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## Paranormal Beliefs and Analytic Cognitive Thinking Style within Different Age Groups

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**Abstract.** This study tested two hypotheses related to the relationship of paranormal beliefs with the analytic cognitive thinking style of Russian citizens: 1) whether the relationship between these variables is negative; 2) whether the relationship between the variables will be significantly stronger for the middle age group rather than for the young or senior groups. In order to test our hypotheses, a quota sample of Russian participants ( $n = 1498$ ,  $M_{age} = 41.65$ ,  $SD_{age} = 12.72$ ) completed an online survey that included selected subscales from the Manchester Metropolitan University New (MMU-N) Paranormal Scale and the three-item Cognitive Reflection Test. As a result, based on multiple hierarchic linear regression modeling, the study confirmed only the first hypothesis: controlling for the socio-demographic variables, those with higher levels of paranormal beliefs demonstrated lower analytic cognitive thinking style propensities. As for the second hypothesis, the study did not confirm it. Contrary to our hypothesis, compared to middle-aged participants, young participants showed the strongest negative relationship between paranormal beliefs and analytic cognitive thinking style propensity. Although we discuss in this paper certain study limitations that need to be further addressed, current results already extend our understanding of the relationship between paranormal beliefs and neurocognitive indicators, such as analytic cognitive thinking style propensity, among Russian citizens. Furthermore, educational institutions can also consider them while creating school/university curriculums aimed at enhancing a scientific worldview among younger generations.

**Keywords:** paranormal beliefs, analytic cognitive thinking style, age differences, Cognitive Reflection Test, CRT.

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## Паранормальные явления и аналитический когнитивный стиль мышления в разных возрастных группах

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**Аннотация.** В исследовании проверялись две гипотезы о взаимосвязи паранормальных убеждений с аналитическим когнитивным стилем мышления граждан России: 1) является ли связь между этими переменными отрицательной; 2) будет ли связь между переменными значительно сильнее для группы среднего возраста, чем для молодых или пожилых групп. Для проверки гипотез квотная выборка российских участников ( $n = 1498$ ,  $M_{age} = 41.65$ ,  $SD_{age} = 12.72$ ) заполнила онлайн-опрос, который включал выбранные подшкалы из шкалы паранормальных явлений Манчестерского столичного университета (MMU-N) и трехпунктовый тест когнитивной рефлексии. В результате на основе моделирования множественной иерархической линейной регрессии исследование подтвердило только первую гипотезу: при контроле социально-демографических переменных лица с более высоким уровнем паранормальных убеждений демонстрировали более низкие склонности к аналитическому когнитивному стилю мышления. Что касается второй гипотезы, то исследование ее не подтвердило. Вопреки нашей гипотезе, по сравнению с участниками среднего возраста, молодые участники показали самую сильную отрицательную связь между паранормальными убеждениями и склонностью к аналитическому стилю когнитивного мышления. Хотя в данной статье обсуждались определенные ограничения исследования, которые необходимо рассмотреть дополнительно, текущие результаты расширяют наше понимание связи между паранормальными убеждениями и нейрокогнитивными показателями, такими как склонность к аналитическому стилю когнитивного мышления среди граждан России. Кроме того, образовательные учреждения также могут учитывать их при создании школьных/университетских учебных программ, направленных на повышение научного мировоззрения среди молодого поколения.

**Ключевые слова:** паранормальные убеждения, аналитический когнитивный стиль мышления, возрастные различия, тест когнитивной рефлексии, CRT.

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## Introduction

Different types of paranormal beliefs have always been widespread among humanity. It was estimated that around 90 % of the world's population believes in some form of divinity (Zuckerman, 2006). In accordance with Russian Public Opinion Research Center (VCIOM) statistics, 28 % of Russians believe in foretellers, 25 % believe in witches, and 12 % – in communication with dead people (VCIOM, 2022). For these reasons as well as many others, researchers found it not only interesting but also important to study this phenomenon to understand why some people share such beliefs and some do not.

The first definition of paranormal beliefs that we can provide defines them as beliefs in “physical, biological, or psychological phenomena that feature core ontological (physical, biological, or psychological) properties of another ontological category” (Lobato et al., 2014). Therefore, in compliance with this definition, physical and biological phenomena can possess psychological characteristics, for instance, motives or wishes (Betsch et al., 2021). Similarly, physical and psychological phenomena can have core features of biological organisms, such as healing or living. Finally, psychological phenomena can possess core features of physical phenomena, such as the autonomous presence or the ability to touch objects (Betsch, Aßmann and Glöckner, 2020; Lindeman and Aarnio 2007; Lindeman and Saher, 2007).

