Youth and science: A randomized survey experiment on adolescents' trust in scientific institutions

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1. Introduction

Public erosion of trust in science is a controversial topic for everyday life, as well for research advancement, especially when experts misconduct becomes visible. People are very sensitive to a large number of factors which contribute to the weakening of public trust. Increasing lack of transparency has resulted in quality uncertainty, which represents a detrimental factor for people ability to trust scientific outcomes (Vazire, 2017).

As we have experienced so far with the rise of COVID-19 pandemic, trust is needed to cope with emergency situations, but is also under threat due to it (Jennings et al., 2021). Trust plays a pivotal role in the effectiveness of government (OECD, 2017), enabling greater compliance with measures and vaccine adoption. In short, the public needs science (Goldenberg, 2022), and the scientific community depends on strong public support for its endeavours.

The present analysis aims at measuring the level of trust in scientific and medical institutions in a very challenging period, since answers were collected at the beginning of 2022 when COVID-19 still represented a global emergency. The study presents a randomized survey experiment designed to verify whether adolescents have been affected by the "replication crisis" and to discover possible ways to stimulate trust among young people. We decided to restrict our attention to this age range since we strongly support the theory that trust and other beliefs mainly modify when young people pass through early adolescence, facing evolving skepticism, self-consciousness and higher risk behaviours.

Several contributions have been devoted to trust in science evaluation, especially with the advent of the COVID-19 when trust represented a determinant factor of measures compliance. Anvari and Lakens (2018) examined whether informing people about three aspects of the replication crisis, namely replication failures, criticisms of questionable research practices, and reforms, affects how much people trust research. Despite this branch of research intensified with the rise of the pandemic, it remained less common for adolescents.

Kennedy et al. (2011) conducted a systematic review to assess the level of teenagers trust regarding health information on social media, discovering a complex interplay between trust in social media platforms, other users and health content.

Overall, very few studies have been devoted to the analysis of adolescents' trust in scientific institutions. Thus, we aim to provide a unique contribution to previous literature in the field, analysing a new dataset by the means of a randomized survey experiment on Italian high school individuals. The experiment presents two separate treatments: first, believing that trust in a person is able to facilitate operations that lead to benefits for the trustor (Freeman et al., 2020), we evaluate the reaction to either favourable or pessimistic medical response when some health issues emerge. Secondly, we focus on the impact that different key figures generate on young individuals trust on specific health recommendations, with a special attention to the influence

exercised by doctors, parents and friends on adolescents' beliefs. The study also assesses trust in public institutions like schools, political system and judicial bodies.

To address all these issues it is important to stress the way institutions communicate with adolescents and young adults. Research underlines the importance of implementing strategies to reduce the barriers in raising and discussing health-related concerns (Kim and White, 2018), as well enhancing transparency, necessary to sustain trust in health authorities and impede the spread of conspiracy beliefs (Sheluchin et al., 2020). Recent findings support the need for targeted communication strategies to improve vaccination rates (Muscillo et al., 2023).

The work is articulated in five sections: we offer a review of past contributions, then we describe the experiment design and data collection process, and in the end we present the methodology and discussion of empirical results

2. Experimental approach and methodology

The article offers a quantitative research design on adolescents trust, with data collected through a randomized survey experiment in the period February 2022 to April 2022. The experiment was performed online with Qualtrics and it was administered to Italian high school individuals thanks to the collaboration the no-profit foundation Fondazione Mondo Digitale (FMD), after the approval of the Ethical committee of the University of Siena. Schools self-selected their participation to the project, but single students were randomly assigned to the treatment.

The survey includes the following sections: after an introduction and consent request, it presents demographic questions (i.e. gender, age, region, school, parents' education) and information concerning habits and healthy lifestyle (i.e. alcohol, smoke, fast-food and mobile phone addiction). The core part is based on two different treatments: the "Personal Experience Treatment", designed to test the adherence to expert's suggestions concerning healthy lifestyle, and the "authority treatment", designed to evaluate the influence of different key figures on adolescents opinion. We also include three trust items (i.e. trust in science, trust in medicine and trust in future advances). Answers are collected on a 10-point Likert scale from "Strongly disagree" to "Strongly agree".

For the "Personal experience treatment" individuals have to imagine a dialogue with a doctor where after some days of strong stomach ache, they decide to ask for an expert opinion; each individual is required to assign a score from 0 to 10 to indicate how much he is convinced by the expert's diagnosis. The sample is randomly divided in two groups: on the one hand (T1) respondents receive a comforting response without any additional exams, while on the other (T2), they receive a pessimistic response, with the doctor recommending additional exams to investigate the cause of the problem.

