TeensLab dataset: Economic preferences and cognitive abilities of 7,073 teenagers *

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Abstract

This project provides a database of teenagers from 33 different educational centers in Spain. We elicited 7,073 observations of students from 10 to 23 years old, in different educational stages (elementary, middle school, high school, and vocational training). Both the collection process and the available variables on economic preferences and abilities are described.

Keywords: Teenagers, lab-in-the-field experiment, economic preferences

JEL codes: C81, C91, D90

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1 Introduction

It is well known that individual preferences and cognitive abilities are important determinants of decision-making, not only in modeling economic events but also in empirical studies (Dohmen et al., 2010; Eckel et al., 2005; Guiso and Paiella, 2004). For this reason, there is a great interest in understanding the outcomes of the decision-making behavior of individuals and the underlying motivations of the subjects in the design of public policies (Chapman, 2003).

In order to understand and predict economic behavior, it is essential to study individual attitudes towards risk preferences, since they are involved in most of the decisions that individuals must make throughout their lives (Sutter et al., 2013). Not only in the short term but also in the long term, for example, it has been found to be related to entering the labor market or earning higher salaries (Heckman et al., 2006). That is why there is a current awareness about conducting research with adolescents, as it is a key stage in their development (List et al., 2023). In this line, Golsteyn et al. (2014) explore how time preferences are related to social and economic outcomes across the adolescent lifetime (see Bettinger and Slonim (2007) and Castillo et al. (2011)). And also for risk taking decisions (Belzil and Leonardi, 2013; Dohmen et al., 2010; Dohmen et al., 2011; O'Donoghue and Rabin, 2001).

However, the implications are not only associated with economic results but go beyond that. Relevant research shows the relationship between time preferences and specific health problems such as smoking or obesity (Lawless et al., 2013). Thus, much of the research focuses on discussing aspects that predict or relate to adolescent risk behavior (Anderson and Mellor, 2008). Furthermore, O'Donoghue and Rabin (2001) observed that as discount rates decreased with age, adolescents tend to show little regard for future health consequences. Hence, programs that aim to raise the awareness of young people regarding healthier choices focus on showing the short-term consequences (e.g. in sexual relationships and behavior (Chesson et al., 2006)).

Also in the educational context, there are studies that relate certain behaviors to educational expectations, such us more patient adolescents believe that they are more likely to go to university (Anders and Micklewright, 2015; Belzil and Leonardi, 2013; Hanushek et al., 2020).

The policy implications therefore have scope for future economic outcomes for adolescents; if it is possible to design interventions to enhance cognitive abilities to lead the increase of patience and to acquire a higher willingness to take risks, this is an extraordinary additional effect that should definitely be applied (Dohmen et al., 2010).

In addition to the administrative data recorded, a few databases with more than 1000 observations are publicly available. [CITAR PAPERS CON DATASETS]

Our project aims to contribute to providing a dataset for future research in adolescents. We conducted our experiment (Lab-in-the-field) in 33 different educational centers. The experimental design allowed us to elicit 7,073 observations of Spanish students. The data contain unique identifiers and other general information in the first place. The complete experiment has several sets of variables: (1) sociodemographic survey, (2) time preferences elicitations, (3) risk preferences elicitations, (4) social preferences task, (5) Probabilistic beliefs tasks, (6) Abilities tasks, (7) Networks, (8) Bullying, (9) Strategical thinking, (10) Creativity.

Recent developments in the open data initiative have generated a growing interest of researchers in sharing datasets. This drive to use Information and Communication Technologies (ICT) to create open data initiatives for the purpose of advancing scientific research has gained visibility. The emergence of Web 2.0, which promotes peer-to-peer collaboration, interactivity and user-generated innovation, has further catalyzed the development of open data initiatives aimed at sharing and distributing information among diverse stakeholders to address societal problems Mergel et al., 2009.

The main benefits of sharing research datasets are manifold. First, it facilitates the ability to enrich and promote the progress of scientific research. The availability of open data allows researchers to build on previous datasets, encouraging them to generate new knowledge and foster advanced discoveries from old datasets Kaye et al., 2009. In addition, data sharing encourages researchers to reconsider and reinterpret the meaning of previous datasets in the light of modern thinking Bryn, 2009. It could be argued that sharing datasets by reconstructing and/or combining multiple existing datasets represents the essence and basis of knowledge generation in today's research. In short, the open data initiative has become an essential driver for the advancement of science and knowledge generation.

The structure of this article is straightforward. Section 2 describes the process and characteristics of how the data were collected and Section 3 describes all the available variables grouped by topic. Finally, Section 4 concludes with some endnotes.

2 Methodology

Other studies have collected data in schools. When dealing with minors, there are special protections and laws that must be rigorously followed. Our project was approved by the Ethical Committee of Universidad Loyola Andalucía. In addition, all responses are guaranteed to be anonymized and researchers are not able to recognize or associate subjects.

There are some additional complications associated with non-standard samples. To avoid missing data, the format of the answers is simplified, most of the questions are presented with multiple-choice answers instead of open answers. Also, subjects could not skip questions without answering due to the format of the software we used. However, for some questions that might be sensitive for subjects, we gave them the possibility to answer with an option of *"I would prefer not to specify"*.

We use STATA for the data pre-processing, except for the networks, for which we use R to obtain the measurements which are later incorporated into the complete database.

The dataset was posted on an online repository[1], it was published in different formats (xls, cvs, dta). We also included the STATA scripts for some basic summaries or analyses mentioned throughout the paper.

2.1 Data collection

The data sample was obtained through agreements with school directors who agreed to integrate the experiment into their pedagogical curriculum and to carry it out as a classroom activity. Consequently, we achieved an increase in participation, as predicted in Alfonso et al. (2023). We proceeded directly to the schools to run the experiment in an online format through a platform called SAND, which allows greater control over the privacy of the data. Students read the instructions and navigated through the questionnaire, which contained multiple screens, via their devices.

The entire instrument was administered in Spanish. All responses remained anonymous and subjects were paid with hypothetical payments since schools did not accept real money experiments. It has been demonstrated that teenagers do not change their behavior and decisions in the presence of hypothetical incentives in risk and time preferences i.e. the results obtained are similar (Alfonso et al., 2023; Beattie and Loomes, 1997; Brañas-Garza et al., 2021; Brañas-Garza et al., 2023; Chuang and Schechter, 2015; Horn and Freund, 2022; Kühberger et al., 2002; Read, 2005).

3 Variables

The variables are grouped by topics. In bold we emphasize the name of the variable in the data set.

