COMPARING SKILLS AND ATTITUDES OF SCIENTISTS, MUSICIANS, POLITICIANS AND STUDENTS

Klaus Jaffe, Astrid Florez, Valentina Grigorieva, Guillermo Mascitti and Isabel Castro

SUMMARY

In order to study the presumed existence of specialized skills and attitudes related to scientists, questionnaires sent to authors publishing during the last three years in academic journals from different disciplines, and to elected members of Latin American parliaments, were analyzed. To correlate skills and attitudes with success in science the questionnaire was also sent to a targeted group of scientists in Venezuela and Russia. In addition, first year higher education students from different countries were questioned. To tease out the effect of age and culture the results from all the three groups were compared. A discriminant factor analysis of the results grouped the different branches of the natural and life sciences in a single compact cluster showing that natural scientists from different disciplines share fundamental values, skills and attitudes. The social sciences clustered in another separate group. Musicians and politicians fell far outside both clusters. Low levels of religiosity in research scientists were also found. Politicians differed most from natural scientists, whereas social scientists were somewhat intermediate between these two extreme groups. Despite the fact that our samples came from very different populations, reflecting different interests, backgrounds, nationalities and cultures, a relationship between religiosity, skepticism and belief in science was detected. Similarities among students of the five countries studied, and among all researchers sampled, were significantly greater than cultural similarities between students and researchers of the same country, showing that recognizable sub-cultures driven by their interest in science are being formed.

Introduction

All extant sophisticated animal societies tend, at one phase of their evolution, to produce specialization of labor (Wilson, 1975). Humans have evolved, trough nature and nurture, different types of tasks during the last few thousands of years (Hawks *et al*., 2007), producing specialized labor skills for various tasks including collecting and hunting, agriculture, animal breeding, and craftsmanship and commerce (Klein, 1989). Despite the specialization in tasks performed by individuals there has been no tendency for morphological polymorphism among humans (McKellar and Hendry, 2009). Thus, other mechanisms that allow divergence in task specialization must be at work, possibly associated to complexity, with more efficient information transmission and storage, with higher social cohesiveness, and with a more sophisticated division of labor (Jaffe, 2007).

The mechanisms and underlying genes defining task specialization have profound effects on the working of our society because they mould its characteristics (Fowler *et al*., 2008). From a biological perspective, the future evolution of modern human society may follow two different routes. We could continue the trend of ever finer task specialization of our members (Smith, 1838), eventually including specialization in

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COMPARACIÓN DE HABILIDADES Y ACTITUDES DE CIENTÍFICOS, MÚSICOS, POLÍTICOS Y ESTUDIANTES

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RESUMEN

Para identificar posibles actitudes y habilidades relacionadas al ejercicio profesional de las ciencias, se analizó un cuestionario que fue enviado a académicos que publicaron artículos en revistas especializadas durante los últimos tres años. También se envió el cuestionario a miembros electos de parlamentos latinoamericanos y a un grupo seleccionado de científicos en Venezuela y Rusia, y se recogieron las respuestas al cuestionario de estudiantes de primer año universitario de países diversos. La comparación de las respuestas de estos grupos diversos permitió identificar efectos relacionados con edad y cultura. Un análisis de factores discriminantes identificó a un grupo de académicos de diferentes disciplinas de las ciencias naturales que comparten valores fundamentales, actitudes y habilidades. El análisis reveló un segundo grupo formado por profesionales de las ciencias sociales. Músicos y políticos se ubicaron bien fuera de cualquiera de estos dos grupos. El análisis reveló que investigadores científicos mostraron los niveles de religiosidad más bajos. Los políticos mostraron las mayores diferencias con los científicos naturales, mientras que los científicos sociales mostraron características intermedias entre estos dos grupos. A pesar de que la muestra provenía de poblaciones muy diferentes, que podrían significar diferencias de intereses, nacionalidades y culturas, se detectaron correlaciones muy significativas entre la religiosidad, escepticismo y aprecio a la ciencia. La similitud entre los estudiantes de los cinco países estudiados, y entre todos los investigadores estudiados, eran significativamente mayores que las similitudes entre estudiantes y profesionales del mismo país. Ello sugiere que se están formando sub-culturas basadas en intereses hacia la ciencia.

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RESUMO

Para identificar possíveis atitudes e habilidades relacionadas ao exercício profissional das ciências, foi analisado um questionário que foi enviado a acadêmicos que publicaram artigos em revistas especializadas durante os últimos três anos. Também se enviou o questionario a um grupo selecionado de científicos na Venezuela e Rusia, e se recolheram as respostas ao questionario de estudantes de primeiro ano universitário de países diversos. A comparação das respostas destes grupos diversos permitiu identificar efeitos relacionados com idade e cultura. Uma análise de fatores discriminantes identificou a um grupo de acadêmicos de diferentes disciplinas das ciências naturais que compartem valôres fundamentais, atitudes e habilidades. A análise revelou um segundo grupo formado por profissionais das ciências sociais. Músicos e políticos se situaram bem fora de qualquer de estes dois grupos. A análise revelou que investigadores científicos mostraram os níveis de religiosidade mais baixos. Os políticos mostraram as maiores diferenças com os científicos naturais, enquanto que os científicos sociais mostraram características intermedias entre estes dois grupos. Apesar de que a amostra era proveniente de populações muito diferentes, que poderiam significar diferenças de interesses, nacionalidades e culturas, se detectaram correlações muito significativas entre a religiosidade, ceticismo e apreço à ciência. A similitude entre os estudantes dos cinco países estudados, e entre todos os investigadores estudados, eram significativamente maiores que as similitudes entre estudantes e profissionais do mesmo país. Isto sugere que se estão formando sub-culturas baseadas em interesses com a ciência.

reproductive tasks, following the path to eusociality as exemplified by social insects and the naked mole rats (*Heterocephalus glaber*). Alternatively, our species could eventually stop evolving more cohesive societies and evolve individuals with better and more diverse skills as is the case of a large number of non-social species. That is, future societies might tend to dilute task specialization by developing professional skills that can be handled equally well by most people. However, the little empirical evidence available for humans indicates that they will continue towards greater task specialization (Jaffe *et al*., 1993)

Among the new professionals modern society has developed are research scientists. The professions are in continuous evolution (Herrera *et al*., 2010) helping to shape modern society. Science, through its scientists, has had a very large impact on human society in the last millennium (Jaffe, 2000). It is often assumed that scientists have special personalities, or at least skills that differ from professionals in other areas. Yet, what are the skills, if any, that are particular to scientists and what are the personality traits that favor success among scientists?

Empirical evidence shows that, when analyzed at the level of different countries, science is strongly correlated with industrial and economic development (Jaffe, 2005). This analysis also showed that between and inside countries there is a negative relationship between indexes of religiosity and development. Examination of publication patters showed that a gradient of skepticism characterizes the various sciences, where hard sciences such as physics report more negative results than softer sciences such as sociology (Fanelli, 2010), confirming that skepticism and the prevalence of empiricism over pure rationality are the basis of modern science (Jaffe, 2009).

