

## **A Stigmatising Stereotype or a Universal Gap in Expectations? Lessons in Mathematics in the Perception of Polish and Ukrainian Students**

### **Abstract**

Referring to the results of the authors' own research published in *The New Educational Review* (Turska, Bernacka 2010; Turska 2011), this article attempts at competitive verification of a hypothesis that explains differences in the perception of a mathematics teacher by Polish male and female students in view of a popular stereotype that Mathematics is a domain for males. It was assumed that diverse perceptions may result from different interpersonal expectations of the two genders. A comparative study carried out on a group of Ukrainians, established in accordance with the principles of ecological validity, seems to further substantiate the stigmatising effect of the stereotype in Poland.

**Keywords:** *stereotypes, mathematics as a domain for males, interpersonal expectations*

### **Introduction**

The majority of the students at technical universities in Poland are male. The preponderance of male students who major in strictly technical fields of study closely linked to mathematics (e.g. mechatronics) can be as high as 98% (Sivińska 2011). *Perspektywy*, a non-government educational foundation, was the first to undertake measures to counteract the prevailing trend. The "Girls for Engineers" programme, implemented in 2006, is today a recognised permanent feature of technical university recruitment campaign. In 2009 the programme, conducted

under the auspices of the Minister of National Education, obtained official support of the rectors of technical universities and of the Ministry of Science and Higher Education in the form of scholarships for outstanding female students.

While the activities undertaken are fully justified, they are hardly sufficient, since they focus on decreasing the impact of the phenomenon without explaining its root causes. The apparent natural superiority of males over females in terms of mathematical capacity cannot be easily accepted be it merely in the light of the report by PISA (2011) – in Poland the average score of males was only marginally higher than that of females (497 and 493 respectively). The explanation proposed in the authors' research refers to the stereotype whereby "mathematics is a domain for males" (Gavin, Reis 2003). It was assumed that the content of the stereotype, a part of which is regarded as common knowledge, also determines education at large, as it provides teachers of mathematics with ready-made models of what is expected of students of the opposite sex. These expectations, in turn, translate into a different approach of the teacher. In line with the self-fulfilling prophecy in education (Dee 2007), teachers activate the Golem effect with respect to female students and the Pygmalion effect with respect to males. The results of a comprehensive study, (Turska, Bernacka, 2010), demonstrating that female students (in relation to male students) register a less favourable climate of a maths lesson, the superficiality of feedback, a lower level of encouragement and stimulation of cognitive processes seem to confirm the hypothesis suggested. Another argument in favour of the hypothesis comes from the proposed interpretation of the particularly unfavourable perception by female students of classes conducted by female teachers (Turska, 2011). References to the concept of a stereotype threat (Schmader, Johns, Forbes, 2008) help explain the phenomenon as a sign of rejection by female teachers of their own gender group identification. This mechanism makes sense only when the commonly held conviction about mathematical capacity of females is stigmatising in nature.

However, in order to avoid the trap of a "paternal effect" with respect to the conclusions drawn, the author decided to confront her interpretation with a competitive proposition. After all, "the history of science in general, and the history of psychology in particular, prove that many of us remain in the wrong longer than they should because we widely overrate our own theories" (Rosenthal, 1991, p. 238). Consequently, the purpose of this article is to formulate and to verify the viability of a method to explain the results obtained, which stands in contrast to that based on the stereotype that "mathematics is a domain for males".

## **Competitive explanatory hypothesis**

The existing interpretation of the results obtained stressed the significance of expectations formulated by teachers. In the first instance (Turska, Bernacka 2010) these were diverse interpersonal expectations addressed to students in different gender groups caused by the effects of the stereotype; in the other instance, these were the expectations of female teachers themselves as to how they should behave in order to avoid being pigeonholed as acting in compliance with the stereotypic perception of the stigmatised group (Turska 2011). It is worth bearing in mind that education is an interactive process and not merely a reaction of students to stimuli offered by their teachers. A different perception of a teacher's conduct depending on the student's gender may therefore be caused primarily by diverse interpersonal expectations of boys and girls with respect to their male and female teachers. So far, such an interpretation has not been taken into consideration.

Assuming that a typical female student, relative to a typical male student, is statistically less frequently criticised and reprimanded by her teachers due to her higher degree of concentration on school-related activity (Turska 2006), such critical remarks and reprimands must be subjectively perceived as more potent. Incomplete though promising, this is a totally new explanation of a particular sensitivity of female students to the climate of a lesson whose assessment was the lowest of all the aspects of the teacher conduct, notably, female teachers. Furthermore, Cross and Markus (2002) claim that women and men use different forms of discourse and diverse verbal communication styles. Women tend to adopt a pro-social and empathic style, while men tend to underline competition and hierarchy. For this reason, female students may tend to formulate higher expectations of female teachers, perceived as members of a more empathic gender group, as to their friendliness and willingness to help, in line with the metaphorical "angel of the classroom" (cf.: Tamboukou 2003). This aspect of the teaching profession is likely to have a lesser appeal to male students.

