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"Quick and dirty": Intuitive cognitive style predicts trust in Didier Raoult and his hydroxychloroquine-based treatment against COVID-19

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Abstract

In the context of the COVID-19 pandemic, French public opinion has been divided about Pr. Didier Raoult and his hydroxychloroquine-based treatment against COVID-19. In this paper, our aim is to contribute to the understanding of this polarization of public opinion by investigating the relationship between (analytic vs. intuitive) cognitive style and trust in Didier Raoult and his treatment. Through three studies (total *N* after exclusion = 950), we found that a more intuitive cognitive style predicted higher trust in Didier Raoult and his treatment. Moreover, we found that Trust in Raoult was positively associated with belief that truth is political, belief in conspiracy theories, belief in pseudo-medicines and pseudo-medical and conspiratorial beliefs regarding the COVID-19 pandemic. We also found a negative association with knowledge of scientific methods and regard for scientific method over personal experience. However, higher trust in Didier Raoult was not associated with self-reported compliance with official regulations concerning the COVID-19 pandemic.

Keywords: analytic thinking, cognitive style, Didier Raoult, hydroxychloroquine, intuitive thinking

"Le professeur Raoult, qu'est-ce qu'il a fait ? Il a fait de la science *quick and dirty* !" Idriss Aberkane, 2020

1 Introduction

1.1 Didier Raoult, hydroxychloroquine, and the polarization of French opinion

On January 23th, 2020, the WHO declared that the COVID-19 outbreak constituted a Public Health Emergency of International Concern (PHEIC) (World Health Organization, 2020a). On March 11th, it labelled the outbreak as the "first pandemic caused by a coronavirus" and called countries to take "urgent and aggressive actions" (World Health Organization, 2020b). However, at the time, there were already rumors that a cure to COVID-19 (at least at an early stage of the disease) had been found. On March 21st, U.S. president Donald Trump tweeted that "HYDROXYCHLOROQUINE & AZITHROMYCIN, taken together, have a real chance to be one of the biggest game changers in the history of medicine" (Solender, 2020). These were the first hints of a heated debate that would go on for months, around the efficiency of hydroxychloroquine (combined or not to azithromycin and zinc) in treating COVID-19 – a debate that would even interfere with clinical trials' capacity to recruit volunteers (Raulin, 2020; NPR, 2020).

One key actor in this debate and the rise of hydroxychloroquine as a potential treatment was Didier Raoult, a French microbiology professor at Aix-Marseille II University. On February 25th, Didier Raoult's research institute (the "IHU Méditerranée-Infection") uploaded on its YouTube channel a video originally entitled "Coronavirus : Fin de partie !" (in English: "Coronavirus : Game Over!") (Raoult, 2020a). In this video, Didier Raoult claimed that Chinese researchers had just found that 500mg of chloroquine per day during 10 days led to spectacular improvements in people suffering from COVID-19. The video (the title of which has been changed since) ended with the following joke: "be careful! Pharmacies will soon run out of chloroquine."

This video quickly went viral in French media and, to this day, has been seen 760,000 times. In a first time, Didier Raoult's video and statements were flagged as "fake news" by various sources such as Facebook, "Les décodeurs" (a group of fact-checkers affiliated to the widely read newspaper *Le Monde*), and the French Ministry of Health (Perrier, 2020). However, this did not prevent Raoult from becoming a member of the scientific committee advising the French government on COVID-19-related matters. In another video published on March 16th (and which has received almost

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1.5 million views to this day), Didier Raoult claimed that a non-randomized clinical trial led by his research institute had shown that a combination of hydroxychloroquine and azithromycin led to a reduction of the viral load in patients suffering from COVID-19 (Raoult, 2020b). On March 20th, a preprint of this study was published online in the *International Journal of Antimicrobial agents*, claiming that "hydroxychloroquine treatment is significantly associated with viral load reduction/disappearance in COVID-19 patients and its effect is reinforced by azithromycin" (Gautret et al., 2020). The paper ends on the following recommendation: "We therefore recommend that COVID-19 patients be treated with hydroxychloroquine and azithromycin to cure their infection and to limit the transmission of the virus to other people in order to curb the spread of COVID-19 in the world."

However, the study suffered from several serious methodological shortcomings: extremely small sample, lack of randomization, unmatched control group recruited in a completely different center, participants withdrawn from the control group because they went to intensive care or died, analyses stopped before the planned (and pre-registered) endpoint, or missing data (in the preprint) replaced by extrapolated data (in the published paper) (Bik, 2020; Rosendaal, 2020; Schneider, 2020). Thus, it failed to convince scientists of the efficiency of what would since then be called the "protocole Raoult". However this did not prevent his declaration to have a worldwide impact. In the United States, Donald Trump made a statement on March 23th that described this treatment as a "gift from God" and in which he promised to expand medical access to hydroxychloroquine and chloroquine (AFP, 2020). This would ultimately give birth to the United States' own version of the "Raoult protocol": the "Zelenko protocol", named after Vladimir Zelenko, a New York physician claiming to save COVID-19 patients using a combination of hydroxychloroquine, azithromycin and zinc (LaFraniere & Roose, 2020). In Brazil, President Jair Bolsonaro reacted by claiming that "God is Brazilian, the cure is right here!" and that "Chloroquine is working everywhere", even though many experts now consider that his focus on chloroquine and hydroxychloroquine as miracle cures was one of the factors that contributed to worsen Brazil's health crisis (Londoño & Simões, 2020).

France itself has not been spared by the "hydroxychloroquine craze" and by what some have perceived as a "politicization" of the medical debate. For example, the Mayor of Nice, Christian Estrosi, publicly supported Didier Raoult and the efficiency of his protocol (Chazot, 2020). On March 23th, Idriss Aberkane, a French life coach and YouTuber who used to pose as a Phd in Neurosciences (Acermendax, 2016), published a video entitled "Pourquoi RAOULT est un héros" (in English: "Why RAOULT is a hero"). To this day, the video has received almost 1 million views (Aberkane, 2020). On April 5th, the French newspaper *Le Parisien* released the results from a poll which showed that 59% of French people believed that the "Raoult protocol" was effective against COVID-19 (against 20% believing it was ineffective and 21% answering they did not know) (Corsan, 2020). On July 2020, Martine Wonner, a member of the French Parliament, published in the *Asian Journal of Medicine and Health* a research article supporting the use of hydroxychloroquine and azithromycin in treating COVID-19 (Guérin et al., 2020), leading a team of French and Swiss researchers to publish a hoax paper in the very same journal to demonstrate its predatory nature (Oodendijk et al., 2020).

However, one specificity of the French situation is that these developments did not only led people to become polarized about the efficiency of hydroxychloroquine in the treatment of COVID-19 — they also led to a polarization about the persona of Didier Raoult himself. Indeed, one difference between France and countries such as United States and Brazil is that the French government never officially recognized nor promoted the "Raoult protocol" as a miracle cure. Even when, on April 9th, the French president went to meet Didier Raoult in Marseille to talk about the Coronavirus treatment (Poujoulat, 2020), this was not presented as an official endorsement of Didier Raoult's treatment. This contrast between a renowned scientist claiming to have found a cure to COVID-19 and the apparent hostility of the French government led Didier Raoult to become an "anti-system" figure (Soullier, 2020). He himself contributed to this image in his various videos and tweets by calling himself a "maverick", by stressing the difference between the "real scientists" and the "so-called experts who advise the government", by emphasizing the contrast between Paris (the capital) and the rest of the country (notably Marseille), or even by opposing YouTube to the traditional media, that he considers to be "less reliable" (Verner, 2020).

As such, Didier Raoult himself (along with his treatment) has become a "heated topic" in France. A recent poll by BFMTV suggests that 32% of French people consider that he had a positive impact in the COVID-19 crisis, while 25% think that his impact was negative (Paollini, 2020). Another poll puts him in third position in the ranking of personalities French people trust to "reinvent France" (Le Meneec, 2020). In parallel, support for Didier Raoult has been growing on social media. For example, Facebook groups such as "Didier Raoult Vs Coronavirus" and "COALITION MONDIALE EN SOUTIEN AU DOCTEUR DIDIER RAOULT" gather respectively 500,000 and 76,000 members, while (as of October 2020) Didier Raoult's own Twitter account has more than 700,000 followers. This situation has raised many passionate debates on social media, including (but not limited to) ones about scientific method and what counts as proof in medical research.

1.2 "Post-modern epistemology": Cognitive style as a polarization factor

In this paper, our goal is to contribute to a better understanding of the psychological factors underlying this polarization. Several factors have already been highlighted, most of which are political and socio-economic factors: polls and analyses of Facebook posts have suggested that people who felt closer to "anti-system" political parties or movements were more likely to believe in the efficiency of chloroquine-based treatments (Kraus & Sibai, 2020) and to support Didier Raoult on social medias (Audureau & Maad, 2020).