The relationships between science and development reported in Jaffe (2005) support studies of modern economy that relate scientific development with technological advances and economic development (Schumpeter, 1939; Pérez, 2002). Yet science seems to be a relative novel area of human knowledge and is by far the most difficult to study compared to other more traditional areas of knowledge. For example, Kelly (1976) measured the relative difficulty in studying certain subjects and found that A-level Physics and Chemistry were much more difficult than Arts and Sociology. The same trend was evident even when using various different and more sophisticated methods to evaluate the relative difficulty between subjects (Korobko *et al*., 2008).

Several cross cultural comparisons of vocational preferences have been published (e.g. Rounds and Tracey, 1996; and Fouad, 2002; amongst others), but few systematic studies about scientific personalities exist, de-

spite many prejudgments regarding the personality of scientists in the popular literature, Notable exceptions are studies on gender differences and professional preferences for science, such as that of Gardner (1974). To fill this gap in knowledge, a special questionnaire was developed aiming at characterizing the personality of scientists. The questionnaire builds on a previous study examining the propensity for the belief in the paranormal (Bressan, 2002).

The present study aims at identifying skills and attitudes that are correlated with active research scientists, and contrast them with those of other non-scientific professionals. Potential respondents were selected among academics that authored articles published in peer reviewed international journals in Physics, Mathematics, Chemistry, Botany, Sociology, Business and Music, and compare them with politicians recruited among deputies of the national assemblies or congresses on three Latin American countries. As a more focused reference, authors publishing in the highly selective interdisciplinary journal *Nature* were also included. To tease out the effects of culture and age high caliber scientists were targeted in two countries and the skills and attitudes of first year undergraduates examined.

Methods

A questionnaire was developed, aimed to explore aspects of introvert-extrovert personality, subjective appreciation of probability, authority *vs* evidence based personality, degrees of self-confidence, fallibility, gullibility, affection, empathy, social networking, honesty, curiosity, motivation towards scientific research, and a self-evaluation of skills and interests. Biological features (sex and age) were also asked. A preliminary version of the questionnaire was tested and validated among students and researchers in Italy, Venezuela and Switzerland and highly correlated answers were eliminated so as to prune down the questions to a list that required ticking 42 choices and that could be answered in 5-8min. Versions of the questionnaire in English, Spanish, German and Russian were produced. The questionnaire can be downloaded at www.dic.coord.usb.ve/AcadSkillsLimeSurvey.pdf

The electronic version of the questionnaire was send by e-mail using "Lime Survey" to authors publishing during the years 2006-2009 (from now on referred to as 'academic authors'). The following journals were used to extract the e-mail addresses (number of authors contacted in parenthesis): The general science journal *Nature* (410); physics**:** *New Journal of Physics* (1087); chemistry**:** *Inorganic Chemistry* (499), *Organic Letters* (501); Botany: *Annals of Botany* (499); mathematics: *ESAIM* (423); sociology**:** *Behavior and Social Issues* (43), *Electronic Journal of Sociology* (88), *Bangladesh e-Journal of Sociology* (39), *American Journal of Economics and Sociology* (135), *Annual Review of Sociology* (130), *International Journal of the Sociology of Law* (101), *International Journal of Sociology of Agriculture and Food* (36), *Sociology of Religion* (162), *Rural Sociology* (137), *Qualitative Sociology* (263), *Journal of Political and Military Sociology* (20), *Journal of Sociology and Social Welfare* (10), *International Journal of Japanese Sociology* (51), *Canadian Review of Sociology and Anthropology* (93), *Chinese Sociology and Anthropology* (3), *Canadian Journal of Sociology* (43), *Current Research in Social Psychology* (14); psychology: *Addictive Behavior* (143), *Applied Cognitive Psychology* (32), *Developmental Psychology* (39), *Social Psychology* (23), *Perceptual Cognitive Psychology* (7), *Electronic Journal of Research in Educational Psychology* (14), *Current Psychological Letters* (30); psychiatry: *Archives of Clinical Neuropsychology* (26), *British Journal of Psychiatry* (329); business: *International Business Review* (280); and music: *Music Theory on Line* (368), *South Central Music Bulletin* (85), *Journal of Seventeenth Century Music* (47), *Revista Electrónica de Musica* (13). Authors with more than one published paper were filtered so as to send them the questionnaire only once. For this group, profession was determined by the journal where he/she published his/her work. In addition, for comparisons with out-groups 586 politicians were surveyed (elected members of the National Congress of México, Chile and Colombia).

Scientists that publish in professional journals have a highly diverse cultural background, come from a wide range of countries, and have different ages and academic histories. For these reasons a second part to this study, which sought uniformity in age, cultural background and academic history, was designed. To test whether age influenced the results of the inquest, groups of first year higher education students from Switzerland (155), Venezuela (165), Russia (182), Germany (92), and New Zealand (329) were asked to answer to the questionnaire. From now on these will be referred to as 'students'. To address differences in response due to culture and academic history the questionnaire was sent to experienced researchers in Russia and Venezuela (from now on referred to by nationality). The questionnaire for these two last groups included questions that allowed a measure of achievement or productivity. All groups were asked the same questions, except Venezuelan authors and those publishing in *Nature*, who were asked to write a random number rather than identify one from a list. In Venezuela researchers were drawn from the list of 1500 researchers registered at the Venezuelan Science Ministry in the so called *Programa de Promoción del Investigador* or PPI, which classifies researchers in five levels according to their scientific productivity and impact factor, normalized by discipline. This classification was used as a proxy to academic achievement. The group of Russian scientists (50) included people working in economics, mathematics, physics, geography and biology. They were asked to report their total number of publications and indicated the number published in peer reviewed journals to use this information as a proxy for academic achievement.

Answers to the questions from the groups of inquest in various combinations were analyzed using MANOVA to determine the effect of profession on the answers given. Cluster analyses, using single linkage with Euclidean distance, was used to give a visual representation of the differences in the answers obtained. A sample of professions reflecting the results of the MANOVAs were used for a discriminant analysis. Statistics were done using Excel 97, Statistica 6.0 and SYSTAT 12. In order to reduce type I statistical errors, only those results where the null hypothesis is rejected with $p<0.001$ were analyzed.

Results

Response to the questionnaire

The level of response to the questionnaire (results given as mean ±1 standard deviation) was similar to that reported in other studies worldwide. On average 8.08 ±2.72% (3.75-11.76%) of the academic authors in the selected journals and 11% of Venezuelan scientists (173 of 1500) responded. The situation was different for students because the questionnaire was offered before or immediately after classes and most students tended to respond. Sample sizes for each group tested varied from 22-173 for authors, Venezuelan and Russian scientists (50.07 ±39.47). For students response ranged from 92 to 329 (184.60 ±87.60) and depended on class size.