3.1 Sample variables

A total of 7,073 observations, sample variables include a unique identifier for each subject (***usuario_id***), as well as an identifier of the network to which the subject belongs (***net_id***). The ***yeardone*** variable indicates the year in which the experiment was run, 2021 to 2023. The ***privacy*** variable specifies when the subject has accepted the data protection before starting the experiment and it allows us to record the answers of the subject. We find that 16.73% of the subjects do not agree to do the experiment and therefore do not start the study. From the remainder who started the experiment, we found a drop-out rate of 10.34% (***dropout***).

In addition, another important issue in our study is that it has evolved over time, according to some of the results we observed. In other words, tasks have been included, withdrawn, or transformed over the period. However, most of the main variables remain the same and are comparable across the whole sample. Therefore, we have to take into account that for some

[1] https://github.com/teenslab/datateenslab

specific tasks we only have a small subset of observations. Table X shows the changes in the experiment and the data available for each study identifier in each school (***study***).

[Incluir tabla con cambios de la encuesta a lo largo del tiempo]

3.2 School variables

Available information is available for each center where data is collected. The unique identifier for each high school is ***school***. Although most of the high schools are public, there are semi-public ones as well (***schooltype***: 1 = Public, 2 = Semi-public). The sample was collected in two regions of Spain, 68.13% in 5 different provinces of Andalusia (11 different towns in total) and the remaining 31.87% in 8 different locations in Barcelona. Table 1 shows that information corresponds to the variables ***schoolprov*** (Province of the school) and ***schooltown*** (Location of the school), respectively.

Table 1: Distribution of observations by province and high school location

	School province						
Town where the school is	1	2	3	4	5	6	**Total**
1	1,112	0	0	0	0	0	**1,112**
2	193	0	0	0	0	0	**193**
3	245	0	0	0	0	0	**245**
4	0	501	0	0	0	0	**501**
5	0	105	0	0	0	0	**105**
6	0	908	0	0	0	0	**908**
7	0	457	0	0	0	0	**457**
8	0	0	170	0	0	0	**170**
9	0	0	0	475	0	0	**475**
10	0	0	0	0	483	0	**483**
11	170	0	0	0	0	0	**170**
12	0	0	0	0	0	1,249	**1,249**
13	0	0	0	0	0	55	**55**
14	0	0	0	0	0	422	**422**
15	0	0	0	0	0	160	**160**
16	0	0	0	0	0	163	**163**
17	0	0	0	0	0	58	**58**
18	0	0	0	0	0	48	**48**
19	0	0	0	0	0	99	**99**
Total	**1,720**	**1,971**	**170**	**475**	**483**	**2,254**	**7,073**

In addition, for each student, the ***stage***, the year or ***grade*** (see Table 2), and also the ***group*** in which they are in are specified. In total, we get 255 classes in the whole sample. The size of each group can also be obtained with the variable ***class_size***.

Table 2: Distribution of observations by stage and grade

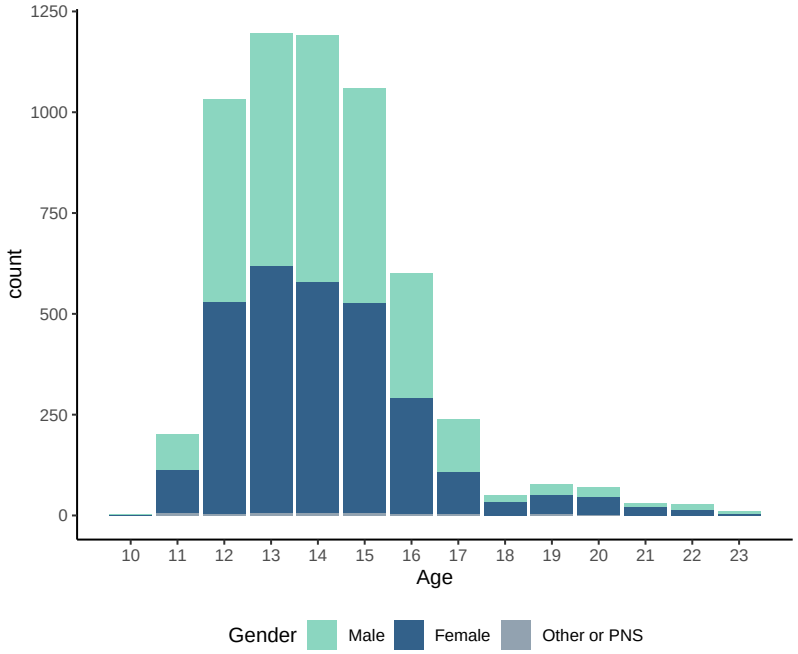
	Year/Grade						
Stage	1	2	3	4	5	6	**Total**
Elementary school	0	0	0	0	219	316	**535**
Middle school	1,676	1,733	1,461	1,178	0	0	**6,048**
High school	122	0	0	0	0	0	**122**
Vocational training	208	160	0	0	0	0	**368**
Total	**2,006**	**1,893**	**1,461**	**1,178**	**219**	**316**	**7,073**

3.3 Sociodemographic and related variables of individuals

Regarding individual-level attributes, the gender of the participants is coded with the variable ***female*** (0 = Male, 1 = Female). Actually, 47.38% of the sample is female and 48.62% male,

the remaining part is unknown[2] (***gender*** = 99). Their ***age***[3] is given in years but also the year of their birth is known (***yearbirth***).

Figure 1: Sample distribution by age and gender



Family. On the other hand, information concerning their family is also included. Siblings and how many of them they have are reported, ***siblings*** and ***nsiblings***[4], respectively. For those who report siblings, we also ask about their position among their siblings with ***rankbrother***. The immigrant origin is also collected with the variable ***migrant***. They can report that they or their parents were not born in Spain. Indeed our sample shows 14% of cases with an immigrant origin.

We also cover information on household income. However, aware of the difficulty of such a question for the subjects of this study, we decided to adapt it to their level. We asked it in a relative way: Imagine a stairway with ten(five) steps, where on step 1 are the poorest families in Spain, and on step 10 (5) are the richest ones. On which step of the stairway would you place your family? First, we use a 10-step version (***stairs10***) and then a 5-step version (***stairs5***), both of which are normalized in the ***stairsN*** variable.

Grade Point Average. We also asked them about their academic results, if they have obtained any A (***mark10***) or B (***mark8***), and how many of them in core subjects such as Maths, Literature, and English, but we also include an open category under "other subject". (***nmark10*** and ***nmark8***). The original answers with the courses are kept with the name ***nmark10_text*** and ***nmark8_text***. We define a total variable where only the three main subjects are taken into account (***gpa***). this variable takes values from 0 to 9 according to the combination of A and B, as can be seen in Table 3. It is also normalized from 0 to 1 (***gpaN***).