However, in this paper, our hypothesis was that part of the disagreement about Didier Raoult and his treatment might have to do with differences in cognitive styles (analytic vs. intuitive). Indeed, a recent psychological literature has stressed the importance of cognitive style in public perception of various issues and debates, such as evolution theory (Gervais, 2015), vaccination (Sarathchandra et al., 2018), conspiracy theories (Pennycook et al., 2015) and fake news (Pennycook & Rand, 2019, 2020c). In the context of the COVID-19 pandemic, a recent study even showed that cognitive sophistication (a composite measure including cognitive style) could be a better predictor of misconceptions about the pandemic than political orientation (Pennycook et al., 2020a).

But why think that cognitive style would be related to support for Didier Raoult and his hydroxychloroquine-based treatment? One reason (and the one that spurred the present research) is that controversies about Didier Raoult and his treatment have included debates about the methodology of medical research. Indeed, Didier Raoult presents himself as an "epistemologist" (Malherbe (de), 2020) and even claims to have a "postmodernist" approach to science (Raoult, 2015). However, his approach to the methodology of science might better be described as "pre-modern", as it is very close to 16th century thinkers, such as Francis Bacon, whom he frequently cites (Cova, 2020a, 2020b). Indeed, Raoult rejects the "tyranny of methodologists", the emptiness of mathematical approaches to science and scientists' attachment to theories and hypotheses (Million & al., 2020) to emphasize impartial observations and the direct, personal experience of experts such as him (Raoult, 2015). These oppositions can be observed in the title of the meta-analysis he published with his research team on the efficiency of his treatment against COVID-19: "Clinical Efficacy of Chloroquine derivatives in COVID-19 Infection: Comparative meta-analysis between the Big Data and the real world", in which they define "big data studies" as studies "conducted on electronic medical records extracted by public health specialists and epidemiologists who did not care for COVID-19 patients themselves" (Millon & al., 2020). Finally, his emphasis on direct experience against abstract theorizing and mathematical models can be also seen in his dismissal of global warming on the basis that he cannot personally see the ice cap shrink on satellite photos (Serrajordia, 2020).

In France, Didier Raoult's personal epistemology has triggered reactions from other scientists who have condemned what they saw as a mere reliance on personal "intuition" (Vanier, 2020; Alexandre, 2020). In Switzerland, 2400 health professionals have signed a statement arguing that intuition and "common sense" won't be enough to face the health crisis (Collective of 1600 persons, 2020). More and more, the debate has been framed as a conflict between trust in the expertise and intuition of "true experts" and rigorous research methods that have been designed to correct for the biases that plague personal experience. As such, this opposition is reminiscent of the distinction psychologists have drawn between intuitive and analytic cognitive style. This distinction is itself grounded in another distinction between two kinds of cognitive processes (Evans & Stanovich, 2013): Type-1 processes, that are typically characterized as "fast, high capacity, and able to operate in parallel" and operate as "quick and dirty" heuristics (Carruthers, 2009), and Type-2 processes, that are typically "slower, analytical, resource demanding, and able to operate only serially" (Pennycook, Fugelsang & Koehler, 2015). An analytic (or reflective) cognitive style will be defined by contrast with a more intuitive style as a greater tendency to inhibit Type-1 processes to rely on Type-2 processes. As such, "an analytic cognitive style will typically involve a broader assessment of problem elements as well as an examination and critical evaluation of intuitions" (Pennycook et al., 2012).

Thus, without assuming anything about the existence of two different cognitive systems, the contrast between intuition and deliberation can be easily put in parallel with the conflicting epistemologies that oppose each other in the debates about Didier Raoult and his treatment. As such, it seems reasonable to hypothesize that a more intuitive cognitive style (i.e., a higher tendency to rely on intuition) might lead to greater support to hypotheses that are defended on the basis of intuition and personal experience, and thus to Didier Raoult and his treatment.

1.3 Conspiracy theories and pseudo-medicines

In addition to these anecdotal observations, there are two more theoretical reasons for our hypothesis. The first one is that Didier Raoult's treatment has been the topic of numerous conspiracy theories trying to explain why the French government would not generalize its use or recognize its efficiency (Conspiracy Watch, 2020; Leloup & Soullier, 2020). Didier Raoult himself has contributed to fuel these theories by publishing a paper claiming that opposition to his hydroxychloroquine-based treatment was motivated by financial conflicts of interests (Roussel & Raoult, in press) or

suggesting in interviews that this same opposition was not scientifically justified and had to be due to other reasons.

However, past research has suggested a positive relationship between intuitive cognitive style and endorsement of conspiracy theories. For example, Swami and colleagues (2014) found that a more analytic cognitive style was correlated with a lower tendency to believe in conspiracy theories and that participants' endorsement of conspiracy theories could be lowered by priming a more analytic mindset. In line with these results, van Prooijen (2017) found that cognitive style partly mediated the relationship between education and belief in conspiracy theories, and Mikušková (2018) observed that future teachers who believed in conspiracy theories were significantly lower in analytic thinking style than those who did not. Finally, recent research found that endorsement of COVID-19-related conspiracy theories was also predicted by a more intuitive cognitive style (Pennycook et al., 2020b).

The second reason is that there seems to be a link between Didier Raoult and adhesion to alternative or pseudo-medicines. Indeed, several pseudo-medicines gurus have expressed their support to Didier Raoult (Regenere/Thierry Casasnovas, 2020), and recent research has found a correlation in a French sample between belief in chloroquine-related conspiracy theories and refusal to be vaccinated against COVID-19 when a vaccine is available (Bertin, Nera & Delouvée, 2020). But, here again, past research has found a connection between cognitive style and adhesion to pseudo-medicine: as mentioned earlier, intuitive cognitive style is linked to lower trust in vaccination (Sarathchandra et al., 2018). Moreover, bullshit receptivity (a trait linked to intuitive cognitive style) predicts the use of essential oils (Ackerman & Chopik, 2020).

Thus, beliefs in conspiracy theories and pseudo-medicines are linked both to trust in Didier Raoult and a more intuitive cognitive style. These are two more reasons to hypothesize that a more intuitive cognitive style might be linked to higher trust in Didier Raoult and his treatment.

1.4 Aim of our studies

Thus, in the three studies presented in this paper, our main goal was to investigate the presence of a link between cognitive style and trust in Didier Raoult and his treatment. A secondary goal was to investigate the potential practical implications of trust in Didier Raoult and his treatment by investigating (a) its connection with conspiratorial and pseudo-medical beliefs regarding the COVID-19 pandemic and (b) its impact on people's compliance with official regulations regarding the COVID-19 pandemic. Additionally, we also explored the connection between trust and Didier Raoult and other attitudes such as (i) greater distrust of political and scientific authorities, (ii) greater distrust of evidence-based medicine and higher support for alternative, pseudo-medicines, (iii) lower familiarity and higher regard for scientific methods.

2 Study 1

In study 1 we used two different self-assessments measures, Faith in Intuition and Need for Evidence, to test our hypothesis that there is a link between cognitive style and trust in Didier Raoult and his treatment.

2.1 Method

2.1.1 Participants

Recruitment of participants began on April 13th and ended on April 20th. Participants were recruited online through ads posted on social networks. Initially, the ad was posted on the study authors' Facebook and Twitter accounts, with a message encouraging those interested to share and disseminate the study. To motivate people to participate, the announcement indicated that 8 participants would be drawn to receive a 25 euros gift voucher. Due to the unbalanced nature of our sample (see below) we also posted the ad on a Facebook group supporting Didier Raoult ("WORLD COALITION IN SUPPORT OF DIDIER RAOULT").

525 participants completed the entire questionnaire. 97 participants were excluded for failing an attention check (see below), leading to a total of 428 participants: $M_{\text{age}} = 35.13$, $SD_{\text{age}} = 13.09$; 238 men, 188 women and 3 identifying neither as a man nor as a woman. Participants came mostly from France: 351 in France, 50 in Switzerland, 8 in Belgium, 6 in Canada, 13 in other countries and 1 "at home". Political orientation was very skewed on the left: $M = -1.35$, $SD = 1.33$ on a scale from -3 (= "very on the left") to 3 (= "very on the right"). 88 participants declared to be "very on the left", 148 "on the left", 72 "rather on the left", 80 "neither on the left, neither on the right", 28 "rather on the right", 11 "on the right", and 1 "very on the right".

2.1.2 Procedure

In all three studies, our survey took the form of a LimeSurvey online questionnaire hosted by the University of Geneva (https://www.limesurvey.org/fr/). Participants first read a consent form indicating the purposes of the study and information about data protection, before answering two questions indicating their agreement with these conditions. A third question asked whether they were 18 or more years old. Participants who answered that they were under 18 were denied access to our questionnaire.