Another most commonly used definition in the scientific field describes paranormal beliefs as “beliefs, entities, practices, and processes that contradict the basic limiting principles of science” (Fiorito, Abeyta and Routledge, 2021). Hence, under such definitions can fall the following concepts: extrasensory perception, telekinesis, ghosts, poltergeists, life after death, reincarnation, faith healing, human auras, etc.

Paranormal beliefs were found to be significantly linked with a great number of cognitive characteristics and phenomena. In accordance with the latest systematic review done by Dean et al. (2022), significant links were found for paranormal beliefs and cognitive thinking styles, confirmatory bias, conditional reasoning ability, perception of randomness, perceptual decision-making, jumping to conclusions and repetition avoidance, the conjunction fallacy, probabilistic reasoning, critical thinking ability, intelligence, and memory. However, not every topic showed consistency in the results among its studies.

For instance, a considerable amount of research focused its attention on the relationship between paranormal beliefs and the critical thinking abilities of a person, however, the results of these studies are rather controversial: while some have managed to find a significant negative relationship (Alcock and Otis, 1980; Smith, Foster and Stovin, 1998; Stuart-Hamilton, Nayak and Priest, 2006), others did not find any associations (Hergovich and Arendasy, 2005; Roe, 1999; Royalty, 1995).

Greater consistency is shown for paranormal beliefs with an increased confirmatory bias (Blanco, Barberia and Matute, 2015; Drinkwater et al., 2019; Griffiths et al., 2019), decreased conditional reasoning ability (Lawrence and Peters, 2004; Pérez Navarro and Martínez Guerra, 2020), decreased perception of randomness (Dagnall et al., 2014; Dagnall, Parker and Munley, 2007), and, especially with an increased intuitive thinking style (Branković, 2019; Lasikiewicz, 2016; Majima, 2015; Svedholm and Lindeman, 2013).

In general, cognitive thinking style can be defined as the extent to which a person can “critically evaluate initial misleading intuitions and persist in analytic processing” (Pennycook et al, 2012). Cognitive styles are usually

divided into two types: intuitive and analytic (Alaybek et al., 2021; Stone, 2016). Such a division can be explained by the so-called Type 1 and Type 2 systems of the brain and their connection with religious and supernatural beliefs (Yilmaz, 2020). The Type 1 system is associated with intuitive thinking and does not require much effort for the conclusions to be made by the person (this connection is often called intuitive belief). The Type 2 system, on the other hand, doubts the intuitive conclusions and beliefs that a person can simultaneously make, therefore this system is thought to be responsible for analytical thinking and requires certain cognitive strain from a person (Evans & Stanovich, 2013).

However, despite the common usage of such a division of cognitive thinking styles into intuitive and analytic ones, researchers are united only in their ability to find a positive relationship between paranormal beliefs and intuitive thinking style (Branković, 2019; Lasikiewicz, 2016; Majima, 2015; Svedholm and Lindeman, 2013). When it comes to confirmation of a negative relationship between paranormal beliefs and analytic thinking style as well, some of the studies are capable of finding it (Aarnio and Lindeman 2005; Pennycook et al., 2012; Rizeq, Flora and Toplak, 2020; Stone, 2016), while others are not (Genovese, 2005; Irwin, 2015).

### **Statement of the problem**

As the relationship between paranormal beliefs and intuitive cognitive thinking style was extensively explored by previous research, we have focused our attention on the relationship of paranormal beliefs with analytic cognitive thinking style. Our study was based on an adult Russian sample, as we were aiming to decrease the population gap that is present in almost all current research, with the majority of them focusing on university students, specifically those majoring in psychology (Aarnio and Lindeman, 2005; Gronchi and Zemla, 2021; Toplak, West and Stanovich, 2011). Hence, the relationship between the stated variables that is currently known to us could not be generalized for people of different age categories. In addition to that, paranormal beliefs as a concept are

highly understudied in Russia, a gap that we also believe needs to be closed.

We expect the analytic cognitive thinking style to have a greater association with the level of paranormal beliefs in the middle age group, as we believe that there might be a larger amount of variables that could have a significant impact on this relationship for other age groups.

