How Openness to experience relates to Conspiracy mentality and Vaccine hesitancy

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Economic Psychology

Tilburg University, March 2020

Abstract

People nowadays are more likely to have doubts about vaccinating their children. In this study we aim to gain insight in the cause for this phenomenon that we refer to as *vaccine hesitancy*. The personality trait *openness to experience* and people's tendency to believe in conspiracy theories, referred to as *conspiracy mentality* are tested for an association with vaccine hesitancy. In a sample of 197 Dutch and 127 international first year psychology students at Tilburg University a correlation is found between both conspiracy mentality and vaccine hesitancy, and conspiracy mentality and openness. Openness and vaccine hesitancy however show no association. Concluding, people's attitudes towards vaccines are related to their attitudes towards conspiracy theories and this conspiracy mentality is related to openness.

Keywords: Openness, Conspiracy mentality, Vaccine hesitancy.

Despite the worldwide success of vaccinations, anti-vaccinations sentiments have increased over the last few years. There seem to be many factors affecting this phenomenon of vaccine hesitancy. Common skepticisms are: low perception of efficacy and usefulness of vaccines, concerns about vaccine safety, fear of side effects and lack of awareness or knowledge about vaccination. Other more personal factors are distrust in healthcare providers and the health system, perceptions around health and prevention, a preference for "natural" health, fear of pain at immunization and fear of needles (Dubé & MacDonald, 2018).

The decrease in trust among the public in vaccinations is also referred to as the vaccine confidence gap (Larson et al., 2011). While studying the underlying psychological factors of this confidence gap Browne, Rockloff & Pennycook (2015) found the following factors to be associated with anti-vaccination attitudes: use and preference of complementary and alternative medicine, spirituality, and the personality trait openness. The personality trait openness to experience (from henceforth referred to as openness) is associated with the anti-vaccination movement leading to rejection of conventional medical authorities and taking a more emotional and spiritual approach to health decisions (Browne, Rockloff & Pennycook, 2015). Openness in general is associated with acquiring knowledge, solving abstract problems and an interest in unconventional ideas. People who score high on openness also have a higher preference of using their imagination and are less interested in science (de Vries, Ashton, Lee, 2009).

Now I will discuss a different angle, in the effort to battle anti-vaccination attitudes one research has focused on the conspiracy theories surrounding vaccinations (Jolley & Douglas, 2017*).* This study showed that participants showed less intent to vaccinate a fictional child after seeing anti-vaccination conspiracy theories, however when they were also shown anti-conspiracy arguments before seeing the conspiracy theories this effect disappeared. This is one paper where anti-vaccination attitudes and conspiracy theories seem

to be connected. Conspiracy theories usually involve a secret network which aims to perpetrate evil acts. Most conspiracy theories emerge after important events such as war, natural disasters and acts of terrorism, where there are gaps in information (Goreis & Voracek, 2019). There are multiple ideas where this conspiracy belief in humans comes from. Some theories state that the origin lies within our evaluation, where psychological mechanisms such as pattern recognition, agency detection, threat management and alliance detection proved to be vital for our survival. Conspiracy belief could either be a by-product of these mechanisms or a similar mechanism on its own dedicated to rooting out conspiracies that were plotted against humans in ancestral times (Van Prooijen & van Vugt, 2018). Conspiracy belief does not limit itself to popular political conspiracy theories, in a study by Galliford & Furnham (2017) the belief in political conspiracies and medical conspiracies correlated strongly among participants.

In a 24-nation investigation of anti-vaccination sentiments and the underlying psychological factors, conspiracy mentality was shown to be the highest correlated factor out of the ones they investigated (Hornsey, Harris, & Fielding, 2018). In this study the researchers also tried to replicate the result that the belief in conspiracies is linked to openness (Swami et al., 2010), however when measuring personality the researcher did not find that effect in this case, making the relation with openness ambiguous. Other research into conspiracy beliefs showed an effect of the personality traits openness and agreeableness, however this effect disappeared when effect sizes were combined of multiple samples of participants (Goreis & Voracek, 2019).

The above studies detail in multiple ways how vaccine hesitancy and the belief in conspiracy beliefs are linked, leading us to the research question for this proposal: ‘What is the underlying process linking vaccine hesitancy and conspiracy beliefs?’. Based on the discussed research I think a high score on openness is what leads to a higher score on vaccine

hesitancy and conspiratorial beliefs. If the theory that I just described is true, then we should see that openness will be a positive predictor for vaccine hesitancy (H1a), and conspiracy beliefs (H1b). Furthermore, if the first model displayed in Figure 1 is correct for the relation between the three factors we also predict that when controlling for openness to experience, partial correlations between conspiracy mentality and vaccine hesitancy will decrease (H2a). When controlling for conspiracy mentality, partial correlations between openness and vaccine hesitancy will not decrease (H2b).

