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Perception of the Image of Scientist by Israeli Student Teachers from Two Distinct Communities in Israel: Arabs and Jews

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This is a comparative study of the image of the scientist held by Israeli Jewish and Arabic student teachers from various backgrounds. The image of female scientists among these groups was also investigated. Five groups of female students (N=500) from four colleges were studied. Traditional tools (DAST) were combined with more informative methods (captions, statements, and free writing) and supplemented by interviews. The stereotypic image of the scientist was found to be a bespectacled male using conventional research equipment, who prefers intellectual occupations for leisure pursuits was perceived by most participants. The image held by the secular Jewish student teachers largely conformed to the Western image of the scientist – a disheveled man working in a laboratory, with few social connections. An image of a scientist as a revered, authoritative teacher or scholar emerged amongst the traditional groups (Bedouin, Orthodox, and Ultra-Orthodox). The image found amongst Arabic student teachers of the North (a moderately traditional group) was unique: a young scientist, using computers, whose work is partially done outside of the laboratory. Among the traditional groups, the female scientist is perceived to be "torn" between her career and tradition. Conclusions from this research and implications for science study and teaching curricula are discussed.

Keywords: Cultural Influence, Scientist's Image, DAST, Israel, Jews, Arabs

INTRODUCTION

Investigation of the image of the scientist is not new - over the last fifty years, several studies have been published on this topic. Most of them surveyed schoolchildren from Western populations, focused mainly on physical (clothing and place of work) and societal attributes of the scientist, and, in some cases, on his/her personal features. The most well-known studies of the scientist's image, carried out among pupils ranging from elementary school to high school age were reported by Song and Kim (1999). Fifteen studies undertaken between 1983 and 1998 revealed a stereotypical image of the scientist: that of a smooth-faced, messy-haired, bespectacled man in a white lab coat, experimenting alone in a laboratory using traditional lab tools (such as test tubes) (a detailed list of previous research on stereotypic images of the scientist can be found in Türkmen, 2008). The scientist's societal characteristics are: "a nerd, socially inept, working on subjects that no normal person would find interesting" (Sagan, 1995). Among pupils he/she is characterized as intelligent, industrious, dedicated, willing to work long hours, and deriving a great deal of personal satisfaction from work at the expense of social life (Koren & Bar, 2008). Review of studies conducted in the second half of the last century show that in many cases images of scientists among student teachers and teachers were very similar to that held by their pupils (Beardslee & O'Dowd, 1961; Mbajiorgu & Iloputaife, 2001).

A few investigators who reported on the image of the scientist among non-Western cultures showed

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ethnic minority representations of the scientist: Fung (2002) found that pupils drew scientists as Chinese; Some Afro-American pupils (Finson, 2003) drew them as Afro-American. An ethnic image of a scientist as an Arabic scholar (drawings of the famous scientist Ibn Khaldun) appeared among younger Bedouin pupils in our former study (Koren & Bar, 2008). In some non-Western countries, students did not depict any minorities as scientists, a fact explained by the origin of the population and their acquaintance with minorities in their state (Türkmen, 2008).

Other studies investigated the attitude toward the scientist in different countries. Sjøberg (2002) found a difference between the image of the scientist in twenty undeveloped and developed countries. In industrialized (developed) countries the image was found to be rather stereotypical – as was described above (Sagan, 1995; Song & Kim, 1999), with a certain (but not very high) percentage depicting 'the mad scientist'. This reflects the attitude in Western countries that science both harms and benefits the world. In undeveloped countries the scientist is perceived as very heroic, brave, and intelligent, helping others by curing the sick and improving the standard of living for all. Anderson's (2006) research in Ghana also showed that scientists are perceived as helping the poor and underprivileged. Scientists are viewed as servants of humanity and heroes of society, perceptions rarely mentioned in responses from pupils in the West (Anderson, 2006).

This paper presents an investigation of the image of the scientist among two main ethnic groups in Israel: Hebrew-speaking and Arabic-speaking student teachers (designated here as Jewish and Arabic groups or student teachers, respectively).