Table 3: GPA score

		Num. A			
		0	1	2	3
Num. B	0	0	2	5	9
	1	1	4	8	x
	2	3	7	x	x
	3	6	x	x	x

[2]Either because they did not want to answer or they selected another category, or because they dropped out.
[3]We compute the missing ages, according to the mode of the class to which the student belongs (***age_assumed***).
[4]Note that in the latest surveys there is also a sister (***nsister***) and brother (***nbrother***) split variables.

In addition, two-thirds of the studies included the question of whether they had repeated a year. The variable ***repeater*** is equal to 1 if they have repeated any year, 0 if they have not, or 99 if they do not want to answer. Moreover, some questionnaires also included a question on optional subjects, the answers are collected in the ***optional*** variable.

Mood. Moreover, we included three questions about their mood regarding school and social relationships. We used a frequency Linkert scale for the three questions: Never/almost never/sometimes/almost always/always

Q1 Over the last week, have you been doing well at high school? (***general***)
Q2 Over the last week, have you had fun with your friends? (***fun***)
Q3 Over the last week, have you felt lonely? (***alone***)

We created a total score from the ***moodgeneral***, ***moodfun*** and ***moodalone*** variables, which include responses coded on a scale of 0-4 (0 = Never, 1 = Almost never, 2 = Sometimes, 3 = Almost always, 4 = Always). Note that the last question is on an inverted scale in the original. Then, we obtain ***happy*** variable with the total mood score (0-12). Also, ***happyN*** is presented with normalized values between 0 and 1.

Physical attributes. The ***height_original*** and ***weight_original*** variables contain the original raw responses, while the ***height*** and ***weight*** variables include information in centimeters and kilograms respectively. Although we do not have precise BMI information due to the fact that many subjects did not want to answer[5] the height and weight questions, we include a task that requires self-identification using body shapes. A screen with 8 figures in a fixed order (from thinnest to fattest) is presented to the students. Depending on the gender they have indicated beforehand, male or female figures are presented. Therefore, ***obesity*** variable takes values from 1 to 8. However, there is also the possibility of not responding to this question (***obesity*** = 99).

Expectations. We asked about their future expectations regarding university, traveling and living in another country (on a scale from 0 to 100), as well as the profession they would like to become (from an eligible list).

Q1 On a scale from 0 to 100, please give a score on whether you would like to go to university in the future. (***uniwant***)
Q2 On a scale from 0 to 100, please give a score on whether you would like to do a round-the-world trip in the future. (***world***)
Q3 On a scale from 0 to 100, please give a score on whether you would like to live in another country in the future. (***abroad***)
Q4 Among all the professions we suggest, which one would you like to become your future job? (***willwork***)

For questions **Q1**, **Q2** and **Q3**, two randomized procedures are used, in the case of using a slider, the variable ***wish_slider*** takes value 1, while if the subjects have to enter the exact number directly, it takes value 0. Furthermore, it is clarified in the statements that if it is something they would like very much, they should enter a number close to 100, while if they would not like it, close to 0, or if they do not know it, they can enter a number around 50.

Good at and likes.

Q1 How good do you feel you are at solving numerical and monetary problems?
Q2 How good do you feel you are at solving mathematical problems with mental arithmetic?
Q3 How good do you feel you are at multiplying and dividing?

Q1 How much do you like solving numerical and monetary problems?
Q2 How much do you like solving mathematical problems with mental arithmetic?
Q3 How much do you like multiplying and dividing?

3.4 Time preferences

In order to elicit temporal preferences we use *The truck task*, a tool introduced by Alfonso et al. (2023). This task preserves the essence of Coller and Williams (1999) with a visual format which has been shown to give better results in terms of consistency in a young population. Students are asked to make 6 decisions within a fixed order, choosing between two options. In option A, the money is always delivered in one day, while in option B it is delivered in eight days. Both options start from the same initial payoff, but only option B increases.

[5]The option to not answer personal questions and continue forward was available.

For each decision, one variable is assigned starting with *money* and the number of the decision: ***money1***, ..., ***money6***; (0 = Option A, 1 = Option B). Table 4 shows the percentage of responses for each option, with respect to the subjects who do answer that task.

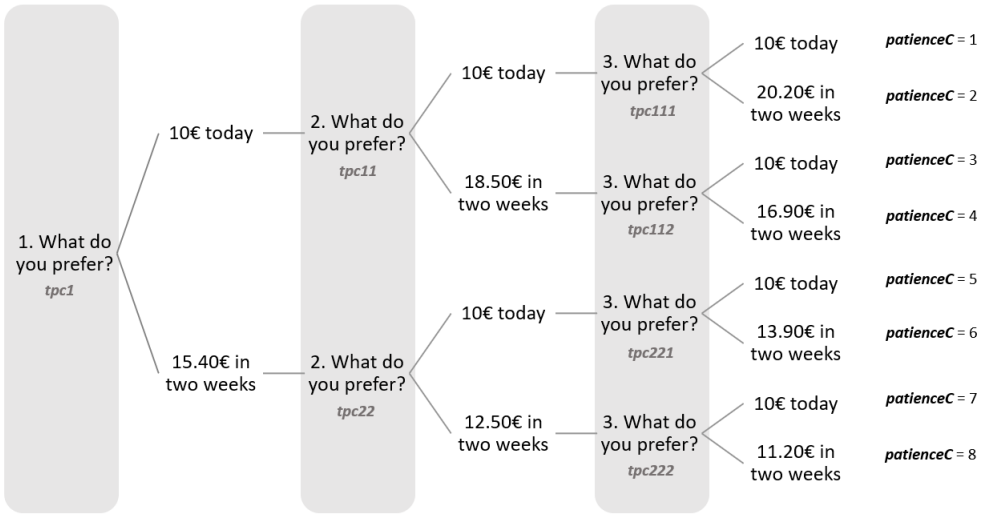
Table 4: Percentage of responses for each decision

	A	B	n
money1	83.63%	16.37%	5,693
money2	57.80%	42.20%	5,692
money3	46.93%	53.07%	5,689
money4	39.34%	60.66%	5,689
money5	36.66%	63.34%	5,687
money6	29.19%	70.81%	5,686

From these results, the variable ***patience*** is constructed as the total number of options B chosen by the individual, as well as the normalized one (***patienceN***). Furthermore, a variable called ***cns_td*** is also included to indicate which individuals show consistent behavior. We consider that an individual shows consistent behavior in time preference elicitation when, once she has chosen option B (receive in eight days instead of tomorrow), she does not choose option A in the following decisions. In other words, if they are consistent, they do not switch back.

In addition, we include an additional task on time preferences in a conditional setting that does not include figures. We use a version of a *staircase* procedure by Falk et al. (2016). They are informed that they will have to make three decisions (one per screen) on how they want to receive a hypothetical amount of money. Figure 2 shows the different options according to the previous answers of the subjects.