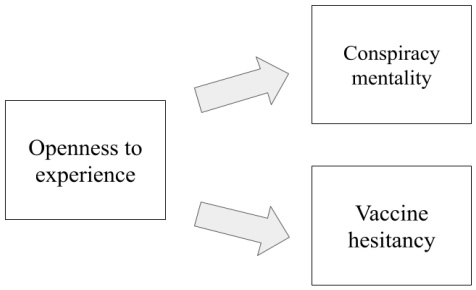
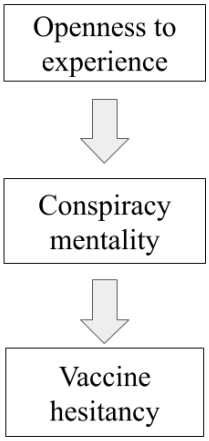
Graphical representation	Predictions
	When controlling for Openness to experience, partial correlations between Conspiracy mentality and Vaccine hesitancy will decrease. (H2a) When controlling for Conspiracy mentality, partial correlations between Openness and Vaccine hesitancy will not decrease. (H2b)
	When controlling for Openness to experience, partial correlations between Conspiracy mentality and Vaccine hesitancy will not decrease. (H3a) When controlling for Conspiracy mentality, partial correlations between Openness and Vaccine hesitancy will decrease. (H3b)

Figure 1. Proposed models

Alternatively, it could be the case that conspiracy mentality is a mediator and that openness influences conspiracy mentality and conspiracy mentality influences vaccine

hesitancy with no direct causal link between openness and vaccine hesitancy. If this alternative model, shown at the bottom of graph 1 is correct we predict that when controlling for openness to experience, partial correlations between conspiracy mentality and vaccine hesitancy will not decrease (H3a) and when controlling for conspiracy mentality, partial correlations between openness and vaccine hesitancy will decrease (H3b). If we find support for H1 and H2 then this will support the theory that openness positively predicts conspiracy mentality and vaccine hesitancy. If H1 and H3 are correct then we find support for the theory that openness positively predict conspiracy mentality and conspiracy mentality positively predicts vaccine hesitancy.

Methods

A student sample was recruited at Tilburg University consisting of Dutch and international psychology undergraduates. All of them participated through the SP-Lab at Tilburg University and received a partial course credit for their participation. The sample consists of 332 participants (M age = 20.38; SD = 2.87) of which 259 are female (79.9%) and 64 are male (19.8%). Only 4 (1.2%) participants indicated that they have children and only 1 (0.3%) participant indicated they are part of a religious and/or spiritual group that opposes vaccinations. Out of the 332 participants, 197 (81,7% female) filled in the Dutch version (M age = 19.90; SD = 2.02) and 127 (77.2% female) filled in the English version (M age = 21.13; SD = 3.72).

In order to measure vaccine hesitancy, the 5C scale (Betsch et al., 2018) is used. This scale was chosen for its thorough look at vaccine hesitancy and its recent development. The scale focuses on five psychological antecedents of vaccination. These are confidence in vaccines and the system (α = .85), complacency; not perceiving preventable diseases as high risk (α = .76), constraints such as structural and psychological barriers (α = .85), calculation; engagement in extensive information searching (α = .78) and collective responsibility;

willingness to protect others (α = .71). In order to end up with a single score for Vaccine Hesitancy, the scores of the Confidence and Collective responsibility subscales were reversed and combined with the score of the other subscales in one scale.

To measure conspiracy beliefs a scale is required that can be applied to participants regardless of geography and age. Therefore I have settled on the Conspiracy Mentality Questionnaire (CMQ; Bruder et al., 2013) (α = .84). This questionnaire has shown to be reliable and region and age agnostic which makes it preferable over measures which focus on old conspiracy theories and American politics which our sample might not be familiar with.

For personality I have chosen the HEXACO model (de Vries, Ashton, Lee, 2009). The decision to go for this model, instead of the Big Five used in earlier research, is the different formulation of the trait openness and the subscale for altruism within the personality inventory. Openness within the HEXACO model does not contain intellect as narrow trait and focuses more on the inquisitiveness narrow trait and the scale is reliable (α = .81).

Multiple regression will be used to test if the personality trait significantly predicted the participants score on vaccine hesitancy and conspiracy beliefs. An a priori power analysis was conducted using G*Power 3.1 (Faul, Erdfelder, Lang, & Buchner, 2007), based on earlier research the expected effect is a small to medium correlation, the required sample size is 134 participants (Browne, Rockloff & Pennycook, 2015; Hornsey, Harris, & Fielding, 2018). Approval from the ethics board of the School of Social and Behavioral Sciences (ERB) at Tilburg University was secured for this research.