Both the 'Arabic' and 'Jewish' student teachers study at similar academic institutions. In other words, this study was carried out among two distinct national cultures exposed to a uniform academic culture. The Arab sector in Israel is perceived by the majority as "another culture" (Peleg & Raslan, 2002); It is an ethnic, religious, linguistic, national, and geographic minority. In recognition of their linguistic differences, the State of Israel established two distinct education systems (one for Jews and one for Arabs). This decision has had far-reaching implications for teacher training, and for many years, two different kinds of institutions have been maintained, one for the Arabic sector and one for the Jewish sector. Their point of contact has been at the level of national planning, and, consequently, the model for training and content authorized by the Council for Higher Education is uniform for both sectors; their main differences lie in *religious* aspects.

Three different groups of Jewish student teachers were studied: secular, religious (Orthodox), and extremely religious (Ultra-Orthodox), each of whom has a unique set of norms, beliefs, and values. The religious Jewish culture tends to provide an ordering of life that requires strict adherence to daily rules and rituals based on the Jewish tradition, while the secular Jewish tradition does not require such adherence. This is reflected, for example, in the different numbers of hours that each college (religious and non-religious) devotes to religious topics, The Arabic student teachers studied consisted of two groups, differing in their exposure to modernity: Bedouin from the Center and Arabic Muslims from the North. Bedouin society is of the Islamic faith and has a traditional culture. The Bedouin often have a high rate of unemployment, are regarded as having a small share in the benefits of education, and are less exposed to technology. The Arabic Muslim student teachers from the North come from a more modern society – they are exposed to technological tools in their college and display less adherence to tradition.

Student teachers were chosen for several reasons: This group has been investigated less and are more accessible for study than practicing teachers, and their ideas are more liable to change by virtue of instruction since they are still learners. Thus it seems important, according to the constructivist's approach to the teaching of science, to identify their existing ideas and to instruct them accordingly. Student teachers are future teachers, and as such their views will influence their pupils consciously or unconsciously (Rosenthal, 1993). The ideas of student teachers will affect the pupils regardless of them being science or general teachers, especially regarding the attitudes towards science and scientists.

That our participants include mostly women is consistent with the striking finding that women generally do not display an interest in science in school or choose science as a profession internationally (Brandt, 1996; ROSE, 2007) including Israel (Mullis et al., 1997). Because of the assumption that a lack of or unfavorable images of female scientists reduces the chances that female students and student teachers will opt to pursue science subjects (Noh & Choi, 1996; ROSE, 2007), we must examine their images of scientists.

RESEARCH QUESTIONS AND DESIGN

The main purpose of this study is:

1. *To compare the (physical, social, and personal) image of the scientist among two different nations in Israel: Jewish versus Arabic, differing in their adherence to tradition: Secular (Jews), traditional (Bedouin, Orthodox, and Ultra-Orthodox Jews) and moderately traditional group (Arabic Muslim students from the North).*
2. *To find the image of the female scientist amongst the various groups.*

Participants

The present investigation was carried out among two different ethnic groups of Israeli student teachers (N=500): The Jewish student teachers (N=300) consists of three groups: Secular (N=200), Orthodox (N=80), and Ultra-Orthodox (N=20), all of whom are from either the capital city or the center of the country; The Arabic (N=200) student teachers come from either the center of the country (Bedouin, N=100) or from the North (Arabic Muslims, N=100). The student samples are random.

Structure of the college

The Jewish (secular and religious) and Arabic (mostly Muslims) participants were drawn from four different academic colleges of education. The colleges chosen are representative of the different groups investigated; in each of them the average level of achievement is more or less average, and they have mainly the same teaching courses typical of teacher colleges in Israel (see below).

The first is a secular college attended by Jewish students from the center of the country as well as Bedouin from the South that immigrated to this area and study only at this college. Student teachers attending this college are enrolled in a three-year program, at the end of which they receive a teaching certificate. Following a further year of study they receive a B.Ed (Bachelor of Education) degree. The college provides two separate courses of study tailored to each ethnic group. Student teachers take a variety of teaching courses that prepare them to teach one of the following: special education, pre-school, elementary, or junior high school.

The second college is an Orthodox Jewish college whose level of religious instruction is fitting to the religious background of the enrolled population. It offers a four year course for teachers and pre-school educators (women only), at the end of which they receive a B.Ed degree. Some 200 students attend the college. There are three main study tracks: for pre-school education, elementary school education, and junior high school education. The sample included representatives of all of these groups.

