

# COVID-19 Compliance Behaviors of Older People: The Role of Cognitive and Non-Cognitive Skills\*

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## Abstract

This paper examines the empirical relationship between individuals' cognitive and non-cognitive abilities and COVID-19 compliance behaviors using cross-country data from the Survey of Health, Ageing and Retirement in Europe (SHARE). We find that both cognitive and non-cognitive skills predict responsible health behaviors during the COVID-19 crisis. Episodic memory is the most important cognitive skill, while conscientiousness and neuroticism are the most significant personality traits. There is also some evidence of a role for an internal locus of control in compliance.

**Keywords:** Cognitive skills; Locus of control; Personality traits; Compliance.

**JEL Classification Codes:** D81; H12; I12.

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# 1 Introduction

The COVID-19 pandemic has presented enormous public-health challenges, and many countries have introduced social-distancing and hygiene recommendations to contain the spread of the Coronavirus. The success of these measures depends heavily on individuals' behavioral compliance with COVID-19 regulations, and a number of contributions have highlighted the various factors that underlie this compliance (see [Brodeur et al. \(2021\)](#) for a review).

Recent economics research has related COVID-19 health behaviors to individual non-cognitive skills such as risk and time preferences ([Müller and Rau, 2021](#)), prosociality ([Campos-Mercade et al., 2021](#)), and the sense of civic duty ([Barrios et al., 2021](#)).<sup>1</sup> Using data from the Survey of Health, Ageing and Retirement in Europe (SHARE) covering people aged 50+, we present large-scale cross-country evidence on the link between both cognitive and non-cognitive skills and COVID-19 compliance behaviors. Our focus on elderly people is important, as they face the greatest health risk from the Coronavirus ([Mallapaty, 2020](#)). We extend the existing work by analyzing the role of cognitive ability, an important determinant of economic behaviors under risk and uncertainty ([Christelis et al., 2010](#); [Gong and Zhu, 2019](#)). We also contribute to the literature on the behavioral consequences of non-cognitive skills by considering both the locus of control, a psychological trait reflecting individuals' beliefs about the extent to which their life outcomes are determined by their own behavior ([Cobb-Clark and Schurer, 2013](#)), and the Big Five personality traits. Our results have greater external validity than those estimated using data from only one single country.

## 2 Data

The SHARE data come from a cross-national panel of individuals aged 50 or older. This biannual survey started in 2004, and the eight current waves have covered all continental European countries plus Israel. The non-cognitive and cognitive skills information come from the regular SHARE Waves 7 (collected in 2017) and 8 (from October 2019 to March 2020), while compliance is measured

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<sup>1</sup>A few contributions have also examined region-level trust ([Brodeur et al., 2021](#)) and civil capital ([Barrios et al., 2021](#)).

in the SHARE COVID-19 Survey (from June to August 2020). We consider a balanced panel of respondents who appeared in all three of these waves, producing a final sample of 25,878 individuals (with 11,053 men and 14,825 women).<sup>2</sup> The fact that cognitive and non-cognitive skills were measured before compliance behaviors helps to minimize any simultaneity bias in our estimations.

The compliance measures we analyze come from the SHARE COVID-19 Survey. There is information on the following five health behaviors in response to COVID-19: whether the respondent (i) always wears a face mask when going outside; (ii) always keeps a distance to others outside; (iii) washes hands more frequently than usual; (iv) uses special hand sanitizer more frequently than usual; and (v) pays special attention to covering their face when coughing or sneezing. These represent the common hygiene and behavioral recommendations that have been made by governments and health professionals. We also construct an overall compliance index via a polychoric principal component analysis (PCA) of these five binary measures. The index, which is the first PCA component that has an eigenvalue above 1, is then standardized to have zero mean and unit standard deviation.

Cognitive ability is measured in Wave 8. Cognition comprises different skills that work together to produce overall intelligence, and there are three cognitive tasks in Wave 8: (i) an immediate and delayed memory-recall test; (ii) a numeracy test; and (iii) a verbal fluency test ([Christelis et al., 2010](#)). In the memory-recall test, the interviewer read out a list of 10 common words: the respondent was then asked to memorize and immediately recall them in any order, followed by a similar delayed recall test after the respondent had answered a number of other questions. Each correctly-recalled word is given a score of 1, and the total memory-recall score (the sum of the immediate and delayed recalls) ranging from 0 to 20 is a measure of episodic memory. The numeracy test evaluates the ability to carry out basic numerical operations, which may influence the evaluation of risk and uncertainty before making economic or behavioral decisions. Respondents were asked to calculate five serial subtractions of seven from one hundred, with the number of correct answers yielding a numeracy score from 0 to 5. Last, verbal fluency produces an indicator of executive function.