Results

The means, standard deviation, range and reliability of the used scales are show in Table 1. The reliability of the 5C subscales was high when combined into a single scale for further analysis. No scores were unusual, except a higher score on Calculation compared to the other subscales.

Table 1

Means, standard deviation, range and reliability of the scales used.

	Range	M (SD)	Cronbach's Alpha
Openness to Experience	1-5	3.34 (0.68)	.809
Conspiracy Mentality	1–7	4.60 (0.92)	.767
Vaccine Hesitancy	1–7	2.67 (0.78)	.695
Confidence (reverse)	1–7	2.34 (1.12)	.812
Complacency	1-7	2.29 (0.93)	.537
Constraints	1-7	2.00 (1.05)	.731
Calculation	1-7	4.30 (1.54)	.782
Collective responsibility (reverse)	1–7	2.40 (1.07)	.560

The pearson's correlations of the studied variables are shown in Table 2. The Dutch and English sample show a difference on Openness, Conspiracy Mentality and age as seen in Table 2. A further t-test shows the difference in Openness between the Dutch sample (M = 21.10; SD = 6.22) and the English sample (M = 27.03; SD = 6.16) to be significant (t (322) = -8.42, p <.001). So do the Dutch scores on Conspiracy mentality (M = 16.96; SD = 4.47) versus the English scores (M = 19.61; SD = 4.32) (t (322) = -5.27, p <.001). Vaccine Hesitancy did not significantly differ between language (t(322) = .47, p =.638) therefore further analyses were done on the combined Dutch and English sample.

Table 2

Pearson's correlation matrix of the studied variables.

Variable	1	2	3	4	5	6
1. Vaccine Hesitancy	-					
2. Openness to Experience	-.048	-				
3. Conspiracy Mentality	.207***	.223***	-			
4. Age	.020	.190***	.245***	-		
5. Gender[1]	.060	-.181***	-.006	-.237***	-	
6. Language[2]	.027	-.426***	-.287***	-.211***	.048	-

Note. [1] 0 = male, 1 = female; [2] 0 = English, 1 = Dutch.

*p <.05; ** p <.01; *** p <.001.

A multiple linear regression was performed to predict Vaccine Hesitancy based on Openness, Conspiracy Mentality, age, gender and language. The assumptions for normality, linearity, homoscedasticity and absence of multicollinearity were not violated. A significant regression equation was found ($F(5,317) = 3.872$, $p = .002$), with a R^2 of .058. The participants' predicted vaccine hesitancy increased .21 for each point of conspiracy mentality, which was a significant predictor for vaccine hesitancy. Openness was not a significant predictor for vaccine hesitancy ($p = .296$). The full regression model can be found in Table 3.

Table 3

Linear regression with Vaccine Hesitancy as dependent variable.

Predictor	B	SE B	β	t	p	Zero -order	Partial
Constant	1.83	.36		5.07	<.001		
Openness	-.07	.07	-.07	-1.05	.296	-.048	-.059
Conspiracy Mentality	.21	.05	.24	4.13	<.001	.207	.226
Age	.00	.02	-.002	-.03	.977	.020	-.002
Gender[1]	.09	.11	.05	.80	.420	.060	.045
Language[2]	.11	.10	.07	1.06	.291	.027	.059

Note. [1] 0 = male, 1 = female; [2] 0 = English, 1 = Dutch

Hypothesis 1a stated that openness would be a positive predictor for Vaccine Hesitancy, as shown in Table 3 openness has a negative association that is not significant. Openness is a positive predictor for Conspiracy Mentality which was the prediction of hypothesis 1b. The prediction was that controlling for Openness the partial correlation between Conspiracy Mentality and Vaccine Hesitancy would decrease (H2a), this was not the case. The partial correlation for conspiracy mentality was higher when controlling for openness ($r = .226$, $p < .001$). This result is in line with the alternative model that was proposed in hypothesis 3 that predicted that partial correlations between Vaccine Hesitancy and Conspiracy Mentality would not decrease controlling for Openness (H3a). It was also predicted that when controlling for Conspiracy mentality, partial correlation between Openness and Vaccine hesitancy will not decrease (H2b). This partial correlation did

decrease, however it was not significant (r = -.059, *p* = .296). This result would be in line with hypothesis 3b, however the result remains not significant