The third college is attended by Ultra-Orthodox Jewish students who receive a teaching certificate at the end of their course of study. The seminar trains pre-school educators and elementary school teachers. In general, the Ultra-Orthodox population is rather closed to outside investigation; and they usually don't allow people outside of their group to interfere with their education method and curriculum. Since this group is difficult to investigate, it is a "convenience sample" and is limited.

The fourth college is an Arabic Teachers College with mainly Muslim and some Christian students in a small village in the north of the country that grants a B.Ed degree. It offers a four year course for student teachers and teachers (mainly women) in the following fields: Early childhood education, special education, and junior high school education.

Tools, their application, and methods of analysis

Over time, various research tools have been developed and used to identify perceptions of science and the scientist. Each tool is designed to test a different aspect of the scientist's image. We combine here traditional tools (DAST) with more informative methods (Captions, Statements, Free writing, and Interview) to obtain clear insights into adults' images of scientists. The tools were applied in the students' native languages. We used these tools:

Draw-a-Scientist and captions

The most commonly employed tool for determining the physical and social image of the scientist is DAST (Draw-a-Scientist Test) (Finson, 2003), in which participants are instructed to draw one (or more) scientists on a blank sheet of paper. DAST can be used to indicate outward appearance and gender, as well as place of work, tools employed, and whether the scientist works alone or with others. Barman (1999) and Finson (2003) established the validity of DAST as a tool in multicultural populations and Sjøberg (2002) utilized DAST in his international study.

Participants were asked to elaborate on their drawings using captions (short explanations accompanying the drawings). The possibility of depicting a female scientist was emphasized in our requests due to the fact that in both Hebrew and Arabic, words for male scientist and female scientist differ. The student teachers' drawings were analyzed based on Finson, Beaver and Crammond (1995)'s Draw-A-Scientist Checklist (DAST-C), which was widened to allow special ethnic traits to be analyzed (traditional dress, symbols of knowledge, etc). The Statistical T-test was used to analyze the differences between the groups (see Results).

Statements and Free writing

The participants were provided with a list of eleven short statements (of one or two words) pertaining to properties of 'the scientist' (for example, clever, diligent), family and social connections, and his/her leisure time activities and hobbies. The students were asked to declare their agreement to each statement using a four-grade scale, ranging from 1: "no scientists" to 4:

"all scientists". The average mark for each statement made by the participants of each group was calculated together with the standard deviation, the differences between averaged marks of the groups were measured. Significance of the deviations between the averages of the two groups for each property was determined by a standard T-test.

Pairs of opposite properties (such as clever/foolish, attractive/ugly, and tidy/untidy) were presented in the statements for validation of the statements tool. Participants were also asked to describe features of the scientist through free writing before or after being presented with the statements.

Personal Interviews

The student teachers were asked whether they would like to add oral explanations to their drawings and to their level of agreement to their statements. A small number of student teachers (N=30) agreed to explain certain features depicted in the drawings or described in the captions that followed the drawings (tool A), as well as to verify their level of agreement with various statements (tool B). These interviews helped to deepen our understanding of the results.

RESEARCH FINDINGS

Results from the three tools will be combined here.

The main features depicted in the drawings are shown in Figure 1. The average level of agreement with each statement is shown in Table 1.