For example, young people may be more likely to accept paranormal beliefs because of their still-developing cognitive abilities (Craik and Bialystok, 2006) and evolving frontal cortex responsible for accepting and solving challenging situations (Narmashiri et al., 2022), which in turn can urge them to use paranormal beliefs as a protective mechanism in such situations (Mathijssen, 2012). The younger age is also associated with the period of experimentation in every sphere of life and younger people tend to have greater levels of openness to new experiences (Soto et al., 2011).

On the other hand, among the elderly there is a presence of a deterioration in their fluid intelligence (Salthouse, 1996) and a revival of certain beliefs: for instance, a belief in animism reappears among older people, a concept usually observed only among children (McDonald and Stuart-Hamilton, 2000).

### *Hypotheses:*

(1) There will be a significant negative relationship between the level of paranormal beliefs and analytic cognitive thinking style propensity.

(2) There will be a stronger negative relationship between paranormal beliefs and an analytic thinking style propensity among people from the middle age group, rather than among those in younger or older age groups.

### **Methods**

The research is based on the data from the cross-sectional survey study. A total of 26 measures were used in the cross-sectional survey study, with two of them related to paranormal beliefs and analytic cognitive style of thinking.

### ***Participants & Procedure***

A quota sample of 1498 participants was recruited from the participants of the online panel “Anketolog” which aimed to represent

basic socio-demographic characteristics of the adult population of Russia (age, sex, and living in urban or rural areas). The age of participants ranged from 18 to 80 ( $M = 41.7$ ,  $SD = 12.7$ ).

The data collection took place in December 2022 in the format of an online survey. All respondents received a small compensation after the completion of the survey. The compensation was defined by the platform agency and was equal for each participant. All participants gave anonymous informed consent for the participation.

All research protocols and procedures were reviewed and approved by the Ethics Committee of Herzen University in Saint-Petersburg (IRB 00011060 University of Russia IRB#1, record #22).

## Measures

### *Paranormal Beliefs*

Paranormal Beliefs were measured using seven subscales of the Manchester Metropolitan University New (MMU-N) Paranormal Scale that originally contained 9 subscales (Hauntings, Superstition, Other Life, Religious Belief, Extrasensory Perception, Psychokinesis, Alien Visitation, Astrology, and Witchcraft) and 59 questions with a 5-point Likert Scale, where  $-2$  stands for “strong disagreement” and  $2$  stands for “strong agreement” with the statements (Dagnall et al., 2010).

To decrease the participants’ burden, the number of items on the MMU-N scale was reduced. In the result, two subscales (Psychokinesis and Alien Visitation) were deleted from our research, and the number of questions in some of the remaining subscales was decreased: “Haunting” subscale was reduced from 8 to 4 questions, “Other Life” subscale – from 6 to 4, “Superstition” subscale – from 7 to 4, “Religious Belief” subscale – from 6 to 4, “Extrasensory Perception” subscale – from 7 to 6, “Astrology” subscale – from 7 to 4. Only one subscale (Witchcraft) remained the same in its size.

In the result, 29 questions on 7 subscales were translated and included in the study, their internal reliability will be further measured.

### *Analytic Cognitive Thinking Style*

In line with the previous studies (Gronchi and Zemla, 2021; Patel, Baker and Scher-

er, 2019; Pennycook et al., 2012) we used a performance-based scale – the Cognitive Reflection Test (CRT). It utilizes three nontrivial arithmetic problems that require a longer and more thorough analysis of the information for the correct answer to be made (Frederick, 2005).

Three possible answer types exist for a person to come up with on each of CRT items: the correct one, the intuitively incorrect one (the first incorrect option that comes to our minds), and any other incorrect one. When taking only the sum of correct answers on the CRT scale into account, the so-called CRT-Reflective (or analytic) measure is created (Pennycook et al., 2016).

A shortened tested Russian version of CRT in the adaptation of O. Rodina and P. Prudkov (2019) was used since it showed similar relationships with paranormal beliefs as the extended version (Rodina and Prudkov, 2019).

In Russian tasks of the CRT scale are presented in the following way:

(1) “A ballpoint pen with a cap costs 110 rubles. A pen is more expensive than a cap by 100 rubles. How much does a cap cost?” (Correct response = 5 rubles; Intuitive response = 10 rubles);

(2) “If five pancake-making machines make five pancakes in five minutes, how long before 100 machines make 100 pancakes?” (Correct response = 5 min; Intuitive response = 100 min);

(3) “Lilies appeared on the pond. Every day the area they occupy is doubled. If the lilies cover the whole pond in 48 days, how many days will it take for them to cover half the pond?” (Correct response = 47 days; Intuitive response = 24 days).

