they

perceive to be the overrated role of science and the scientific community in society. That is, they distrust scientific theories to the point that they question the benefits of science for society at large. Accordingly, they consider science lessons a waste of time and scientific research a waste of money.

The second factor ($\alpha = .783$) gathers opinions associated with *unrealistic expectations about science* (i.e. that science requires certainty). Doubt is an essential step in the scientific method, and debates between scientists are crucial for scientific development. On the contrary, respondents displaying higher scores on this factor believe that uncertainty is the opposite of what science should be. Debates put them off, especially at present, when the pandemic is demanding quicker solutions. They also question the ways in which science is communicated and transferred to the public, suggesting that debates between scientists who have different ideas on the same topic are bad for society.

Finally, a third factor was extracted ($\alpha = .780$) associated with respondents' perceptions of the safety and efficacy of vaccines, individual vaccination choices and opinions on the mandatory nature and perception of the information available on the vaccination campaign. Although the items loading on to this factor point to a quite heterogeneous set of personal positions on vaccination issues, we assumed that these would all be strongly correlated in the specific context of the COVID-19 pandemic, thus justifying the label of *anti-vax postures*. As such, respondents with higher scores can be defined as anti-vaxxers, as they question vaccines' safety and effectiveness, while they are suspicious of the pharmaceutical companies, which are seen as the sole winners in the production of vaccines.

Overall, the CFA model showed a satisfactory fit ($\chi^2/df = 4.1$; comparative fit index (CFI) = .917; Tucker–Lewis index (TLI) = .907; root mean square error of approximation (RMSEA) = .047), with Cronbach's alpha values consistently above the desirable cut-off ($\alpha > .7$), thus providing support in estimating the structural model.

Structural model

In light of the research hypotheses, the specification of the structural model implied regressing the outcome latent variable of *anti-vax postures* on the latent variables labelled *scepticism about science* and *unrealistic expectations about science*, respectively. At the same time, the model also shows a direct relationship between unrealistic expectations about science and scepticism, moderated by the *need for closure* (NFC). Finally, to be able to control for possible confounders that could influence both the dependent variable and the independent variables, the structural model includes four additional dummy variables referring to the sources of information prevalent among our sample of young respondents.

We first calculated an NFC index following the procedure set out by Roets and Van Hiel (2011). The NFC index ($\alpha = .736$) is the result of the average score of the 15 items, which was used as an independent variable in our model based on the hypothesis that the influence of unrealistic views about science on scepticism is conditioned by different individual levels of the NFC. The items included in the abridged version of the NFC scale are listed in Table 2. All of them are expressed in a 4-point Likert-type scale from 1 (strongly disagree) to 4 (strongly agree); therefore, higher values are associated with a greater need for closure.

To test the possible influence of the sources of information on the latent variables, respondents were asked how often they read or watched science and technology–related content in websites and blogs, rather than in daily newspapers, radio and TV, as well as if they share science-related content through social networks. In all these cases, they were asked to choose from among five options, from never (1) to every day (5). The answers to these questions were used to calculate four dummy variables and classify the respondents into four groups: those who mainly use traditional sources

of information (newspapers, radio and TV); those who mainly use Internet-based sources of information (websites and blogs); those who use social media as a primary source of information and share content with little or no supporting information, as a proxy measure of compulsive sharers; and those who do not inform themselves at all, as opposed to a residual group of people who obtain information about science regardless of the source used.

Parameters were estimated with maximum likelihood with robust standard errors.

5. Results

The unstandardized coefficients (B) are reported in Table 3.

Our model reveals that anti-vax postures are strongly correlated with sceptical views about science ($B = .573$; $p \leqslant .001$) (H1a), but not with unrealistic expectations about science (H1b), a direct relationship with the outcome variable that was found not to be statistically significant ($B = .024$; $p = .470$). However, the path between these two variables turns significant after considering the mediation role of scepticism in the equation ($B_{ind} = .248$; $p \leqslant .001$). In simpler terms, if unrealistic expectations about science lead to greater scepticism, then they are indirectly correlated with anti-vax positions.

As for the moderating role of NFC (H2), results show that both the direct relationship between unrealistic expectations about science and scepticism (see Figure 2a to c), and the indirect relationship between the former and anti-vax postures change at different individual levels of the NFC. When NFC levels approach 2.5 standard deviation (SD) above the mean, the effect of unrealistic expectations on science scepticism ($B = .433$; $p \leqslant .001$) increases by 40.4% ($B = .608$; $p \leqslant .001$). Similarly, the strength of the indirect effect of unrealistic expectations mediated by scepticism is significantly different ($B_{ind} = .348$; $p \leqslant .001$) when considering the moderating role of the NFC.

