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Social Representations of Science among University Students and Teachers in Latvia

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The aim of this research was to study the social representations of science of university students and teachers in Latvia. A sample of 185 undergraduate students and 26 university teachers took part in the study. Respondents had to assess the similarity between the seven disciplines: physics, psychology, astrology, biology, mathematics, history, and philosophy on a five-point scale. Multidimensional scaling in two dimensions of perceived similarity of the disciplines was used. The respondents grouped the seven disciplines around two dimensions: 'precise' and 'humanistic' sciences. Psychology and astrology were located in intermediary positions. All the disciplines were rated to the extent they use the principles of science on a five-point scale. Humanitarian disciplines were regarded as less relying on scientific principles in comparison to the natural sciences. Surprising was the fact that all the respondents found a higher degree of similarity between physics and mathematics and astrology than psychology. Economy and biology undergraduates and teachers of psychology perceived astrology as being more scientific than philosophy and history.[1]

Keywords: social representations, science, undergraduate students, university teachers

Social representations are values, ideas, and collectively practiced forms of cognition shared within a society, which facilitate the understanding and communication of the world (Moscovici, 1984). The theory of social representations is based on Emil Durkheim's assumption of 'collective psyche'. Social representations are cognitive systems with their own language and logic. They do not simply represent 'beliefs about', 'images', or 'attitudes', instead, they are 'theories', and 'knowledge systems' ready to organize reality (Moscovici, 1981), they are a kind of modern myths. Social representations may be common for the whole nation (society), and may act as knowledge structures enhancing the differentiation between social groups. Social representations are prescriptive with respect to human cognition, however, people often are unaware of this determinacy and call it 'common sense'.

Social representations have three main functions (Moscovici, 1976): (1) they are an instrument for understanding the social world, that is, they are categories used by individuals to describe, classify, and explain, (2) they mediate behavior – determine group communication within a group, denote values, regulate behavior, (3) they are an instrument for adaptation – relate the perceived to the known and help to maintain a stable view of the world.

The development of social representations is based on two processes (Moscovici, 1981). First, anchoring implies that unfamiliar objects are classified and designed by comparing them to the known and culturally available categories. It is a social tendency to give names and labels by comparing with a prototype. It is not solely an intellectual operation as 'recognition'; it also

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includes a formation of an attitude towards the object. Second, objectification is a process that turns unfamiliar and abstract ideas and images into a concrete and objective reality of common sense. Unclear notions are transformed into a clear image by the reality construction. The most common way of objectification is by personifying, for example, psychoanalysis and Freud. The new knowledge is included into the earlier structures by simplifying them. For instance, such conceptual and analytical categories as 'neurosis' and 'complexes' (also 'ego' and 'psyche') are perceived as objective realities with definite physical attributes.

The development of the theory of social representations started with the research of the socially shared knowledge of psychoanalysis in French society in the late 1950-ies (Moscovici, 1961/1976). Further research was oriented to understanding the social nature of health and illness representations (Herzlich, 1976; Jodelet, 1991; de Rosa, 1987).

The range of study of social representations has widened both in content and methodology during the last decade. These studies include social representations of Europe and the European Union (Barret, 1996; Cinnirella, 1997; Hilton, Erb et al., 1996; Huici & Ros, e.a., 1997; Rutland, 1998), nationalism and collective identity (Augoustinos, 1993; Orfali, 2000), democracy (Markova, Moodie & Plichotva, 2000), universe (Nasciemento-Shulze, 1999), information technologies (Chaib, 2000), internet (Capozza, Falvo, Robusto & Orlando, 2003).

Moscovici (Moscovici, 1984) argues that one of the reasons social representations evolve is an attempt of people to explain dicoveries and theories of science in a manner that is understandable to them. The majority of social representations describe how scientific terms and concepts turn into simplified, common language representations that serve as a basis for assimilation of new information. For Moscovici (Moscovici, 1981) science is related to the so called 'reified universes' in which a society views itself as a system in which every participant is determined 'exclusively by the level of qualification, e.g., as a physicist, as a psychologist etc. (Moscovici, 1981, p.187). Social representations are part of 'consensual universe' in which society 'recognizes itself as a visible, continuous creation which is imbued with meaning and aims' (Moscovici, 1981, p. 186). Every individual is free to behave as an amateur and to express her/his opinions and to create her/his own 'theories' on any kind of matter in this universe.