Figure 2: Decision tree in conditional time preference task



Note: The staircase procedure worked in the same way as Falk et al. (2016). First, the leftmost decision node starts with the question of whether one would prefer to receive 10 euros today or 15.40 euros in 2 weeks. In case of choosing to receive it today, in the second question, the payment in 2 weeks was adjusted upwards to 18.5 euros. Alternatively, if 2 weeks is chosen, the payment is adjusted downwards to 12.5 euros. The procedure is repeated twice and follows the same logic. The name below each decision node is the name of the variable that records the response.

The variable ***patienceC*** contains the level of patience measured with the task with values from 1 to 8, while ***patienceCN*** is normalized.

3.5 Risk preferences

Similar to eliciting preferences for time discount, we use a visual task to measure risk aversion based on Holt and Laury (2002). According to the results reported by Vasco and De Francisco (2023), this task (*The Gumball Machine*) is best suited in contexts with non-standard subjects.

In this shorter version, students have to make 6 decisions in a fixed order. Each decision has two options presented with gumball machines presenting different payoffs and different probabilities. Option A is the safer alternative and Option B is the riskier one.

For each decision, a variable is associated with the name prob followed by the number of the decision: ***prob1***,...,***prob6***; (0 = Option A, 1 = Option B). Table 5 shows the proportion of responses.

Table 5: Percentage of responses for each decision

	A	B	n
prob1	89.43%	10.57%	5,599
prob2	80.88%	19.12%	5,597
prob3	45.41%	54.59%	5,596
prob4	18.19%	81.81%	5,595
prob5	10.03%	89.97%	5,593
prob6	5.24%	94.76%	5,592

The level of risk is calculated by simply adding up all the decisions that option B has been chosen, ***risky***, this variable has also been normalized (***riskyN***). In order to differentiate individuals who show consistent behavior, we focus on recognizing three types of inconsistencies (Vasco and De Francisco, 2023). The ***dominated1*** variable refers to individuals who choose option A, the dominated option, in the first decision. While the ***dominated6*** variable collects information on individuals who choose option B, the dominated option, in the last decision. In addition, we also include a variable relating to any switch back in the set of decisions made by the individual, ***swb_risk***. Finally, the variable ***cns_risk*** identifies those individuals who show consistent behavior.

In addition, to test whether the order of the tasks influences the answers, an alternative version was run in 12 schools, where the risk task is presented before the time task. About 30% of the responses are with this version which is identified with the binary variable ***hlbeforetd***, it takes value 0 when the time task comes first and 1 when the risk task comes first. We also modified the order in which payoffs are presented in the gumball machine pictures with a new distribution in 18% of the sample. The binary variable ***newdesignhl*** takes a value of 1 when this new design is used and 0 otherwise

3.6 Social preferences

For testing inequality aversion in teenagers, we used two experimental designs. The variable ***sp_version*** refers to the version used, almost 85% of the sample has version 1 while the remaining 16% of the sample has version 2. The first one was based on Fehr et al. (2008). We built three decisions where subjects must decide between altruistic and individualistic choices. These decisions were presented in the same order for one part of the sample (49.78%), and it was randomized for another part of the subjects (34.27%).

This first experimental design included:

Q1 What do you prefer?
A) 10€ for you and 10€ for the other person; B) 10€ for you and 0€ for the other person (***socpref1***)

Q2 What do you prefer?
A) 10€ for you and 10€ for the other person; B) 10€ for you and 20€ for the other person(***socpref2***)

Q3 What do you prefer?
A) 10€ for you and 10€ for the other person; B) 20€ for you and 0€ for the other person (***socpre3***)

The second experimental design was based on Corgnet et al. (2015) and Brañas-Garza et al. (2022). It was a version extended of the first one, where subjects must decide between two choices in six questions. These decisions were always presented in the same order, and it included:

Q1 What do you prefer?:
A) 1€ for you and 1€ for the other person; B) 0.8€ for you and 1.6€ for the other person (***sp1***)

Q2 What do you prefer?
A) 1€ for you and 1€ for the other person; B) 1.2€ for you and 0.4€ for the other person (***sp2***)

Q3 What do you prefer?
A) 1€ for you and 1€ for the other person; B) 1€ for you and 1.8€ for the other person (***sp3***)

Q4 What do you prefer?
A) 1€ for you and 1€ for the other person; B) 1€ for you and 0.6€ for the other person (***sp4***)

Q5 What do you prefer?
A) 1€ for you and 1€ for the other person; B) 1.6€ for you and 0.4€ for the other person (***sp5***)

Q6 What do you prefer?
A) 1€ for you and 1€ for the other person; B) 1.1€ for you and 1.9€ for the other person (***sp6***)

The answers are included in binary variables where they take the value 0 if they choose A and 1 in the case of B. Table 6 shows the proportion of responses.

Table 6: Percentage of responses for each decision

	A	B	n
sp1_v1	86.85%	13.15%	4,479
sp2_v1	65.01%	34.99%	4,501
sp3_v1	63.27%	36.73%	4,500
sp1_v2	85.56%	14.44%	859
sp2_v2	73.75%	26.25%	857
sp3_v2	74.91%	25.09%	857
sp4_v2	81.10%	18.90%	857
sp5_v2	70.83%	29.17%	857
sp6_v2	70.36%	29.64%	857

Note: The ending name of the variable refers to the version used: version 1 (v1) and version 2 (v2).

3.7 Probabilistic beliefs

We test their probability knowledge with an adaptation of Estepa et al. (2021) based on the approach of Delavande and Kohler (2009). The task involves specifying a value from 0 to 100[6] the probability of an event actually occurring. We include the following seven questions[7]:

Q1 Imagine I have a basket with 5 apples: 1 green and 4 red. If I ask you to pick one of the apples without looking at the inside of the basket, how likely (from 0 to 100) do you think you will pick the green apple? (***delavande_apple20***)

Q2 Imagine I have a basket with 10 apples: 1 green and 9 red. If I ask you to pick one of the apples without looking at the inside of the basket, how likely (from 0 to 100) do you think you will pick the green apple? (***delavande_apple10***)

Q3 How likely (from 0 to 100) do you think you will eat rice in the next week (including today)? (***delavande_riceweek***)

Q4 How likely (from 0 to 100) do you think you will eat rice in the next month (including today)? (***delavande_ricemonth***)

Q5 How likely (from 0 to 100) do you think you are not going to attend school during the entire next month (including today)? (***delavande_sch0***)

Q6 How likely (from 0 to 100) do you think you are going to take a shower at least once in the next month (including today)? (***delavande_bath100***)

Q7 How likely (from 0 to 100) it is that you will go to university? (***delavande_uni***)

We check the consistency of their responses to three extents. First, let Q1 be greater than Q2, then let Q3 be less than or equal to Q4 and finally let Q5 be less than Q6. Therefore, ***delavande_total*** takes values from 0 to 3, however, we normalize it to ***delavande_totalN***. Table 7 displays the main statistics of the related variables.