Next, we set up another treatment to test whether different authorities are able to affect the way teenagers accept health recommendations, and we call it the "Authority treatment". In this setting, we provide an information concerning the negative impact of social network abuse on mental health, and respondents are randomly assigned to one of the three groups: they receive the information either from a doctor (T1), or from friends (T2) or from parents (T3). The goal is to discover which key figure is more effective in persuading with adolescents on health issues.

We build a randomized control trial to identify the main factors able to influence adolescents confidence and behaviours and we began with two hypothesis:

First hypothesis: "Trust in science is compatible with higher support of experts' suggestions", as trust is associated to larger measures compliance (Devine et al., 2021).

Second hypothesis: "Respondents who receive health recommendation by a doctor are more inclined to trust the suggestion rather than those who are advised by parents" (Fox et al., 2022).

The empirical analysis includes two different frameworks: the evaluation of trust and the estimation of the average treatment effect. For the measurement of trust we adopted an *ordered probit* model, since we use ordered variables going from 0 to 10 as dependent. Here we performed

three regressions: we worked with "trust in science", "trust in medicine" and "trust in future advances" respectively as dependent variables. We adopted demographic characteristics as controls.

For the second part of the analysis, the one concerning the average treatment effect, we chose a relatively simple linear model:

$$Y = \propto + T\beta + X\gamma + Z\delta + \varepsilon$$

where T represents the matrix of treatments (either "personal experience treatment" or "authority treatment"); X is a matrix of demographic controls and includes all the observable characteristics available from the survey (i.e. gender, age, school type, father and mother education), while Z represents a matrix of trust items (i.e. trust in science, trust in future scientific advances and trust in medicine). The dependent variable is represented by individual responses to the questions asked in the treatments: "response acceptance" and "response rejection", for the first treatment; how much they are going to follow the advice received, for the second treatment designed.

Since we are interested in the effect size, in the experimental framework the nature of the dependent variable does not have any implication and the outcome is unbiased and consistent (Gomila, 2021). For robustness, we also repeated the analysis by using an ordered probit model, which we do not discuss now since it provided the same outcomes. In addition, we performed the non-parametric Mann-Whitney U test, whose null hypothesis supports equal distribution of characteristics of different groups.

2. Empirical analysis and results

The sample under analysis consists of N=1,433 individuals who attend high schools in Italy: the majority attend lyceum (62%), with the rest split among professional institute (10%) and technical institute (28%). The sample consists of 608 males and 768 females, while the 4% prefers not to declare it. The geographical distribution is heterogeneous, with a higher concentration of participants in Piedmont, Lazio and Lombardy regions. Also the family background is quite heterogeneous, characterized by higher frequency for graduated mothers (29%) than graduated fathers (23%). We also collected some personal information about people habits (i.e. smoke, alcohol, phone and fast food addiction).

Overall, adolescents show a positive perception of scientific and medical institutions. We asked them how much they trust each of the trust item and answers have been collected on a 10-point Likert scale from "Strongly Disagree" to "Strongly Agree". Results exhibit high confidence in science (mean = 7.329, SD = 2.268) as well in medicine (mean = 7.069, SD = 2.114). The highest score has been recorded for trust in future discoveries (mean = 7.592, SD = 2.181), despite respondents display some concerns about the consequences of boundless advances of scientific research (mean = 5.240, SD = 2.780).

Due to the nature of the dependent variables, we adopted an ordered probit model to evaluate which controls have an impact on trust items. There is lower probability that females reach high scores of trust in science, in medicine and in future research outcomes. On the other hand, adolescents attending lectures at lyceum tend to have higher probability to trust science and medicine. Adolescents around 18 years old tend to trust more science and future advances. Moreover, the willingness to continue with scientific and medical studies produces a strong significant effect, increasing the likelihood of selecting higher scores of trust in science, in medicine and in future developments.

Concerning the treatments responses we checked for distributional differences with a χ^2 test: we rejected the null hypothesis of equality in distribution of the "personal experience treatment" (p-value= 0.024) and we strongly reject the null of the "authority treatment" for what concerns doctor's advice and parents' advise (p-value= 0.004), instead, we weakly reject

the null for doctor's advice and friends' advise (p-value= 0.079) and we did not observe any difference among parents and friends affecting individuals behaviours.