Professional characteristics among academic authors

Table I summarizes the academic authors' mean score for each question grouped by profession. The data showed much higher inter-groups variability compared to intra-group variance. Of the 30 items each analyzed with ANOVA in Table I, 19 showed statistically significant variances between the groups at $p<0.001$.

TABLE I
RANGE OF VALUES, MEAN RESPONSES BY ACADEMIC AUTHORS AND POLITICIANS, AND ANOVAS, FOR EACH OF THE QUESTIONS ASKED

Question	Num	Natu	Bot	OChe	IChe	Phys	Mat	Soc	Bus	Psol	Psat	Music	Pol	F	p
1 A leader has to use some pressure	1-5	3.75	3.58	3.58	3.82	3.38	3.24	3.51	3.47	3.71	3.22	3.80	3.19	1.343	0.197
2 I think of doing things differently	1-5	2.80	2.96	3.54	2.86	2.96	2.84	3.09	3.33	2.68	2.78	3.24	2.19	1.893	0.038
3 I take decisions without much thinking	1-5	2.03	1.98	1.96	2.05	2.32	2.04	1.99	1.80	1.96	2.25	1.68	2.05	1.058	0.394
4 I take risks	1-5	2.80	2.98	2.92	2.27	3.00	2.72	2.64	2.50	3.04	2.47	2.68	2.38	1.720	0.066
5 I look at others from their perspective	1-5	4.08	4.19	4.08	3.91	3.88	3.86	4.46	4.13	4.25	4.36	4.36	4.52	3.411	0.000
6 I can imagine how others feel	1-5	3.93	3.92	3.83	4.05	3.76	3.86	4.11	3.97	3.82	3.83	4.16	4.10	1.172	0.304
7 Most people tell a lie	1-5	2.63	2.90	2.79	2.77	3.00	3.20	2.82	2.73	2.86	2.64	2.80	3.19	1.177	0.300
8 If he compliments he wants a return	1-5	2.55	2.44	2.83	2.50	2.51	2.56	2.34	2.27	2.18	2.25	2.40	2.57	1.227	0.266
9 Giants of the past allow to see further	1-5	3.85	4.00	3.75	3.95	4.01	3.76	3.97	3.63	4.11	3.86	4.24	3.48	1.176	0.301
10 If I don't see... I don't believe	1-5	2.90	2.83	3.21	3.05	2.80	3.08	2.38	2.33	2.29	2.58	2.16	3.10	3.240	0.000
11 Better a bad explanation to none	1-5	1.70	2.42	2.63	2.09	2.42	2.94	1.89	2.57	2.04	2.09	1.52	3.10	5.529	0.000
12 Repetitions in random sequences	0/1	*	0.15	0.17	0.23	0.22	0.18	0.09	0.10	0.18	0.17	0.12	0.19	3.549	0.000
13 Odds according to sample size	0-5	1.35	1.10	0.93	1.02	1.06	0.97	0.97	0.97	0.93	1.11	1.05	0.90	3.569	0.000
15 Participation and decisions	1-5	2.53	2.62	2.54	2.36	2.65	2.54	2.84	2.70	2.71	2.67	2.72	3.05	1.786	0.054
16 Dependence on intuition	1-5	3.50	3.44	3.58	3.64	3.65	3.50	3.50	3.60	3.39	3.50	3.56	3.67	0.872	0.568
17 Professional self esteem	1-5	3.98	3.88	4.17	4.00	4.15	3.78	4.00	4.10	4.00	4.00	4.16	4.19	1.654	0.081
18 Religiosity	0/1	0.13	0.28	0.09	0.38	0.25	0.30	0.30	0.28	0.35	0.23	0.36	0.70	2.539	0.004
19 Belief in astrology	0/1	0.15	0.18	0.05	0.07	0.06	0.05	0.15	0.09	0.08	0.09	0.14	0.05	0.692	0.746
20 Belief in luck	0/1	0.48	0.36	0.52	0.37	0.30	0.45	0.40	0.36	0.26	0.34	0.48	0.50	0.790	0.650
21 Belief in science	0/1	0.58	0.48	0.67	0.57	0.61	0.47	0.38	0.35	0.55	0.63	0.30	0.54	1.780	0.056
22 Number of contacts	1-5	2.50	2.48	2.25	2.45	2.34	2.54	2.57	2.53	2.86	2.86	2.52	3.76	5.119	0.000
23 Degree of honesty	1-5	2.68	2.60	2.46	2.41	2.53	2.58	2.60	2.37	2.46	2.56	2.64	2.52	0.814	0.626
24-1 Skills with numbers	1-5	2.15	2.48	2.29	2.36	1.92	2.44	2.75	2.53	2.36	2.28	2.16	2.14	4.379	0.000
24-2 Skills in recognizing faces	1-5	2.40	2.33	2.63	2.59	2.62	2.48	2.38	2.73	2.43	2.86	2.52	2.38	0.949	0.493
24-3 Skills in remembering names	1-5	3.48	3.56	3.21	3.45	3.59	3.28	3.38	3.50	3.43	3.67	3.68	2.95	1.148	0.321
24-4 Skills in remembering events	1-5	2.40	2.38	2.67	2.77	2.46	2.48	2.41	2.40	2.39	2.44	2.52	2.33	0.463	0.926
24-5 Skills with writing	1-5	2.35	2.27	2.29	2.36	2.24	2.22	2.21	2.00	2.43	2.28	1.88	2.00	0.901	0.539
24-6 Skills in noticing details	1-5	2.23	2.15	2.54	2.64	2.34	2.64	2.51	2.67	2.61	2.56	2.32	2.38	1.460	0.143
24-7 Skills in detecting magic tricks	1-5	3.53	3.65	3.46	3.77	3.32	3.58	3.97	3.83	3.68	3.89	4.40	3.71	3.338	0.000
25 Perceived professional impact	1-5	2.48	2.46	2.63	2.86	2.18	2.22	2.49	2.33	2.64	2.81	2.08	3.33	4.121	0.000
27 Number of interests	1-5	2.30	2.48	2.29	2.41	2.39	2.44	2.53	2.53	2.57	2.42	2.52	2.76	0.658	0.778
26-1 Interest in history	1-5	4.00	3.90	3.63	4.18	3.85	3.76	4.21	4.17	3.82	4.11	4.04	4.52	2.101	0.019
26-2 Interest in geography	1-5	3.68	3.83	3.17	3.86	3.27	3.42	3.70	3.83	3.18	3.39	3.56	3.67	2.177	0.015
26-3 Interest in politics	1-5	3.88	3.37	3.17	3.59	3.51	3.38	4.31	3.87	3.68	3.69	3.52	4.52	6.374	0.000
26-4 Interest in economics	1-5	3.25	2.96	2.88	3.14	3.18	3.08	3.68	4.20	3.18	3.39	2.72	4.05	5.780	0.000
26-5 Interest in nature	1-5	4.78	4.69	4.00	4.14	4.19	3.88	3.56	3.70	4.00	3.94	3.88	4.05	7.909	0.000
26-6 Interest in society	1-5	3.98	3.65	3.13	3.86	3.41	3.28	4.79	4.20	4.07	4.14	3.96	4.33	17.51	0.000
26-7 Interest in psychology	1-5	3.38	3.29	2.75	3.45	3.24	2.76	3.80	3.53	4.54	4.42	4.00	3.43	10.26	0.000
26-8 Interest in arts	1-5	3.55	3.40	3.00	3.68	3.20	3.26	3.67	3.27	3.75	3.50	4.88	3.48	5.205	0.000
26-9 Interest in sports	1-5	2.85	2.94	3.38	2.95	2.57	2.76	2.76	2.67	2.54	2.83	2.56	3.57	1.474	0.138
26-10 Interest in family	0-5	4.20	4.21	4.21	4.36	4.14	4.10	4.45	4.20	4.32	4.58	4.52	4.14	1.359	0.189
28 Gender F=1, M=2	1/2	1.85	1.76	1.83	1.73	1.94	1.87	1.60	1.87	1.26	1.75	1.68	1.81	14.25	0.000
29 Age	>18	43.0	42.4	42.4	49.5	38.6	41.3	47.4	48.6	45.9	42.8	43.9	47.8	4.2	0.000
30 Interest in questionnaire's results	0/1	0.70	0.67	0.75	0.64	0.76	0.56	0.51	0.50	0.79	0.69	0.64	0.86	2.344	0.008
Percent responding		10.2	11.2	4.79	4.41	7.96	11.8	11.8	8.3	9.72	10.1	6.3	3.8	-	-
Number of persons contacted		410	464	501	499	942	425	853	360	288	355	400	586	-	-
Number of responders		42	52	24	22	75	50	72	30	28	36	25	22	-	-