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<sup>2</sup>These respondents are from 26 countries in Southern Europe (Bulgaria, Croatia, Cyprus, France, Greece, Italy, Israel, Malta, Romania, and Spain), Central Europe (Austria, Belgium, Czechia, Germany, Hungary, Luxembourg, Poland, Slovakia, Slovenia, and Switzerland), and Northern Europe (Denmark, Estonia, Finland, Latvia, Lithuania, and Sweden).

Respondents were asked to name as many animals as possible in one minute, with score of the number of unique animals named ranging from 0 to 45.

The non-cognitive skill measures come from Wave 7. Regarding locus of control, SHARE respondents gave a score from 1 (Often) to 4 (Never) to each of the following 11 statements (Becchetti and Bellucci, 2021): (i) “Age prevents from doing things you would like to do”; (ii) “What happens to you is out of your control”; (iii) “Feel left out of things”; (iv) “Family responsibilities prevent you from doing what you want to do”; (v) “Shortage of money stops you from doing the things you want to do”; (vi) “You can do the things that you want to do”; (vii) “Look forward to each day”; (viii) “Look back on life with a sense of happiness”; (ix) “Feel full of energy these days”; (x) “Life is full of opportunities”; and (xi) “Future looks good for you”. The first five statements (i–v) refer to individuals’ external control and the other six (vi–xi) to their internal control. Those with an internal locus of control believe that life outcomes result from their own behavior, while individuals with an external locus of control attribute life outcomes to external factors such as fate and luck. The locus of control index is the sum of the responses to the 5 external items, minus the sum of responses to the 6 internal items, plus a constant of 30. The subsequent index ranges from 11 to 44, with higher values indicating greater internal locus of control.

The Big Five personality traits (Agreeableness, Conscientiousness, Extraversion, Neuroticism, and Openness to experience) were measured using the 10-item version of the Big Five Inventory (BFI-10), which has five sub-scales with two bi-directional items for each of the Big Five personality factors.<sup>3</sup> Respondents rated each item on a five-point scale from 1 (Disagree strongly) to 5 (Agree strongly). The score for each trait is standardized to lie between 1 and 5 in SHARE.

The summary statistics are presented in Table 1. The first column shows the overall sample means, and columns two and three the figures for men and women respectively. In response to the crisis, 58% of individuals always wear face masks when going outside and 77% always keep a social

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<sup>3</sup>The 10 items for the five traits are: (i) Agreeableness (“I see myself as someone who is generally trusting”, and “I see myself as someone who tends to find fault with others”); (ii) Conscientiousness (“I see myself as someone who does a thorough job”, and “I see myself as someone who tends to be lazy”); (iii) Extraversion (“I see myself as someone who is outgoing, sociable”, and “I see myself as someone who is reserved”); (iv) Neuroticism (“I see myself as someone who is relaxed, handles stress well”, and “I see myself as someone who gets nervous easily”); and (v) Openness to experience (“I see myself as someone who has an active imagination”, and “I see myself as someone who has few artistic interests”).