Studies of social representations describe how a 'reified universe' (scientific theories and ideas) is turning into a consensual universe (common sense understanding). The theory of social representations implicitly assumes that there is only one point of view about the meaning of the word 'science'. Meanwhile, at present scientists themselves have very different views on what science is. Karl Popper's 'critical rationalism' is opposed by 'hermeneutic' understanding of science, for example, in psychotherapy (Pritz, 1999). Some theoreticians of social constructionism suppose that science is one of the social conventions, which could pretend to be true to the same degree as the other social conventions, such as mythology, folklore and occultism (Gergen, 1994). The postmodernistic perspective opens a very broad use of the term 'science' (Woods, 1999).

Such a postmodern view on science now is commonly found in social and natural sciences. Some examples from Latvian science have been described elsewhere (Reņģe, 2003; Reņģe & Austers, 2003). Papers based on methods of astrology, esoteric teachings and occultism have been published as being a 'true psychology' in an edited collection of scientific papers of a leading university. Some of the leading Latvian physicists and mathematicians call for the union of esoteric and scientific knowledge and turning to the world of the 'Great Cosmic Spirit'.

Universities are regarded as academic/scientific institutions. Keeping in mind the existing pluralism of opinions, it was important to find out what 'science' means to university teachers and students. However, one could find several possibilities how to answer this question. In the present study we focused on two issues – (a) what is the perceived point of reference for judging various disciplines following the principles of science, and (b) what are the dimensions employed by students and teachers to account for relationships between different scientific disciplines.

Method

A total of 211 students and university teachers took part in the study. Out of them 63 were undergraduates of economics, 63 were university students of psychology, 59 were biology undergraduates, and 26 were university teachers of psychology. Respondents represented several universities and university colleges of Latvia. All the respondents filled in the questionnaire containing several blocks of questions. First, respondents had to assess the similarity between the following disciplines: physics, psychology, astrology, biology, mathematics, history, and philosophy. The similarity ratings were made on a five-point scale with the end-points marked as "very similar" and "very dissimilar". Second, all the disciplines were rated to the extent that they use the principles of science on a five-point scale with the end-points marked as "completely follows scientific principles" and "does not follow scientific principles at all". The questionnaire was always filled out in a group setting.

Results and Discussion

First we computed the means of the rated extent the seven disciplines employ the principles of science (see Table 1). As it is clearly seen from the results, the general tendency among the respondents was to rate physics, mathematics, and biology as more scientific compared to other disciplines, while other disciplines are considered as being less scientific. A one-way ANOVA with repeated measures showed that there are significant differences in the perceived degree of disciplines as being scientific ($F(6, 774)=107.29$, $p< .000$). The LSD post-hoc comparisons pointed to significant differences ($p< .05$) among all the pairs of comparison except psychology and astrology, and mathematics and biology.

Table 1. *Means and standard deviations of the rated extent the disciplines employ the principles of science across all the subjects*

	Mean	SD
Physics	4.65	0.59
Psychology	3.16	0.92
Astrology	3.20	1.44
Biology	4.33	0.79
Mathematics	4.36	0.94
History	2.87	0.99
Philosophy	2.53	1.13

All the respondents assessed physics, mathematics, and biology as more 'scientific' than other disciplines. We would like to regard the word 'science' as an anchor for the natural and exact sciences. Thus, 'precision' may be a cue word for sciences. A plausible explanation for this finding is that mathematics and physics are taught at schools as the most important subjects. Although history is also taught at schools, students have experienced the facts of history, and contemporary history especially could be interpreted very differently and it might not fit with the representation of science as something precise.