The overall analytic cognitive thinking style propensity was measured as a sum of correct answers (min – 0, max – 3) on all three questions, with the smaller sum indicating a lower propensity toward analytic cognitive thinking style, and a larger sum – a higher propensity toward an analytic cognitive thinking style.

### *Age*

Age was measured with the year of birth of a person, and then later recalculated to ob-



tain the traditional version of age (the age of a person in the year 2022).

To our best knowledge, there are no studies related to paranormal beliefs and/or cognitive thinking styles where all age groups were included, current studies are usually focused on teenagers (Aarnio and Lindeman, 2005; Gronchi and Zemla, 2021; Toplak, West and Stanovich, 2011), elderlies (Banziger, 1983; Stuart-Hamilton, Nayak and Priest, 2006), or teenagers and elderlies (Vitulli, Tipton and Rowe, 1999). The same is correct for the absence of unified scientific-based methodological recommendations regarding the classification of age interval for cognitive studies. For this reason, the division of age was based on the existing recommendations of international agencies and on studies of other scientific fields where there are age divisions present (Solhi, Pirouzeh and Zanjari, 2022; UN, 2017; Yon et al., 2014): 18–44 years old were considered young people, 45–59 years old – as middle-aged people, and 60 and more years old – as senior people.

In the result, 111 (7.4 %) respondents fell into the senior age category, 524 – into the middle age category (34.9 %), and 863 – into the young age category (57.6 %).

#### *Control Measures*

The control variables included in our study are the sex and education level of the participants. Of our sample, 789 (52.7 %) were females and 709 (47.3 %) were males. The majority of respondents had finished a secondary vocational school ( $n = 699$ ; 46.7 %) or had a higher education ( $n = 486$ ; 32.4 %). A small percent of respondents had just 9 years of education or less ( $n = 51$ ; 3.4 %) or did not yet finish a higher education ( $n = 60$ ; 4.0 %). Every 8th respondent had finished 10–11 years of school education ( $n = 202$ ; 13.5 %).

As we have a number of quite small educational groups, we united them together for further analysis. Hence, “9 years of education or less” and “10–11 years of education” were combined into school education ( $n = 253$ ), “unfinished higher education” and “finished higher education” were combined into university education ( $n = 546$ ). The “Secondary vocational education” group was not changed ( $n = 699$ ).

#### *Data Analysis*

Descriptive statistics, Kendall’s correlation, one-way ANOVA, and multiple hierarchic linear regression tests were performed to check our hypotheses.

In addition, Confirmatory Factor Analysis and Cronbach’s Alpha were used to measure the internal reliability of the reduced Paranormal Belief scale. All analyses were made in R-Studio with the help of the R programming language, the following packages were used for the statistical analysis: stats, car, DescTools, ggpubr.

#### **Results**

##### *Analytic Cognitive Thinking Style Propensity*

The majority of respondents (48.2 %) did not provide any correct answer on the CRT scale. Every fourth participant answered correctly once (25.6 %), 14.4 % – twice, and 11.9 % provided correct answers for all three tasks, meaning that the distribution of correct answers on the CRT scale is left-skewed.

##### *MMU-N Paranormal Belief Scale*

###### *Internal Reliability*

As the MMU-N Paranormal Belief Scale used by us in this study was translated into Russian for the first time, as well as being significantly shortened, we checked several basic parameters in order to confirm that the MMU-N scale can be used as an accurate measure further in this study.

Confirmatory Factor Analysis (CFA) showed an acceptable fit of the reduced scale with the initially proposed subscales (Table 1) and the internal reliability of the scales was also on a good level (Table 2).

Cronbach’s alpha was measured to determine the internal reliability of the subscales. In the result, all 7 subscales of the MMU-N Paranormal Belief Scale were internally reliable, with  $\alpha \geq 0.77$ , indicating good and even excellent internal consistency of the subscales. The final alpha scores, as well as other descriptive statistics of each subscale, can be observed in Table 2.