[6] Values outside this range are denoted by 999

[7] An eighth question was included in the latest versions: **Q8** How likely (from 0 to 100) do you think you will continue your education next year? (***delavande_study***)

Table 7: Summary statistics of Delavande variables

	Obs	Mean	Std. Dev.	Min	Max
delavande_apple20	5448	29.559	46.079	0	999
delavande_apple10	5447	20.382	44.710	0	999
delavande_riceweek	5436	59.73	51.672	0	999
delavande_ricemoth	5436	80.579	65.492	0	999
delavande_sch0	5426	19.662	52.843	0	999
delavande_bath100	5426	84.030	82.122	0	999
delavande_uni	5419	65.834	46.711	0	999
delavande_study	2720	88.014	30.899	0	999
delavande_slider	2746	0.502	0.500	0	1
delavande_total	5426	2.361	0.762	0	3
delavande_totalN	5426	0.787	0.254	0	1

About 40% of the sample, we also tested these questions with two treatments: numerical values (19.34%) and sliders (19.48%). In the first one subjects must answer by typing the number they thought, while in the second one, they must move a slider to the value they wanted to answer (***delavande_slider***=1).

3.8 Abilities

We included two tasks to measure skills: the Cognitive Reflection Test (CRT) and some mathematical-financial questions (FinAb). Subjects always answered both tasks in the same order: first they responded CRT and then FinAb. Both tasks were included in that fixed order, although the questions in each task were displayed randomized.

On the one hand, in the same vein as Thomson and Oppenheimer (2016), we include three adapted CRT questions:

Q1 Emily's father has three daughters. The first two are named April and May. What is the third daughter's name?
- Intuitive answer: June, Correct answer: Emily
- Reflective variable ***crt1***: 0 = Other , 1 = Emilia
- The original response is included in ***emily***.

Q2 In a library, the number of books doubles every month. If the library takes 48 months to fill, how long will it take to fill it halfway?
- Intuitive answer: 24, Correct answer: 47
- Reflexive variable ***crt2***: 0 = Other, 1 = 47
- The original response is included in ***library***.

Q3 If you are running a race and you pass the person in second place, what place are you in?
- Intuitive answer: 1, Correct answer: 2
- Reflexive variable ***crt3***: 0 = Other, 1 = 2
- The original response is included in ***race***.

On the other hand, FinAb includes basic operations and interest rates[8]:

Q1 If there are 5 people holding a winning lottery ticket and the price to be distributed is 2 million euros, how much money will each person receive?
- Correct answer: 400,000
- ***fin1***: 0 = Incorrect, 1 = Correct
- The original response is included in ***lottery***.

Q2 Imagine you have 100 euros in a savings account. The account is earning interest at an annual rate of 10%. How much will you have in the account after two years?
- Correct answer: 121
- ***fin2***: 0 = Incorrect, 1 = Correct
- The original response is included in ***bank1***.

Q3 Imagine you have 100 euros in a savings account and the annual interest rate you earn on your savings is 2%. If you keep the money in the account for 5 years, how much money will you have at the end of 5 years? Multiple choice answer: A) Less than 102 €, B) Exactly 102 €, C) More than 102 €, D) I don't know (99).
- Correct answer: C) More than 102 €

[8]Those who refused to answer or did not know the answer could enter 99

- ***fin3***: 0 = Incorrect, 1 = Correct
- The original response is included in ***bank2***.

The total number of correct answers per task are collected in the variable ***crttotal*** and ***fintotal***, respectively, taking values from 0 to 3. The distribution is shown in Table 8. Meanwhile, the same total is collected in a normalized form in ***crtN*** and ***finN***.

Table 8: Distribution of total correct answers per ability task.

	CRT	FinAb
0	14.36%	31.08%
1	32.47%	41.01%
2	46.37%	24.55%
3	6.81%	3.36%
	100.00%	100.00%

3.9 Networks

We elicit four social networks for each year, two positives (friends and best friends) and two negatives (enemies and worst enemies). We displayed a list of students in the same year, including other groups, and we asked participants to tick their friends on the first screen. They are then asked to report who their best friends are from the students they have selected as friends. The next screen showed the same list but asked them to tick their enemies[9]. Finally, they are also asked to select the worst relationships, from those that they have identified as bad relationships.

In addition, we have included new questions related to beliefs. Subjects have to predict who from the list shown will select them as friends, best friends, enemies or worst enemies.

Other types of questions related to the position in the network are included. We asked about the class delegate. They also report who they think is the most popular person and the most connected person.

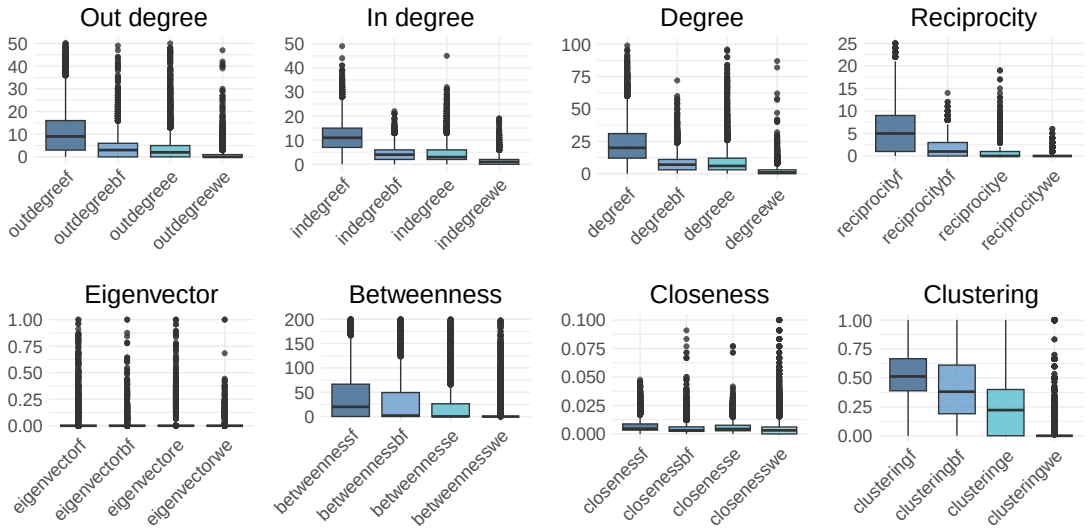
Q1 Please select your friends (***friend***)
Q2 Please select your best friends (***friend2***)
Q3 Please select those with whom you do not have a good relationship (***enemy***)
Q4 Please select those with whom you have an especially bad relationship (***enemy2***)
Q5 Who do you think will select you as a friend? (***sfriend***)
Q6 Who do you think will select you as a best friend? (***sfriend2***)
Q7 Who do you think will select you because you don't have a good relationship with that person? (***senemy***)
Q8 Who do you think will select you because you have an especially bad relationship with that person? (***senemy2***)
Q9 Who is the delegate of your classroom? (***delegate***)
Q10 Who do you think will be the person most often identified as a best friend? (***friend3***)
Q11 If you would like to send a message and you would like it to spread to the whole class, but you could only contact one person, who would you choose? (***message***)

Once we have the information about the interactions reported by the students, we build the social networks and proceed to the social network analysis. We provide both individual and global measures of each network[10]. Figure 3 shows the box plots of each individual measure by network type.