In the next step of the analysis we took a closer look to the same ratings of the extent the seven disciplines follow the scientific principles by all the subgroups of the sample. The results are presented in Table 2. We ran a 4 (Group of subjects) X 7 (Discipline) ANOVA with repeated measures for the second factor. There was a nonsignificant main effect for Group, F (3, 126)=1,79, n.s., a significant effect of Discipline, F (6,756)=88.34, p< .000, and a significant interaction of the two factors, F (18,756)=5.22, p< .000. For the sake of readability we focus on the most interesting post-hoc comparisons (LSD test, p< .05). The undergraduate respondents tended to regard their own major discipline (biology and psychology) as more scientific compared to the opinion by others. Both economy and biology undergraduates believed astrology to be more scientific than psychology undergraduates did, and teachers of psychology perceived astrology to be more scientific in comparison to humanitarian disciplines of history and philosophy. Psychology undergraduates thought of psychology as being more scientific compared to history and philosophy, while teachers of psychology considered only philosophy as being less scientific Also, it was a general trend among students of psychology and biology undergraduates to judge history and philosophy as the least scientific among all the disciplines. At the same time, all the respondents ascribed the highest ratings of being ‘scientific’ to physics, mathematics, and biology and less to other disciplines. One could suggest that physics, mathematics, and biology are a part of the objectification contents of the term ‘science’. These words are used nearly as synonyms of science.

Table 2. *Means and standard deviations of the rated extent the disciplines employ the principles of science across all the subjects given by different groups of the respondents*

	Undergraduates of economics		Undergraduates of psychology		Teachers of psychology		Undergraduates of biology	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Physics	4.76	0.54	4.71	0.56	4.82	0.40	4.47	0.67
Psychology	3.00	0.86	3.47	0.80	2.82	1.17	2.91	0.92
Astrology	4.38	0.80	2.54	1.25	3.09	1.87	3.53	1.37
Biology	4.33	1.02	4.21	0.82	4.73	0.47	4.37	0.66
Mathematics	4.62	0.74	4.51	0.83	4.09	0.94	4.09	1.11
History	3.14	1.15	2.91	0.91	2.40	0.67	2.74	1.07
Philosophy	2.43	1.16	2.68	1.00	2.90	1.22	2.49	1.24

We began the analysis of the similarity ratings of the seven disciplines by running a repeated measures MANOVA with subjects’ group membership as a between-subject factor, and all the pairs of disciplines as a within-subject factor. There was a nonsignificant effect of group membership, F(3, 193)=1.76, n.s., significant effect of the within-subject factor, F(20, 174)=93.67, p< .000, and a significant interaction between the two factors, F(60, 528)=4.16, p< .000.

We also performed post-hoc (LSD) tests to gain a more clear understanding of the underlying data pattern. In the sake of readability we mention the most intriguing differences (p< .05), see Table 3.

Table 3. *Means and standard deviations of the rated similarity among pairs of disciplines*

	Undergraduates of economics		Undergraduates of psychology		Teachers of psychology		Undergraduates of biology	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Physics and psychology	1.67	0.78	2.24	0.96	2.68	0.90	1.98	0.90
Astrology and biology	2.44	1.12	2.10	0.86	2.08	0.76	2.47	1.16
Mathematics and psychology	2.49	1.03	2.73	1.04	3.08	0.91	2.29	1.03
Physics and history	2.43	1.24	2.08	0.96	2.32	0.63	2.12	1.00
History and philosophy	3.92	0.96	4.16	0.77	4.04	0.73	4.17	0.83
Biology and physics	3.52	1.07	3.32	1.03	3.64	0.81	4.10	0.76
Mathematics and astrology	3.94	1.09	3.30	1.16	3.72	1.10	3.76	1.24
Philosophy and physics	2.08	1.02	2.02	1.01	2.38	0.97	2.17	1.02
Psychology and history	2.84	1.05	3.33	0.98	3.44	0.87	3.29	1.13
Astrology and physics	4.38	0.79	3.25	1.23	3.16	1.07	3.69	1.37
Mathematics and biology	2.30	1.03	2.81	1.13	3.20	1.04	3.58	1.03
Philosophy and mathematics	2.14	1.11	2.14	1.16	2.32	0.90	2.42	1.18
Biology and psychology	2.90	1.15	3.85	0.87	4.08	0.76	3.10	1.05
Astrology and philosophy	2.40	1.14	2.89	1.17	3.00	0.91	2.84	1.14
History and mathematics	2.06	0.90	2.03	1.00	2.08	0.70	2.22	1.02
Biology and philosophy	1.95	0.99	2.05	1.01	2.32	0.69	2.55	1.03
Psychology and astrology	2.17	1.09	2.49	1.11	2.76	0.93	2.63	1.17
History and biology	2.05	1.14	2.14	0.96	2.16	0.62	2.40	1.08
Philosophy and psychology	3.83	1.09	4.40	0.66	4.12	0.73	4.05	1.08
Mathematics and physics	4.63	0.58	4.62	0.55	4.56	0.51	4.67	0.69
History and astrology	2.48	0.96	2.14	0.88	2.16	0.69	2.52	1.08