A competitive hypothesis was adopted, whereby the reported differences between the way teachers of mathematics are perceived by male and female students result from diverse interpersonal expectations of boys and girls. In order to verify the adequacy of this hypothesis, more research was required.

## **Verification procedure adopted**

The apparently obvious procedure consisting in replicating the study already performed with respect to other subjects, e.g., falling within the terms of reference

of humanities, was abandoned. It turned out that adapting individual items of the research tool (Turska, Bernacka 2010) to reflect the specific nature of another subject would place students under significantly different stimuli from those originally used. Therefore, a quasi-experimental research model was developed based on two groups and a post-test on the dependent variable (Brzeziński 2000, p. 366).

Assuming (in a consistent manner) that the effects of the stereotype (in Polish experimental conditions) constitute the main independent variable, there is a need to find “a social milieu” (i.e., control conditions) where this variable is either absent or occurs to a lesser degree. It was further assumed that a comparison of the values of the main dependent variable (teacher conduct as perceived by students), using the same diagnostic tool, will help establish sound grounds for the verification of one of the competitive hypotheses: the effects of the stereotype or universal differences in interpersonal expectations of male and female students. At this point, it is important to justify the claim that control conditions exist in the “social milieu” of Western Ukraine.

Gender-related stereotypes, deeply rooted in Ukrainian society, constitute an important mechanism of social control and provide justification for patriarchy and prestige (Gender Plan of Action 2001; Goroshko 2008; Shmelova, Parsons, Shmelova 1995). An in-depth study by Goroshko (2008), which outlines a wide spectrum of gender-related stereotypes, does not include a conviction that “mathematics is a domain for males.” Despite numerous demands to counteract gender discrimination, the report by the Ukrainian Minister of Education and Science (2010) does not indicate the pressing need to increase the number of females in technical education. Arguably, such a stand may be a side effect of the gravity with which mathematical education was perceived in the former Soviet Union. Mathematics was seen as an important weapon of the Cold War, and later as a measure with which the famous slogan by Khrushchev of 1957 – to catch up and overtake America – was to be implemented (Karp 2006) and a key tool of the “scientific and technological revolution,” as announced by the Central Committee of the Communist Party (1966) (Wirszup 1981). Several years of concerted efforts of a team of distinguished mathematicians headed by Kolmogorov and psychologists of learning, teachers and methods specialists have resulted in the development of an educational programme that was modern in content, innovative in approach, well-integrated, and highly sophisticated. “Moreover, hundreds of thousands of youngsters take part in an exceptional range of extracurricular activities – mathematics clubs, circles, and contests – or study in unique schools specializing in mathematics, all designed to discover mathematical talent and to train it from the earliest possible age” (Wirszup 1981, p. 359). It does not seem

“economical” to restrict talent search and development only to half of the student population. The effects of a strong conviction about the importance of mathematics, deeply instilled in all students, can now be easily traced in the children from the former Soviet Union who live in Israel. Apparently, and irrespective of their gender, they treat fluency in mathematics as a major part of their own identity (Sfard, Prusak 2005).

For the purposes of the study described here, it was assumed that a similar diversity of perception of mathematics lessons by male and female students in control conditions (the Ukrainian test group) and in Polish experimental conditions will be ascribed to universal differences in interpersonal expectations between boys and girls. Consequently, a hypothesis whereby a less favourable perception of teachers (and female teachers specifically) by Polish female students is caused by the effect of the stereotype that “mathematics is a domain for males” will no longer hold.

## **Method and Participants**

The Teacher Conduct Scale developed by D. Turska, and translated and adapted by O. Hirnyy<sup>1</sup>, was used, the same as the scale applied to Polish students. The scale measures four aspects of teacher conduct, i.e., climate, feedback, input, and output. The person examined is to assess the degree of accuracy of a given statement (in the scale from 4 – “totally true” to 1 – “totally untrue”). Theoretically, the raw result of each subscale ranges from 6 to 24 points.

No effort was spared to ensure that the criteria of selecting Ukrainian participants matched those used in Poland (students from secondary schools located in small towns of the Lubelskie Voivodship, Turska, Bernacka 2010). Out of 314 students selected, 163 were females and 151 males from grades 10–11 (years of schooling comparable with those of Polish secondary school students), from small towns of the District of Lviv (like the Lubelskie Voivodship, a border district).