All questionnaires were in French. So, examples of materials presented in this paper are translations. Original materials for Study 1 can be found at osf.io/h2ycq/

Compliance with regulations. Participants were presented with five recommendations put forward by authorities to slow down the spread of COVID-19: (i) staying home as much as possible (excluding necessary trips such as going to work, purchasing necessary goods, or medical appointments), (ii) coughing into one's elbow instead of one's hands, (iii) avoiding touching one's face, (iv) keeping one's distances from other people and avoiding contact with them, and (v) washing one's hands regularly. For each of these instructions, participants were asked to indicate to which extent they had complied with it in the last 7 days, on a 6-points scale ranging from 0 (= Not at all) to 5 (= Always (without exception)).

Number of unnecessary outings. Participants were then asked the four following open-ended questions:

- In the last 7 days, how many times have you left your home for work-related reasons (to go to work, make deliveries, etc.)?
- In the last 7 days, How many times have you left your home to get essential goods for yourself or someone else (to do groceries, etc.)?
- In the last 7 days, how many times have you left your home for medical reasons (to go to the doctor, hospital, pharmacy, etc.)?
- In the last 7 days, how many times have you been out from home for reasons unrelated to the reasons listed above (e.g., for a walk or physical activities)?

Our variable of interest was participants' answer to the fourth question (i.e., number of unnecessary outings).

Fear of COVID-19. Participants then filled a French translation of the Fear of COVID-19 scale developed by Ahorsu and colleagues (in press). The scale is composed of seven items with which participants must rate their agreement on a scale from -3 (=Strongly disagree) to 3 (=Fully agree). The scale also included an attention check ("I can shoot lasers with my eyes").

Trust in Didier Raoult and his hydroxychloroquine treatment. In this section, participants were asked a series of questions about the controversy surrounding Didier Raoult and its hydroxychloroquine-based treatment. The section started with a short introduction recapitulating the controversy, then participants were asked whether they had heard about this debate before taking the questionnaire ("Yes I carefully followed it" / "Yes but only a little bit" / "Not at all"). After this, participants were asked to answer 5 questions on a scale of −3 to 3:

1. Do you think that the hydroxychloroquine treatment proposed by Prof. Raoult is effective? (−3 = I am persuaded that it is not effective, 3 = I am persuaded that it is effective)
2. Do you think Professor Raoult's studies are convincing? (−3 = I think they are not convincing at all, 3 = I think they are quite convincing)
3. Do you think we should wait for the results of new studies before treating massively COVID-19 patients with hydroxychloroquine? (−3 = I don't think we have time to wait, 3 = I think we should definitely wait for the results of new studies)
4. In your opinion, should the authorities pay more attention to what Prof. Raoult said? (−3 = Most definitely not, 3 = Yes, they should listen to him and follow his advice)
5. How much do you trust Professor Raoult? (−3 = Not at all, 3 = Completely)

For each question, the middle of the scale (0) was labeled "I have no opinion one way or the other." A "Trust in Raoult" score was calculated from participants' responses, by reverse coding the answers to question 3 and averaging the responses.

Support to Didier Raoult on social networks To measure the extent to which our participants tended to support/criticize Didier Raoult on social networks, we asked them the following two questions:

1. Have you ever defended/supported Prof. Raoult on the internet (comments, social networks, etc.)? (0 = No, never, 1 = Once or twice, 2 = A certain number of times)
2. Have you ever criticized/attacked Prof. Raoult on the internet (comments, social networks, etc.)? (0 = No, never, 1 = Once or twice, 2 = A certain number of times)

By subtracting the answers to Question 2 from those given to Question 1, we calculated a "Support tor Raoult" score.

COVID-19 related statements (pseudo-medical, conspiratorial, accurate). Participants were then asked to indicate their agreement (on a scale from −3 = Strongly disagree to 3 = Strongly agree) with 12 statements related to the COVID-19 pandemic. 4 statements bore on *medical* beliefs about COVID-19 and measured participants' attraction towards dubious medical claims (e.g. "Taking vitamin C protects against COVID-19"). 4 other statements bore on *political* beliefs about COVID-19 and measured participants' attraction towards the idea that people in power are behind the pandemic or taking advantage of it (e.g. "The virus responsible for the COVID-19 was created by the Pasteur Institute"). Finally, in order not to present our participants only with dubious statements, the four last statements were true statements, or at least statements that we had good reason to consider as *accurate* at the time (e.g. "The virus can survive for up to several days on some surfaces"). Accurate statements acted as fillers, and were not included in our analyses.

Belief in Conspiracy Theories. To measure participants' tendency to endorse conspiracy theories, we used a single-item scale of Belief in Conspiracy Theories, designed by Lantian and colleagues (2016).

Cognitive style: Faith in Intuition and *Need for Evidence.* To measure participants' cognitive style, we used two scales: the *Faith in Intuition for Facts* and *Need for Evidence* scales (from Garrett & Weeks, 2017). Each scale was composed of four items with which participants had to rate their agreement (on a scale from −3 = Strongly disagree to 3 = Strongly agree):

Faith in Intuition for facts:

- I trust my guts to tell me what's true and what's not.
- I trust my initial feelings about the facts.
- My initial impressions are almost always right.
- I can usually feel when a claim is true of false even if I can't explain how I know.

Need for Evidence:

- Evidence is more important than whether something feels true.
- A hunch needs to be confirmed with data.
- I trust the facts, not my instinct, to tell me what is true.
- I need to be able to justify my beliefs with evidence.

Belief that "Truth is Political". Finally, we measured a number of attitudes that have been traditionally associated with a more intuitive cognitive style and might plausibly be associated with trust in Didier Raoult (see section 1.3). The first type of difference was participants' tendency to believe that "truth" (i.e., what is presented as the truth) is shaped by political forces. This belief (which we will call the belief that "truth is political") was measured by participants' agreement with four assertions (Garrett & Weeks, 2017):

- Facts are dictated by those in power.
- What counts as truth is defined by power.
- Scientific conclusions are shaped by politics.
- "Facts" depend on their political context.

Belief in conspiracy theories. To measure participants' tendency to believe in conspiracy theories, we used a single-item measure of belief in conspiracy theories (on a scale from 1 to 9) (Lantian et al., 2016).

Belief in pseudo-medicines. To measure participants' belief in "alternative" medicine (i.e., medicine that is not based on scientific evidence), we asked them to indicate their agreement with the following four statements (on a scale from −3 = Strongly disagree to 3 = Strongly agree):

- Evidence-based medicine is the only medicine we can trust. [reverse-coded]
- Homeopathy is an effective medicine
- Alternative medicines are just as legitimate and scientifically sound as "traditional" medicine
- Beware of vaccines! They are often more dangerous than the diseases they are supposed to prevent.

Familiarity with the scientific methods. To measure participants' familiarity with scientific methods (notably in the field of medicine), we asked them to indicate their agreement with the following four statements (on a scale from −3 = Strongly disagree to 3 = Strongly agree):

- If I take medication, and I feel better in a few days, that's very strong evidence that the medication is working [reverse-coded]
- When testing a medicine, double-blind studies involve blindfolding a patient's eyes so that they do not know if they are taking a real drug [reverse-coded]
- A meta-analysis is a study in which a large number of patients were recruited [reverse-coded]
- If a medical doctor wishes to test a drug in an experiment, he or she must determine in advance a specific number of patients to be included in the study.[1]

Personality (openness to experience and neuroticism). We added four exploratory questions to measure two personality traits: openness to experience and neuroticism (items were drawn from Gosling 2003). We found nothing interesting, hence we will not detail here the results obtained for these two variables.

Demographic information. Finally, we asked the participants to provide us with some information about themselves (gender, age, country of residence, education level or – if they were still students – education level of their parent with the highest education level, religiosity and political orientation).

Reward. At the end of the study, participants were offered to participate in a lottery in which 8 participants were drawn at random to receive a 25 euros Amazon/FNAC voucher.

2.2 Results

All materials and data are available at https://osf.io/h2ycq/. Zero-order correlations between main dependent variables are summarized in Table 1.

H1: Connection between Cognitive Styles and Trust in Raoult. Our first hypothesis was that a more intuitive (vs. analytic) cognitive style would lead participants to report

[1]As pointed by Jonathan Baron, Bayesian approaches might actually allow experimenters to recruit participants without specifying a predetermined number of participants. Moreover, in certain contexts (like testing a medical treatment), there might be ethical reasons to stop treatment before the target sample size is reached (for example, when it becomes clear that the treatment is effective). For Study 1, removing this item did not substantially change our results. In Study 2, this item was replaced by another one: "The result of a single scientific study is not enough to conclude; one has to wait for the results of other studies." In Study 3, our measure was substantially modified and this item did not appear in the new version (see Study 3).

TABLE 1: Correlations (Pearson's *r*) among primary measures in Study 1. Cronbach's Alpha for each scale is listed in italics along the major diagonal. Correlations in bold are significant at $p < .05$. Correlations equal or superior to $r = 0.13$ are significant at $p < .01$, while correlations equal or superior to $r = 0.17$ are significant at $p < .001$ (N = 428).