*A different question was included in the questionnaire.
Num: range of values for answers, Nat: publishing in *Nature*, Bot: botany, OChe: organic chemistry, IChe: inorganic chemistry, Phy: physics, Mat: mathematics, Soc: social sciences, Bus: business, Psol: psychology, Psat: psychiatry, Music: academic musicians, Pol: politicians, p values ≤0.01 are considered significant.

Some of the results shown in Table I could have been expected on the basis of stereotypes or preconceived ideas. For example, politicians reported to have the most empathy whereas mathematicians the least (Q5: 4.52 ±0.9 *vs* 3.86 ±0.8). Chemists were the least gullible, in terms of physical evidence, whereas musicians the most (Q10: 3.21 ±1.3 *vs* 2.16 ±1.1). Politicians reported to contact the most people in everyday life whereas organic chemists the least (Q22: 3.76 ±1.09 *vs* 2.25 ±0.98). Politicians reported the highest professional impact whereas musicians the lowest (Q25: 3.33 ±0.65 *vs* 2.08 ±0.86). In general, the interests reported (Q26) corresponded to what is expected by the given profession. Inorganic chemists were on average the oldest respondents whereas physicists the youngest (Q29: 49.5 years old ±12 *vs* 38.6 ±10)

More surprising results were that politicians were happy with any explanations whereas musicians preferred none to a bad one (Q11: 3.10 ±1.4 *vs* 1.52 ±0.7). Sociologists reported to have the highest skills working with numbers whereas physicists reported the lowest (Q24-1: 2.75 ±0.9 *vs* 1.92 ±0.7). Musicians felt most confident in catching magician's tricks whereas physicists were the least confident (Q.24-7: 4.40 ±0.7 *vs* 3.32 ±1).

The results deemed to be more relevant to the aim of the study include finding that physicists had the best intuition of what a random number should look like (Q12), followed by chemists, botanists, mathemati-

cians and politicians, whereas sociologists, business and musicians had the lowest scores. Authors publishing in *Nature* demonstrated the highest understanding that increased sample size provides statistical robustness (Q13). Scientists generally were not religious; the least religious were the organic chemists and the authors publishing in *Nature* whereas politicians were the most religious (Q18: 0.13 ±0.3 *vs* 0.7 ±0.4).

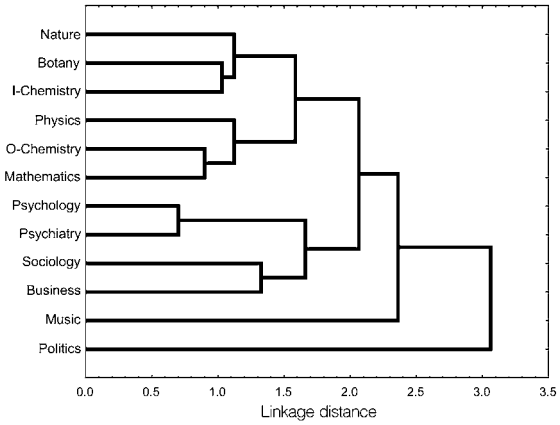

Figure 1. Cluster analysis using weighted pair-group averages and Euclidean distances of the data from Table I.

Gender inequality was found to be very high (Q28). Most professional researchers answering the questionnaire were males, except among psychologists and sociologists.

A cluster analysis of the 31 items in Table I, giving the aggregate differences of the scores given to the questions (excluding age and sex), separated the professionals in two main groups (Figure 1 and Table II). The professionals in the social sciences associate together in one group and professionals in the natural sciences in the other, although all the researchers had some degree of overlap. Politicians as a group, differed significantly from the other professionals questioned (Figure 2 and Table III).

Interestingly, large differences between sub-disciplines such as organic and inorganic chemistry were revealed, whereas disciplines that call themselves very distinct from each other, such as psychology and psychiatry, showed very similar results (Figures 1 and 2, Tables II and III).

Correlations with scientific achievement

Among Venezuelan researchers (Table IV), correlations between academic achievement as measured by the level of the researchers in the PPI, and the responses to the questionnaire, were as follows: High academic classification levels in PPI correlated with less religiosity (Q18; r= 0.4, p<0.001), and with a more critical attitude as measured by Q10 (r= 0.17, p= 0.03). Interestingly, increased modesty regarding the estimation of its impact on society (Q25) also correlated positively with academic excellence(r= 0.21, p= 0.008). None of the responses to these three questions differed statistically between the different areas of science (ANOVAs p for Q10, Q18, Q25 ≥0.5).