Table 1: Descriptive statistics

	All	Men	Women
PCA index of COVID-19 compliance	0.00 (1.00)	-0.10 (1.06)	0.08 (0.95)
COVID-19 compliance behaviors (Yes=1):			
Always wears a face mask when going outside	0.58	0.54	0.61
Always keeps a distance to others when going outside	0.77	0.73	0.79
Washes hands more frequently than usual	0.90	0.89	0.91
Uses special hand sanitizer more frequently than usual	0.86	0.84	0.87
Pays special attention to covering coughs and sneezes	0.86	0.85	0.88
Cognitive ability:			
Memory (Range: 0–20)	9.64 (3.46)	9.14 (3.29)	10.01 (3.53)
Numeracy (Range: 0–5)	4.28 (1.24)	4.37 (1.14)	4.21 (1.30)
Fluency (Range: 0–45)	21.24 (7.25)	21.08 (7.11)	21.35 (7.34)
Locus of control (Range: 11–44)	34.39 (5.52)	34.71 (5.40)	34.16 (5.60)
Big Five personality traits:			
Agreeableness (Range: 1–5)	3.76 (0.81)	3.71 (0.81)	3.79 (0.80)
Conscientiousness (Range: 1–5)	4.20 (0.76)	4.16 (0.77)	4.23 (0.75)
Extraversion (Range: 1–5)	3.60 (0.91)	3.56 (0.91)	3.62 (0.92)
Neuroticism (Range: 1–5)	2.71 (1.02)	2.57 (0.97)	2.82 (1.04)
Openness to experience (Range: 1–5)	3.44 (0.93)	3.38 (0.92)	3.48 (0.93)
Age	69.8 (8.6)	70.3 (8.3)	69.4 (8.8)
Years of education	11.6 (4.0)	11.8 (4.1)	11.4 (4.0)
Married (Yes=1)	0.71	0.81	0.63
Retired (Yes=1)	0.68	0.74	0.65
Disabled (Yes=1)	0.02	0.02	0.02
Family size	2.03 (0.91)	2.14 (0.89)	1.95 (0.92)
Observations	25,878	11,053	14,825

*Notes:* The standard deviations of the continuous variables appear in parentheses. All of the male–female differences are statistically significant at the 1% level, except for disabled.

distance to others. The figures for the other three public-health behaviors are notably higher: 90% report washing their hands more, 86% use hand sanitizer more, and 86% cover their face when coughing or sneezing. The male compliance figures are systematically a little lower than those for women. In terms of cognitive abilities, older women have better memory scores than men, but there is little gender difference in numerical skills and verbal fluency. Equally, the psychological traits are similar for older men and women.

### 3 Empirical analysis

We model compliance behaviors as follows:

$$CB_i = Cog'_i\alpha + NonCog'_i\beta + X'_i\gamma + \epsilon_i \quad (1)$$

where  $CB_i$  denotes either the PCA compliance index or a binary variable for one of the health behaviors during COVID-19,  $Cog_i$  is the vector of cognitive ability measures, and  $NonCog_i$  the vector of psychological traits. For ease of interpretation, all cognitive and non-cognitive measures are normalized to have zero mean and unit standard deviation in the estimations.  $X_{it}$  is a vector of explanatory variables including age, age-squared, years of education, number of family members, dummy variables for gender, marriage, retirement, and disability, and country-by-month (of the COVID Survey) fixed effects.  $\epsilon_i$  is the idiosyncratic error term. Equation (1) will be estimated via OLS regressions.<sup>4</sup> Standard errors are clustered at the country-by-month level to account for any correlation in health behaviors across individuals who were interviewed in the same country in the same month of the SHARE COVID-19 Survey.

The OLS estimation results appear in Table 2. We first discuss the estimates for the overall compliance index in Column (i). Of the three cognitive measures, both episodic memory and numeracy have a significantly positive association with the PCA compliance index, while verbal fluency does not. A one standard-deviation higher memory and numeracy score is associated with a

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<sup>4</sup>The estimated coefficients from logit estimation of the binary dependent variables are very similar in terms of sign and significance.

rise in the compliance index of 0.06 and 0.02 standard deviations, respectively.