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<sup>1</sup> I wish to thank dr O. Hirnyy of the Post-Graduate Teacher Training District Institute in Lviv for his work on adapting the scale and organizing research in Ukraine.

## Results

In order to determine whether Ukrainian male and female students assess the conduct of teachers of mathematics differently, a single factor ANOVA variance analysis was performed with respect to the results obtained from the four subscales. Statistical conclusions are presented in Table 1 (relevant results of the Polish research by Turska, Bernacka, 2010 are shown for comparative purposes).

**Table 1.** Conduct of teachers of mathematics in the perception of Ukrainian (U) and Polish (P) female and male students

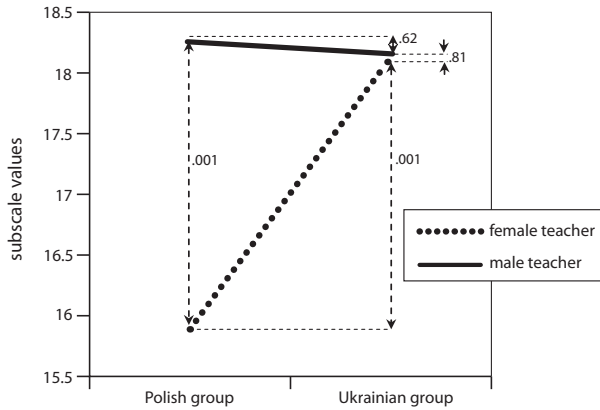
PERSONS EXAMINED	SUBSCALE							
	<i>Climate</i>		<i>Feedback</i>		<i>Input</i>		<i>Output</i>	
	U	P	U	P	U	P	U	P
Female pupils	18.54	16.66	18.24	17.39	20.50	17,55	19.56	16.89
Male pupils	18.41	17.25	18.04	17.90	20.19	18,35	19.34	17.73
Value F	.18	6.31	.34	4,65	.79	8,37	.35	10.19
Significance	p=.66	p<.01	p=.55	p<.05	p=.37	p<.01	p=.55	p<.001

The data presented in Table 1 indicate no significant differences in the assessment of Ukrainian male and female students with respect to all subscale results of the Teacher Conduct Scale. It was therefore agreed that subsequent analyses concerning the importance of the gender of the teacher would be carried out with the exclusion of one variable, i.e., the gender of the student, since it proved insignificant in the study described. A two-factor variance analysis was employed: country X teacher gender.

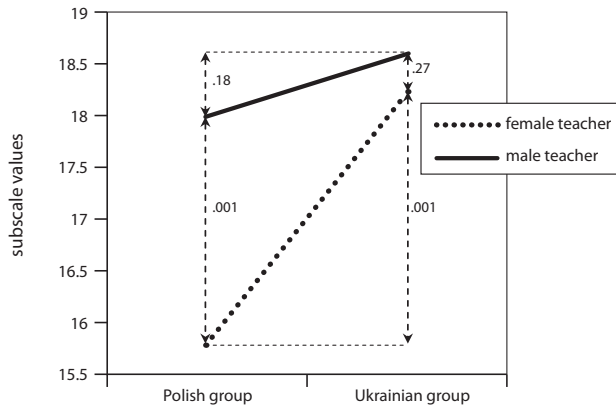
The data obtained were subsequently classified under two analytical categories. The first one refers to the results reported on the *Feedback* (Figure 1) and *Climate* (Figure 2) subscales. No significant differences were reported for the Ukrainian test group as regards the assessment of teachers of the opposite sex. Interestingly, the result is significantly different for female teachers (*Feedback* – F=56.99; p<.001; *Climate*-F=82.07, p<.001) from the one reported for the Polish test group. No differences were reported in the assessment of male teachers depending on the country of origin.

The second analytical category refers to the results obtained on the *Input* (Figure 3) and *Output* (Figure 4) subscales. This time, teacher gender is also significant for the Ukrainian test group although this significance stands in reverse relation to

**Figure 1.** Assessment of the conduct of maths teacher. Comparative analysis: country x teacher gender. Subscale: *Feedback*

