Modern sciences in religious Iran: An assessment of the educated Iranians' attitude toward biological evolution*

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It is often assumed that there is a confrontation between science and Islam, especially in religious communities. Biological evolution is often one of the constant sources of contention due to its metaphysical implications. Although there are some empirical data showing low acceptance of evolution and understanding its basic principles in Sunni-majority countries, there has been a categorical lack of data about Iran as the most influential Shiite-majority state. Therefore, in order to reach a better understanding of the culture and world-view of Iranians, we implemented two established questionnaires and phone interviews to assess educated Iranians' attitude toward evolution. We reach an important conclusion, which is supported by extensive quantitative data obtained from two separate questionnaires, that most Iranians accept both underlying principles as well as controversial topics such as human evolution in a striking rate. Additionally, key concepts of evolution were greatly understood by a large fraction of our participants. Finally, the research exhibited that Iranians did not consider evolution and their religious belief system as two rival systems, regardless of identifying themselves as religious or non-religious individuals. To investigate the reason for this cultural phenomenon that is unique among major Islamic countries, we suggest that it is due to three reasons. Central national education system implementing evolutionary science at both high school and university levels, explosive accessibility of academic atmosphere for the public, and more science-friendly interpretation of Islam are thought to be responsible factors for such a high level of acceptance and understanding. This study has crucial implications for revisiting the nature of Science-Islam interaction among various Muslim communities, Shiite Iranians included.

Keywords: science and Islam, evolution acceptance, Iran, evolution and religion.

Introduction

The way people interact with scientific topics has been a point of cultural studies for many years. A relatively old presumption states that the more religious people are, the less likely they embrace modern science. In this context, the conflict between religiosity and accepting the theory of evolution has been extensively studied in European and North Ameri-

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can contexts. Evolution receives more attention in debate between science and religion mainly because its implications usually violate established traditional beliefs and alter people's worldviews. Incompatibility between the Darwinian theory of evolution (supported by biologists and evolutionists) and its new interpretations, the existence of a deity who purposefully manages and controls the world, a teleological view towards the natural world, objectivity of moral norms, such irreducible human faculties as free will, cognition, and consciousness, literal understandings of religious textbooks' account of life, and above all human evolution are among the most controversial topics in the current debate over the relation between science and religion. These issues provide reasons to dismiss the theory of evolution and hence modern science as the supporter of such an adversary theory for religion [1].

However, while public acceptance of evolution significantly varies among different nationalities, the most religious countries normally have the lowest degree of conformity to let their children learn evolutionary theory as a scientific fact. In this context, Miller [2] showed that the United States has one of the lowest levels of acceptance (ca. 40%) among Western countries. The obstacles for the acceptance of evolutionary theory in the US are mainly due to the ordinary people's religious and political backgrounds .

It is widely accepted that Islamic countries have a lower acceptability ratio in comparison with majority Christian countries. Turkey, the only Muslim-majority country in Miller et al. [2], exhibited the lowest level of acceptance, supporting the idea of the escalated conflict between evolution acceptance and Islam. Other investigations confirm this. "Only 8% of Egyptians, 11% of Malaysians, 14% of Pakistanis, 16% of Indonesians, and 22% of Turks agreed that Darwin's theory is probably or most certainly true. The country with the highest rates of acceptance was the former Soviet republic of Kazakhstan, where only 28% feel that evolution is false, which is lower than the U.S. (where rejection is approximately 40%). Thus, it appears that evolution is rejected by a large majority of the public in most Islamic countries" [3].

However, in this study, we try to demonstrate that there is a singularity among the Middle Eastern countries and societies: Iran has exhibited extraordinarily high acceptance of modern science and evidently evolutionary theory. So far, all data has been acquired from Sunni majority countries or individuals who practice Sunnism in other countries, leaving the Shiite population unexplored. In this context, Iran seems intriguing as the biggest and most populated Shiite majority country. Burton [4; 5] argued that educational systems and socioeconomic policies are two main factors leading to high acceptance and understanding of evolution among Iranians. The same arguments were then raised by Kazempour and Amirshokoohi [6], who called for quantitative data on the general public's beliefs and attitude with respect to evolution to test their hypothesis.