Table 2: Cognitive abilities, non-cognitive skills, and compliance behaviors

	(i) PCA	(ii) Mask	(iii) Distance	(iv) Hands	(v) Sanitizer	(vi) Covering
Cognitive ability measures:						
Memory	0.056*** (0.011)	0.008** (0.003)	0.009* (0.004)	0.016*** (0.004)	0.010*** (0.002)	0.014*** (0.004)
Numeracy	0.018** (0.008)	0.004 (0.003)	0.009** (0.004)	0.002 (0.002)	0.002 (0.002)	0.002 (0.003)
Fluency	-0.001 (0.011)	0.000 (0.004)	0.004 (0.005)	0.002 (0.003)	-0.004 (0.003)	-0.002 (0.003)
Locus of control	0.021* (0.011)	0.006* (0.003)	0.015*** (0.004)	0.002 (0.004)	0.001 (0.003)	0.000 (0.003)
Big Five personality traits:						
Agreeableness	0.018** (0.008)	0.003 (0.003)	0.004 (0.003)	0.005 (0.003)	0.005** (0.002)	0.002 (0.003)
Conscientiousness	0.055*** (0.011)	0.021*** (0.004)	0.023*** (0.004)	0.008*** (0.002)	0.003* (0.002)	0.008** (0.004)
Extraversion	0.008 (0.008)	-0.004* (0.002)	0.004 (0.002)	0.003 (0.003)	-0.001 (0.002)	0.004 (0.003)
Neuroticism	0.028*** (0.008)	0.008*** (0.003)	0.003 (0.003)	0.006* (0.003)	0.007*** (0.002)	0.006** (0.003)
Openness to experience	0.017** (0.007)	0.005 (0.003)	0.007** (0.003)	0.001 (0.002)	0.003* (0.002)	0.003 (0.003)
$R^2$	0.101	0.459	0.076	0.058	0.020	0.055
Observations	25,878	25,878	25,878	25,878	25,878	25,878

*Notes:* The dependent variable in Column (i) is the PCA index of COVID-19 compliance, and those in Columns (ii)–(vi) are whether the respondent (ii) always wears a face mask when going outside; (iii) always keeps a distance to others when going outside; (iv) washes hands more frequently than usual; (v) uses special hand sanitizer more frequently than usual; and (vi) pays special attention to covering coughs and sneezes. The control variables are age, age-squared, years of education, number of family members, dummy variables for gender, marriage, retirement, and disability, and country-by-month fixed effects. Standard errors clustered at the country-by-month level appear in parentheses. \*  $p < 0.10$ ; \*\*  $p < 0.05$ ; \*\*\*  $p < 0.01$ .

Non-cognitive skills also matter. Individuals who believe that what happens in life stems more from their own actions rather than from external factors are more compliant. Among the Big Five personality factors, only extraversion (characterized by sociability, talkativeness, and excitability) is not positively correlated with health behaviors during the pandemic. As a tendency to be organized and responsible, conscientiousness can help individuals to re-organize their lives in the unprecedented situation and follow safety recommendations. Neuroticism is associated with sensitivity to unfavorable situations and threats, and the more neurotic take more safety precautions

in the SHARE survey. Last, the more agreeable (exhibiting a tendency to act in a cooperative and prosocial way) and those who are more open to experience (tendency to be open to new cultural or intellectual experiences) comply more.<sup>5</sup>

Columns (ii)–(vi) of Table 2 then turn to the individual compliance behaviors. Amongst the cognitive-ability variables, episodic memory is consistently and significantly positively correlated with all five compliance measures. However, numeracy only predicts social distancing, and there continues to be no evidence of a significant correlation between verbal fluency and compliance behaviors during COVID-19. Individuals with more internal locus of control are more likely to wear face masks and comply with social-distancing guidelines when going outside. In terms of the Big Five personality traits, both conscientiousness and neuroticism correlate positively and significantly with almost all five health behaviors. The results for the other three personality factors (agreeableness, openness, and extraversion) are in general smaller and less often significant.

We next ask whether the PCA compliance index results in Column (i) of Table 2 differ by observable characteristics, and consider age, gender, and country groups. The results appear in Table 3. We consider the age cut-off of 65 as it is the most general retirement age in Europe. In Panel A, memory matters more for overall COVID-19 compliance among people aged 66+ than for those aged 50–65. On the contrary, numeracy is positively correlated with compliance only for the younger. The estimates for non-cognitive skills are generally similar between the two age groups. In Panel B there are almost no gender differences: cognitive and non-cognitive skills and compliance are related in the same way for older men and women. Last, the cross-country SHARE data allow us to consider the different country groups of Southern, Central, and Northern Europe. In Panel C there is little statistical evidence of any geographical variation in the correlation between cognition and compliance; however, there is more variation in the correlations with non-cognitive skills, which are more prominent in Central Europe.<sup>6</sup>

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<sup>5</sup>As some statistically-significant coefficients on the three cognitive and six non-cognitive skills in Column (i) of Table 2 may occur by chance, we use the Romano and Wolf (2005) stepdown method for multiple hypothesis testing. After the correction, the adjusted  $p$ -values for the nine skill measures are 0.010, 0.039, 0.951, 0.049, 0.030, 0.010, 0.376, 0.010, and 0.030, respectively. As such, our main conclusions continue to hold. The results for the individual compliance behaviors in Columns (ii)–(vi) of Table 2 are also robust to multiple hypothesis testing.