Physics and psychology was considered to be dissimilar by all the respondents with a few exceptions: psychology students and teachers saw more similarity between the two disciplines in comparison to the students of economics, and biology students saw less similarity compared to teachers of psychology. Mathematics and psychology was considered to be similar to the same extent by all the respondents except the students and the teachers of psychology who thought the two disciplines to more similar than did biology students, and the teachers of psychology believed the two disciplines to be more similar than economics students did.

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This pattern of results could reflect a widespread common sense belief that psychology has more to do with intuition and insight than with scientific research. Psychology students and teachers, on the other hand, acknowledged that from the very beginnings psychology as a science was related to physics (e.g. appearance of psychophysics in early 30-ies of the 19th century). Modern psychology is unthinkable without statistics and different kinds of mathematical methods. The majority of modern research in psychology is done acccording to the natural science's paradigm in the Kuhnian sense (Kuhn, 1977). This is ignored by the lay people who still consider psychology as related to physics and mathematics to the same degree as philosophy and history – the ratings of being 'scientific' were low and they are assessed as being far from precise.

Psychology and astrology were supposed to be similar to the same extent with exception -- psychology teachers believed the two disciplines to be more similar than the undergraduates of economics did. The students of economics considered physics and astrology as more similar compared to any other group. We included astrology in the list of disciplines for rather a provocative purpose, as it is generally considered as a pseudoscience (Peyser, 1998). However, the results show that the majority of respondents had a different view about astrology. All the respondents thought of physics and mathematics as being more similar to astrology than to psychology. There are two likely explanations: (a) both astrology and psychology are regarded as somehow different but scientifically equal approaches to understanding human character, or (b) astrology is not differentiated from astronomy. Further research is needed to prove which of these explanations is true. Results from economics undergraduates seemingly confirm the second explanation. A speculative explanation for it could be the fact that astronomy is not a taught subject in Latvian schools.

A surprising finding was that psychology teachers assessed astrology on the same level of 'scientificity' as psychology. It could be explained by the fact that a part of the teachers' sample was quite heterogeneous and represented also schools where such pseudopsychologies as ontopsychology and akmeology are accepted as teaching subjects. We were also interested in uncovering the underlying dimensions people may use in their thinking of different scientific fields. In order to do it, we performed a multidimensional scaling[2] on the similarity rating of all the pairs of the seven disciplines for the total sample and for each of the subject groups separately. This method is used in order to show each data unit (in our case, each of the disciplines) as a point in multidimensional space, while the distances between the data units reflect the level of similarity between the data units (the smaller the distance, the greater the similarity). In all the five cases a two-dimensional solution appeared appropriate to the data (stress values ranged from 0.02 to 0.08).

As shown in the figures (see Figures 1 to 5), the two vectors[3], which describe the spatial pattern of disciplines' arrangement, are 'humanistic' and 'precise'. 'Humanistic' means that disciplines in the direction of arrows are more concerned with discovering the human nature (e.g., the position more in the direction pointed by an arrow means a higher degree of interest in humans). 'Precise', however, holds for a higher degree of exact measures employed in respective disciplines (e.g., the position more in direction pointed by an arrow means a higher degree of precise measurement employed by a discipline). As one can see from the figures, the angles between the vectors differ – the most acute angles are for psychology undergraduates (see Figure 3) and university teachers of psychology (see Figure 4). Hence, for representatives of those groups the relationship between 'precise' and 'humanistic' seem to be less independent. It seems to reflect the same pattern discussed above – the 'own' discipline is always considered as being more 'scientific', consequently, the dimensions become more dependent if persons being related to psychology perform the similarity ratings.

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[2] We used the SPSS software for the calculations, the symmetric matrix of distances served as input data.