The detailed analysis showed that the “Other Life” subscale was not closely related to other subscales as it has small correlation co-

Table 1. CFA Model Fit measures before and after the deletion of the “Other Life” subscale

	Before	After
CFI	0.935	0.943
TLI	0.926	0.934
RMSEA	0.058	0.059
SRMR	0.046	0.042

Table 2. Descriptives for the Paranormal Belief Subscales

	Min	Max	Mean	SD	Alpha
Hauntings	-8	8	0.8	4.7	0.9
Other Life	-8	8	3.4	3.9	0.9
Superstition	-8	8	-0.8	4.2	0.8
Religious Belief	-8	8	1.0	4.4	0.8
Extrasensory Perception	-12	12	0.4	5.8	0.8
Astrology	-8	8	-0.4	4.3	0.8
Witchcraft	-6	6	0.8	3.7	0.9

efficients (ranging from 0.01 to 0.15, data not present). Therefore, the following analysis was performed with the “Other Life” subscale deleted from the overall Paranormal scale. This exclusion did not drastically change model fit measures (Table 1).

After the separation, 25 questions over 6 subscales constituted an overall reduced Paranormal Belief Scale by taking the average count for each participant on the final set of questions. The Paranormal Belief measure (Fig. 1) was normally distributed and ranged from -2 to 2,

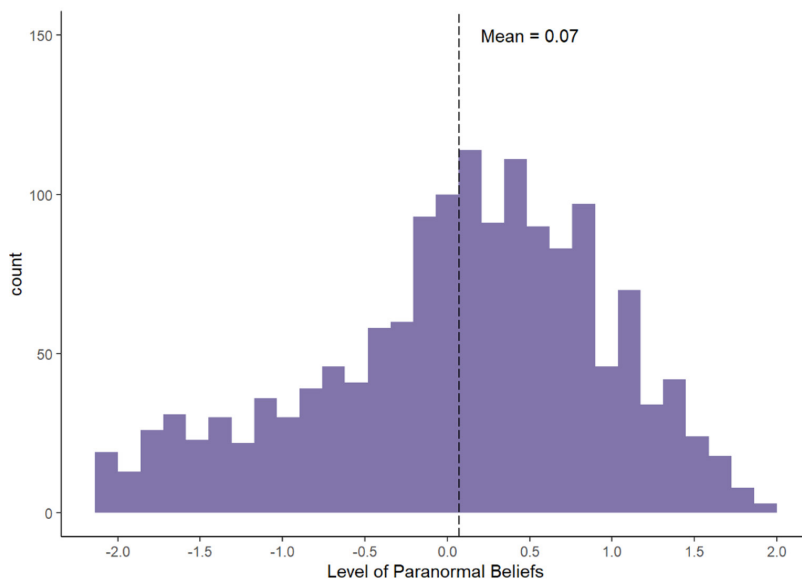


Fig. 1. The distribution of Paranormal beliefs measure

where  $-2$  stands for absolute absence of paranormal beliefs, and  $2$  stands for absolute presence of paranormal beliefs ( $M = 0.1$ ,  $SD = 0.9$ ).

### *Age and Paranormal Beliefs*

Based on Kendall's correlation results, age, and paranormal beliefs were positively correlated with a weak correlation coefficient,  $r_{\tau} = .065$ ,  $p = 2e-04$ . The scatterplot shows the relationship between the two variables: we seem to have an inverted U-shape form (Fig. 2A).

As for the age with the division of participants into "middle", "young", and "senior" categories, the mean in the level of paranormal beliefs is the highest among the middle-aged participants ( $M = .13$ ), followed by senior-aged participants ( $M = .06$ ) and young participants ( $M = .04$ ). However, this difference is not statistically significant: a one-way ANOVA showed the absence of the main effect of age group on the level of paranormal beliefs,  $F_{\text{Welch}}(2, 309.41) = 1.93$ ,  $p = .15$ .

### *Age and Analytic Cognitive Thinking Style Propensity*

Kendall's correlation results showed us that there is no statistically significant correlation between age (without categorical division)

and analytic cognitive thinking style propensity,  $r_{\tau} = -.0095$ ,  $p = .63$ .

At the same time, as with the relationship between age and level of paranormal beliefs, by looking at the scatterplot between age and analytic cognitive thinking style propensity, we can observe that the relationship seems to have a U-shaped form (Fig. 2B).

With the division of age into categories, the mean in the analytic cognitive thinking style propensity is highest among senior participants ( $M = .93$ ), with the mean of middle-aged and young participants being approximately the same ( $M_{\text{middle}} = .90$ ,  $M_{\text{young}} = .89$ ). Again, no statistically significant main effect of age group on analytic cognitive thinking style propensity was found,  $F_{\text{Fisher}}(2, 1495) = 0.05$ ,  $p = .95$  (one-way ANOVA).