Regarding the Russian sample, which was smaller, fewer statistically significant correlations were found. These

TABLE II
CANONICAL DISCRIMINANT FUNCTIONS FOR FOUR PROFESSIONAL GROUPS*. STANDARDIZED BY WITHIN VARIANCES

Question	1	2	3
1 A leader has to use some pressure	0.019	0.361	0.050
2 I think of doing things differently	0.190	-0.247	-0.131
3 I take decisions without much thinking	0.153	0.070	-0.541
4 I take risks	0.223	0.050	0.321
5 I look at others from their perspective	-0.145	0.360	0.368
6 I can imagine how others feel	-0.057	-0.253	-0.404
7 Most people tell a lie	0.067	0.031	0.150
8 If he compliments he wants something	0.132	-0.031	0.282
9 Giants of the past allow to see further	0.016	-0.242	0.454
10 If I don't see and touch, I don't believe	-0.113	-0.029	0.083
11 Better a bad explanation to none	0.088	0.575	0.003
12 Nr of repetitions in random sequences	0.254	0.091	-0.225
15 Participation and decisions	-0.096	0.033	-0.076
13 Sample size and determining odds	0.123	-0.246	0.187
16 Dependence on intuition	0.248	0.237	-0.098
17 Professional self esteem	-0.015	-0.346	0.007
18 Religiosity	0.051	0.397	-0.248
19 Belief in astrology	-0.252	-0.037	-0.033
20 Belief in luck	0.028	0.034	0.072
21 Belief in science	0.189	0.123	0.041
22 Number of contacts	0.080	0.580	0.059
23 Degree of honesty	-0.061	-0.107	0.103
24-1 Skills with numbers	-0.524	-0.050	0.286
24-2 Skills in recognizing faces	0.148	-0.036	-0.031
24-3 Skills in remembering names	-0.038	-0.235	-0.108
24-4 Skills in remembering events	0.023	-0.093	0.139
24-5 Skills with writing	-0.051	-0.385	0.216
24-6 Skills in noticing details	0.054	-0.027	-0.496
24-7 Skills in detecting magic tricks	-0.321	0.093	0.521
25 Perceived professional impact	-0.049	0.337	-0.055
27 Number of interests	-0.128	0.201	-0.121
26-1 Interest in history	-0.089	0.104	-0.089
26-2 Interest in geography	-0.112	-0.530	0.293
26-3 Interest in politics	0.050	0.507	-0.494
26-4 Interest in economics	0.048	0.170	-0.322
26-5 Interest in nature	0.468	0.214	0.535
26-6 Interest in society	-0.946	-0.173	0.245
26-7 Interest in psychology	-0.185	-0.253	-0.545
26-8 Interest in arts	0.376	-0.050	-0.026
26-9 Interest in sports	-0.150	0.214	0.131
26-10 Interest in family	0.364	-0.266	-0.041
Interest in questionnaire	0.241	0.135	0.210

* Botany. physics. politics and sociology.

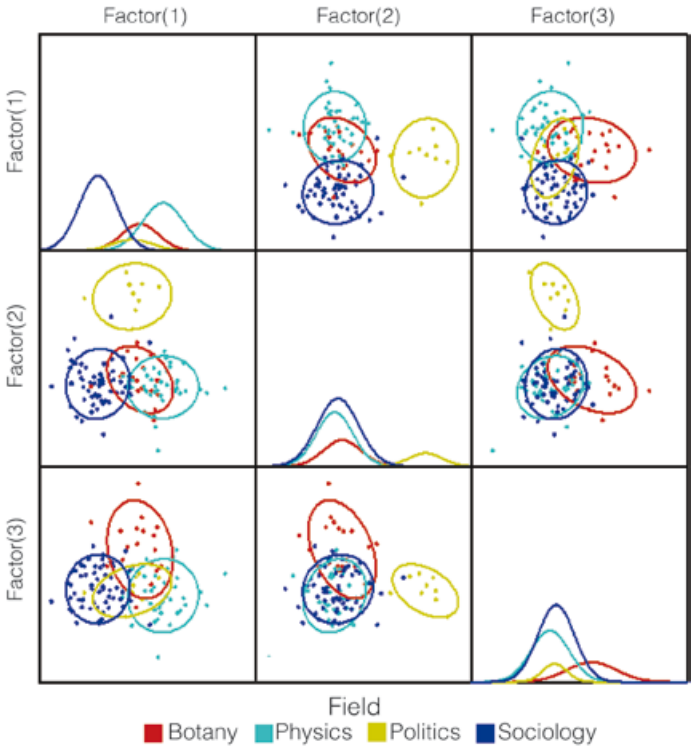

Figure 2. Canonical scores plot of the discriminant analysis for four selected groups of professionals. Data from Table II.

TABLE III
CANONICAL SCORES OF MEANS OF FOUR PROFESSIONAL GROUPS STANDARDIZED BY WITHIN VARIANCES

	1	2	3
Botany	0,629	-0,084	1,646
Physics	1,819	-0,470	-0,500
Politics	0,229	4,198	-0,261
Sociology	-1,533	-0,304	-0,186

were: Self esteem (Q17) correlated with total number of publications reported (r= 0.46, p<0.01), but not very convincingly with the number of publications in peer-reviewed journals (r= 0.37, p= 0.02). Both publication indices correlated significantly with age (r= 0.57 and 0.55, p<0.0001) and with responses to the question regarding giants of the past (Q9: r= 0.45 and 0.42, p<0.01).

One important result, thus, is that low religiosity and high tolerance-humility correlate with scientific productivity in the samples of Venezuelan and Russian researchers, and this is also found in the sample of academic authors. This suggests that the results drawn are rather robust, given that the same trends emerged even if the selection of individuals was very different.

Cultural differences

Cultural differences might be responsible for many of the different responses found. Therefore, we tested the questionnaire comparing academics in single countries, Venezuela and Russia. The results for scientists in Venezuela (Table IV) followed a similar pattern as that described for academic authors, showing that professionals in different disciplines respond significantly different to the questionnaire (Table I). Even details such as natural scientists showing poor statistical intuition and social scientists reporting good skills working with numbers were confirmed in this sample.

Comparisons between groups

Table V shows the means for the answers from different groups of students and researchers. To make comparisons between students of different countries and between the group of students and the researchers, the data in Table I was pooled so that all researchers from botany, physics, mathematics and chemistry were grouped in RN (research in natural science) and those from business and sociology in RS (research in social science). Musicians and politicians were groped in O (others). Students (S) were grouped according to nationality in Swiss (SS), German (SG), Russian (SR) and Venezuelan (SV), and so were researchers (R) from Russia (RR) and Venezuela (RV).

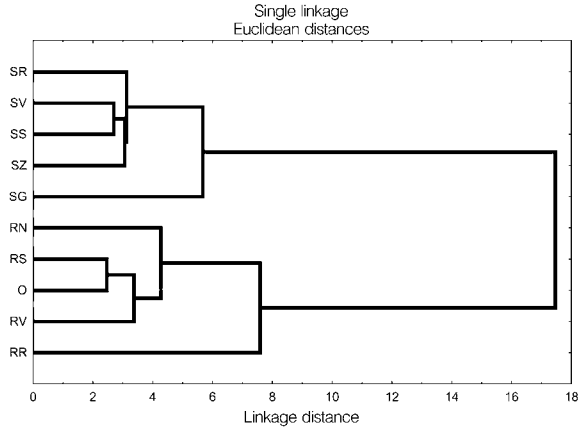

Figure 3. Cluster analysis of the data from Table V.

There were highly significantly differences among these groups (Table VI). The exploratory multivariate analysis (Tables VI and VII, and Figures 3 and 4) shows that two main clusters emerge, namely students and researchers, with a large gap between them (Figure 3). This separation emerged despite the fact that we worked with students from different academic careers, including social and natural science; and despite the cultural differences due to nationality.