Table 1: Personal experience treatment regression (standard errors in parentheses)

	Response acceptance		Response rejection	
	(1)	(2)	(1)	(2)
T2 (negative feedback)	0.223*	0.023**	1.455***	1.476***
	(0.116)	(0.117)	0.161	(0.158)
Female	-0.275**	-0.136	0.314*	0.231
	(0.134)	(0.124)	(0.186)	(0.183)
Lyceum (school)	1.342*	0.066	-0.162	0.534
	(0.784)	(0.694)	(1.035)	(1.031)
Mother's ed. high school	0.478*	0.196	-0.265	-0.098
	(0.228)	(0.228)	(0.341)	(0.247)
Trust in science		0.067**		-0.102**
		(0.032)		(0.047)
Trust in future advances		0.112***		0.019
		(0.033)		(0.048)
Trust in medicine		0.305***		-0.142***
		(0.030)		(0.043)

*** p< 0.01, ** p< 0.05, * p<0.10

For the estimation of the average treatment effect, we performed a linear regression, taking as dependent the individual response recorded a 10-points Likert scale ("response acceptance" and "response rejection respectively"). Regression outcomes concerning the "personal experience treatment" are presented in Table 1. For each regression all the control variables (i.e. gender, age, school, parents' education) have been considered. In column 1 we consider as explanatory variables the treatment dummy and demographic characteristics: we can observe a stronger tendency to reject the expert's recommendation when they receive a negative feedback; in addition, the effect is larger for females.

For robustness we performed a new regression checking also for trust items, and results presented in columns (2) concerning the effect of the treatment are consistent with previous findings. Moreover, we observe that trust items play a very fundamental role in response acceptance. Higher trust in science, in medicine and in future scientific advances produces a positive effect in response acceptance, while it generates an opposite effect in response rejection. From these results, we can conclude that young individuals are in general more prone to reject an health recommendation when it includes additional controls, and that at the same time, having higher trust in scientific institutions is a key predictor of medical experts' recommendations.

Table 2 reports the results for "authority treatment". The dependent variable is the individual response to the question "How much are you going to follow the healthy advice concerning social network abuse and its consequences on mental stability?" delivered either by a doctor, or friends or parents. Column 1 includes only the treatment dummy and exhibits a negative statistical significant effect of both friends (p-value = 0.001) and parents (p-value = 0.000) on doctor's advice. Column 2 collects regression results adding all demographic controls previously specified, while Column 3 also includes trust items. Both outcomes confirm previous findings, keeping high statistical significance: individuals who receive a suggestion from friends and parents are less likely to follow it rather than those who are recommended by a doctor. In addition, in Column 2 we observed a lower tendency to trust doctor's advice for

females; in Column 3 instead we get a strong positive effect of trust in science and trust in medicine in following doctor's recommendation. We also employed an Ordered Probit model or both treatments analysis and it delivered very similar results.

Table 2: Authority treatment regression (standard errors in parentheses)

	Dependent variable		
	(1)	(2)	(3)
Friends	-0.589***	-0.536***	-0.566***
	(0.180)	(0.179)	(0.175)
Parents	-0.701***	-0.656***	-0.632***
	(0.180)	(0.180)	(0.175)
Female		-0.356**	-0.234
		(0.169)	(0.166)
Trust in science			0.115***
			(0.042)
Trust in future advances			0.051
			(0.043)
Trust in medicine			0.206***
			(0.039)

*** p< 0.01, ** p< 0.05, * p<0.10

For robustness, we relaxed some assumption and we adopted the Mann-Whitney U test to check for treatment effects. The non-parametric test confirmed the outcomes obtained with previous regressions: for "Personal Experience Treatment" we find out a strong significance difference in distributions among the two groups (p-value = 0.000).

Concerning the "Authority Treatment" we cannot accept the null hypothesis of no difference in distribution of values among those receiving the news from doctor and from friends (p-value = 0.001); even much stronger difference among doctor and parents (p-value = 0.000); no significant difference among friends and parents' advice.

2. Conclusions

With the current analysis we aim to provide valuable results to the branch of literature dedicated to adolescents' trust, which has not been extensively explored thus far. The experiment offers interesting results concerning the degree of trust in science and in medicine among young individuals, as well it provides useful insights on how effectively foster trust in public institutions in young generation, relevant for policy recommendations.

What emerges from the study is that Italian adolescents, although the large inconvenience caused by the outbreak of the pandemic, are very confident in the role played by scientific research and strongly support public institutions like hospitals, research centres and school. In policy terms, higher investments should be devoted to the education system and to those activities committed to enhance trust building, given the massive effects that public trust generates in the society.

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