[3] *We decided to use oblique vectors instead of independent dimensions as a method for interpretation of the obtained pattern.*

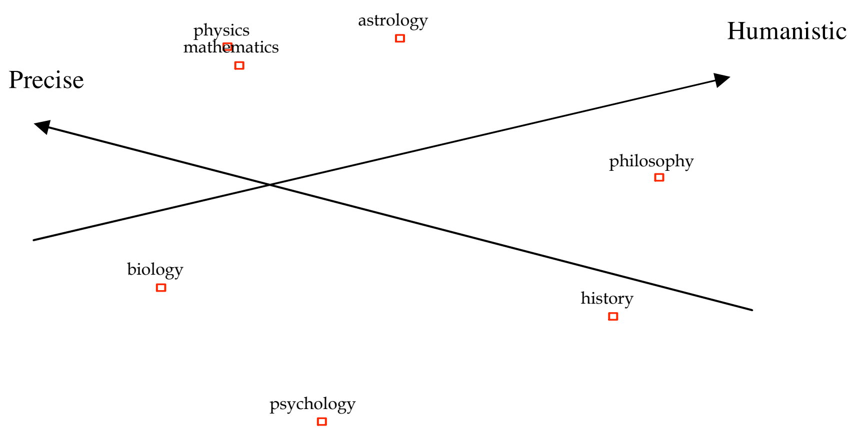


Figure 1. *Multidimensional scaling in two dimensions of similarity among the pairs of disciplines by all respondents*

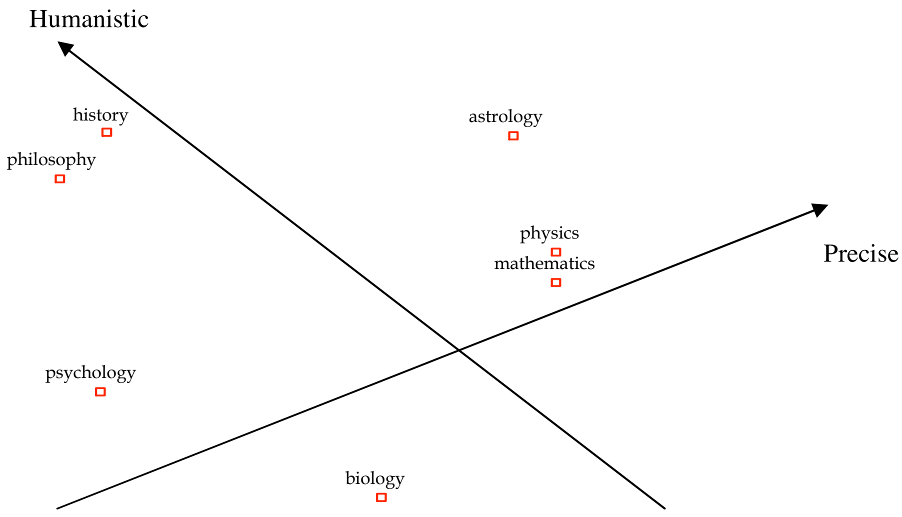


Figure 2. *Multidimensional scaling in two dimensions of similarity among the pairs of disciplines by economics undergraduates*

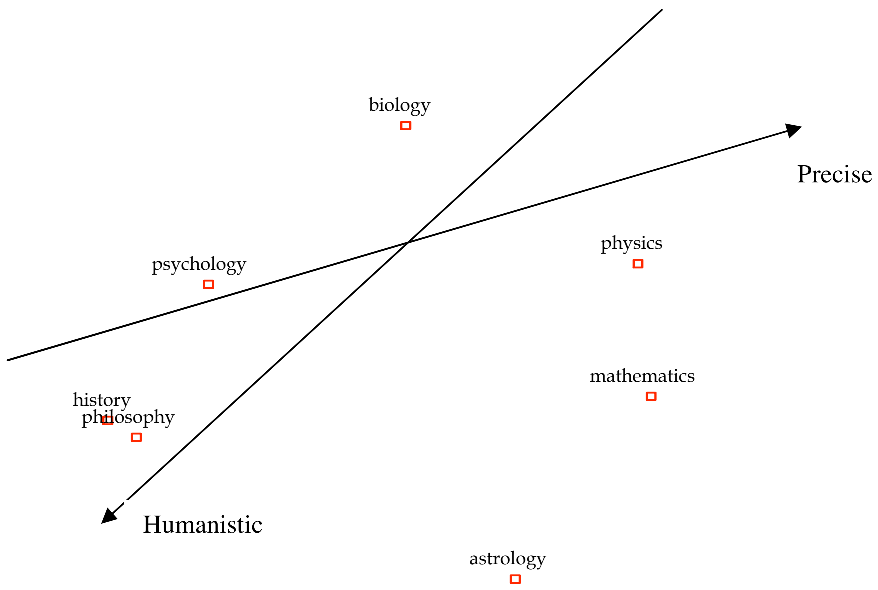


Figure 3. *Multidimensional scaling in two dimensions of similarity among the pairs of disciplines by psychology undergraduates*