	1	2	3	4	5	6	7	8	9	10	11	12	13
1. Trust in Raoult	*0.90*	**0.41**	**0.39**	**−0.34**	**0.45**	**0.32**	**−0.52**	**0.59**	**0.37**	**0.39**	−0.04	0.06	**0.11**
2. Support to Raoult		NA	**0.10**	**−0.15**	**0.19**	**0.20**	**−0.22**	**0.26**	**0.21**	**0.10**	0.00	0.03	0.00
3. Intuition			*0.80*	**−0.38**	**0.44**	**0.33**	**−0.43**	**0.51**	**0.34**	**0.34**	−0.03	**0.10**	0.07
4. Evidence				*0.61*	**−0.34**	**−0.30**	**0.30**	**−0.50**	**−0.24**	**−0.30**	0.01	0.00	0.00
5. Truth Political					*0.78*	**0.48**	**−0.40**	**0.49**	**0.36**	**0.55**	−0.09	0.01	**0.14**
6. Conspiracy						NA	**−0.31**	**0.42**	**0.26**	**0.50**	0.04	−0.05	**0.16**
7. Familiarity Science							*0.48*	**−0.54**	**−0.38**	**−0.26**	0.05	−0.07	**−0.12**
8. Pseudo-medicine								*0.83*	**0.42**	**0.45**	−0.03	0.05	**0.11**
9. Pseudo-medical									*0.73*	**0.31**	**−0.14**	0.06	0.04
10. Conspiratorial										*0.60*	−0.04	−0.07	**0.20**
11. Compliance											*0.55*	**−0.10**	**0.20**
12. Outings												NA	−0.08
13. Fear of COVID													*0.84*

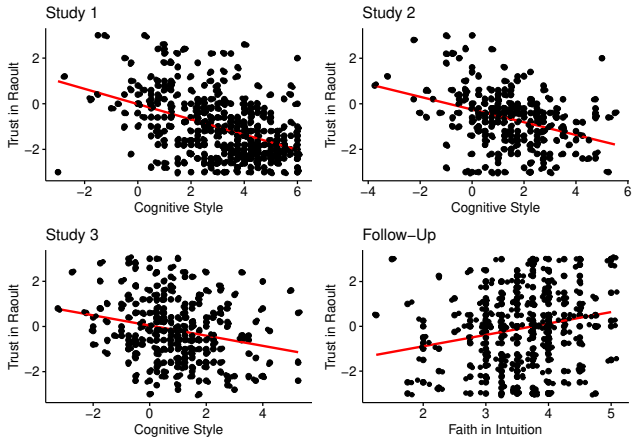

FIGURE 1: Participants' Trust in Raoult in function of their Cognitive Style (Evidence − Intuition) for all three studies. Bottom right panel presents Trust in Raoult in function of participants' Faith in Intuition in a follow-up study (see General Discussion).

higher trust in Didier Raoult and offer him more support on social networks. As represented in Table 1, Faith in Intuition positively correlated with Trust in Raoult ($r = 0.39$, $p < .001$) and Support to Raoult ($r = 0.10$, $p = .047$). Need for Evidence negatively correlated with Trust in Raoult ($r = −0.34$, $p < .001$) and Support to Raoult ($r = −0.15$, $p = .003$). Additionally, a combined measure of Cognitive Style, obtained by subtracting Faith in Intuition scores from Need for Evidence scores, correlated negatively with Trust in Raoult ($r = −0.44$, $p < .001$) and Support to Raoult ($r = −0.14$, $p = .004$) (Figure 1). Overall, our results supported our initial hypothesis.

H2: Connection between Trust in Raoult and endorsement of COVID-19-related statements. Our second hypothesis was that higher trust in and support to Didier Raoult would be associated with higher endorsement of pseudo-medical and conspiratorial statements about the COVID-19 pandemic. The results presented in Table 1 show a positive relationship between Trust in Raoult and participants' agreement with both pseudo-medical and conspiratorial statements about COVID-19 ($r = 0.37$, $p < .001$; $r = 0.39$, $p < .001$) Thus, higher trust in Didier Raoult was connected to higher trust in unproven (or even disproven) medical interventions and lower trust in the action of the government during the COVID-19 pandemic.

H3: Connection between Trust in Raoult and Compliance with official recommendations. To test whether Belief and Trust in Raoult were connected to lower or higher compliance with official recommendations, we computed correlations between (a) Trust in Raoult and (b) Support to Raoult and (i) Compliance with official regulations and (ii) Number of unnecessary outings. For the latter, participants who reported a number of unnecessary outings that were more than two standard deviations beyond the mean were excluded. Results are presented in Table 1. As one can see, we found no relationship between Trust or Support and behavior (either compliance with regulations, or number of unnecessary outings). We wondered whether this could be due to the fact that some of our participants did not live in France, and were located in countries where confinement was not enforced. Thus, we ran our analyses anew after excluding

people who were not located in France, but still did not find any significant effect.

Relationships between Cognitive style, Trust in Raoult and other beliefs. As shown in Table 1, we replicated earlier findings by finding a significant correlation between intuitive cognitive style and belief in conspiracy theories, belief that truth is political, familiarity with scientific methods and belief in pseudo-medicines. Moreover, all four types of beliefs were also significantly correlated with higher Trust in Raoult, suggesting that Trust in Raoult is closely related to other beliefs traditionally associated with intuitive cognitive style.

2.3 Discussion

The results of Study 1 confirmed our main hypothesis: participants with a more intuitive cognitive style were more supportive of Didier Raoult. Our second hypothesis was also confirmed: higher trust in Didier Raoult predicted a higher endorsement of pseudo-medical and conspiratorial claims in relation with COVID-19. However, contradicting our third hypothesis, we did not find any significant relationship between trust in Didier Raoult and compliance with official regulations regarding the COVID-19 pandemic. Moreover, higher trust in Didier Raoult was associated with other beliefs traditionally predicted by a more intuitive cognitive style, such as Belief that Truth is Political, Belief in Conspiracy Theories, Belief in Pseudo-medicines and Familiarity with scientific methods.

However, our study suffered from several limitations. The most important one is the representativeness of our sample: as mentioned above, the political orientation of our sample was mostly skewed left. Moreover, participants tended not to trust Didier Raoult ($M = -1.07$, $SD = 1.33$). This is probably due to the fact that the announcement for our study was mostly shared on social networks by people interested in science and scientific methods. Thus, it was necessary to replicate our results in more balanced samples.

The second limitation is that we used only self-report, explicit measures to measure cognitive style. This leaves the possibility that trust in Raoult is not connected with cognitive style, but with one's beliefs about one's cognitive style or with the desire to present oneself as having such and such cognitive style. Thus, we decided to introduce other measures of cognitive styles in subsequent studies.

3 Study 2

To correct for the shortcomings of Study 1, we decided to run a second study in which (i) we used another recruitment method (i.e., recruiting participants through Prolific Academic), and (ii) we added a measure of cognitive style that did not depend on self-reports (the Cognitive Reflection Test).

3.1 Method

3.1.1 Participants

Participants were recruited through Prolific Academic with the following constraint: they had to be French (i.e., Nationality = France). They were paid GBP 1.35 for their participation. Our target sample size was 250 participants but, foreseeing exclusions, we decided to recruit 300 participants. Recruitment took place between the 28th and 29th of April, 2020.

In total, 301 participants completed our questionnaire. 1 participant was excluded for providing nonsensical answers (= random letter strings) to the CRT questions. 16 participants were excluded based on an attention check ("Can you shoot lasers with your eyes?"), and 26 participants were excluded because they reported not having heard about the controversy on hydroxychloroquine. This left us with 258 participants: $M_{age} = 29.00$, $SD_{age} = 9.65$, 148 men, 107 women and 3 identifying neither as a man neither as a woman. Again, our sample did not seem representative of the overall population. First, it was a very cosmopolitan sample: despite our constraint on nationality, 55 lived outside of France. Moreover, political orientation was again skewed on the left ($M = -0.81$, $SD = 1.44$), with 27 "very on the left", 76 "on the left", 40 "rather on the left", 71 "neither on the left, neither on the right", 27 "rather on the right", 13 "on the right", and 4 "very on the right".

3.1.2 Procedure

The study and analyses were preregistered on OSF: https://osf.io/s3ur8.

The questionnaire was similar in structure to the one we used in Study 1. However, we made a few modifications.

Cognitive Reflection Test (CRT). One major modification was the inclusion of the Cognitive Reflection Test at the very beginning of the questionnaire. The Cognitive Reflection Test was composed of three reasoning problems, presenting an intuitive but misleading answer, which means that answering them correctly requires inhibiting one's automatic reactions (Frederick, 2005). However, we did not use the original formulation of the problems, fearing that they might be too familiar to participants, but three modified, less familiar versions of the problems (Finucane & Gullion, 2010).

Fear of COVID-19 scale. Given that the relationship between fear of COVID-19 and trust in Didier Raoult in Study 1 was weak ($r = 0.11$), the Fear of COVID-19 scale was removed.