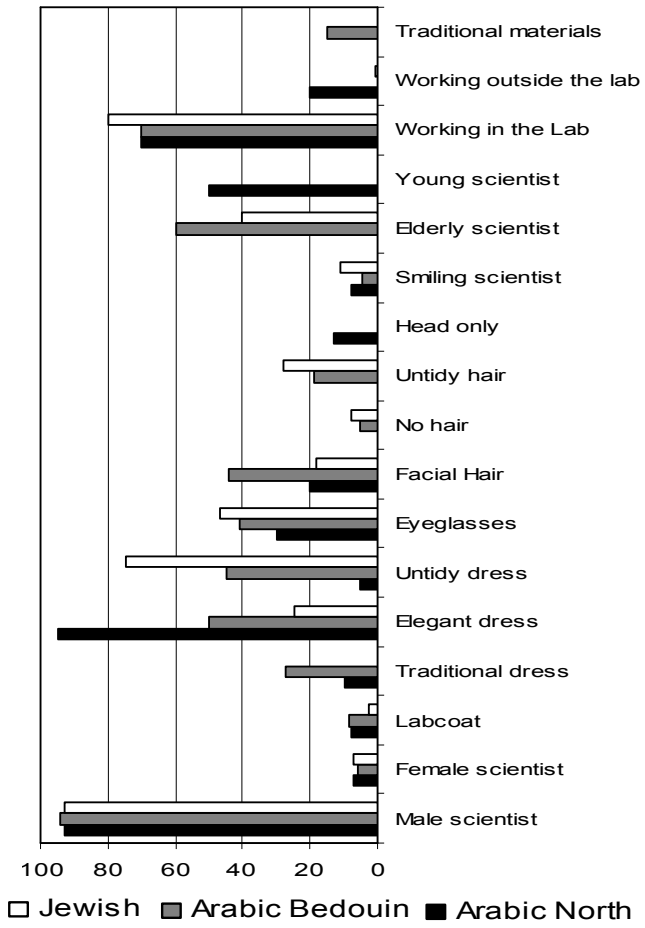

Figure 1. Main features showing in the Drawings (%)

Findings common to all participants

Image of the male scientist

Common to most participants was the previously described stereotypic image of the scientist consisting of a male (93-94%) wearing eyeglasses (30-47%), using conventional research equipment (Figure 2b).

The scientist works alone in the lab (70-80%), one interviewee explained: "because this is the environment in which he feels a sense of belonging and comfortable."

Contrary to the study of Sjøberg (2002) in developed countries, no mention of the mad scientist was made. One explanation for this omission was given during an interview: "*Contrary to (the depiction of scientists in) the movies, I do not think the scientist is mad; he is enthusiastic about his work, but not crazy*".

According to the statements and interviews, the qualities attributed to the scientist by all participants related to intelligence: logical, clever, creative ("*because he is doing something no one did before*"); curious ("*If he wasn't curious, he wouldn't search for new things*") and serious. Other qualities are connected to hard work, such as diligence and being systematic (All of these properties mentioned here ranked more than 2.5 on the scale).

'The scientist' was described as someone who does not participate in sport (ranked 1.3 to 1.9 on the scale). One interviewee commented: "*I wouldn't say exactly that he does not like sport; I would say that he doesn't play sports because he would prefer to spend time on his research*".

Image of the female scientist

Very few drawings depicted female scientists (6-7%). Several characteristics were unique to male and female scientists: according to the DAST results, the female scientist is both younger and more elegantly dressed than the male scientist. The captions accompanying the drawings and the interviews show that she is more likely to work as part of a team, and devotes fewer hours to work than her male counterpart.

Apart from the infrequent image of the female scientist, our study revealed differences between the images held by Jewish and Arabic student teachers and by student teachers from different religious backgrounds.

Table 1. Average level of agreement with the statements - Jewish and Arabic student teachers (1="no scientists", 4="all scientists").

Properties	Jewish(N=300)	Arabic(N=200)
Clever	3.9	3.6
Logical and systematic	3.5	2.5
Creative	2.8	3.3
Serious	3.5	2.9
Diligent	3.1	3.3
Tenacious	3.1	1.8
Works many hours	3.2	2.7
Family and social connections		
Spends time with friends	2.3	3.5
Takes part in family chores	2.0	3.2
Leisure time activities and hobbies		
Plays chess	2.6	2.3
Participates in sport	1.9	1.3

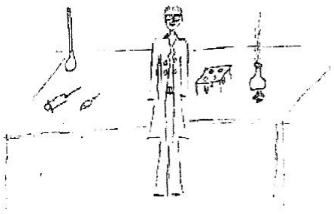

Figure 2a. The typical scientist among Jews.

Figure 2b. The typical scientist among Arabs.