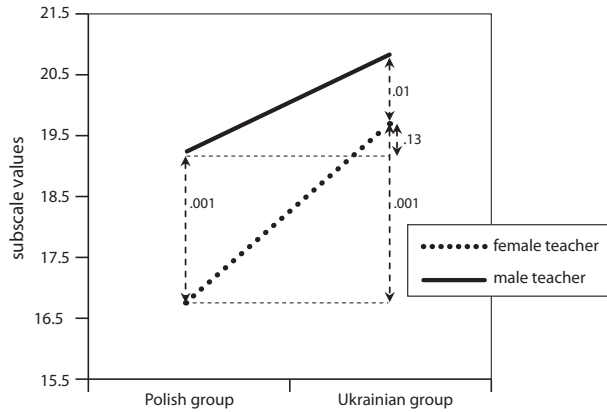


**Figure 2.** Assessment of the conduct of maths teacher. Comparative analysis: country x teacher gender. Subscale: *Climate*

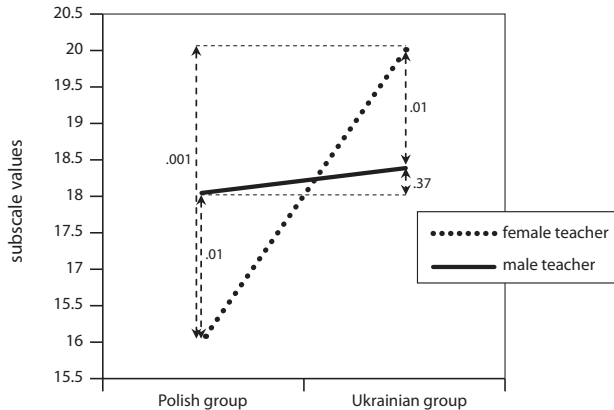


the Polish test group. The Ukrainian students give a higher score to the conduct of female teachers ( $p < .01$ ) as compared with that for male ones. Thus, the diversity of assessments of female teachers' conduct by the students representing the two groups under analysis demonstrates its discriminatory value on an unprecedented scale (*Input*  $F=164.08$ ;  $p < .001$ ; *Output*  $F=163.76$ ;  $p < .001$ ). And again, there are no grounds to establish that the assessment of male teachers in the Polish and Ukrainian test groups is any different.

**Figure 4.** Assessment of the conduct of maths teacher. Comparative analysis: country x teacher gender. Subscale: *Output*



**Figure 3.** Assessment of the conduct of maths teacher. Comparative analysis: country x teacher gender. Subscale: *Input*



### Discussion

A discussion of the results presented should start from their reliability. A quasi-experimental research model involving two groups was employed, since such a procedure offered the possibility of a comparative analysis and interpretation of the results obtained. This approach did not, however, have the precision required of an experimental method. There was no manipulation of the main independent variable (the stereotype that stigmatises girls and women); it was simply assumed



that this variable has an effect on the Polish participants in the study while this effect is not reported for the Ukrainian test group. The justification for such an assumption may not necessarily convince everyone. Furthermore, the content of the items in the Teacher Conduct Scale, despite cultural transposition, may have had a somewhat different meaning to the Polish and Ukrainian students. Nevertheless, there are grounds to believe that the comparative study was performed in a reliable manner. This is evidenced in the identical assessments of Polish and Ukrainian male teachers (i.e. representatives of the group which the stereotype favours) in all the aspects of their professional conduct. It is highly unlikely that such a convergence was accidental, especially if the average raw result of approximately 18 points should be treated as the “golden mean” of a realistic assessment – neither excessively critical nor overtly uncritical.

Arguably, the results obtained seem to disprove the adopted competitive hypothesis whereby the diversity of perceptions of mathematics lessons depending on the teacher and student gender can be ascribed to universally diverse interpersonal expectations of boys and girls. In the Ukrainian conditions (described as control conditions), student gender does not determine the assessment of a teacher’s conduct (as is the case in the Polish conditions). Moreover, the effect of a teacher’s gender clearly differs between the Ukrainian and Polish groups. It is worth bearing in mind that Ukrainian male and female students perceive male and female teachers in an identical manner in situations that require an individual contact between the teacher and the student, where young people are addressed directly. It is therefore clear that female students do not expect a greater degree of empathy from their female teachers. On the other hand, all the students rate the value of the lessons conducted by female teachers higher than those conducted by male teachers. This is easily noticeable with respect to the care about the clarity of the subject matter presented in class ( $F=33.03$ ;  $p<.001$ ) and activating all students ( $F=20.01$ ;  $p<.001$ ).

It was not the purpose of this article to determine the perception of mathematics lessons by Ukrainian students in an independent manner, but to establish a point of reference against which to compare the results of the Polish research. The rationale behind this approach was to avoid “the paternal effect” with respect to the hypothesis presented in earlier publications by the author. Arguably, the study provides additional evidence in support of the hypothesis put forward by its author: in Poland the stereotype, according to which mathematics is a domain for males is still alive.

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