Geneva Sentimentality Scale (GSS). For purely exploratory purposes (in relation with another research project), we included the Geneva Sentimentality Scale,

TABLE 2: Correlations (Pearson's *r*) among primary measures in Study 2. Cronbach's Alpha for each scale is listed in italics along the major diagonal. Correlations in bold are significant at $p < .05$. Correlations equal or superior to $r = 0.17$ are significant at $p < .01$, while correlations equal or superior to $r = 0.21$ are significant at $p < .001$ (N = 258).

	1	2	3	4	5	6	7	8	9	10	11	12	13
1. Trust in Raoult	*0.89*	**0.34**	**0.25**	**−0.34**	**−0.15**	**0.28**	**0.40**	**−0.31**	**0.38**	**0.38**	**0.47**	−0.04	**0.22**
2. Support to Raoult		NA	0.11	−0.09	−0.09	0.10	**0.18**	**−0.28**	**0.18**	0.07	0.12	−0.05	**0.16**
3. Faith in Intuition			*0.75*	**−0.31**	**−0.15**	**0.21**	**0.33**	**−0.40**	**0.38**	**0.30**	**0.34**	−0.06	0.04
4. Need for Evidence				*0.76*	**0.13**	**−0.26**	**−0.24**	**0.27**	**−0.48**	**−0.29**	**−0.28**	0.07	−0.1
5. CRT					*0.58*	−0.07	**−0.24**	**0.28**	**−0.20**	**−0.17**	−0.10	−0.09	−0.03
6. Truth is Political						*0.73*	**0.45**	**−0.19**	**0.29**	**0.27**	**0.46**	−0.03	−0.04
7. Conspiracy							NA	**−0.31**	**0.33**	**0.36**	**0.57**	0.08	0.01
8. Familiarity Science								*0.51*	**−0.37**	**−0.29**	**−0.31**	−0.05	−0.1
9. Pseudo-medicine									*0.79*	**0.33**	**0.39**	−0.04	0.11
10. Pseudo-Medical										*0.73*	**0.47**	0.00	0.08
11. Conspiratorial											*0.67*	−0.08	0.01
12. Compliance												*0.64*	−0.01
13. Outings													NA

a measure of participants' tendency to feel 'moved' or 'touched' (Cova & Boudesseul, 2020).

COVID-19-related political statements. To keep up with the latest conspiracy theories, we replaced one political statement ("The virus which causes COVID-19 was created by the Pasteur Institute") by another ("The virus responsible for COVID-19 escaped from a laboratory in Wuhan").

Competence & Warmth. We added 2 series of 11 items supposed to measure participants' self-perceived "warmth" and "competence" (Fiske & al., 2007, Gebauer & al., 2012). Indeed, one possible explanation of our results in Study 1 was that people who were less likely to trust Didier Raoult were also more likely to paint themselves in a positive light (e.g. as more reflexive). If this explanation is right, we should expect these same people to attribute themselves more warmth and competence (two positive traits), and thus trust in Didier Raoult to correlate negatively with self-attribution of desirable properties such as warmth and competence.[2]

Demographic information (region). In addition to the demographic information mentioned in Study 1, we also asked participants to indicate which country they were currently living in or, if they lived in France, the specific region of France they lived in.

Order of presentation. Compared to Study 1, the order of presentation of the different measures was changed. We began with certain measures of individual differences (CRT, GSS, Faith in Intuition, Need for Evidence, Truth is Political, Belief in Alternative Medicines, Familiarity with Scientific Methods), then measures related to the COVID-19 pandemic (Compliance with recommendations, Number of confinement breaks, Trust and Online support to Raoult, Endorsement of COVID-19 related pseudo-medical, conspiratorial and accurate statements), beliefs in Conspiracy Theories, measures of Warmth and Competence, and finally demographic questions.

3.2 Results

All materials and data are available at osf.io/3b2m9/. Zero-order correlations between all main dependent variables are summarized in Table 2.

H1: Connection between Cognitive Styles and Trust in Raoult. To test our first hypothesis, we computed correlations between (a) Trust in Raoult and (b) and Support to Raoult and (i) Faith in Intuition, (ii) Need for Evidence, and (iii) CRT (see Table 2). CRT scores were computed as the total number of good answers provided by participants (between 0 and 3). We found a significant correlation between Trust in Raoult and Faith in Intuition ($r = 0.25$, $p < .001$), Need for Evidence ($r = -0.34$, $p <. 001$), and CRT scores ($r = -0.15$, $p = .015$). However, there was no significant correlation between Support to Raoult and Faith in Intuition ($r = 0.11$, $p = .088$), Need for Evidence ($r = -0.09$, $p = .141$), and CRT scores (-0.09, $p = .163$). One reason for the lack of correlation with Support to Raoult was probably that very few of our participants actually reported supporting or

[2]There was also another, more exploratory reason, for this addition. According to the work of Altay and Mercier (2020) people high in communion and warmth tend to share "happy" thoughts, i.e., information that makes other people happy. The Raoult protocol promised great effectiveness in healing people and thus in putting a quick end to the crisis. Thus, it was reasonable to expect that participants high in communion and warmth would tend to believe and share this positive information.

criticizing Raoult online: out of 258 participants, only 28 reported online activity.

Moreover, we found no significant correlation between Trust in Raoult and Competence ($r = 0.06$, $p = .35$) or between Trust in Raoult and Warmth ($r = 0.11$, $p = .092$). So, it does not seem that the correlations between explicit measures of cognitive style and Trust in Raoult can be explained by a higher tendency to self-ascribe positive characteristics in participants less likely to trust Didier Raoult.

H2: Connection between Trust in Raoult and endorsement of COVID-19-related statements. As in Study 1, our results showed a positive relationship between Trust in Raoult and participants' agreement with both Pseudo-Medical and Conspiratorial statements about COVID-19 ($r = 0.38$, $p < .001$; $r = 0.47$, $p < .001$), suggesting that Trust in Raoult is connected to more distrust in the action of the government during the COVID-19 pandemic, and more trust in unproven (or even disproven) medical interventions.

H3: Connection between Trust in Raoult and Compliance with official recommendations. To test whether Belief and Trust in Raoult were connected to a lower or higher compliance with official recommendations, we computed correlations between (a) Trust in Raoult and (b) Support to Raoult and (i) Compliance with official regulations and (ii) number of unnecessary home exits. For the latter, participants who reported a number of unnecessary outings that were more than two standard deviations beyond the mean were excluded. Results are presented in Table 2. As one can see, we found no relationship between Trust and Support and Compliance ($r = -0.04$, $p = .528$; $r = -0.05$, $p = .419$), but a significant relationship between Trust and Support and the number of unnecessary outings ($r = 0.22$, $p < .001$; $r = 0.16$, $p = .012$). We wondered whether this could be due to the fact that some of our participants did not live in France, and were located in countries where confinement was not enforced. Thus, we ran our analyses anew after excluding people who were not located in France. This did not change our conclusions: we still found a significant correlation between number of unnecessary outings and Trust in Raoult ($r = 0.28$, $p < .001$) and Support to Raoult ($r = 0.21$, $p = .004$).

Relationships between Cognitive style, Trust in Raoult and other beliefs. As in Study 1, we replicated earlier findings by finding a significant correlation between intuitive cognitive style and belief in conspiracy theories, belief that truth is political, familiarity with scientific methods and belief in pseudo-medicines (see Table 2). Moreover, all four types of beliefs were again significantly correlated with higher Trust in Raoult.[3]

[3]In our OSF pre-registrations for Studies 2 and 3, we said that we would use structural equation models to test which of these four categories of beliefs could be considered as mediators of the relationship between cognitive style and belief in Raoult. However, editor Jonathan Baron pointed out that it would be odd for certain beliefs such as belief in pseudo-medicine or in a conspiracy to be the cause of another belief such as belief in Raoult, and that inter-correlations between our potential mediators were too strong and that including all of them in the same model would mask their separate effects. The results of the structural equation models are still available on the corresponding OSF registries.

3.3 Discussion

As in Study 1, we found that a more analytic cognitive style predicted higher trust in, and online support to Didier Raoult. As in Study 1, Trust in Didier Raoult was positively associated with Need for Evidence and negatively with Faith in Intuition. Moreover, higher CRT scores predicted higher Trust in Raoult, providing further evidence for a connection between Trust in Raoult and intuitive cognitive style.

Regarding the practical impact of trust in Didier Raoult, we once again observed that both trust in and support to Didier Raoult were positively correlated with higher endorsement of pseudo-medical and conspiratorial statements about COVID-19. As in Study 1, we did not find a significant relationship between trust in Didier Raoult and self-reported compliance with recommendations. However, we did find a positive relationship between trust in Didier Raoult and higher numbers of unnecessary outings.

One limitation of our study was again the peculiarities of our sample. As stated earlier, the political orientation was skewed on the left, and an important number of participants did not live in France. Moreover, our sample tended not to trust Didier Raoult ($M = -0.67$, $SD = 1.23$). We thus decided to once again change our recruitment method.