The most striking difference between all student groups and all researcher groups was reflected in religiosity (Q18) with an ANOVA F= 22.8, p<0.001; belief in astrology (Q19) with F= 39.5, p<0.001; and belief in science (Q21) with F= 6.2, p<0.001), as shown in Table VI. That is, the skeptical attitude and belief in the scientific method is less present in students and more prevalent in researchers in all countries.

TABLE IV
AVERAGE RESPONSES BY GROUPS OF AREAS OT KNOWLEDEGE, FROM A SAMPLE OF VENEZUELAN RESEARCHERS WHOSE *CURRICULA VITAE* WERE ACCESSIBLE

Question	PCM	AE	L	ENG	SS	F	p (ANOVA)
6 I can imagine how others feel	3.33	4.03	4.17	4.06	4.37	4.563	0.002
9 Giants of the past allow to see further	3.00	1.87	2.94	2.88	2.69	4.164	0.003
10 If I don't see and touch, I don't believe	3.27	2.69	2.94	2.25	2.47	2.142	0.078
13 Sample size and determining odds	3.00	4.19	3.70	3.53	3.54	3.243	0.014
18 Religiosity	1.53	1.32	1.38	1.31	1.33	0.674	0.611
24-1 Skills with numbers	2.07	2.44	2.40	2.25	3.00	4.405	0.002
24-2 Skills in recognizing faces	2.80	2.69	2.52	3.31	2.37	2.534	0.042
25 Perceived professional impact	2.80	2.71	3.44	3.00	3.33	2.976	0.021
26-1 Interest in history	3.20	3.77	3.60	3.50	4.00	1.879	0.116
26-2 Interest in geography	2.87	3.79	3.52	3.31	3.15	2.965	0.021
26-3 Interest in politics	3.20	3.18	3.00	3.13	3.98	5.136	0.001
26-4 Interest in economics	2.80	2.97	2.50	3.31	3.52	5.316	0.000
26-5 Interest in nature	3.93	4.64	4.52	3.88	3.55	11.438	0.000
26-6 Interest in society	3.27	3.49	3.19	3.50	4.58	14.302	0.000
26-7 Interest in psychology	2.87	3.26	3.23	3.25	4.00	5.374	0.000
26-8 Interest in arts	3.47	2.97	3.52	3.00	3.41	1.687	0.155
26-9 Interest in sports	2.73	2.62	2.65	2.80	2.31	0.675	0.610
26-10 Interest in family	3.47	3.95	4.04	3.13	4.07	3.787	0.006
28 Gender	1.33	1.44	1.54	1.13	1.58	3.322	0.012
29 Age	44.4	47.4	47.5	43.3	47.8	0.957	0.433
Educational level (median)	4	4	4	4	4	1.049	0.302
Years of post graduate studies (median)	4	5	5	4	6	2.04	0.060
Classification in PPI	2.80	2.31	2.81	2.25	2.53	1.536	0.194
Number of publications SCI (median)	34	25	29	19	23	0.957	0.492
Year of first publication (median)	1990	1990	1987	1993	1990	1.001	0.425
Interest in questionnaire (median)	1	1	1	1	1	0.998	0.473
Time to respond questionnaire (median)	54	81	84	75	75	1.151	0.291
Sample size n	15	39	48	16	55		

Areas of knowledge: physics-chemistry and mathematics (PCM), agriculture and ecology (AE), life sciences (L), engineering (ENG), and social sciences (SS). P values ≤0.05 are considered significant.

Discussion

Of the various interesting results found, we will focus on the following five features revealed by the study:

1. *A uniform personality prevails among natural scientists*. It is interesting to note that our cluster analysis and the discriminant factor analysis pooled the different branches of the natural sciences in a single compact cluster. Thus, scientists from the various different disciplines within the natural sciences share fundamental values, skills and attitudes that seem to be related to their professional activity.

2. *Lack of religiosity is correlated with scientific professions*. The finding of lower religiosity in more productive scientists supports the assumption that science favors the development of a skeptical attitude among its practitioners, or that individuals with

TABLE V
RANGE OF VALUES, MEAN RESPONSES FOR GROUPED STUDENTS AND RESEARCHERS, AND ANOVAS, FOR EACH OF THE QUESTIONS ASKED