Figure 3. The scientist as a teacher by Jewish student teachers

Cultural and traditional differences among Jewish student teachers

Results obtained from the secular Jewish group largely conformed to the image of the Western male scientist (Sjøberg, 2002). Drawings and interviews that followed showed that the scientist in not trendy (75%). One student teacher mentioned that "*his dress and hair is not stylish*". His scientific work is conceived of as mainly experimental (also found in Driver, Leach, Miller, & Scott, 1996), "*finding new things every day"* and *"solving any problem*". His social life is not central to his life; generally he is *"lonely and unhappy*".

The Orthodox and Ultra-Orthodox Jewish groups often depicted the scientist as a revered teacher lecturing in a large hall full of people (Figure 3).

Drawings of female scientists also varied from group to group. Student teachers at the secular college depicted a well-groomed woman, younger than the man, elegantly or casually dressed, with a stylish hairdo (Figure 4).

The Orthodox student teachers depicted female scientists dressed in accordance with religious styles – in a long dress (Figure 5). Student teachers indicated that the female scientist is conflicted between her home obligations and her scientific career.

Jewish students focused on tenacity (3.1 on the scale; "*Does not despair and invests a great number of hours to find a solution*") in contrast to the non-tenacious image (1.8 on the scale) of the scientist in the Arab sector. Tenacity among the Jewish group meant that the scientist is steadfast in his/her opinion, and keeps on trying, while in the Arabic group it meant to resist authority. The male scientist works long hours (3.2 on the scale) and has limited social and family ties (2.0 on the scale) ("*doesn't spend much time with friends*"). He continues to work at home at the expense of hobbies, social ties, and particularly family relationships (emphasized in the interviews).

Arabic student teachers

Two different images of scientists were found among the two groups of Arab student teachers. Among the Bedouin, the scientist is depicted as a religious figure (25%), relatively older (60%), and wearing a "galabiya" (27%), typical of the culture. A similar image was found in our previous study among a young Bedouin pupil (Koren & Bar, 2008) who declared: '*I want to be a scientist in Islamic studies*" (This pupil eventually considers Islamic studies a science, even superior to Western science). He is neatly dressed with a dignified appearance (50%), in contrast to the unkempt image depicted by Jewish secular student teachers (25%). In one drawing captioned Ibn Khaldoun, he is portrayed as a philosopher using a quill to inscribe a scroll (Figure 6).

Figure 4. Image of female scientist by secular student teacher. Caption reads: super scientists. Pays tribute to her being both scientist and family woman.

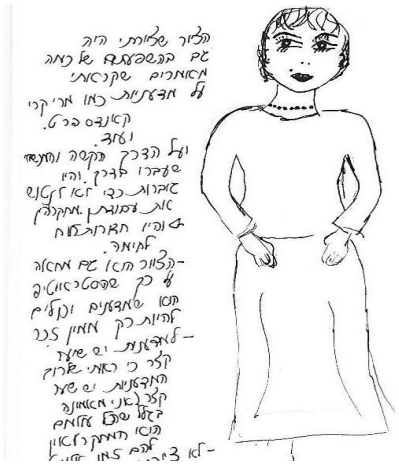

Figure 5. Image of female scientist by orthodox student teacher.

Caption reads: I drew her as a woman through the inspiration of a book I read about women scientists and the hard way they had to travel not to abandon the science. They had to be full of strong spirit to fight for their way. This picture shows that the stereotype of a male scientist is not correct. This woman devotes her life to science.

The appearance of the scientist as a dignified religious, traditional person is not consistent with the figure of Bedouin doctors, lawyers, and teachers that the participants encounter in their everyday lives and in the media.

The scarcity of drawings of female scientists (6%) may be explained by economic and religious traditional limitations in the society (Anderson, 2006). The female scientist is frequently described as "torn" between her career, household duties, and tradition (similar to the description by Orthodox Jewish student teachers); the

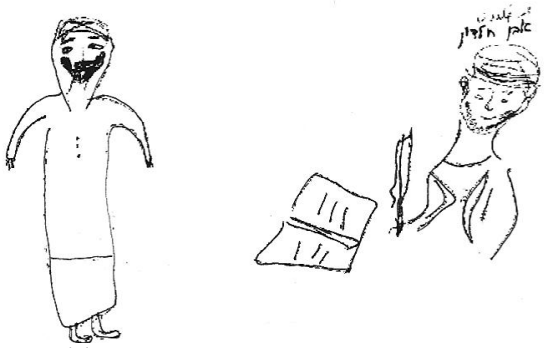

Figure 6. The scientist as a scholar among the Bedouin caption reads Abn khaldun.