4 Study 3

To correct for the shortcomings of Study 2, we decided to run a third study in which we used another recruitment method (i.e., recruiting participants through Crowdpanel, a website recruiting participants exclusively in France). Moreover, we took advantage of this study to include one additional measure of cognitive style (the Belief Bias task), and to test one additional hypothesis: that trust in Didier Raoult would be correlated with higher receptivity to Bullshit and ability to discriminate Bullshit (i.e., Bullshit discrimination). We also tried to manipulate participants' answers by asking them to reply intuitively or reflectively, in order to assess the causal direction of the link between cognitive style and trust in Raoult.

4.1 Methods

4.1.1 Participants

Participants were recruited through Crowdpanel. Our target sample size was 250 participants but, foreseeing exclusions, we dedicated to recruit 300 participants. Recruitment took place between the 28th and 29th of April, 2020.

In total, 304 participants completed our questionnaire. 33 participants were excluded based on an attention check ("Can

you shoot lasers with your eyes?"), and 7 participants were excluded because they reported not having heard about the controversy on hydroxychloroquine. This left us with 264 participants: M_{age} = 40.56, SD_{age} = 12.78, 135 women and 129 men. Again, our sample did not seem representative of the overall population. All lived in France. This time, the repartition of political orientation seemed more balanced (M = −0.23, SD = 1.44), with 12 "very on the left", 48 "on the left", 40 "rather on the left", 95 "neither on the left, neither on the right", 37 "rather on the right", 21 "on the right", and 11 "very on the right". This was also true for opinions about Didier Raoult and his treatment (M = −0.17, SD = 1.39).

4.1.2 Procedure

Study and analyses were preregistered on OSF. The preregistration form can be found at https://osf.io/ucf6w

The questionnaire was similar in structure to the one we used in Study 2. However, we made a few modifications.

Belief Bias task. We added a second non-self-report measure of cognitive style: the Belief Bias task. Our belief bias task was composed of four simple syllogisms (two premises, one conclusion) that were either valid but leading to a false conclusion, or leading to a true conclusion but invalid (Markovits & Nantel, 1989). Here is an example of the former case:

> Suppose that:
>
> 1) All mammals walk.
>
> 2) Whales are mammals.
>
> If these two statements are true, can we conclude from them that "whales walk"?

Because Belief Bias probes present a tension between an easy, intuitive and attractive answer (accepting or rejecting the syllogism based on the truth or falsity of its conclusion) and a more reflective one (assessing the syllogism on the basis of its logical validity, while ignoring the truth or falsity of its conclusion), they can be considered as problems that require a more analytic mindset to be solved. Participants' scores to the task was computed as the number of correct answers (between 0 and 4). Belief bias task was presented at the very beginning of the study, along with CRT.

Measures of behavior. Measures of behavior, such as compliance with sanitary regulations, or number of unnecessary outings were omitted. They were replaced by three items asking participants about their emotional state in the three last weeks. These items were not for analysis, but served as a 'buffer' between measures of cognitive style and individual differences and questions about Didier Raoult and COVID-19-related statements, so that participants did not directly associate the two.

Familiarity with scientific methods and regard for scientific method. In previous studies, the internal coherence of our measure of familiarity with scientific method was poor (Study 1: alpha = .48; Study 2: alpha = .51). We hypothesized that this might be because our measure mixed three items measuring familiarity with technical terms and methods, and one item measuring regard for personal experience over scientific knowledge (i.e., "If I take medication, and I feel better in a few days, that's very strong evidence that the medication is working").

We thus decided to break these two dimensions apart by having two different measures composed of five items each. The first measure, still called "Familiarity with scientific methods", was focused on participants' knowledge of technical terms and procedures (i.e., "A meta-analysis is a study in which a large number of patients were recruited"). The second measure, called "Regard for scientific method", measured participants' tendency to put scientific results over common sense and (one's own, but also others') personal experience:

- If I take medication, and I feel better in a few days, that's very strong evidence that the medication is working. [reverse-coded]
- The result of a single scientific study is not enough to conclude; one has to wait for the results of other studies.
- If a reputable expert says a treatment is likely to work, this is proof that the drug works, even in the absence of published data about its effectiveness. [reverse-coded]
- If a friend takes a drug and tells me she feels better, that's a very strong evidence that the drug is effective. [reverse-coded]
- If the results of a scientific study seem to go against common sense, I prefer to follow common sense rather than the conclusions of the study. [reverse-coded]

Competence & Warmth. Measures of competence and warmth were discarded, given the absence of effect in Study 2.

Bullshit receptivity and discrimination. To measure participants' receptivity to bullshit and their ability to discriminate between genuine sentences and randomly generated bullshit, we used a shortened version of Pennycook et al., (2015)'s Bullshit receptivity scale. The short version of the scale was composed of 5 randomly generated sentences (e.g. "Our minds extend across space and time as waves in the ocean of the one mind"), of 5 motivational quotes (e.g. "A river cuts through a rock, not because of its power but its persistence"), and 2 trivial statements that acted as filler. Participants were asked to rate how profound they found these statements, on a scale from 1 = Not profound at all, to 5 = Extremely profound. Bullshit receptivity was computed by averaging answers for the randomly generated sentences.

TABLE 3: Correlations (Pearson's r) among primary measures in Study 3. Cronbach's Alpha for each scale is listed in italics along the major diagonal. Correlations in bold are significant at $p < .05$. Correlations equal or superior to $r = 0.17$ are significant at $p < .01$, while correlations equal or superior to r = 0.20 are significant at $p < .001$ ($N = 264$).

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1. Trust Raoult	*0.92*	**0.38**	**0.17**	**−0.20**	**−0.16**	**−0.12**	**0.24**	**0.31**	−0.1	**−0.46**	**0.50**	**0.27**	**0.45**	**0.21**	**0.13**	−0.12
2. Support Raoult		NA	**0.15**	**−0.14**	−0.01	−0.05	**0.24**	**0.22**	−0.1	**−0.39**	**0.22**	0.09	**0.25**	**0.22**	**0.14**	−0.12
3. Faith in Intuition			*0.79*	**−0.19**	**−0.13**	**−0.16**	**0.30**	**0.22**	**−0.13**	**−0.29**	**0.26**	**0.17**	**0.23**	**0.26**	**0.25**	−0.05
4. Need for Evidence				*0.76*	**0.13**	**0.12**	−0.06	−0.12	**0.19**	**0.36**	**−0.48**	**−0.26**	**−0.24**	0.01	0.02	0.01
5. CRT					*0.57*	**0.37**	−0.07	**−0.15**	**0.19**	**0.25**	**−0.22**	0.00	**−0.22**	−0.05	−0.01	0.05
6. Belief Bias						*0.76*	−0.11	**−0.14**	**0.22**	**0.21**	**−0.19**	−0.02	**−0.19**	−0.05	−0.03	0.02
7. Truth Political							*0.77*	**0.39**	**−0.14**	**−0.21**	**0.24**	**0.25**	**0.45**	**0.20**	**0.15**	−0.08
8. Conspiracy								NA	**−0.13**	**−0.26**	**0.34**	**0.23**	**0.55**	**0.18**	**0.20**	−0.02
9. Familiarity Science									*0.57*	**0.30**	**−0.15**	**−0.20**	**−0.22**	**−0.19**	−0.01	**0.20**
10. Regard Science										*0.66*	**−0.49**	**−0.35**	**−0.45**	−0.09	−0.06	0.05
11. Pseudo-medicine											*0.73*	**0.43**	**0.48**	0.11	0.09	−0.04
12. Pseudo-medical												*0.76*	**0.45**	0.04	0.07	0.03
13. Conspiratorial													*0.72*	0.08	0.09	0.00
14. BS Receptivity														*0.80*	**0.52**	**−0.61**
15. Motivational quotes															*0.67*	**0.35**
16. BS Discrimination																NA

Bullshit discrimination was computed by subtracting bullshit receptivity from the average score for motivational quotes.[4]

Experimental manipulation. One interpretation of the connection between cognitive style and trust in Raoult that we observed in Studies 1 and 2 is that taking a step back from one's intuitions lead to be more suspicious of Didier Raoult's claims. To test this hypothesis, we decided to ask one half of our participants to answer the questionnaire intuitively ("We are now going to ask you a series of questions about your feelings and beliefs. Please answer them as fast as possible, by relying on your intuition"), and the other half to answer the questionnaire reflectively ("We are now going to ask you a series of questions about your feelings and beliefs. Take the time to think before answering them, and do not answer the first thing that comes to your mind"). After reading the corresponding instruction, participants were presented with an attention check asking them what they had been just asked to do. Instructions came just before questions about Didier Raoult and COVID-19-related statements.

Order of presentation. We began with certain measures of individual differences (CRT, Belief Bias, Faith in Intuition, Need for Evidence, Truth is Political, Belief in Alternative Medicines), the three questions about participants' emotional states, instructions related to the experimental manipulation, beliefs in Conspiracy Theories, measures related to the COVID-19 pandemic (Trust and Online support to Raoult, Endorsement of COVID-19 related statements), Familiarity with and Regard for scientific method, and finally the Bullshit Receptivity scale.