Material and methods

In order to determine whether educated Iranians accept and understand the theory of evolution, we conducted two online surveys, the Generalized Acceptance of Evolution Evaluation (GAENE) [7] and the Measure of Understanding of Macroevolution (MUM) [8], respectively. Phone interviews were also used for understanding how participants consider the theory of evolution and related philosophical, religious, and social issues. The results of this study have important implications for appreciating how Muslims, especially Shiite communities, interact with the modern science.

Two separate links were generated and then distributed on social networking sites (mainly Telegram and Instagram* networking platforms) to conduct the GAENE and MUM surveys. The GAENE questionnaire consists of 16 Likert scale questions evaluating the level of acceptance in terms of 3 criteria, including evolution in general (9 questions), species evolution (4), and human evolution (3). The following scores were given to each question: 5= Strongly agree, 4= Agree, 3= Neutral, 2= Disagree, 1= Strongly disagree. There were 5 reverse questions that were scored contrariwise. Therefore, participants with the highest and lowest levels of acceptance received 80 and 16 scores, respectively. The MUM questionnaire, on the other hand, has 9 multiple-choice items designed for assessing people's understanding of 5 crucial concepts in the theory of evolution, namely "Classification", "Deep time", "Fossils", "Speciation", and "Nature of Science". Each multiplechoice item is associated with a figure and an explanatory paragraph, which is followed by a question. At the end of both surveys, participants answered demographic questions (sex, age, current status (high-school students, students, graduates), educational level, and major at university). Also, specifically, participants answered two more questions in the MUM survey, including "Where do they get their information about evolution from?" and "Do they accept evolution?". The scores 1 and 0 were given to each correct and wrong choice, respectively. Thus, participants with the highest and lowest levels of understanding got 9 and 0 scores, respectively.

More than 200 individuals who participated in the MUM survey were randomly selected for the phone interviews. After sending the phone interview invitation, 42 individuals agreed to participate. The protocol developed by Everhart and Salman [9] was used to evaluate how participants interact with evolution and related topics. There are nine separate sections in the protocol, including "Understanding evolution", "Assessing professional attitudes", "Personal attitudes regarding Evolution", "Islam, evolution, and origins", "Religiosity", "Underlying issues", "Personalities," "Semantic Differential," and "Wrapping Up". All interviews were recorded and analyzed according to participants' responses.

Result

In total, 2458 and 2044 individuals participated in the GAENE and MUM with the completion rate of ca. 97 and 87%, respectively (the % of individuals who answered all the questions). Also, 42 individuals participated in the phone interview phase. The length of the interviews ranged from 12 to 51 minutes. Table 1 shows how participants are distributed with respect to different demographic features (sex, age, current status, educational level, and major at university).

Acceptance measured by the GAENE questionnaire

Nearly 82% of our sample population completely agreed/agreed with the theory of evolution based on all 16 questions from the GAENE questionnaire. In other words, nearly 66% of participants got at least 60 out of 80 scores (Fig. 1A). The results were homogenous with respect to the 3 criteria implemented in the GAENE questionnaire (including evolution in general, species evolution and human evolution exemplified by questions 2, 12, and 13, respectively shown in Fig. 1B).

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Demographics	The GAENE		The MUM		Phone interviews	
	Total	% (≈)	Total	% (≈)	Total	% (≈)
Gender						
Male	1640	69	1033	58	21	50
Female	742	31	742	42	21	50
Age						
≤18	132	6	226	13	7	17
19–30	1193	50	955	54	20	47
31-40	637	27	382	21	10	24
41-50	273	11	127	7	5	12
≥51	147	6	85	5	-	-
Current status						
High school student	144	6	168	9	5	12
Student (at University)	948	40	702	40	18	43
Graduates	1202	50	826	47	19	45
Others	88	4	79	4	-	-
Educational level (for students and graduates)						
Associate diploma	149	7	156	10	-	
Bachelor of Science	1028	48	719	47	22	59
Master of Science	524	24	368	24	12	32
PhD	373	17	183	12	3	9
Not mentioned	76	4	102	7	-	-
Major (for students and graduates)						
Engineering sciences	645	30	522	34	9	25
Humanities	510	24	412	27	12	32
Basic sciences	426	20	238	16	8	22
Medical sciences	221	10	175	12	3	8
Agriculture & Veterinary	131	6	49	3	3	8
Others	58	3	67	4	2	5