Figure 7. The scientist image by Arabic students from the North

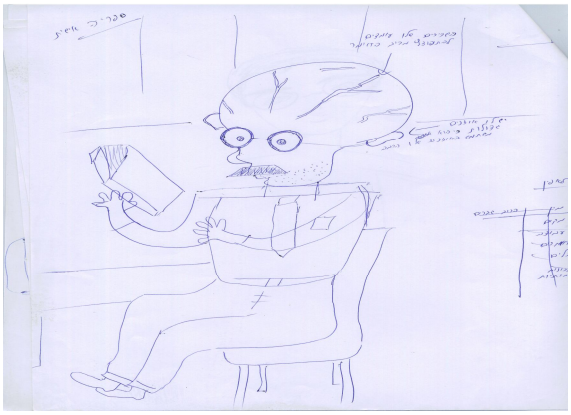

Figure 8. The "heads only" image of the scientist

need to divide her time between family and work makes her a "Super Woman".

Findings from statements, captions, and interviews emphasized that the Arabic scientist spends less time on experiments and more time reading and writing: "*The scientist reads books to become more acquainted with his profession, and when he comes home he reads books until he falls asleep*".

His working hours may be somewhat shorter than that perceived by the Jewish student teachers (ranked 2.7 on the scale). It was expressed in "Free writing" that he spends time with friends and shares the burden of running the household (shopping in the market).

Some of the captions emphasized the contradiction of being a scientist and their tradition. A Bedouin female student teacher explained in the interview: "*The scientist is a man. I cannot be a scientist; it's against our customs*". She added: "A*nyway, I will get married and become pregnant*". Other Bedouin interviewees commented: "*It isn't suitable for a woman to be a scientist: It harms the family. It's not acceptable in our society; I'm planning to marry anyway*".

Arab student teachers from the North perceive the scientist as a much younger man (50%), well dressed (95%) and adorned with less traditional traits than the Bedouin image, occasionally with a head dress (10%). Drawings by this group depict symbols of knowledge such as books and posters (20%), and modern technological equipment such as computers (21%) (as in Figure 7).

Evidence of the outdoors (drawings of field research and of home and school environments) (20%) also exists followed by captions, for example: "*there are scientists who work outdoors*" and an oral explanation: "*I know now that there are many kinds of scientists. Not all of them work in laboratories. There are those who also work outdoors such as ornithologists and those who study dinosaurs*". Fung (2002) also mentions scientists working outdoors and cites She (1995) who observed drawings of the outdoors in depictions of scientists.

Typical to this group is an image of a philosopher in thought: According to captions that followed pictures of heads only (13%) or very large heads (Figure 8), the scientist is "*thinking very hard, his head almost bursting*".

Many of the features discerned using the DAST tool (see Fig. 1) differ between the Jewish and Arab groups: Some features are typical to one group only (traditional materials, working outside the lab, young scientist, and head only) and others exhibit significant difference (untidy vs. elegant dress, $p.<0.05$), while most of the properties discerned using the statement tool (see Table 1) are common to the two groups (with the exception of tenacity, spends time with friends, and takes part in family chores, $p<.05$).

DISCUSSION AND CONCLUSIONS

Previous studies have indicated that a student's cultural background can mold his/her image of the scientist (Finson, 2003). The significance of this study is the differences in the image of the scientist held by different cultures in one diverse country: Arabic culture versus Jewish culture and between groups differing in their adherence to tradition. The information gleaned from use of the DAST tool was supplemented by captions, statements, and interviews, which explained the reasons for the particular depiction.

Image of a male scientist

The results common to all the participants resemble the findings of previous research: The scientist is generally perceived of as a male (only a minority of

females is presented) and to be rather lonely, intellectual, logical, diligent (long work hours), and curious. With the exception of the northern Arabic student teachers, the laboratory is perceived to be the main work environment. .