Question	Students					Professional researchers					ANOVA	
	SZ	SS	SG	SV	SR	RV	RR	RN	RS	O	F	p
1 A leader has to use some pressure	3.74	3.48	3.47	3.11	3.75	3.35	3.94	3.51	3.50	3.52	6.545	0.000
2 I think of doing things differently	3.49	3.07	2.95	2.58	3.45	2.21	3.12	2.97	3.13	2.76	19.213	0.000
3 I take decisions without much thinking	2.64	2.63	2.15	2.88	2.55	2.06	2.22	2.10	1.95	1.85	15.969	0.000
4 I take risks	3.06	2.65	3.02	2.97	2.81	2.48	2.36	2.84	2.60	2.54	6.402	0.000
5 I look at others from their perspective	3.92	3.74	4.19	4.08	3.70	4.52	3.98	3.99	4.38	4.43	14.848	0.000
6 I can imagine how others feel	3.80	3.47	3.90	3.88	3.75	4.10	3.78	3.87	4.08	4.13	7.059	0.000
7 Most people tell a lie	3.30	4.13	3.55	4.16	3.54	3.68	2.98	2.92	2.80	2.98	32.677	0.000
8 If he compliments he wants something	2.39	2.17	2.56	2.29	2.91	2.19	3.02	2.54	2.32	2.48	11.819	0.000
9 Giants of the past allow to see further	3.12	2.40	2.68	2.47	3.47	2.61	3.86	3.91	3.90	3.89	45.092	0.000
10 If I don't see and touch, I don't believe	2.70	2.90	1.80	2.90	2.99	2.68	3.14	2.93	2.37	2.59	10.199	0.000
11 Better a bad explanation to none	2.88	2.65	2.22	2.16	2.87	2.02	3.24	2.40	2.03	2.24	12.610	0.000
13 Sample size and determining odds	1.47	0.97	0.82	0.69	0.08	0.74	0.78	1.07	0.77	0.76	23.586	0.000
15 Participation and decisions	2.06		2.47	2.89	2.38	2.65	2.08	2.57	2.80	2.87	23.784	0.000
16 Dependence on intuition	3.57	3.56	3.58	3.36	3.51	3.51	3.60	3.55	3.52	3.61	1.820	0.060
17 Professional self esteem	3.54	3.10	3.51	3.57	3.51	4.31	3.62	3.99	4.02	4.17	47.603	0.000
18 Religiosity	0.35	0.43	0.30	0.81	0.41	0.65	0.32	0.24	0.29	0.52	22.864	0.000
19 Belief in astrology	0.33	0.27	0.39	0.23	0.81	0.48	0.54	0.10	0.12	0.10	39.494	0.000
20 Belief in luck	0.49	0.59	0.56	0.35	0.70	0.55	0.64	0.40	0.37	0.49	7.976	0.000
21 Belief in science	0.44	0.21	0.24	0.35	0.34	0.28	0.52	0.56	0.37	0.39	6.249	0.000
22 Number of contacts	2.88		2.79	2.85	2.55	2.44	2.28	2.43	2.57	3.09	8.682	0.000
23 Degree of honesty	2.34	2.10	2.22	2.21	1.91	2.59	2.44	2.56	2.54	2.59	25.160	0.000
24-1 Skills with numbers	2.68	3.01	2.44	2.53	2.68	2.56	2.42	2.24	2.71	2.15	10.469	0.000
24-2 Skills in recognizing faces	2.18	1.99	2.46	2.24	2.27	2.59	2.90	2.50	2.46	2.46	6.384	0.000
24-3 Skills in remembering names	3.02	2.52	3.35	3.16	3.05	3.43	3.14	3.46	3.40	3.35	11.126	0.000
24-4 Skills in remembering events	2.46	2.39	2.49	2.18	2.14	2.30	2.26	2.49	2.40	2.43	2.511	0.007
24-5 Skills with writing	2.65	2.29	2.27	2.56	2.33	2.04	2.24	2.28	2.15	1.93	8.083	0.000
24-6 Skills in noticing details	2.46	2.42	2.55	2.44	2.51	2.50	2.90	2.39	2.54	2.35	1.567	0.120
24-7 Skills in detecting magic tricks	3.50	3.61	3.72	3.93	3.45	4.06	3.90	3.52	3.95	4.09	6.675	0.000
25 Perceived professional impact	3.27	1.96	2.79	2.79	3.26	3.15	2.20	2.39	2.45	2.65	34.451	0.000
26-1 Interest in history	2.80	3.20	3.95	2.99	3.25	3.70	4.12	2.40	2.54	2.63	39.278	0.000
26-2 Interest in geography	3.33	3.04	3.36	2.75	2.69	3.39	3.60	3.87	4.20	4.26	32.069	0.000
26-3 Interest in politics	2.99	2.56	3.89	2.52	3.14	3.40	3.10	3.51	3.72	3.61	22.949	0.000
26-4 Interest in economics	2.33	3.01	3.46	2.56	3.87	3.05	3.42	3.49	4.22	3.98	49.434	0.000
26-5 Interest in nature	2.20	3.65	3.77	3.53	3.12	4.13	4.16	3.10	3.79	3.33	61.434	0.000
26-6 Interest in society	4.33	3.56	4.42	3.19	3.91	3.72	3.30	4.30	3.59	3.96	29.368	0.000
26-7 Interest in psychology	3.47	3.52	3.83	2.96	3.71	3.41	3.14	3.54	4.66	4.13	23.387	0.000
26-8 Interest in arts	3.51	2.77	3.17	3.01	3.60	3.29	3.90	3.16	3.74	3.74	11.458	0.000
26-9 Interest in sports	2.99	3.60	2.72	3.48	3.71	2.56	2.80	3.33	3.57	4.24	18.697	0.000
26-10 Interest in family	3.51		4.46	4.38	4.76	3.89	4.68	2.83	2.73	3.02	72.307	0.000
27 Number of interests	4.52		3.01	3.19	2.37	2.98	1.80	4.18	4.40	4.35	135.70	0.000
28 Gender	1.69	1.61	1.45	1.42	1.66	1.47	1.32	1.74	1.66	1.74	11.660	0.000
29 Age	19.8	19.5	24.6	17.8	17.1	46.9	54.5	41.8	47.7	45.7	524	0.000

SS, SG, SR, SV and SZ: students from Switzerland, Germany, Russia, Venezuela and New Zealand, respectively. RR, RV, RN and RS: researchers from Russia, Venezuela, natural sciences (worldwide) and social sciences (worldwide). O: other (includes musicians and politicians. P values ≤0.05 are considered significant. Shadowed columns correspond to answers from countries represented in both groups: students and professional researchers.

skeptical attitudes are more likely to be important in science, and thus more likely to advance their careers. If it is accepted that increased skepticism is related to increased awareness of the statistical nature of chance events, then this result expands previous findings by Bressan (2002), who showed that frequent experience of coincidences and a more biased representation of randomness correlate with belief in the paranormal. The finding that first year science students were significantly more religious and less skeptical than professional scientists supports this claim. This difference in religiosity between students and researchers within the same culture suggests either that students suffer a fundamental change during their studies or that non-skeptical religious students are more likely to drop out from scientific careers before engaging in professional science.

3. *Politicians are less skeptical than scientists.* Politicians are clearly very different from scientists. This may help to explain the difficulties in communication between both groups. The differences are not only related to skills and interests but are also evidenced in different values and ways of thinking. For the future success of modern society, these differences need to be better understood in order to facilitate communication between the two groups.

4. *Sociologists are the academics less similar to natural scientists and closest to business people.* Sociologists differ significantly from other scientists. They seem to be divided into two groups. One of the groups aligns with the social scientists, while the other aligns with the natural scientists. Thus, practitioners of sociology seem not to have stabilized as a professional group. Many of the practitioners of sociology seem to have similar personalities to other sciences, making the enterprise of conciliating the social sciences with the natural sciences an endeavor that is not necessarily doomed to fail. Interestingly, researchers in business seem to show responses similar to sociologists. This probably reflects academic historical constraints in that business studies are more influenced by the social sciences than by the natural sciences.

5. *Cultural differences, although strongly affecting the answers to the questionnaire, did not hide the link between religiosity, skepticism and belief in science.* Our samples came from very different populations, reflecting different interests, backgrounds, nationalities and culture. Yet cultural differences, although strongly affecting the answers to the questionnaire do not hide the link between religiosity, skepticism and belief in science. On the contrary, statistically significant differences between students of all the cultures studied and all researchers, could be demonstrated in the answers to questions relevant to science.

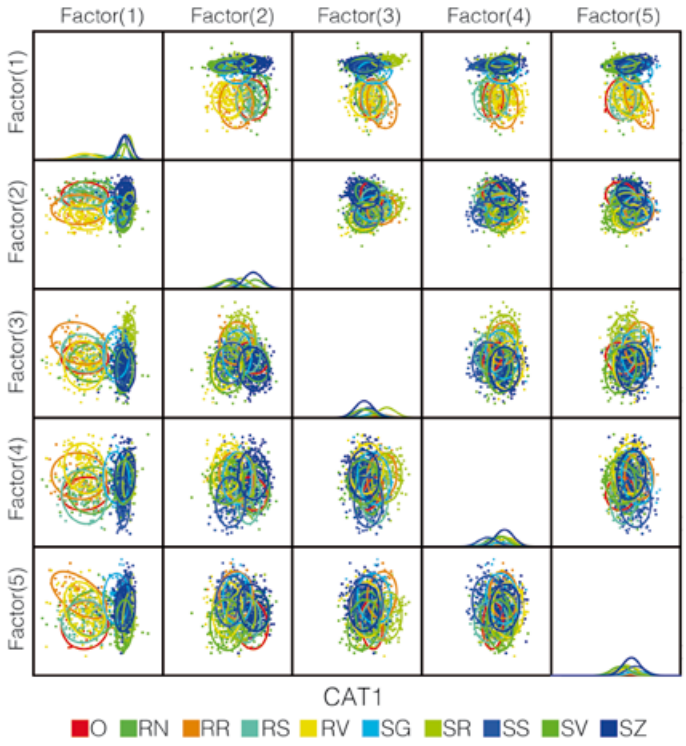

Figure 4. Canonical scores plot of discriminant analysis of data in Table VI.