Table 1. Demographic features of the participants for the GAENE and MUM surveys

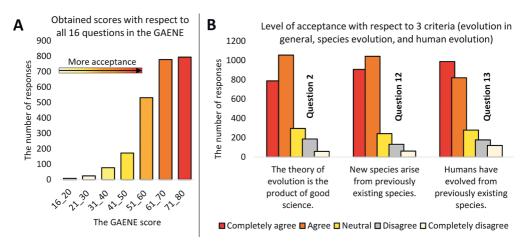


Fig. 1. The level of evolution acceptance based on (A) the obtained scores by the GAENE participants (the score 16=the lowest level of acceptance, the score 80=the highest level of acceptance) and (B) Three criteria implemented in the survey (evolution in general (question 2), species evolution (12), and human evolution (13))

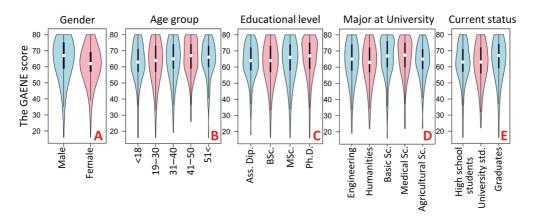


Fig. 2. The range of scores obtained by 2382 participants in the GAENE survey based on demographic features (A: Gender, B: Age group, C: Educational level, D: Major at University, E: Current status). The scores 16 and 80 (shown on the vertical axis) correspond to the lowest and highest level of acceptance, respectively. White circles show the medians; box limits indicate the 25th and 75th percentiles as determined by R software; whiskers extend 1.5 times the interquartile range from the 25th and 75th percentiles; polygons represent density estimates of data and extend to extreme values (Ass. Dip. = Associate Diploma, BSc. = Bachelor of Science, MSc. = Master of Science, Sc. = Sciences, Std. = Student)

Additionally, the level of acceptance was relatively the same with respect to different demographic features (Fig. 2). Curiously, 45 out of 147 participants who received the highest score (80) were engineering students/graduates followed by basic sciences and humanities. There were only four participants with the lowest score (16) including two PhD holders.

Understanding measured by the GAENE questionnaire

The level of understanding was also high in our sample population. Nearly 59% of participants were able to answer at least 6 out of 9 questions from the MUM questionnaire correctly (Fig. 3A). Nearly 87, 75, and 67% of participants answered to the questions 9, 2, and 1 (about fossils, nature of science, and classification, respectively) (Fig. 3B).

Also, Fig. 4 shows that, similar to evolution acceptance, understanding of evolution doesn't change sharply when participants are divided based on demographic features. Expectedly, 25 out of 95 participants who answered all the questions correctly (9 scores) were medical science students/graduates, followed by engineering and humanities.

Phone interviews

The results from the interviews confirmed the results from the GAENE and MUM surveys, even though many interviewees claimed that they are religious individuals who pray three times a day. Self-reported religiosity and the frequency of pray were considered as factors determining whether interviewees are religious. Plotting interviewees' responses based on their self-reported religiosity and frequency of pray showed a relatively unifying acceptance and understanding of different aspects of evolution.

Similar to the two written surveys, regardless of being religious/non-religious, interviewees showed a high level of acceptance regarding different aspects of evolution, such as changes in species and animal as well as human evolution (Fig. 5A). The same patterns were observed when asking about the relationship between interviewees' notion of evolution and their belief system. For instance, regardless of being religious/non-religious, most interviewees saw no conflict between accepting evolution and believing in God. They also rejected the idea that accepting evolution leads to atheism, destroying the meaning of human life (Fig. 5B). They also extended this pattern when evolution and Islam were involved as they rejected the idea that "*evolution is a western idea and doesn't have a place in Islam*" (Fig. 5C).

Discussion

In this study, we took the issue of biological evolution as an example for understanding how modern science is being communicated among Iranians. Previously, scholars like Burton [4; 5] and Kazempour and Amirshokoohi [6] criticized superficial analyses that overly rely on state religiosity to explain the treatment of evolution in national science education without considering local political and social circumstances. A high level of acceptance and understanding of biological science in Iran supported by both quantitative and qualitative data in our study may be explained by cultural, religious, educational, and sociopolitical factors.

It is often challenging to compare studies, as they use different tools and sample populations. However, our results suggest that evolution is being communicated among Iranians differently compared to other Muslim and even secular communities. For instance, Smith et al. [7] used the same tool (the GAENE questionnaire) and a similar sample population (600 American high-school and post-secondary students), which give a solid base for comparing the results. Interestingly, our participants showed a remarkably higher level of evolution acceptance than Smith et al. [7] (Fig. 6).