No mention of mad scientists was made regardless of their teaching courses. The rather positive image of the scientist among these groups of student teachers may be due to their age: adults, in contrast to the image found among younger participants in other developed countries (Sjøberg, 2002; Türkmen, 2008) as well as in our previous study in Israel among population of pupils, the appearance of "mad scientists" decreased with age (Koren & Bar, 2008). This variable (their age) probably enables the student teachers to differentiate between the negative image often presented in the media and literature versus the true identity of the scientist; as demonstrated by one interviewee's statement: "*Despite the movies, I do not think that the scientist is crazy; he is enthusiastic about his work, but not crazy*". This conclusion is supported by several positive statements about the scientist observed in this research, such as: "*he does something that no one did before*" (Similar statements were also found in previous research in Israel among high school pupils, closer in age to our target population: Koren, 2006).

Previous studies (mostly carried out in Western societies) showed a more or less uniform image of the scientist among students of various ages and backgrounds, with some special ethnic images in the drawings of pupils from different cultures and countries (Koren & Bar, 2008; Finson, 2003; Fung, 2002; Sjøberg, 2002). In this study, we found more pronounced ethnic and religious differences than in previous studies, even among students from the same nation and were able to account for these differences through captions and interviews.

Utilizing several tools, we found that while secular (Jewish) student teachers tended to share the Western image of the scientist (a male carrying out experiments alone in a laboratory and a super woman), the student teachers from traditional backgrounds (Orthodox and Ultra-Orthodox Jewish and Bedouin) emphasize some ethnical traits of the scientist and admired the scientist as a revered teacher

The Bedouin view the scientist as an old Arabic male "philosopher" dressed in a dignified manner. According to the emphasis on national tradition, some drawings by Bedouin student teachers portray an Arab scientist holding a scroll while engaged in reading and writing. This inclusion emphasizes the esteem attached to the teacher, regarded by the Bedouin as a figure of authority. The image of a scientist as a teacher, which also emerged from the Orthodox and Ultra-Orthodox participants, indicated a certain degree of similarity between the traditional groups. This respected image of the scientist was also found in previous studies in Israel among younger Bedouin pupils (Bar & Koren, 2008) and among highly educated Muslim science teachers (teacher is a "lofty profession", Abdo, 2001) and may be related to the findings of Haidar (1999) about the image of science defined as divine: "*the divined thing which no human can master*". The "Divined science" is represented in traditional groups as delivered by a respected teacher, and even by the famous teacher and scientist Ibn Khaldun (Figure 4b).

The image of the scientist perceived by Arabic student teachers of the North was contrasted with that held by other Arabic student teachers in this study and also in most of the previous research: a young (even modern) scientist, using computers (found also in Türkmen, 2008), whose study is partially done outside of the laboratory [in the field, at school, and even at home]). An emphasis on the image of the scientist engaged in deep thought is apparent in this group, with drawings of heads only and captions, such as: "*My head will explode from thinking.*" (The usual stereotype is of a 'brainy' scientist with a large forehead, though not with particularly big heads…).

These unique results can be partly explained by the typology of Sjøberg (2002) regarding developed and underdeveloped countries: the Bedouin student teachers come from a religious, traditional society that is similar to that of underdeveloped countries, while the Arabic students from the North come from less a traditional and more modern society, closer to that of developed countries. It can be also due to a strong influence of the instruction: the image of the scientist as young and modern is very similar to that of their college teachers, who depict usage of computers (also found in Türkmen, 2008) and field research during science lessons.

Image of the female scientist

The percentages of scientists perceived as women by all groups researched, as observed through all the tools used, were rather low, indicating a clear tendency to consider science as an essentially male field of endeavor. This observation is consistent with the results of earlier studies conducted among Western students (Schreiner, 2006), among student teachers and teachers in India (Rampal, 1992), as well as among non-Western students in Nigeria (Mbajiorgu & Iloputaife, 2001), pupils in Turkey (Türkmen, 2008), and our former findings (Koren & Bar, 2008).