<sup>6</sup>In June 2020 (when the SHARE COVID-19 Survey started), the Coronavirus death rate was the highest in Southern



Table 3: Heterogeneity in overall compliance

	Panel A: Age		Panel B: Gender		Panel C: Region		
	50-65	66+	Male	Female	Southern	Central	Northern
Cognitive ability measures:							
Memory	0.028** (0.014)	0.071*** (0.013)	0.070*** (0.015)	0.047*** (0.011)	0.061** (0.024)	0.044*** (0.012)	0.073*** (0.023)
Numeracy	0.035*** (0.012)	0.009 (0.009)	0.025* (0.013)	0.012 (0.009)	0.030** (0.013)	0.010 (0.011)	0.009 (0.017)
Fluency	-0.004 (0.019)	0.002 (0.010)	0.002 (0.016)	-0.003 (0.012)	-0.006 (0.021)	0.019 (0.016)	-0.026 (0.016)
Locus of control	0.023* (0.013)	0.016 (0.014)	0.029** (0.012)	0.017 (0.012)	0.003 (0.021)	0.037** (0.017)	0.015 (0.012)
Big Five personality traits:							
Agreeableness	0.025** (0.011)	0.015* (0.009)	0.013 (0.011)	0.023** (0.010)	0.037** (0.014)	0.027*** (0.008)	-0.020 (0.016)
Conscientiousness	0.067*** (0.018)	0.051*** (0.011)	0.061*** (0.014)	0.050*** (0.012)	0.023 (0.015)	0.083*** (0.020)	0.038** (0.014)
Extraversion	0.004 (0.012)	0.010 (0.008)	0.013 (0.012)	0.005 (0.009)	-0.012 (0.009)	0.021 (0.016)	0.009 (0.009)
Neuroticism	0.021 (0.013)	0.031*** (0.009)	0.022* (0.012)	0.030*** (0.008)	-0.002 (0.012)	0.052*** (0.012)	0.020* (0.010)
Openness to experience	0.022* (0.012)	0.014* (0.007)	0.030*** (0.009)	0.009 (0.008)	0.009 (0.012)	0.021* (0.011)	0.017 (0.010)
Observations	8,817	17,061	11,053	14,825	7,522	12,027	6,329
R <sup>2</sup>	0.108	0.097	0.099	0.096	0.109	0.065	0.123

Notes: The dependent variable is the PCA index of COVID-19 compliance. The control variables are age, age-squared, years of education, number of family members, dummy variables for gender, marriage, retirement, and disability, and country-by-month fixed effects. Standard errors clustered at the country-by-month level appear in parentheses. \*  $p < 0.10$ ; \*\*  $p < 0.05$ ; \*\*\*  $p < 0.01$ .

## 4 Conclusion

We use cross-country SHARE panel data to analyze the links between COVID-19 behavioral compliance and individual pre-pandemic cognitive and non-cognitive skills among older Europeans. Cognitive ability comes from the scores in memory, numeracy, and fluency tests, while non-cognitive skills are measured by locus of control and the Big Five personality traits. Older people with higher scores in the memory and numeracy tests are significantly more likely to comply with public-health recommendations. Among the Big Five personality traits, conscientiousness and neuroticism are positively and significantly linked to almost all compliance behaviors. There is also some evidence of a role for an internal locus of control in compliance. While our results are specific to the natural experiment of the COVID-19 pandemic, it is likely that cognitive abilities and non-cognitive skills also play an important role in the health compliance of older people in other situations.

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Europe and the lowest in Central Europe (Fonseca et al., 2020). When COVID-19 risks are high, it is likely that individuals with different skills all follow the safety advice. Skills may become more relevant when compliance behaviors are more of a voluntary choice made by individuals under less serious COVID-19 conditions. While this is an intuitive reading of the data, it is much more difficult to test formally as pandemic prevalence is itself a function of compliance with public-health measures.

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