Discussion

The goal of this study was to gain more insight in the relation between Openness, Conspiracy mentality and Vaccine hesitancy. The hypotheses stated that differences in Openness are the cause of a higher score on Conspiracy mentality and Vaccine hesitancy. The results are not consistent with the notion that Openness predicts Vaccine hesitancy that was found in research by Browne, Rockloff & Pennycook (2015) and therefore I conclude that the results do not support a causal relation, with Openness leading to a higher Conspiracy mentality which in turn leads to more Vaccine hesitancy. Some other researchers also failed to find this effect of Openness (Hornsey, Harris, & Fielding, 2018; Goreis & Voracek, 2019). The results do not support my theory about Openness however the other results do prove interesting. Hypothesis 2a was rejected as partial correlations between Conspiracy mentality and Vaccine hesitancy when controlling for Openness did not decrease. Hypothesis 2b was rejected because when controlling for Conspiracy mentality, partial correlations between Openness and Vaccine hesitancy did decrease but were not significant. With these results we also reject the first model displayed in figure 1. This leaves us with the second model displayed in figure 1 as a candidate of how the relation between these variables work. Hypothesis 3a was confirmed and the results were in line with hypothesis 3b although not significant. However, without hypothesis 1 it cannot be concluded that the model is accurate, since the results don't support the role of Openness as the cause of Vaccine hesitancy.

The results are consistent with the idea that Conspiracy mentality and Openness are related and also Conspiracy mentality and Vaccine hesitancy are related. The relation between Conspiracy mentality and Openness was low to moderate correlation, similarly to Swami et al. (2010) and the relation between Conspiracy mentality and Vaccine hesitancy

also shows a low to moderate correlation similarly to other research (Hornsey, Harris, & Fielding, 2018). Most of the results appear consistent with other research, it is however interesting that there was no relation between Openness and Vaccine hesitancy even though both scores correlate with Conspiracy mentality.

Limitations

In this study it was decided to study attitudes and use a university student sample, however in order to perform research which could aid in fighting Vaccine hesitancy a sample consisting of people who have children would be a better target demographic. Parents and soon to be parents are probably more likely to educate themselves about vaccinations and are perhaps also more likely to have viewed disinformation about vaccines through for example social media such as Facebook.

Furthermore, there was a larger than expected difference on some scores between the Dutch and English language groups. The group did not significantly differ on vaccine hesitancy scores but the Dutch language student did score significantly lower on Conspiracy mentality and Openness. One explanation could be that there were mistakes in the the translation between the different questionnaire, no participants gave any indication of this however. Hornsey, Harris & Fielding (2018) ran a multinational study where multiple cultural difference were found between countries, therefore the difference in this sample is perhaps to be expected.

Conclusion

The relation between Openness and Vaccine hesitancy is unconfirmed based on these results. However Conspiracy mentality and both Vaccine hesitancy and Openness are related. If we were to design a third model based on the results it would like figure 2. It is however unlikely that Conspiracy mentality is the cause of the variance in Openness, since openness is a personality trait and it is more likely that personality is at the basis for other, more specific

individual differences. What we can conclude from this is that when we are looking for the cause of Vaccine hesitancy we should look in the same corner as why people believe in conspiracy theories. The likelihood of people to believe in conspiracy theories, measured by their Conspiracy mentality, is related to the personality trait Openness to experience.

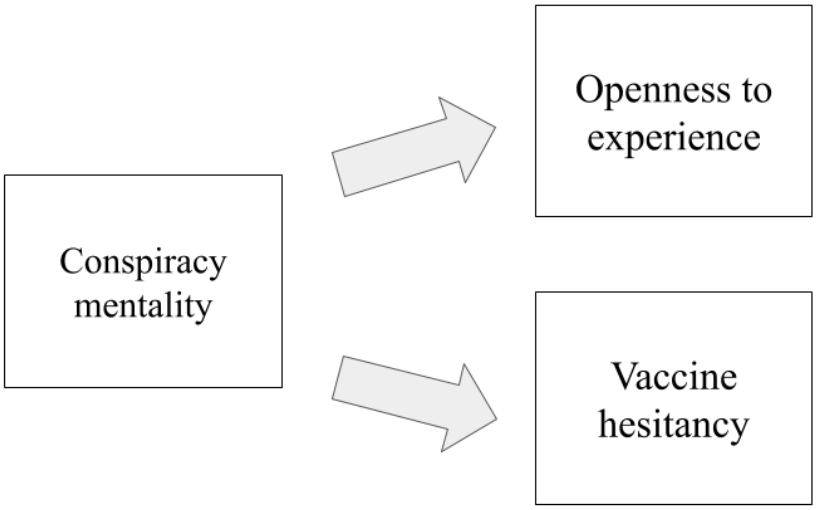


Figure 2

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