Hence, we can conclude that there is no statistically significant relationship between analytic cognitive thinking style propensity and age, both categorized and not.

### *Paranormal Beliefs and Analytic Cognitive Thinking Style Propensity*

Kendall's correlation results show that there is a statistically significant negative correlation between the level of paranormal beliefs

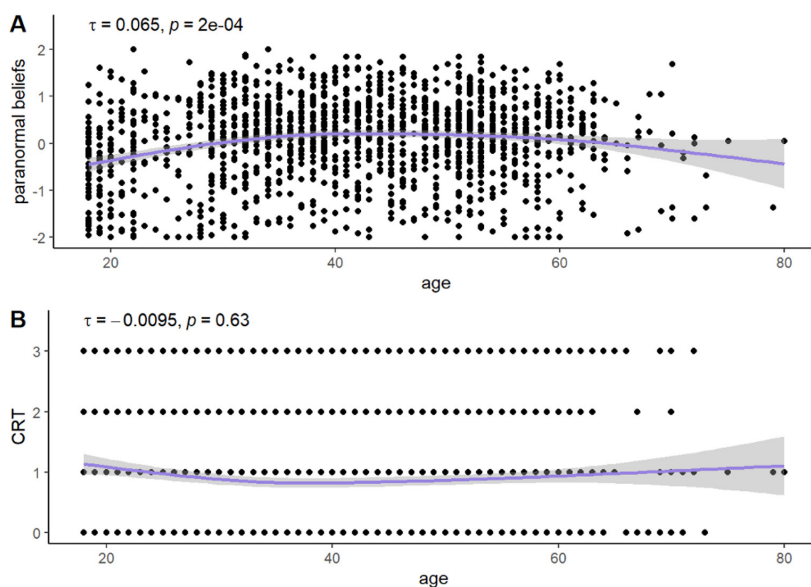


Fig. 2. A) Scatter plot between age (without categorical division) and level of paranormal beliefs together with Kendall's regression results. B) Scatter plot between age (without categorical division) and analytic cognitive style propensity together with Kendall's regression results



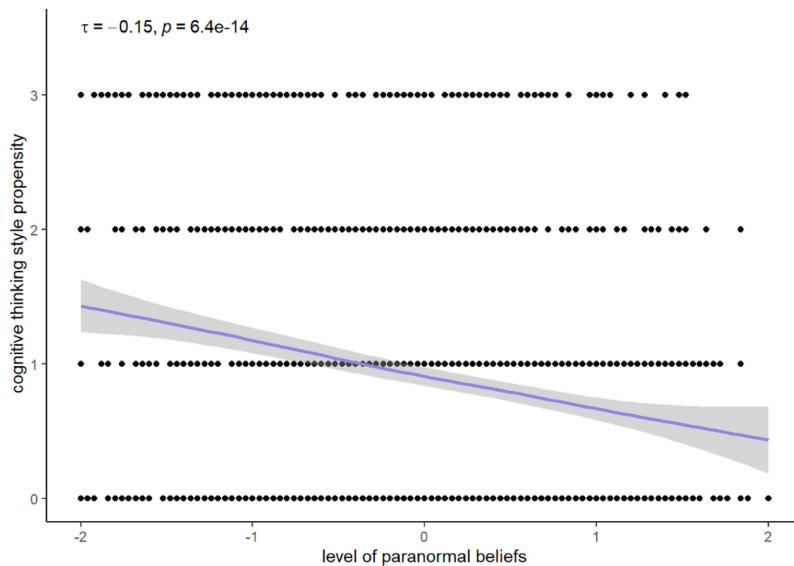


Fig. 3. Scatterplot between the level of paranormal beliefs and analytic cognitive thinking style propensity together with Kendall's correlation results

and analytic cognitive thinking style propensity,  $r = -.15$ ,  $p = .6e-14$  (Fig. 3).

#### ***Associations Between Analytic Cognitive Style and Paranormal Beliefs: Regression Model***

In Table 3 the multiple hierarchical regression models are presented. The first model included control variables (sex and education). After that, each independent variable was separately integrated, and the final models were created together with an interaction effect between analytic cognitive thinking style propensity and age groups. Both  $R^2$  and  $R^2$ -adjusted were increased as new variables were included, with the final model explaining 11.4 % of the variance ( $R^2$ -adjusted = 0.114,  $F(1489) = 25.02$ ,  $p = 2.2e-16$ ). In the final model, four significant predictors were found.