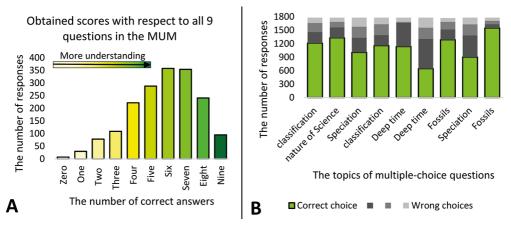


Fig. 3. The range of evolution understanding based on (A) the obtained scores by the MUM participants (Zero = no understanding, Nine = the highest level of understanding) and (B) Five criteria implemented in the survey (classification (questions 1 and 4), deep time (5 and 6), fossils (7 and 9), speciation (3 and 8), nature of science (2)

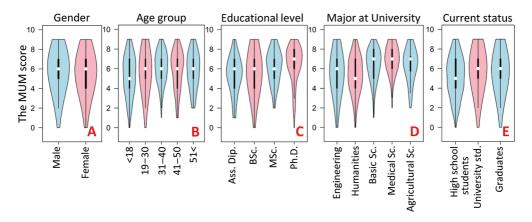


Fig. 4. The range of scores obtained by 1775 participants in the MUM survey based on demographic features (A: Gender, B: Age group, C: Educational level, D: Major at University, E: Current status). The scores 0 and 9 (shown on the vertical axis) correspond to the lowest and highest level of understanding, respectively (the image and abbreviations are explained in Fig. 2's caption)

In one study, BouJaoude et al. [10] reported that Egyptian and Lebanese Muslim students have misconceptions about evolution and the nature of science, which often lead to rejecting evolution. In their studies, for example, 50.5 and 50.9% of the participants disagreed that "*Humans and monkeys share a common ancestor*" and "*All living things on the planet come from the same common Ancestors*", respectively. These results are the exact opposite of 76% of our participants, who completely agreed/agreed with the statement "*Humans have evolved from previously existing species*". Another study [11] showed much lower acceptance and knowledge of evolutionary theory among Pakistani medical students, compared to medical students/graduates in our survey. For instance, the average percentage of the correct answer to 10 questions designed to assess knowledge about evolution was 50.2%, while this value reached 76% in medical students/graduates answering

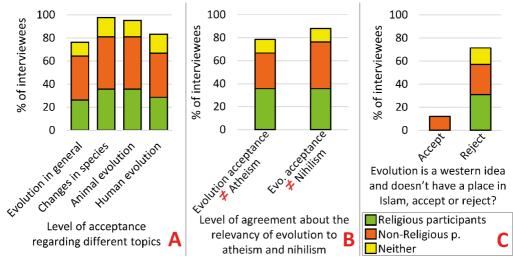


Fig. 5. % of interviewees who (A) accepted evolution in general, changes in species, animal, and human evolution (out of 42 individuals) based on their self-reported religiosity, (B) rejected the idea that evolution acceptance equals atheism and nihilism, and (C) rejected/accepted the idea that "*evolution is a western idea and doesn't have a place in Islam*" (C) (Ambiguous answers are not included)

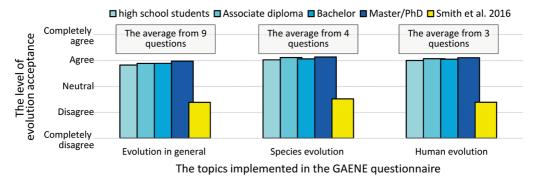


Fig. 6. A comparison of the level of evolution acceptance between our participants (high-school students, Associate diploma, bachelor, master, and PhD students/graduates) (n = 2074) and Smith et al. [7] (600 high-school and post-secondary students) based on the 16 questions implemented in the GAENE questionnaire. The value for the bars evolution in general, species evolution, and human evolution was calculated from taking the average of 9, 4, and 3 questions, respectively

9 questions from the MUM survey in our study. The same was true about acceptance as only nearly 30% of Pakistani medical students showed moderate to high level of acceptance based on the MATE scores, while 93% of medical students/graduates in Iran completely agreed/agreed with evolution based on the GAENE scores. Similar to Bou-Jaoude et al. [10], the clash of religious beliefs with evolutionary teachings and lack of a thorough understanding was proposed by Yousuf et al. [11] as the main reasons for low acceptance of evolution among Pakistani medical students. It is noteworthy to mention again that BouJaoude et al. [10] and Yousuf et al. [11] used different tools to assess acceptance and understanding, which makes apple-to-apple comparison difficult. The length

and the depth of each questionnaire and number of items vary among different tools for assessing acceptance and understanding of evolution. Nevertheless, it seems evident that a high level of religiosity, as well as absence of evolution in the official national curriculum, are important factors leading to misconceptions and misunderstandings about evolution. Nevertheless, the significance of the differences observed in our sample population and these studies is large enough to pursue a rational argument about why evolution is perceived differently in Iran.