TABLE VII
CANONICAL SCORES OF GROUP MEANS FOR GROUPED STUDENTS AND RESEARCHERS

	1	2	3
O	-2.972	1.242	0.149
RN	-2.141	1.595	-0.203
RR	-3.612	-0.531	1.280
RS	-3.087	0.836	0.514
RV	-3.040	-1.542	-0.413
SG	0.539	-0.423	0.418
SR	1.941	0.009	1.836
SS	1.382	-1.157	-0.226
SV	1.412	-1.550	-0.791
SZ	1.496	1.366	-0.699

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TABLE VI
CANONICAL DISCRIMINANT FUNCTIONS FOR GROUPED STUDENTS AND RESEARCHERS, STANDARDIZED BY WITHIN VARIANCE

Question	1	2	3
1 A leader has to use some pressure	0,002	0,003	0,018
2 I think of doing things differently	0,069	0,125	-0,147
3 I take decisions without much thinking	0,004	0,166	0,031
4 I take risks	-0,023	0,001	0,019
5 I look at others from their perspective	-0,086	-0,153	0,189
6 I can imagine how others feel	-0,036	-0,026	0,112
7 Most people tell a lie	-0,173	0,119	0,039
8 If he compliments he wants something	0,127	0,030	0,147
9 Giants of the past allow to see further	0,244	-0,044	-0,153
10 If I don't see and touch, I don't believe	-0,019	-0,063	-0,086
11 Better a bad explanation to none	-0,030	0,189	-0,042
13 Sample size and determining odds	0,055	-0,108	-0,152
16 Dependence on intuition	0,014	-0,026	-0,094
17 Professional self esteem	-0,044	-0,471	0,268
18 Religiosity	-0,416	-0,135	-0,224
19 Belief in astrology	-0,444	0,246	0,103
20 Belief in luck	-0,302	-0,054	0,130
21 Belief in science	-0,636	-0,325	-0,217
23 Degree of honesty	0,007	-0,384	-0,088
24-1 Skills with numbers	-0,072	0,097	-0,120
24-2 Skills in recognizing faces	-0,015	-0,102	0,100
24-3 Skills in remembering names	0,108	-0,165	0,197
24-4 Skills in remembering events	-0,081	-0,035	-0,174
24-5 Skills with writing	-0,067	0,037	-0,008
24-6 Skills in noticing details	0,085	-0,050	0,069
24-7 Skills in detecting magic tricks	-0,058	-0,121	0,096
25 Perceived professional impact	0,029	0,107	0,409
26-1 Interest in history	-0,125	0,325	0,386
26-2 Interest in geography	0,106	-0,424	-0,342
26-3 Interest in politics	0,041	-0,232	0,240
26-4 Interest in economics	0,175	0,298	-0,182
26-5 Interest in nature	-0,181	-0,073	0,291
26-6 Interest in society	0,083	0,030	-0,105
26-7 Interest in psychology	0,063	-0,097	-0,266
26-8 Interest in arts	0,041	0,070	0,131
26-9 Interest in sports	0,006	0,142	-0,270

REFERENCES

Bressan P (2002) The connection between random sequences, everyday coincidences, and belief in the paranormal. *Appl. Cogn. Psychol. 16*: 17-34.

Fanelli D (2010) "Positive" results increase down the hierarchy of the sciences. PLOS One 5(4) doi:10.1371/journal.pone.0010068

Fouad NA (2002) Cross-cultural differences in vocational interests: Between-group differences on the strong interest inventory. *J. Counsel. Psychol. 49*: 283-289.

Fowler JH, Dawes CT, Christakis NA (2008) Model of genetic variation in human social networks. *PNAS 106*: 1725-1730.

Gardner P (1974) Sex differences in achievement, attitudes, and personality of science students: A review. *Res. Sci. Educ. 4*: 231-258.

Hawks J, Wang E, Cochran GM, Harpending HC, Moyzis RK (2007) Recent acceleration of human adaptive evolution. *PNAS 104*: 20753-20758.

Herrera M, Roberts DC, Gulbahce N (2010) Mapping the evolution of scientific fields. PLOS One 5(5) doi:10.1371/journal.pone.0010355

Jaffe K (2000) Step back to see how science and humanity fit in the big picture. *Nature* 407: 128.

Jaffe K (2005) Science, religion and economic development. *Interciencia 30*: 370-373.

Jaffe K (2007) *La Riqueza de las Naciones: Una Visión Interdisciplinaria*. Banco Central de Venezuela and Equinoccio. Caracas, Venezuela. 159 pp.

Jaffe K (2009). *What is Science: An Interdisciplinary Perspective*. University Press of America. Lanham, MD, USA. 120 pp.

Jaffe K, Urribarri D, Chacon GC, Diaz G, Torres A, Herzog H (1993) Sex linked strategies of human reproductive behavior. *Social Biol. 40*: 61-73.

Kelly A (1976) A study of the comparability of external examinations in different subjects. *Res. Educ. 16*: 37-63.

Klein RG (1989) *The Human Career: Human Biological and Cultural Origins*. Chicago University Press. Chicago, IL, USA. 544 pp.

Korobko OB, Glas CAW, Bosker RJB, Luyten JW (2008) Comparing the difficulty of examination subjects with item response theory. *J. Educ. Meas. 45*: 139-157.

McKellar AE, Hendry AP (2009) How humans differ from other animals in their levels of morphological variation. *PLoS ONE 4*: e6876

Pérez C (2002) *Technological Revolutions and Financial Capital: the Dynamics of Bubbles and Golden Ages*. Edward Elgar. Northampton, UK. 208 pp.

Rounds J, Tracey TJ (1996) Cross-cultural structural equivalence of RIASEC models and measures. *J. Counsel. Psychol. 43*: 310-329.

Schumpeter JA (1939) *Business Cycles. A Theoretical, Historical and Statistical Analysis of the Capitalist Process.* McGraw-Hill. New York, USA. 461pp

Smith A (1838) *An Inquiry into the Nature and Causes of the Wealth of Nations*. http://books.google.com/books?id=i_EOvi4LT_QCandprintsec=frontcoveranddq=adam+smith+wealth+of+nationsandas_brr=1andhl=in

Wilson EO (1975) *Sociobiology: The New Synthesis*. Belknap. Cambridge, MA, USA. 697pp.