In comparison with those who received a university education, once age categories were added to the model, the effect of the education level on the paranormal beliefs was only present for those with school education ( $\beta = -.15$ ,  $p < .05$ ), meaning that those with school education are significantly less likely to express paranormal beliefs than those with university education. Sex was also a significant predictor of the level of paranormal beliefs: in compari-

son with males, females have a higher level of paranormal belief ( $\beta = .408$ ,  $p < .001$ ).

No significant difference in the level of paranormal beliefs was found for young or senior age groups in comparison with the middle age group. A negative significant association was found between the level of paranormal beliefs and analytic cognitive thinking style propensity ( $\beta = -.108$ ,  $p < .01$ ).

When looking at the interaction effect of age groups on the relationship between the level of paranormal beliefs and analytic cognitive thinking style propensity, a significant negative relationship is found in the young age group in comparison with the middle one ( $\beta = -.095$ ,  $p < .05$ ), with no significant difference found between our variables in the senior age group, also in comparison with the middle age group (Fig. 4).

#### **Discussion**

The first hypothesis was confirmed by us on an age-diversified sample: a significant negative relationship between the level of paranormal beliefs and analytic cognitive thinking style propensity was found, controlling for the variables related to the sex and education level of participants. Hence, those with higher levels of

Table 3. Multiple hierarchic regression analyses with 'Other Life' subscale deleted from the Paranormal scale

	First Model	Second Model	Third Model	Fourth Model
Predictors	Estimates	Estimates	Estimates	Estimates
(Intercept)	-0.179***	-0.133**	0.062	0.009
sex [male]	Reference	Reference	Reference	Reference
sex [female]	0.432***	0.435***	0.405***	0.408***
education [university]	Reference	Reference	Reference	Reference
education [school]	-0.145*	-0.129	-0.164*	-0.154*
education [secondary vocational]	0.105*	0.109*	0.044	0.049
age [middle]		Reference	Reference	Reference
age [senior]		-0.096	-0.091	-0.113
age [young]		-0.077	-0.075	0.009
style			-0.161***	-0.108**
age [middle] x style				Reference
age [senior] x style				0.022
age [young] x style				-0.095*
Observations	1498	1498	1498	1498
R 2 / R 2 adjusted	0.077 / 0.075	0.079 / 0.076	0.115 / 0.111	0.119 / 0.114
		*p<0.05	**p<0.01	***p<0.001

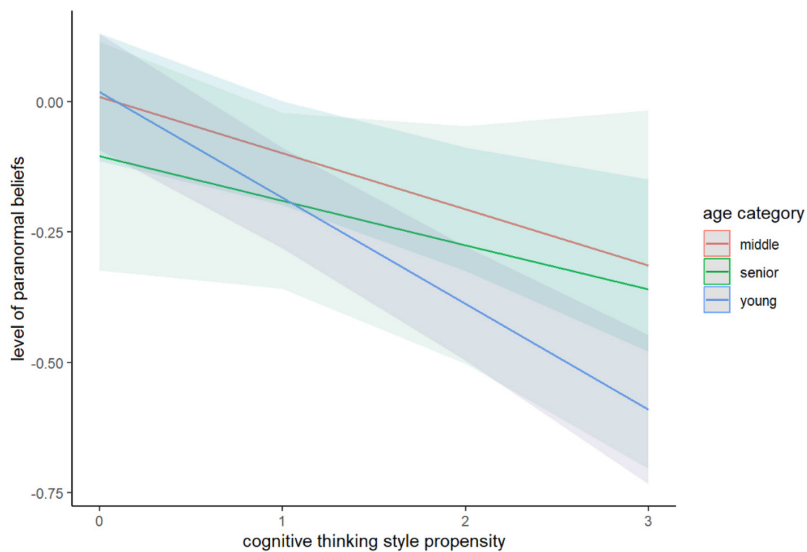


Fig. 4. Interaction effect of age category on the relationship between analytic cognitive thinking style propensity and level of paranormal beliefs

paranormal beliefs demonstrated lower analytical cognitive thinking style propensity, which corresponds with previous findings made with the help of the CRT scale (Pennycook et al., 2012; Rizeq, Flora and Toplak, 2020; Ståhl and van Prooijen, 2018) and confirms their replicability in samples other than the ones studied in Western European and US countries.