Looking at the third set of hypotheses (H3a, H3b and H3c), compulsive sharers are more likely to develop sceptical views ($B = .172$; $p \leqslant .05$) and unrealistic expectations about science ($B = .178$; $p \leqslant .01$). As for anti-vaxxers, they are more likely to be found among those who are poorly informed ($B = .358$; $p \leqslant .01$).

6. Conclusion

The results of this study show that anti-vax postures among young residents in Italy (18–25 years old) were strongly associated with scientific scepticism during the COVID-19 pandemic. Questioning the veracity of scientific claims is at the core of a process that ultimately undermines the perceived efficacy of vaccines in mitigating the spread of the coronavirus disease. On the other hand, contrary to our initial hypothesis, unrealistic expectations about science were not directly related to anti-vax positions. According to the model's output, unrealistic expectations about science should be seen as a strong precondition for scepticism. However, it is only when false expectations turn into actual sceptical views that they end up fostering an anti-vax position. Overall, although disputes are part of the normal functioning of science, the respondents in our sample consider that disputes in science confirm the view that the scientific community is not trustworthy and not credible, which is consistent with the previous literature (Han et al., 2018; Hillen et al., 2017).

Our analysis also adds to the literature by testing the moderating role of people's need for cognitive closure, a psychological trait defined by the desire to have a definite answer or conclusion, as opposed to being exposed to continuing uncertainty and ambiguity (Kruglanski and Webster, 1996; Roets et al., 2015). We found that, as the need for closure increases, the effect of unrealistic expectations about science on scepticism, and indirectly on anti-vax positions, increases with it. This suggests that, when young people expect from science what it cannot give (i.e. absolute certainties and ready-made results), and when these expectations are grounded in a need for certainty even in

Table 3. Model results.

Dependent variables	Predictors	*B*	β
Scepticism about science	Unrealistic expectations about science ***(a1)***	.433*** (.049)	.454*** (.038)
	NFC index ***(a2)***	−.007 (.015)	−.016 (.034)
	Traditional sources of information	.033 (.040)	.024 (.030)
	Internet-based sources of information	−.034 (.074)	−.012 (.027)
	Compulsive sharing	.172* (.069)	.094* (.037)
	Uninformed	.068 (.126)	.019 (.0.36)
Unrealistic expectations about science	Traditional sources of information	.125** (.041)	.088** (.028)
	Internet-based sources of information	−.033 (.089)	−.012 (.031)
	Compulsive sharing	.178** (.069)	.093** (.035)
	Uninformed	.088 (.120)	.024 (.033)
Anti-vax postures	Scepticism about science ***(c1)***	.573*** (.060)	.656*** (.042)
	Unrealistic expectations about science	.024 (0.33)	.029 (0.40)
	Traditional sources of information	.054 (0.36)	.045 (0.30)
	Internet-based sources of information	.031 (0.51)	.013 (0.22)
	Compulsive sharing	.089 (0.48)	.056 (0.30)
	Uninformed	.384** (.135)	.126** (.044)
New additional parameters			
Interaction term ***(b1)*** = $a1 \times a2$		.433*** (.049)	.518*** (.058)
Test for moderation			
$a1 + b1 \times (-2.5)$		.257** (.096)	.307** (.115)
$a1 + b1 \times 0$		.433*** (.049)	.518*** (.058)
$a1 + b1 \times 2.5$		.608*** (.093)	.729*** (.112)
Test for moderated mediation			
$c1 \times [a1 + b1 \times (-2.5)]$		.147** (.055)	.157** (.059)
$c1 \times (a1 + b1 \times 0)$		.248*** (.032)	.266*** (.034)
$c1 \times (a1 + b1 \times 2.5)$		.348*** (.060)	.374*** (.065)

NFC: Need for Closure.
*$p \leq .05$; **$p \leq .01$; ***$p \leq .001$.