Both Jewish and Arabic student teachers hold a very low view of women in science. An image of a female scientist "torn" between her career and her tradition was found especially among the Bedouin and Ultra-Orthodox groups. These findings may be interpreted in three ways: the participants were not familiar with female scientists; mention of their names may contradict

the traditional role of women (Zorman, 1998); or they are under the impression that science is a tough profession, requiring the female scientist to function as a "super-woman", simultaneously managing the demands of her family and her career (see: Drawing 4-5 and Schreiner 2006). It should be noted that in traditional societies, this unfavorable image of the female scientist can lead women to abandon her choice of a career in science and is something that should be borne in mind when planning the teaching curriculum (Rubbin, Bar & Cohen, 2003). Note the drawing by a student who emphasized her depiction of a woman and explained it (Figure 5) in contrast to her Ultra Orthodox background.

Additional findings related to the image of the scientist

In the definition of the scientist's image in most of the previous research, several features were found to be lacking. The drawings contained almost no modern equipment and few computers (apart from the Arabic student teachers of the North). This void can be addressed through the curriculum as shown by Fung (2002). There were no depictions of teams of scientists and very few of pairs working together, in contrast to many modern-day research situations, which should be also emphasized in instruction.

Work was depicted to be conducted mainly in the lab, rather than in space, in the ocean, or up in the mountains (apart from Ilan Ramon, the astronaut who was labeled a scientist by the Ultra-Orthodox). In her use of DAST, She (1995), however, found drawings of animals and plants, and outdoor activity, consistent with the curriculum, as was found among our Arabic student teachers of the North. Presenting the scientist as solely working in the lab can result in the disregard of certain scientific domains including astrophysics, geology, and field biology.

Implications for science study and teaching curricula

The vast variance, which had been hinted at in previous studies, between participants that became evident from this study must be related to on both the theoretical and practical level. On the theoretical level, our study tries to bridge the gap found in the literature of reporting of "*just few studies about the image of the scientist from non-Western countries*" (cited in Türkmen, 2008, p. 56) since our Arabic student teachers resemble non-Western populations. In addition, this study makes a decisive contribution to our understanding that students from different ethnic groups perceive scientific concepts (in this case, the image of the scientist) differently. This conclusion is not obvious, because, in some ethnic minority studies, students did not depict scientists as members of a minority, explained by the acquaintance of thesample with minorities in their state (Türkmen, 2008).

This factor underscores the importance of the theory of social constructivism, with its emphasis on learning as a social process and its assumption that the perception of specific scientific concepts and the overall perception of science and scientists are society-dependent, language-dependent, gender-dependent, and culture-dependent (G'anam, 1999).

The present study also has practical implications for the academic training of student teachers and for teaching curricula, which must be sensitive to different cultural groups – Arabic (from two regions) and Jewish (Orthodox, Ultra-Orthodox, and secular groups) as well as genders (Schreiner 2006). Once the national, traditional, and gender needs of these groups are met, there is a chance that the motivation to learn will increase and the study of science will also benefit (Haidar, 1999). Small wonder that Alhaj (1995) claims that the academic training of Arab teachers, whether in their own seminars or in institutions of higher education, is not relevant to their culture! The curriculum for this sector should include exemplary figures from the Arabic classics (such as Ibn Khaldun and Avicenna) with whom they can identify (Head, 1996).

This does not mean we should not expose students from various cultures to exemplary figures of scientists of other cultures. Considering that some Arab student teachers display a fundamental lack of knowledge about Western scientists (found in our previous research, Koren & Bar, 2008), it is advisable to expose them to such figures (like those identified as prototypes among Jewish student teachers) in order to balance their choice of scientists.

It was also found that the perception of the scientist as a female was lacking in both groups – Jewish and Arabic. This finding, coupled with the declining number of girls opting to study science (particularly physics) in high school, as reported in many studies throughout the world (Zohar & Sela, 2003), raises many questions about the prevailing approach to science education in the last decade: "science for everyone". It is clearly a matter of primary importance that students at various stages of their studies be exposed to the achievements of female scientists, and various methods should be adopted to remedy this problem (for example: Rubbin et al., 2003; Spitulnik, Zembal-Saul & Krajcik, 1998).

In connection with the usual stereotype of the scientist working in the laboratory, investigations at the elementary school level (Fung, 2002) and among the Arabic participants of the North show that using special learning instruction (such as computers and field research) can lead to the perception of scientists

working outside the laboratory using modern equipment, and reduce the stereotype.

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