4.2 Results

All materials and data are available at osf.io/d9ec4/. Zero-order correlations between all dependent variables are summarized in Table 3.

Effect of manipulation on Trust in Raoult. To analyze the impact of our manipulation, we first excluded participants who failed the attention check related to our instruction. 53 participants were excluded, leaving us with 211 participants (79 in the Intuition condition, 132 in the Reflection condition).

To test whether our manipulation was effective, we had two manipulation checks. The first, which we preregistered, was the Bullshit Discrimination scale: based on previous literature, we predicted that participants answering intuitively should display lower Bullshit Discrimination. However, a t-test did not find any significant difference between the Intuition and the Reflection conditions ($M = 0.45$, $SD = 0.81$ vs. $M = 0.55$, $SD = 0.90$): $t(178.07) = -0.870$, $p = .386$, $d = 0.12$.

Another manipulation check, which we did not think to pre-register, is the time spent by participants on the questions about Raoult and his treatment.[5] After excluding partici-

[4] In Pennycook et al., (2015)'s original paper, Bullshit Discrimination was called Bullshit Sensitivity. However, we changed the label to make the contrast with Bullshit Receptivity more salient.

[5] This manipulation check was inspired by another study in which we observed an effect of an identical manipulation on participants' response

pants whose completion time was more than two standard deviations below or over the average completion time (within each condition separately), we compared the completion time across conditions (Intuition: M = 124.65, SD = 39.58; Reflection: M = 140.87, SD = 60.35). There was a significant difference: $t(200.72) = -2.38$, $p = .018$, $d = 0.31$. Thus, even if we cannot conclude that our manipulation was effective in making participants more reflective, it led participants to spend more time on the questionnaire.[6]

Finally, we compared Trust in Raoult across both conditions (Intuition: $M = 0.02$, $SD = 1.45$; Reflection: $M = -0.25$, SD = 1.43). There was no significant difference: $t(162.74) = 1.30$, $p = .197$, $d = -0.19$). Thus, leading participants to take more time to reflect on their answers had no detectable effect on their Trust in Raoult.

H1: Connection between Cognitive Styles and Trust in Raoult. To test or main hypothesis, we computed correlations between (a) Trust in Raoult and (b) and Support to Raoult and (i) Faith in Intuition, (ii) Need for Evidence, (iii) CRT, and (iv) Belief Bias (see Table 2). Belief Bias scores were computed as the total number of good answers provided by participants (between 0 and 4). We found a significant correlation between Trust in Raoult and Faith in Intuition ($r = 0.17$, $p = .005$), Need for Evidence ($r = -0.19$, $p =. 001$), CRT scores ($r = -0.16$, $p = .009$), and Belief Bias scores ($r = -0.12$, $p = .049$). We also found significant correlations between Support to Raoult and self-report measures of cognitive style such as Faith in Intuition ($r = 0.15$, $p = .015$) and Need for Evidence ($r = -0.14$, $p = .024$), but not between Support to Raoult and participants' performance to CRT ($r = -0.01$, $p = .833$) and Belief Bias task ($r = -0.05$, $p = .415$).

H2: Connection between Trust in Raoult and endorsement of COVID-19-related statements. As in Studies 1 and 2, our results showed a positive relationship between Trust in Raoult and participants' agreement with both pseudo-medical and conspiratorial statements about COVID-19 ($r = 0.27$, $p < .001$; $r = 0.45$, $p < .001$).

H3: Relationship between Bullshit Receptivity, Bullshit Discrimination and Trust in Raoult. To test whether receptivity to bullshit and bullshit discrimination were correlated with Trust in Raoult, we conducted two correlation analyses. Trust in Raoult was significantly correlated with Bullshit Receptivity ($r = 0.21$, $p < .001$), but not with Bullshit Discrimination ($r = -0.12$, $p = .061$).

Relationships between Cognitive style, Trust in Raoult and other beliefs. We found a positive correlation between intuitive cognitive style and belief in conspiracy theories, belief that truth is political, familiarity with scientific methods, regard for scientific method over personal experience and belief in pseudo-medicines (see Table 3). With the exception of familiarity with scientific methods, all other forms of beliefs also correlated with Trust in Raoult.

4.3 Discussion

As in Studies 1 and 2, we found that a more analytic cognitive style predicted higher trust in, and online support to Didier Raoult. Again, Trust in Didier Raoult was positively associated with Need for Evidence and negatively with Faith in Intuition. Moreover, higher CRT and Belief Bias scores predicted higher Trust in Raoult.

Additionally, we expanded our findings by observing a connection between Trust in Raoult and another construct that has been shown to be (negatively) related to participants' tendency to engage in reflective thinking: Bullshit Receptivity. Participants reporting higher Trust in Raoult were also more likely to find randomly generated sentences "profound" and "deep". We did not find a relationship between Trust in Raoult and Bullshit Discrimination — probably because tendency to find Motivational Quotes "profound" was also positively correlated with Trust in Raoult. It should be noted that, in our study, Faith in Intuition was associated not only with Bullshit Receptivity, but also with the tendency to find Motivational Quotes "profound" (which might explain why Faith in Intuition was not associated with Bullshit Discrimination).

5 Demographic predictors of Trust in Raoult

As a post-hoc analysis, we investigated to which extent several demographic factors (age, study level, religiosity and political orientation) were associated with Trust in Raoult. Results are presented in Table 4. Across all three studies, religiosity was the most stable predictor of Trust in Raoult, with more religious participants being more likely to trust Didier Raoult. In two studies out of three (and a follow-up study), we also found a positive association between age and political orientation and Trust in Didier Raoult, as well as a negative association between study level and Trust in Didier Raoult. Against the common suggestion that the relationship between Trust in Raoult and political orientation might be U-shaped (with more support to Raoult on both extremes of the political spectrum and less support at the middle), we found that people on the far left of the political spectrum tended to distrust Didier Raoult while people of the far right of the political spectrum tended to trust him (see Figure 2). However, while interpreting our results, it is important to note that very few participants identified as "very on the right" of the political spectrum.

times (Jaquet & Cova, 2020). However, later analyses in this other study revealed that taking longer to fill the questionnaire did not lead participants to perform better on the Belief Bias task. Thus, reflection (giving more counter-intuitive answers) and reflection (taking more time to think) might not explain our results.

[6] An alternate transformation using log-transformation of completion times. We found a significant difference between our two conditions: $t(202.48) = 2.27$, $p = .025$.

TABLE 4: Correlations (Pearson's *r*) between Trust in Raoult and several demographic variables (age, study level, religiosity and political orientation. For study level, we used two approaches for participants who were still students: either (1) we used their current study level, or (2) we used the study level of their parent with the highest study level (an approach often taken for using study level as a proxy for socio-economic status). For political orientation, a higher score indicated that participants identified as being more on the right side of the spectrum. We present correlations separately for all three studies, as well as the results of a follow-up study we discuss in the General Discussion.

	Study 1	*Study 2*	*Study 3*	*Follow-up*
Age	**.28*****	**.20****	.06	.07
Studies (1)	**−0.22**$^{***(1)}$	.01	**−0.13***	**−0.18****
Studies (2)	**−0.16*****	.01	−0.10	-
Religion	**.20*****	**.18****	**.28*****	-
Political Orientation	**.25*****	**.31*****	.10	**.28*****

(1) For Study 1, we did not measure study level for participants who were still students. These participants were thus not included in our analysis.

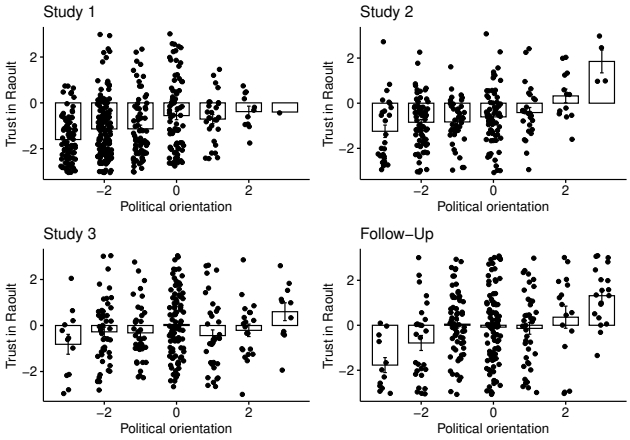

FIGURE 2: Trust in Raoult in function of political orientation for all three studies. Bottom right panel presents the results of a follow-study up we discuss in more detail in the General Discussion.

TABLE 5: Correlations (Pearson's *r*) between participants' political orientation and various beliefs (Truth is political, Conspiracy theories, Pseudo-medicines, Familiarity with and Regard for Scientific Method, Pseudo-Medical and Conspiratorial beliefs about the COVID-19 pandemic).