[9] We never used the term enemy, we rather asked about classmates who aren't friendly or don't have a good feeling for each other.

[10] We identify the network of each measure with a different ending: *f* for the network of friends, *bf* for the network of best friends, *e* for the network of enemies and *we* for the network of worst enemies.

Figure 3: Summary of Individual network measures



- **Individual network measures:**
  - Centrality: Degree, In degree, Out degree, Betweenness, Closeness, Eigenvector
  - Reciprocity: Reciprocal degree
  - Segmentation: Clustering
- **Global network measures:** No. nodes, No. edges, Density, Global reciprocity, Assortativity, Average in degree, standard deviation of in degree, Average degree, Standard deviation of degree, Global clustering, Average clustering, Standard deviation of clustering, Gigant component, No. isolates, Mean distance, Diameter, Gender homophily, Modularity, No. communities, No. important communities.

3.10 Bullying

We include a special section on school bullying. First, we present them a screen with the description. And in the next screen, we ask them to identify the cases they know (max. 3).

> **Definition of school bullying:** "*It happens when, usually, several students intentionally disturb a classmate, who does not manage to stop the behavior. It may involve one or more of the following acts: Teasing, name-calling, bad-mouthing, rejection, negative comments and humiliation, either face-to-face or online (including social media networking (Facebook, WhatsApp, Twitter...), threats, hitting, pushing and similar.*"

As for the network formation, we present them the list with all the classmate names, including themselves. Therefore, we capture two different bullying variables with this design, whether they self-identify as a victim (***self_bullying***) or whether others identify them as a victim (***others_bullying***). Both variables are binary, they take a value of 1 if the subject is a victim and 0 otherwise. Note that if the subject has not answered the question, ***self_bullying*** will be a missing value, but if she has been mentioned by a peer, that value will appear in ***others_bullying***. In addition, we include another numerical variable that counts how many times a victim is mentioned as such by her peers (***n_others_bullying***). Lastly, we do not ask for the name of the bully.

Table 9: Bullying cases

		Reported by peers	
		Yes	No
Self-reported	Yes	65	68
	No	590	5,167

Note: There are 1,183 missing values that we do not have information reported by the subjects themselves. Of those, 113 are mentioned by their peers.

3.11 Strategical thinking

Building a game to measure performance in strategical thinking was not an easy task from the beginning. The mechanism in this part of the research was a continuous trial and error, bringing greater consistency of results as new designs were included.

For testing strategical thinking we designed three different tasks (*Cards*, *PiggyBank* and *Buttons*). All of them were one-shot. These experimental designs were not included in same sessions. That is going to say, subjects just played one of them and as new game was included, it replaced the older. They are going to be shown on timeline.

These games are going to be divided in subsections. Instructions, main variables and number of observations of each design are going to be highlighted.

3.11.1 Cards

Cards consisted on three different games (*Blue*, *Yellow* and *Red*) and a belief (*Belief*) about what the rival was going to select in *Red*. Subjects answered *Blue* and then *Yellow*. Then, at the end of the experiment they answered *Red* and *Belief*. We used a card game to illustrate a beauty contest game. For differentiate the games in *Cards*, we used different colors, increasing also the difficulty as subjects advanced in the experiment.

- **Instructions**:
  - *Blue*:

> Next, you will be **paired** with another participant, but you will **NOT know** who it is.
>
> You both see the same cards. And each of you **chooses one**, at the same time and without talking.
>
> - If you both pick the **same card**, YOU get **the number of points on that card** and THE OTHER PERSON gets **0 points**.
>
> - If you both **DO NOT** pick the **same card**, you EACH get **the number of points shown on that card**.
>
> Which card do you choose?

Figure 4: Design of *Blue*

  - *Yellow*:

Now, **RULES CHANGE**.

- If you both pick the **same card**, YOU get **0** and THE OTHER PERSON gets **the number of points on that card**.

- If you both **DO NOT** pick the **same card**, you EACH get **the number of points shown on that card**.

You both see the same cards. And you each **pick one**, at the same time and without talking.

Which card do you choose?

Figure 5: Design of *Yellow*

– *Red*:

Next, you will be **paired** with another participant, but you will **NOT know** who it is.

You both see the same cards. And each of you **chooses one**, at the same time and without talking.

- If you both pick the **same card**, you EACH get **the number of points on that card DIVIDED BY 2**.

- If you both **DO NOT** pick the **same card**, the person with the LOWEST card gets **the number of points on that card** and the person with the HIGHEST card gets **0 points**.

Which card do you choose?

Figure 6: Design of *Red*

– *Belief*:

Which card do you think the other person has chosen in the previous decision?

Figure 7: Design of *Belief*

The variables of this section are the following:

- st_cards1: card chosen in *Blue*.
- st_cards2: card chosen in *Yellow*.
- st_cards3: card chosen in *Red*.
- st_cards4: card chosen in *Belief*.
- st_cards1_ne: binary variable which takes value 1 if subject found the Nash equilibrium in *Blue*.
- st_cards2_ne: binary variable which takes value 1 if subject found the Nash equilibrium in *Yellow*.
- st_cards3_ne: binary variable which takes value 1 if subject found the Nash equilibrium in *Red*.
- st_cards4_ne: binary variable which takes value 1 if subject found the Nash equilibrium in *Belief*.

Table 10 shows descriptive data for the variables in *Cards*.

