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The influence of intelligence and emotions on the acceptability of genetically modified organisms

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Abstract The purpose of the study was to explore the relation between the acceptance of genetically modified organisms, basic emotions, general (IQ), verbal (VIQ) and procedural (PIQ) intelligence. The sample comprised 123 students of psychology (N = 65; 52.8%) and pre-service teachers (N = 58; 47.2%). There were 52 (42.3%) females and 71 males (57.7%) from one of the Slovenian universities. The conclusions of the study are as follows: a) acceptability of genetically modified organisms cannot be considered as a single group, but each GMO should be considered separately. Plants and microorganisms are much more easily to be accepted than animals and usages others than for food are more acceptable. Females showed higher level of acceptance than males. b) Among responses involving ten basic emotions (fear, anger, joy, disgust, sadness, shame, contempt, guilt, surprise and interest), anger, fear, disgust and contempt are significantly correlated with the rejection of GMOs. Interest and surprise are the most frequent responses towards GMOs but are not correlated with acceptance, showing that interest can be triggered by both negative and positive attitudes toward GMOs. c) IQ in females is negatively correlated with fear, disgust, sadness, shame, contempt, guilt and surprise (statistically significant); VIQ with fear, disgust, shame and guilt; PIQ with joy, shame and guilt. Higher IQ, VIQ and PIQ are connected with the lower emotional response, leading to easier acceptance of GMOs.

Keywords: acceptability, emotions, genetically modified organisms, intelligence

INTRODUCTION

Biotechnology based on organisms with intentional modification of genetic material will change the quality of life either for good or for ill in future generations. Enormous sums have been invested in the development of genetically modified organisms (GMOs), only a few of which have found their way onto the market (Rommens, 2010); what is acceptable in some parts of the world is unacceptable in others (Finucane and Holup, 2005). The transfer of new findings from laboratories to end consumers depends not only on scientific knowledge among scholars but also on legal, social, moral, ethical, and religious issues, as well (Lazarowitz and Bloch, 2005). So, finding and evaluating any factors which can, even marginally, affect the acceptability of GMOs can be regarded as important.

Modern biotechnology, especially when connected with GMOs, is recognized by public opinion not only as something beneficial but also as a threat (Pardo et al. 2002; Christoph et al. 2008; Rommens, 2010). Because issues concerning modern biotechnological practices have reached beyond scientific circles and are causing concern in society (Flores and Tobin, 2002), such issues are called socioscientific issues (Sadler, 2004; Sadler and Zeidler, 2005a; Sadler and Zeidler, 2005b). In previous studies (Šorgo and Ambrožič-Dolinšek, 2009; Šorgo and Ambrožič-Dolinšek, 2010), it was shown that a correlation between knowledge of biotechnology and acceptance of genetically modified organisms (GMOs) does exist but is weaker than the correlation between attitudes towards and acceptance of

GMOs. This finding conforms to relations in other socioscientific issues as well (Allum et al. 2008), leading to the conclusion that any meaningful debate concerning socioscientific issues cannot neglect the attitudes and the emotions that shape them (Šorgo et al. 2011).

In relation to genetic engineering and GMOs, emotions can most often be described in terms of emotional involvement (Spence and Townsend, 2006) from a care perspective, in which empathy and concern for the well-being of others or relations (relatives) lead to guided decisions or courses of action (Sadler and Zeidler, 2005b). Emotions are often hidden in related concepts, such as concern (James, 2004), moral acceptability (Črne-Hladnik et al. 2009), personal or general risk and uncertainty (Finucane, 2002; Ronteltap et al. 2007; Christoph et al. 2008). The most frequently reported emotions concerning GMOs are negative ones such as worry (anxiety) (Yunta et al. 2005), anger (Stewart and McLean, 2005) and fear (Laros and Steenkamp, 2004). Reports of fear concerning genetically modified food (GMF) frequently appear in the mass media (Laros and Steenkamp, 2004), and the term “Frankenfoods” reflects opinions shared by many (Flores and Tobin, 2002). Fear of GMF is positively influenced by consumer concern for the environment and negatively affected by their faith in the technology of food production. Consumers who are more fearful of GMF have a more negative attitude towards genetically modified food and towards genetic modification of animals, and exhibit greater interest in information related to food production (Finucane, 2002; Laros and Steenkamp, 2004), and humans were found to be much more emotionally connected to animals than to plants. Because of their commercial importance, emotions are often evaluated in relation to GM food and food products (Finucane, 2002; Laros and Steenkamp, 2004). One interesting finding is that people expressing anxiety (worry) tend to collect more information before deciding for or against an action or decision, but those who express anger are likely to take immediate action (Stewart and McLean, 2005). Positive emotions are reported less frequently. Recently (Šorgo et al. 2011) it was reported that the levels of interest and surprise when someone faces exposure to GMOs exceeds the levels of other basic emotions as defined by Izard et al. (1993).