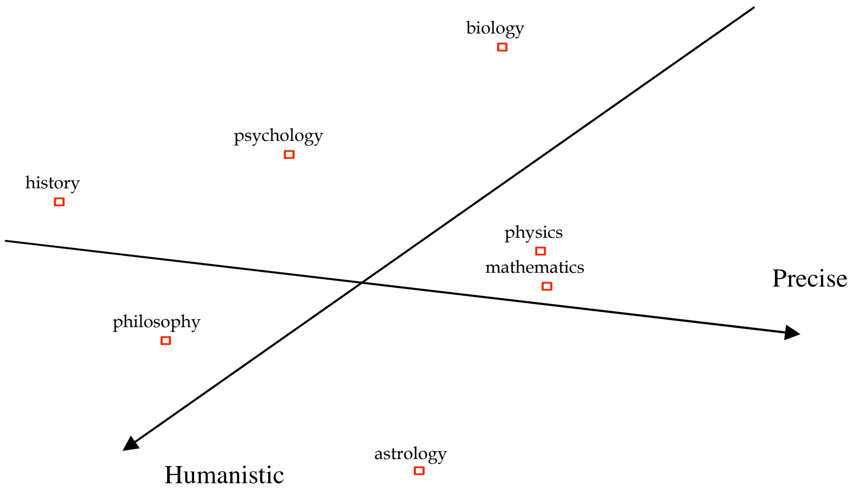
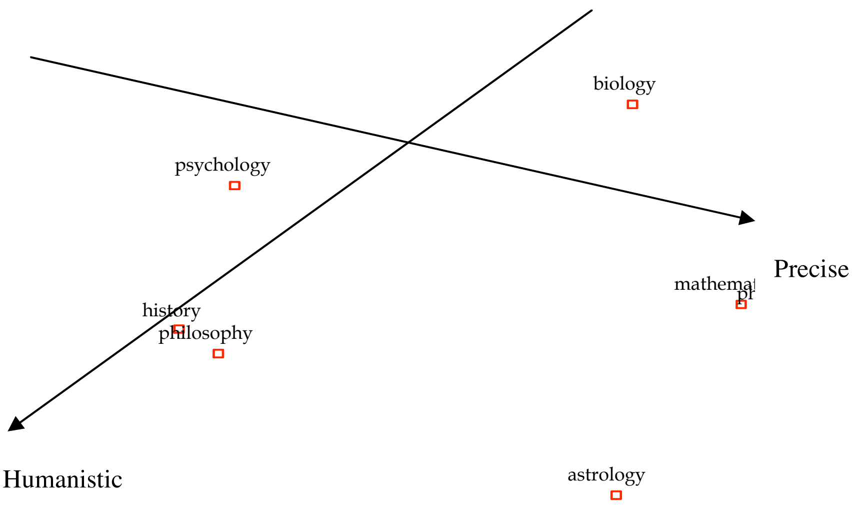


Figure 4. *Multidimensional scaling in two dimensions of similarity among the pairs of disciplines by university teachers of*



psychology
Figure 5. *Multidimensional scaling in two dimensions of similarity among the pairs of disciplines by biology undergraduates*

To prove the suggestions expressed in the discussion and also to qualify important aspects of social representations of science, such as components of objectification, personifications, figurations, and ontologizing (Moscovici & Hewstone, 1983), further research is planned, also using qualitative methods. It is important to mention that the shape of social representations is culturally determined; consequently results of such research first of all should be regarded as something specific to the society of Latvia.

Broader research is needed to find out if there is common social representation of the concept science as well as of particular sciences in different social groups of Latvian society. According to Moscovici's theory, mass media play important role in the process of forming social representations. Considering the way in which Latvian mass media cover the items of astrology and psychology, one could expect that social representations described in the present paper also apply to the society in general.

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