Table 10: Summary statistics of Cards variables

Variable	Obs	Mean	Std. dev.	Min	Max
st_cards1	2,752	3.543968	1.184027	1	5
st_cards2	2,752	3.238372	1.311752	1	5
st_cards3	2,697	3.261031	1.276388	1	5
st_cards4	2,698	3.404003	1.328733	1	5
st_cards1_ne	2,752	.2638081	.4407766	0	1
st_cards2_ne	2,752	.25	.4330914	0	1
st_cards3_ne	2,697	.2944012	.4558576	0	1
st_cards4_ne	2,698	.272424	.4452894	0	1

3.11.2 Piggy Bank

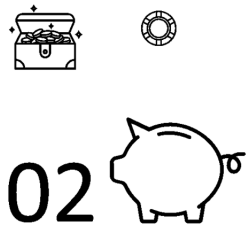
PiggyBank consisted on two different games (0 and 15) and a belief about what the rival was going to do in each game (*Belief*0 and *Belief*15). Subjects answered all the design in a row and the order answering 0 and 15 was randomised. After responding each one, they have to answered *Belief*0 and *Belief*15. We used a gif of a piggy bank (see Figure 8) to illustrate, and the task was limited by time. The piggy bank gif started with 0 coins inside of it and, for every second, it was filled with an additional coin until the 15th second, when the piggy bank would disappear.

Subjects were asked to click the piggy bank gif when they wanted to stop the count of coins that were going inside of it. The difference between 0 and 15 is that the Nash equilibrium in the first one was to click at the beginning of the count while in the second the Nash equilibrium was to click at the end of the count.

- **Instructions**:
  - *Intialscreen*:

> Next, you will then be paired with another partner, but you will not know who it is. The other person will not know who you are either.
>
> Imagine a **piggy bank** like the one below that, every second that goes by, you get one euro for **15 seconds**. For example: in the first second it will have €1, in the second it will have €2 and so on until it reaches €15, and then it will be destroyed.

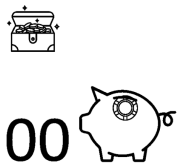
Figure 8: Screenshot of Piggy Bank gif (with 2 coins inside of it)



– 0:

In this case, the money will be kept by whoever presses the piggy bank **FIRST**, with the **euros** they have at that moment. You can click anywhere in the piggy bank to stop. Remember:

- If you are the first to click, you will win the euros in the piggy bank at that moment.
- If you are the second to click or you do not click within 15 seconds, you win 0 euros.
- If you both click at the same time, there is a draw and the euros in the piggy bank will be shared between the two of you.



– $Beleief0$:

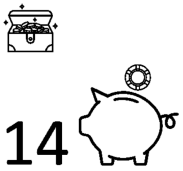
What do you think the other participant did?

- She clicked before me
- She pressed at the same time as me
- She pressed after me

– 15:

In this case, the money will be kept by whoever presses the piggy bank in the **SECOND PLACE**, with the **euros** they have at that moment. You can click anywhere on the piggy bank to stop. Remember:

- If you are the second to click, you will win the euros in the piggy bank at that moment.
- If you are the first to click or you do not click within 15 seconds, you win 0 euros.
- If you both click at the same time, there is a draw and the euros in the piggy bank will be shared between the two of you.



– $Belief15$:

What do you think the other participant did?

- She clicked before me
- She pressed at the same time as me
- She pressed after me

The variables of this section are the following:

- st_piggy_belief0: seconds she believes the rival is going to click in 0.
- st_piggy_belief15: seconds she believes the rival is going to click in 15.
- st_piggy_belief_position_0: position of $Belief0$ with respect to $Belief15$ (before or after).
- st_piggy_belief_position_15: position of $Belief15$ with respect to to $Belief0$ (before or after).
- st_piggy_position_0: position of 0 with respect to 15 (before or after).
- st_piggy_position_15: position of 15 with respect to 0 (before or after).
- st_piggy_0_sec: number of seconds she spent clicking in 0.
- st_piggy_15_sec: number of seconds she spent clicking in 15.
- st_piggy_0_distance_ne: number of seconds of difference between the time she spent clicking and the Nash equilibrium in 0.
- st_piggy_15_distance_ne: number of seconds of difference between the time she spent clicking and the Nash equilibrium in 15.

Table 11 shows descriptive data for the variables in $PiggyBank$.

Table 11: Summary statistics of Piggy Bank variables

Variable	Obs	Mean	Std. dev.	Min	Max
st_piggy_belief15	860	1.127907	.8684954	0	2
st_piggy_belief0	861	.9535424	.8464301	0	2
st_piggy_belief_position_15	860	.5	.500291	0	1
st_piggy_belief_position_0	861	.4994193	.5002903	0	1
st_piggy_0_sec	860	12.36047	12.30029	0	151
st_piggy_15_sec	862	19.10557	14.04139	1	198
st_piggy_position_0	860	.5	.500291	0	1
st_piggy_position_15	862	.5011601	.5002889	0	1
st_piggy_15_distance_ne	862	9.777262	10.81452	0	183
st_piggy_0_distance_ne	860	12.36047	12.30029	0	151

3.11.3 Buttons

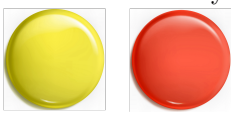
Buttons consisted on two coordination games ($PayD$ and $RiskD$). Subjects had to choose one between two buttons in a payoff dominance solvable game ($Yellow$) and in a risk dominance solvable game ($White$). These two games were played in a row. Subjects also answered after each game two questions about why they have chosen the previous button ($Argument1$ and $Argument2$). Indeed, these two questions had a close list of four possible answers, where "*Because I earned more*" and "*Because it was less riksy*" were the rational answer for constructing $PayD$ and $RiskD$ respectively.

Note that the order of buttons was always randomised, and we included in a second design beliefs about what the subject thought the rival was going to play (and for the arguments too). We also changed the colour to the buttons (ie., where Yellow and Red were the buttons for $Yellow$, in this second design we inverted the colours for White and Blue, that these were the colours for $White$).We also randomised the order of the beliefs: 50% of subjects answered first the belief and then they played *Buttons*, and 50% of the rest played before and then answered to beliefs.

- **Instructions**:
  - $Intialscreen$:

> You will now be paired with a random partner. You are both going to have to **press a button** without being able to talk to each other.
>
> Depending on what you each choose you will have different (hypothetical) prizes.
>
> Click the forward button to move on to the first question.

  - $Yellow$:

> These are the possible results:
>
> - If you click **red** and he **red** you win 5 euros each.
> - If you click **red** and he **yellow** you earn 0 euros each.
> - If you click **yellow** and he **red** you earn 0 euros each.
> - If you click **yellow** and he **yellow** you win 10 euros each.
>
> Which button do you press?
>
> 

  - $Argument1$:

> Why did you choose the previous button?
>
> * Because I earned more
> * Because I earned less
> * Because I liked the colour
> * I chose one randomly

  - $Intermediatescreen$:

> Now you are going to play again with another person, other buttons and other prizes.
>
> Again, you have to choose a button without knowing what the other one does.