Starting with the educational factors, we believe that the inclusion of evolutionary topics in high school and a compulsory unified national curriculum play an important role in our participants' high level of acceptance and understanding. Evolutionary topics have been taught in high school's biology courses that are among all students' compulsory courses in Iran. They may learn that the evolution is guided by God or is according to the laws of the designed world, or some of them can explain the existence of some biological processes but not all of them, especially human cognitive faculties, but still the education of the process of evolution, the hierarchy of categories of species and the evolution of species in millions of years are among the essential part of natural science studies in Iran's schools. For example, we asked interviewees whether they have heard of Charles Darwin. One of the high-school students said: "I heard about the theory of human genesis based on Darwin's ideas... I did some research about it..." Another high-school student stated: "I heard about Darwin in the Campell biology book... I realized that evolution through natural selection was Darwin's work". It is also important to note that Iran is among the top 10 countries with the highest number of universities in the world. Although some criticize such explosive growth in higher education after the 1978 revolution to compromise the quality of the outputs, however, it definitely has created a great opportunity for the public to experience an academic atmosphere more tangibly. This seems among the explanations of wide acceptance and understanding of evolution in today's Iran. There are more than 3 million university students now in Iran across the whole country. The distribution of universities in Iran also is not restricted to big cities, but also one can see them in small towns or even in the countryside. This distribution of the higher education distinguishes Iran from other Muslim countries. Every student can be a missionary of modern science to his/her family and neighbors and so indirectly educate them.

Regarding religious factors, we observed that the way our participants formulated their attributes to religious beliefs and evolution was unique compared to other Muslimmajority countries. It seems that in Iran, people do not oppose the scientific worldview with the religious worldview. That is probably why the acceptability of evolutionary theory is comparably the same among religious and non-religious participants. Comparing our results with Hameed et al. [12] shows that in other Muslim countries, the evolutionary theory is not usually welcomed by even the secular part of the society, similar to the religious part but in a less assertive way. To discriminate between the two poles of the society, we can refer to the statistics based on the frequency of pray, in Hameed et al. [12] or to self-identification as a religious person. According to our survey, Iranians are divided into three groups as 40, 38, and 22 % of them pray three times, never, and occasionally, respectively. Another survey report from 2020 with a sample population of over 50 thousand participants suggested that only 32 % of the Iranian population identifies themselves as Shiite Muslim with the rest as atheist (9%), Zoroastrian (8%), spiritual (7%), agnostic (6%), and Sunni Muslim (5%). Curiously, 33 % of the sample population did not identify themselves to any of the abovementioned categories. The study also states that the Iranian society is under a significant transformation as half of the sample population reported losing their religion. In comparison with the percentage of people who favor Sharia' explicitly to be an official ruler in their country as the sign of identifying themselves as supporting religious life in Afghanistan (99%), Egypt (74%), Iraq (91), Pakistan (84%), as the major neighbors of Iran (according to the studies by Pew Research Center 2013) and also Turkey (12%), only half of Iranian people favors Sharia' as the official ruler. However, while the percentage of religious favoring in other mentioned countries correspondence. Based on our results, about 80% of our participants completely agree or to some extent agree with the evolutionary theory, while they were widely distributed with regard to religiosity as shown in our survey and other's . This strange difference seems to be an indicator that in Iran, people consider science not as an enemy of religion or as its rival but as a separate domain of inquiry.