As for the second hypothesis proposed in this study, it was not confirmed. Contrary to our prediction, in comparison with middle-aged participants, young participants showed a stronger negative relationship between paranormal beliefs and analytic cognitive thinking style propensity. At the same time, no significant difference was found in the associations of paranormal beliefs and analytic cognitive thinking style propensity between senior and middle-aged participants.

Our initial hypothesis about the difference in this relationship between young and middle-aged groups was based on the assumption that the younger group is known to have a bigger openness to new experiences (Soto et al., 2011) and hence, their variety of beliefs could be a result of this trait rather than the lack of analytical thinking. At the same time, the detailed analysis of the previous findings already has shown some signs that the cognitive features (in particular fluid intelligence) are strongly connected with paranormal beliefs in the younger age, while in the other age groups, this relationship has not been found (Dean et al. (2022); for instance, Stuart-Hamilton et al. (2006) did not find an association between fluid intelligence and paranormal beliefs in an older sample, but Smith et al. (1998), on the other hand, managed to find a significant negative association in a younger sample.

Moving further to the absence of differences in the relationship of our variables between middle and senior age groups, we need to be aware of methodological issues: we have a huge disparity in the size of the samples for these groups, the senior group being five times smaller than the middle-aged one, a factor that could have significantly influenced the results of their comparison.

A possible explanation for our findings could be that they are related not to the age per

se but to the generational differences between the age groups: those generational differences could indeed have a stronger influence on the relationship between paranormal beliefs and cognitive thinking styles. To the best of our knowledge, there are no studies on the generational differences in paranormal beliefs, but research on religious beliefs showed their existence: for instance, Bengtson et al. (2015) conclude that from older to younger age groups, spirituality becomes more disassociated from religion, and “conceptualizations of the divine show a shift from a God who is primarily transcendent (out there)” among the oldest generation, to one that is closer and more personal among the youngest generation. The same might be applied to paranormal beliefs and cognitive thinking styles in Russia: for example, the cultural code of older generations includes beliefs in “Domovoy” (Домовой) and the evil eye that might not be related to the intelligence or analytic cognitive thinking style of a person. Further research could focus more precisely on the intergenerational divisions together with the age-related ones.

While discussing the distribution of participants among age groups, it might also be beneficial to remember that our division into age groups is based on general statistical guidelines, which might not be the best practice when talking about neurocognitive and psychological differences among people of different ages. Hence, further studies could try to find a better division of the age groups.

The level of paranormal beliefs was also significantly associated with the sex of the participants, with females showing significantly higher levels of paranormal beliefs in comparison with males. Although this association is not universal and in some cultures, it could be reversed (Narmashiri et al., 2019), our study shows that in this regard the Russian sample demonstrates the same tendencies as the samples from Western Europe (Aarnio and Lindeman, 2005) and the United States (Pennycook et al., 2012).

As for the education levels of our participants, a significant difference was found only between those with a school education and those with a university education, with the former showing significantly lower levels of para-

normal beliefs. One of the possible explanations for this counterintuitive finding can be related to a phenomenon called cognitive polyphasia (Jovchelovitch, 2002) – a highly educated person can be more open to a new experience, as he or she is interested in trying something new.

### Conclusion

The results of this study confirm that paranormal beliefs and the analytic cognitive thinking style propensity of a person are negatively connected. At the same time, the strength of those relationships is not equal across the lifespan: compared with middle-aged people, for young people, this relationship is significantly stronger. Further research is needed to analyze whether there are actually no differences in the association of analytic cognitive thinking style and paranormal beliefs between middle-aged and older people.

Still, the current study can already widen our understanding of the relationship between paranormal beliefs and cognitive characteristics among the Russian population, as well as help educational institutions with the preparation of their curriculums, so that a more scientific understanding of the world could be developed by young minds.

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### Limitations

The main limitation of this study is related to the sampling procedures. As already mentioned, samples of our age groups are highly imbalanced, with senior participants underrepresented in our dataset.

Additionally, the resulting sample of analytic cognitive thinking style propensity is also highly disproportional, with almost half (48.2 %) of the participants failing to provide even one correct answer on the CRT scale. Both imbalances could have influenced the statistical model results and our failure to confirm the second hypothesis.

In the future, it might be beneficial to sample participants more evenly in terms of their age and education groups. As for the analytic cognitive thinking style propensity measurements, a failure of a considerable amount of participants to provide at least one correct answer on the CRT measure can be related to the absence of control over the procedure during which the participants solved all three problems: the questions related to the CRT measure had an open-ended format, meaning that the chances that participants gave answers simply to move on with the questionnaire might be higher.

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