There exist various lists, theories, and grouping criteria for the emotions (Strongman, 2003). Although there is still no definite agreement on the existence or appropriateness of the term ‘basic emotions’ (Ekman, 1992; Ekman, 1999; Barret et al. 2009; Smith and Schneider, 2009) this term is used in the study. For the present study, these emotions that students should easily be able to define and interpret were chosen. Ten basic emotions were used: fear, anger, joy, disgust, sadness, shame, contempt, guilt, surprise and interest, as defined by Izard et al. (1993). The dilemma that influenced our decision was whether students should be asked to respond to GMO use in general, or if they should be offered a list of statements to each of which they would assign a level of potential emotional response (Šorgo et al. 2011). It was decided to use the latter, in the form of statements related to potential real life situations. In this way we sought to find student responses for ten individual emotions on each statement (Appendix 1).

Intelligence represents the individual's overall level of intellectual ability. It serves as a general concept that includes several groups of mental abilities. One of the most influential divisions of intelligence splits it into verbal, performance and social intelligence (Thorndike, 1920). Even though no widely accepted definition of intelligence exists, it usually refers to the ability to solve novel problems, adaptation to the environment, basic mental processes and higher order thinking, like reasoning, problem solving and decision making (Sternberg and Detterman, 1986).

Among the psychological factors, general intelligence (IQ) is known to be the strongest predictor of academic achievement (*e.g.*, Gottfredson, 2002). Contrary to received wisdom, the effects of IQ on economic success are almost entirely mediated by educational attainment. Among persons with equal levels of schooling, IQ has little influence on job performance, occupational standing, earnings or wealth. However, there are other, sometimes surprising, consequences of IQ throughout adult life. The long-term correlates of adolescent cognition include drinking behaviour, survey participation, Internet use, and the timing of menopause (Hauser, 2010). Some early and recent studies have further shown a negative relationship between intelligence and religious belief in the United States and Europe (Lynn et al. 2008), as well as childhood obesity (Yu et al. 2010), and fertility (Meisenberg, 2010).

Another aspect of intelligence that has received much attention is gender differences. Gender differences in general intelligence seem to be negligible (*e.g.*, Halpern, 2000; Hyde, 2005). Regarding specific cognitive abilities, recent systematic analysis suggests that females surpass males in some, but not necessarily in all areas of verbal ability (Garai and Scheinfeld, 1968; Jensen, 1998; Halpern, 2004). The most robust and pronounced gender difference is seen in spatial abilities. A meta-analysis

of studies published before 1973 found an average difference of about half a standard deviation in favour of males on tests of visiospatial ability (Hyde, 1981). Factor analytic studies have shown that spatial ability is not a unitary process and can be divided into three categories: spatial perception, mental rotation, and spatial visualization (Linn and Peterson, 1985). The most pronounced gender differences of nearly one standard deviation have been reported mainly for mental rotation tasks (Voyer et al. 1995; Mackintosh and Bennett, 2005).

Appendix 1: Statements used in the questionnaire measuring emotional response.