Accordingly, religiosity does not seem to be an influential factor when it comes to accepting the evolution among our participants (Fig. 5). Otherwise, we should have observed hesitancy and rejection among religious participants. Based on several participant's quotations, it can be argued that they were able to separate evolution and their belief system, something we cannot see among other Muslim societies, as mentioned in Hameed et al. [12], even though they (physicians and medical students) are expected to do so due to their profession and educational degree. For example, we asked our participants whether they had heard of Richard Dawkins (as a prominent biologist who believes evolution leads to atheism). Interestingly, nearly 45 % of our participants knew him, and they had read his famous books like *The blind watchmaker* or *The selfish gene*, which have been translated and published widely in Iran. Very interestingly, almost all the participants who knew Dawkins paid tribute to him when they were talking about Dawkins' contribution to evolutionary science but negatively criticized him because of his efforts to announce atheism as an undeniable consequence of evolution. One male interviewee with a degree in humanities said: "...Dawkins has some presumptions (his atheistic point of view) which jeopardize his scientific argument..." Another female participant who is a Master graduate in agriculture showed her criticism of Dawkins' worldview as follows: "...I bought one of his books called The blind watchmaker and read it... he completely accepts evolution and rejects the role of God in his book...he also considers humans as robotic and mechanistic creatures... I am 100% in agreement with him about evolution, but I think his mechanistic point of view about humans is too simple-minded. I don't want to say humans are separated from other animals, but he has to be more flexible when it comes to these issues". We came across another participant who had a bachelor degree in humanities. He also felt unpleasant about Dawkins trying to popularize atheist through evolution as follows: "...First I saw some video clips about him on the internet in which atheists and religious people had a debate... I also read The blind watchmaker... I follow him only as an evolutionist who has some opinions about evolution, not more, and when I assess his ideas by my mind... I have recently understood that some philosophers were against his ideas... he is just a biologist and doesn't know more than philosophers". Another participant who is a student also said: "...I accept Dawkins' ideas only scientifically... I am completely neutral toward his beliefs though". In the same way, 38 out of 42 participants believed that people could accept evolution and also believe in Allah at the same time, even though 16 of them considered themselves as non-religious people.

Conclusion

In this paper, we try to demonstrate that upon experimental statistics of the contemporary society of Iran, this country holds an exceptional position among other Muslim countries on acceptance of modern science as the main paradigm of human understanding of the natural world. While recently published reports on the Muslim and Christian worlds show that there is a counterbalance between religiosity of the society and public acceptance of evolutionary theory, in Iran, despite of the fact that most people are identified as religious, a significant majority of individuals (nearly equal to the majority of Northern European societies) accept evolution as a process according to which human beings and other biological systems and species have been developed. Although most Iranians think that evolution might be regarded to be in conflict with religious beliefs or worldview, they try to distinguish scientific theories from religious views. This distinction is also culturally and politically important. Iranians have gone a hard way toward modern society through two revolutions in the recent 100 years and are still striving to find a new way to save their traditional heritage in the modern world.

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Современные науки в религиозном Иране: анализ позиции образованного населения Ирана в отношении вопроса биологической эволюции*

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Мнение о взаимном противоречии ислама и науки, особенно если речь в религиозных обществах, широко распространено. Одним из главных предметов спора является биологическая эволюция, поскольку эта проблема выводит дискуссию на уровень метафизических вопросов. Однако, несмотря на наличие данных о низком уровне принятия концепции эволюции и понимания ее основных принципов в странах с суннитским большинством населения, в шиитском Иране наблюдается во многом иная ситуация. Учитывая это, мы провели исследование с использованием двух опросников и телефонных интервью, целью которого было выявление мнения образованных иранцев об эволюции. В результате мы пришли к важному выводу, подкрепленному внушительным объемом данных, полученных с помощью опросников: большинство иранцев принимают принципы, лежащие в основе как науки, так и религии, и осведомлены о об их противоречиях, в том числе в вопросе эволюции человека. Кроме того, ключевые концепции теории эволюции оказались известными большому количеству респондентов. Наконец, исследование показало, что иранцы — причисляющие себя как к религиозным, так и к нерелигиозным, — не считают эволюцию и систему религиозных верований взаимоисключающими. В процессе изучения этого культурного феномена, уникального среди мусульманских стран, мы высказали предположение, что он возник благодаря трем обстоятельствам: централизованной государственной системе образования, внедряющей естественные науки на уровнях старших классов школы и университета; абсолютной доступности академического знания широким слоям населения; а также достаточно терпимой по отношению к научному мировоззрению интерпретации идей ислама. Данное исследование имеет большое значение для понимания проблемы взаимоотношений науки и ислама.

Ключевые слова: наука и ислам, признание эволюции, Иран, эволюция и религия.

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