	Study 1	*Study 2*	*Study 3*
Truth is political	−0.08	0.06	0.11
Conspiracy	0.04	0.12	**0.22*****
Pseudo-medicine	**0.19*****	**0.13***	−0.03
Familiarity Science	**−0.22*****	**−0.25*****	−0.06
Regard Science			−0.03
Pseudo-medical beliefs	0.07	**0.12***	−0.03
Conspiratorial beliefs	**−0.13****	**0.20****	0.08
Bullshit receptivity			**0.12***

This latter result raises a question: since people on the far right of the political spectrum seem more likely to trust Didier Raoult, and since we have observed that Trust in Didier Raoult was associated with irrational beliefs such as pseudo-medicines and conspiracy theories, are people on the far right of the spectrum more sensitive to such irrational beliefs? Prior studies have suggested that such is the case in the United States, with conservatives being more likely to endorse conspiracy theories (Sutton & Douglas, 2020; van der Linden, in press). But is it the case in France?

There are a few French data on this precise topic. Lantian (2015) found a correlation between scores on the Generic Conspiracist Belief scale on political orientation in a French sample, with higher scores for people on the right. Dieguez, Wagner-Egger and Gauvrit (2015) found a similar result in a sample combining French and Swiss participants. Two national polls organized in 2018 and 2019 by IFOP found that endorsement of conspiracy theories in function of political orientation followed an asymmetrical U-curve: people at both extremes of the political spectrum were more likely to endorse conspiracy theories but this tendency was higher on the far-right of the political spectrum, compared to the far-left (IFOP, 2018, 2019). Finally, in the context of the COVID-19 pandemic, a national poll conducted by Fondation Jean Jaurès and Conspiracy Watch found that people identifying with political on the far right of the spectrum were indeed much more likely to endorse conspiracy theories regarding the pandemic (e.g., that the virus was intentionally fabricated) while, on the far left, endorsement varied a lot from one party to the other, and never reached the same extent (Reichstadt & Fourquet, 2020).

To see whether we could find a similar tendency in our data, we explored the relationship between participants' political orientation and a variety of dubious beliefs (pseudo-medicines, conspiracy theories, belief that Truth is Political, and pseudo-medical and conspiratorial beliefs about COVID-19 pandemic). Results are presented in Table 5. Overall, our results revealed no clear and robust linear relationship between any of these beliefs and political orientation, suggesting that the connection between political orientation and Trust in Raoult is not simply due to a connection between political orientation and irrational beliefs.

6 General discussion

In three studies, we observed a positive relationship between intuitive cognitive style and trust in Didier Raoult and his treatment against COVID-19. People with a more intuitive cognitive style were more likely to trust Didier Raoult and his treatment, whether cognitive style was assessed through self-report measures or reasoning tasks. Moreover, trust in Didier Raoult was also associated with a range of beliefs and attitudes traditionally associated with intuitive cognitive style: belief in conspiracy theories, belief that truth is political, belief in pseudo-sciences, and bullshit receptivity (but not bullshit discrimination). Finally, in Study 3, trust in Didier Raoult was significantly associated with a greater regard for personal experience (the so-called "school of life") over scientific method.

Additionally, our results extend previous avenues of research on the impact of cognitive style on the "everyday consequences of analytic thinking" (Pennycook, Fugelsang & Koehler, 2015) by providing further evidence of the relationship between cognitive style and health-related beliefs. In line with previous literature, we confirmed that intuitive cognitive style predicts higher distrust of vaccines, but we also found that it predicted higher trust in homeopathy and higher endorsement of "alternative" medicines.

Thus, our results suggest not only that trust in Didier Raoult is related to a more intuitive cognitive style, but that it is embedded in a wider web of beliefs traditionally associated with intuitive cognitive style: beliefs not only about politics (conspiracy) or medicine (pseudo-medicine), but also *epistemological* beliefs about how beliefs should be formed and whether intuition should be trusted over evidence, and personal experience over scientific methods. (For recent works stressing the importance of epistemic beliefs in the explanation of irrational beliefs, see: Garrett & Weeks, 2017; Metz, Weisberg & Weisberg, 2018; Pennycook, Cheyne, Koehler & Fugelsang, 2020a).

This also suggests that the extremely quick polarization of the French population around the persona of Didier Raoult can be explained by the fact that pre-existing divides were projected upon the initial scientific debate about the efficiency of his treatment. Somehow, Didier Raoult became a rallying figure for those who distrusted the French government and those who advocated "alternatives" to science-based medicines – in the same way as his provocative methodological statements drew him the favors of those who put intuition and personal experience over the rigor of scientific methods. This is probably what makes the debate about the efficiency of hydroxychloroquine so heated and intractable, as the debate is in fact one more pretext to reignite old battles.

Considering the practical impact of trust in Didier Raoult, we found that trust in Didier Raoult was associated with higher conspiratorial and pseudo-medical beliefs in relation with the pandemic. These results were in line with previous research and some of the anecdotal observations presented in introduction. However, it is not clear to which extent trust in Didier Raoult encourages these pseudo-medical and conspiratorial beliefs, as these might simply the product of more general attitudes associated to trust in Didier Raoult (i.e., general belief in conspiracy theories or pseudo-medicines).

However, we found no robust relationship between trust in Didier Raoult and self-reported compliance with official recommendations regarding the COVID-19 pandemic. We only found a positive relationship between trust in Didier Raoult and number of unnecessary outings in Study 2, and all other correlations were non-significant. Thus, no clear conclusion could be drawn from our results, regarding the impact of trust in Didier Raoult on behavior.

Not only that, but very few of the variables we measured actually showed a significant relationship with self-reported behavior. In line with other studies (Díaz & Cova, 2020; Pennycook et al., 2020b), we found no relationship between behavior and cognitive style and science knowledge. Even more surprising: we also found no relationship between behavior and seemingly relevant behavior such as belief in conspiracy theories, about COVID-19 or not. How can we explain this lack of relationship?

There are several possible explanations. One might be that our study took place in a very particular context: the first French lockdown — a time at which official recommendations tended to be enforced by the state, and in which the crisis was particularly salient (this is in line with the fact that compliance ratings were very high in our studies). Also, at the time, Didier Raoult was much less obvious in his downplaying of the crisis and its criticism of government decisions. Thus, maybe the context provided less room for variation in participants' behavior. But now, at the moment we are writing this conclusion, France is entering its second lockdown, and much more people are prone to voice their disagreement with its usefulness - or even with the existence of a second wave of COVID-19. So, have things changed?

To find out, we took the opportunity of another, unrelated study on people's compliance with official regulations to add two measures relevant to the current matter: a measure of Faith in Intuition, and our Trust in Raoult scale (minus statement 3, which had become obsolete since then). In this follow-up, participants were asked to report to which extent they complied with six official regulations (staying at home as much as possible, coughing in one's elbow, avoiding touching one's face, keeping distances from others, washing one's hands, avoiding parties and family reunions) in the *past* two weeks, and to which extent they planned to respect them in the *next* two weeks. They were also asked (YES/NO) whether they engaged in three "risky" behaviors in the past two weeks (going to the cinema, going to the restaurant, going to a party or a family reunion). Among other variables was also psychological reactance, as measured through the

TABLE 6: Correlations (Pearson's *r*) between relevant dependent variables in our follow-up study (November 2020). *N* = 280. As in Study 3, participants were French people recruited through Crowdpanel. Materials and data are available at https://osf.io/nsfud/.

	1	2	3	4	5	6
1. Trust in Raoult	*0.96*	**0.22*****	−0.01	0.01	−0.04	**0.12***
2. Faith in Intuition		*0.80*	0.09	0.10	−0.04	**0.37*****
3. Past compliance			*0.74*	**0.79*****	**−0.41*****	**−0.17****
4. Future compliance				*0.80*	**−0.28*****	**−0.19****
5. Risky behaviors					NA	0.07
6. Reactance						*0.80*

Hong psychological reactance scale (Hong & Faedda, 1996). Results are presented in Table 6. As one can see, we found once again a positive relationship between Trust in Raoult and Faith in Intuition, but there was still no relationship between Trust in Raoult and self-reported behavior.

One way to dismiss these results would be to conclude that self-report measures of behavior are so unreliable that they prevent the detection of any significant correlation. However, that is simply not true. In Table 6, we included as an illustration one of several correlations we found in this study: a negative relationship between compliance and psychological reactance, which makes theoretical sense. Thus, it does not seem that the absence of relationship between Trust in Raoult and self-reported behavior can be blamed on our measures.

One reason for the lack of relationship might be that the effect of trust in Didier Raoult might have a different impact depending on which aspect of his discourse is the more salient (his tendency to downplay the pandemic might lead to lower compliance, while his tendency to stress that authorities refuse to provide the "unique effective treatment" against COVID-19 might reinforce fear and thereby compliance). In the same way, recent research has shown that belief in conspiracy theories can lead to very different behavior in the context of the COVID-19 pandemic depending on which conspiracy theories one is sensitive to (Imhoff & Lamberty, in press). Thus, the effect of trust in Didier Raoult and belief in COVID-19-related conspiracy theories in general might be more complex and less straightforward that one might readily assume.

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