– *White*:

These are the possible results:

If you click **white** and he **white** you win 10 euros each.
If you click **white** and he **blue** you will earn 5 euros and he 0 euros.
If you click **blue** and he **blue** you win 10 euros each.
If you click **blue** and he **white** you will earn 0 euros and he 5 euros.

Which button do you press?


– *Argument*2:

Why did you choose the previous button?

* Because it was less risky
* Because it was more risky
* Because I liked the colour
* I chose one randomly

The variables of this section are the following:

- st_buttons_game1: button selected in *Yellow*. It takes value 1 if she selected "Yellow" and 0 if she selected "Red".
- st_buttons_game2: button selected in *White*. It takes value 1 if she selected "White" and 0 if she selected "Blue".
- st_buttons_argument1: argument selected in *Arugment*1. It takes value 0 if she selected "I chose randomly", 1 if she selected "Because I liked the color", 2 if she selected "Because I earned less" and 3 if she selected "Because I earned more".
- st_buttons_argument2: argument selected in *Argument*2. It takes value 0 if she selected "I chose randomly", 1 if she selected "Because I liked the color", 2 if she selected "Because it was more risky" and 3 if she selected "Because because it was less risky".
- st_buttons_maxp: binary variable which takes value 1 if she selected "Yellow" in *Yellow* and the argument "Because I earned more" in *Argument*1.
- st_buttons_minr: binary variable which takes value 1 if she selected "White" in *White* and the argument "Because it was less risky" in *Argument*2.
- st_buttons_randomnised: binary variable which takes value 1 if the designed randomised the order of the decisions of the subject and the beliefs about the rival in the same game.
- st_buttons_changedcolor: binary variable which takes value 1 if subjects answered a version with the colours inverted. That is going to say, she would had to choose between White and Blue in *Yellow* and between Yellow and Red in *White* if colours were inverted.
- st_buttons_game1_rival: button that she beliefs the rival is going to choose in *Yellow*. It takes value 1 if the button was "Yellow" and 0 if it was "Red".
- st_buttons_game2_rival: button that she beliefs the rival is going to choose in *White*. It takes value 1 if the button was "White" and 0 if it was "Blue".
- st_buttons_argument1_rival: argument that she beliefs is going to be selected by the rival in *Argument*1. It takes value 0 if she selected "I chose randomly", 1 if she selected "Because I liked the color", 2 if she selected "Because I earned less" and 3 if she selected "Because I earned more".
- st_buttons_argument2_rival: argument that she beliefs is going to be selected by the rival in *Argument*2. It takes value 0 if she selected "I chose randomly", 1 if she selected "Because I liked the color", 2 if she selected "Because it was more risky" and 3 if she selected "Because because it was less risky".

Table 12 shows descriptive data for the variables in *Buttons*.

Table 12: Summary statistics of Buttons variables

Variable	Obs	Mean	Std. dev.	Min	Max
st_buttons_game1	1,819	.7339197	.4420282	0	1
st_buttons_game2	1,800	.5038889	.5001238	0	1
st_buttons_argument1	1,814	2.196251	1.170546	0	3
st_buttons_argument2	1,793	1.810374	1.148448	0	3
st_buttons_maxp	1,819	.5772402	.4941338	0	1
st_buttons_minr	1,800	.2577778	.4375326	0	1
st_buttons_randomnised	1,819	.2100055	.4074242	0	1
st_buttons_changedcolor	1,819	.1121495	.3156371	0	1
st_buttons_game1_rival	381	.5879265	.4928554	0	1
st_buttons_game2_rival	371	.5121294	.5005279	0	1
st_buttons_argument1_rival	378	1.857143	1.301179	0	3
st_buttons_argument2_rival	366	1.655738	1.241544	0	3

3.12 Creativity

In order to measure creativity we used Guilford's Alternative Uses Task (AUT) (Guilford, 1967). We designed a task with two versions. In the original version, we asked the students for all the alternative uses they could imagine using a brick, allowing their responses in free-text format. Whereas in the second version, we changed the object to a rope and we added a screen where several uses could be selected from a list, these uses were randomly ordered. We focus on a component defined by Dippo and Kudrowitz (2013) as the number of uses mentioned by a learner for the object in Guilford (1956) alternative uses task. The sum of these uses provides the fluency score of the student (***creativityf***).

Screen 1: "*In the following screen, you will find an object. We ask you to* ***list*** *in your response* ***ALL the uses*** *that come to your mind with it.* ***Separate*** *each use you mention with a semicolon* ***(;)****.*

This ***IS AN EXAMPLE*** *of the question we are going to ask you. Imagine we ask you:* ***List all the alternative uses you can think of with a paperclip****. Your answers could be: make a hook; make a bracelet; make a fishing hook.*"

Screen 2: "***You can take 5 minutes*** *for the following question.*"

Screen 3: "*Write down all the alternative uses you can imagine for a brick. Remember to separate each idea you write with a semicolon (;)".*

Note: The third screen of the task in the second version only changed in the text from "brick" to "rope".

In the rope task, we had two randomized paths. On the first path the order of the screens was: example, time, task and multiple-choice screen, while the order of the second path was: example, multiple-choice, time and task screen. For the example screen of the second path the instruction was modified removing the phrase "Separate each use you mention with a semicolon (;)."

Screen 4: Multiple choice screen:
"*Select all the options that you consider as a use for a rope.*
I can use the rope to: measure the earth; jump rope; make a bracelet; build a bridge; move the moon; make a rescue in a fire; write; take a picture; act as a ladder; "

Note: This screen only appears in the second version of the task ("rope"). This screen does not always appear in the last place, it is randomized with the third screen.

The original answers are contained in the variable ***brick*** and ***rope*** respectively. In addition, for the second version, ***ropeuse*** includes the uses that are selected from the selection list and the variable ***rope_ order*** takes value 1 when the uses are presented second and 2, when they are presented first.

3.13 Others variables

We control the dominant hand of each student, ***left_ hand*** is a binary variable, where 1 is left-handed (8.88%) and 0 is right-handed (91.12%).

We include a part of questions related to the Covid-19 situation in some questionnaires.

Q1 Do you believe that the situation caused by Covid-19 has negatively affected your educational and learning performance? (***covid1***)

Q2 When in 2020 you had to follow classes online, which device did you use most frequently? (***covid2***)

Q3 The device marked above, were you the only one using it? (***covid3***)
Q4 How did you manage to connect to online classes with your device during 2020? (***covid4***)

Perception of time in future actions at three levels:

Q1 This weekend - *I will go / I am going to go / I am going* - to the cinema (***ftr1***)
Q2 This summer - *I will go / I am going to go / I am going* - on holiday (***ftr2***)
Q3 In 15 years - *I get / I will get / I am going to get* - a job (***ftr3***)

4 Discussion and closing remarks

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