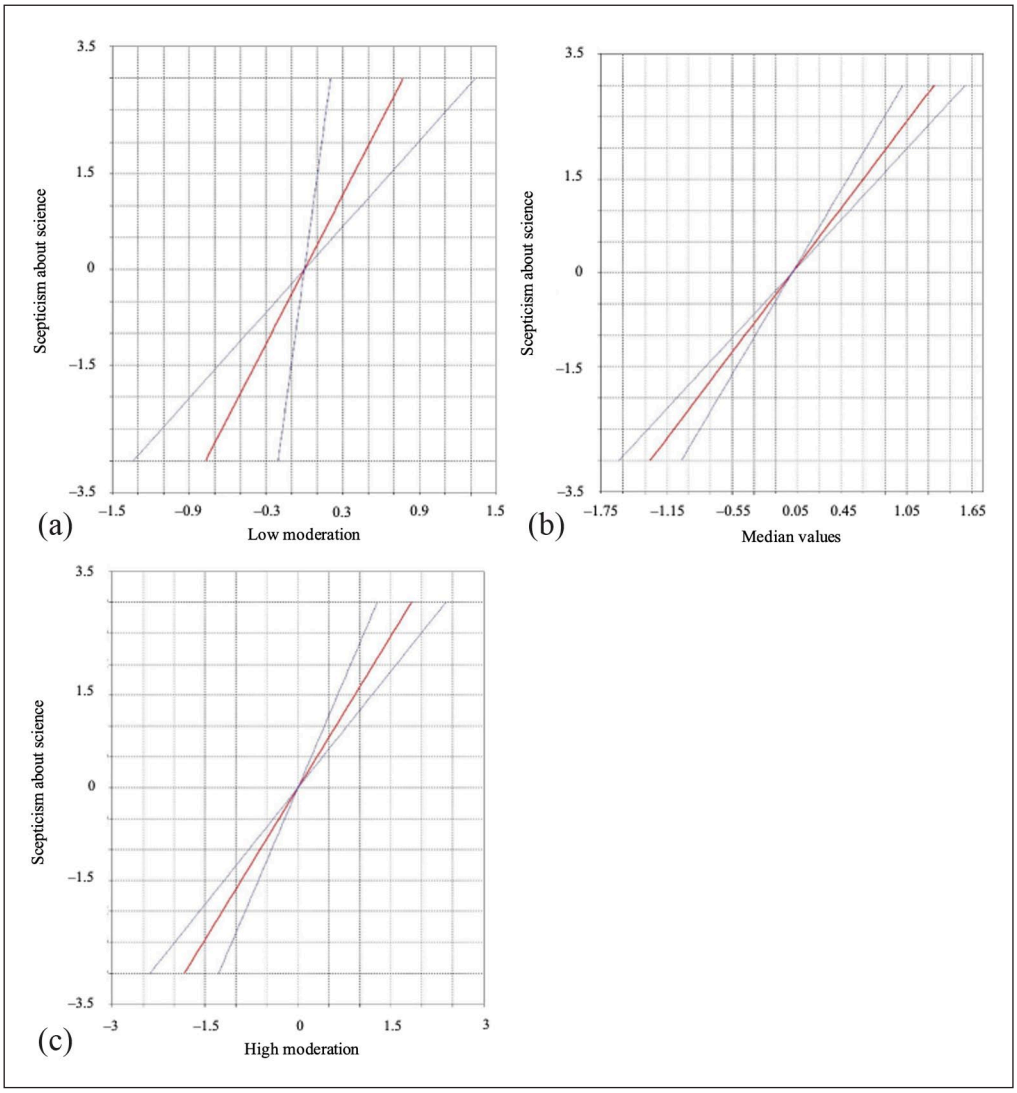

Figure 2. Loop plots showing the slopes of unrealistic expectations about science on scepticism about science for low (less than −2.5 *SD*) (a), median (−2.5 to 2.5 *SD*) (b) and high (more than 2.5 *SD*) (c) values of the need for cognitive closure (NFC). Grey lines are confidence intervals and red lines are actual estimates.

everyday life, then a rebound effect is observed on scepticism about science and, indirectly, on anti-vax postures. On the contrary, when excessive expectations on science coexist with a disposition to cope with daily uncertainties, then this 'multiplier effect' does not occur.

Sources of information about science and vaccines that were consulted and shared were also found to be significantly related to the outcome variables in the model and its explanatory factors. The results show that young people with sceptical views and false expectations about science are more likely to share content without supporting information (compulsive sharing). Also, when information is poor or non-existent, the risk of assuming anti-vax positions increases significantly.

These empirical results stress the importance of sources of information about science and vaccines, and of how this information is shared; they can be interpreted by framing two new hypotheses that should be tested in future research. On one hand, we can imagine that the use of new media exposes people to fake, unconfirmed and contradictory news about science, increasing their scepticism. Following our definition of compulsive sharing, we can assume that people's scepticism is to a certain extent the consequence of their inability to access and/or process rigorous information about science. On the other hand, our data also suggest the existence of a reverse causal relation. More or less intentionally, sceptics and anti-vaxxers can turn to sources where they believe they can find 'alternative' information and opinions with respect to the 'official versions' about science and vaccination.

The results of the survey described here point the way to possible interventions that could target the specific profiles of young people in Italy, especially in the context of the vaccination campaign in this country. At the end of 2021, the percentage of the population that had been completely vaccinated was 75.1%. Future research adapted to other national contexts should use probabilistic sampling and larger sample sizes to study the generalizability of these results. Also, the level of information reliability is essential to support the enhancement of data quality, thus counteracting misconceptions.

These conclusions and the results of this study have been conditioned by the contextual framework in which it took place, namely, in April 2021 in Italy during the pandemic.

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Supplemental material

Supplemental material for this article is available online.

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