V1: You have unknowingly eaten a meal containing food produced from **genetically modified animals** (*e.g.*, Salmon with an additional gene for fast growth, or a pig with genes to change the relation between the content of saturated and unsaturated fats). Shortened: **You have eaten genetically modified food from animals.**
V2: Unknowingly you have eaten a meal containing food produced from g**enetically modified plants** (*e.g.*, Potato resistant to viral diseases, tomatoes with genes that delay softening). Shortened: **You have eaten genetically modified food from plants.**
V3: In the apartment where you live your roommate has brought home a **genetically modified animal** (*e.g.*, A cat with non-allergenic fur, or a fish that glows in the dark). Shortened: **Living with genetically modified animals.**
V4 You have recognized that in your immediate neighbourhood **genetically modified plants** are being cultivated (*e.g.*, Maize MON 810). Shortened: **Genetically modified plants growing in your immediate neighbourhood.**
V5: One of your internal organs is losing its function, and you have been offered replacement of the damaged organ by an organ from a **genetically modified animal**. Shortened: **Transplantation of an organ from a genetically modified animal.**
V6: You have learned that an active substance in your prescription drugs is produced from **genetically modified yeast**. Shortened: **Medicines from genetically modified yeast.**
V7: You have learned that a biotechnical plant in your immediate neighbourhood is producing **chemical substances for use in the paper industry by using genetically modified microorganisms**. Shortened: **Genetically modified microorganisms in the production of chemical substances.**
V8: You have been informed that a nearby biotechnological plant is using **genetically modified plants** (*e.g.*, corn) for the production of biofuels. Shortened: **Genetically modified plants in the production of biofuels.**
V9: Your child or relative has diabetes and will be dependent on insulin throughout his life. You have learned that there is a possibility for **genetic healing**, where new intact genes will be transferred into the cells of the pancreas of the ill person. Shortened: **Genetic healing.**
V10: You have learned that the cotton shirt you are wearing was produced from **genetically modified cotton resistant to insects.** Shortened: **Contact with material produced from genetically modified plant.**

Purpose of the study

To the best knowledge of the authors, no such study, where general (IQ), verbal (VIQ) and performance (PIQ) intelligence and emotions have been connected with acceptance of different kinds of genetically modified organisms, has been published. The study can be regarded as small scale, pilot and exploratory.

MATERIALS AND METHODS

Structure of the sample and sampling

The questionnaire was administered in the autumn of 2010 at the University of Maribor. The sample comprised 123 students of psychology (N = 65; 52.8%) and pre-service teachers (N = 58; 47.2%). There were 52 (42.3%) females and 71 males (57.7%). One student (0.8%) was in the first study year, 55 (44.7%) in the second, 37 (30.1%) in the third, 5 (4.1%) in the fourth, and 25 (20.3%) were in a period between finishing lectures and the writing of the graduation thesis. Because of IQ testing, anonymity was not possible but the confidentiality of results was assured.

Table 1. Acceptance of GMOs among students of psychology and pre-service teachers (N = 123). Min = 1-completely acceptable; Max = 5-completely unacceptable.

Code	Genetically modified organism	Mean	SD
V1	Domesticated animals with new properties (for example, cats with no-shed or non-allergenic fur)	3.28	1.370
V2	Microorganisms used for organic synthesis in the food industry (for example, ethanol)	2.75	1.157
V3	Plants with the ability to synthesize medicinal substances.	2.00	.983
V4	Microorganisms with the ability to synthesize medicinal substances (for example insulin)	1.99	.928
V5	Plants for animal food resistant to pests and pathogens.	2.82	1.181
V6	Microorganisms with the ability to synthesize applicable organic substances (for example various organic acids).	2.50	1.019
V7	Animals, for example goats that produce milk containing medicinal substances (for example, coagulation blood factor)	3.12	1.346
V8	Ornamental garden plants with new properties (for example, blue carnations).	2.55	1.410
V9	Crop plants with increased tolerance to stress conditions (for example drought, salinity, etc.).	2.43	1.181
V10	Animals for food consumption having meat with improved characteristics (for example, meat with low fat or with more intense colour).	3.84	1.333
V11	Microorganisms that can degrade toxic or harmful substances previously biologically non-degradable.	2.29	1.038
V12	Ornamental house plants with new properties (for example, ornamental plants that glow in the dark).	3.17	1.424
V13	Plants used for producing biofuel.	1.97	.999
V14	Animals reared as donors for GM organ transplants (replacing or repairing defective organs or tissue).	3.29	1.329
V15	Plants for human food with improved quality characteristics of fruit (for example, prolonged cold storage).	3.57	1.349
V16	Genetically modified viruses designed for the transfer of genes between organisms.	3.51	1.162
V17	Plants for human food resistant to pests and pathogens.	3.24	1.295
	Total for all 17 items	48,34	12,948

IQ testing

The individuals were tested with 9 WAIS-R subtests (6 verbal: Information, Digit Span, Vocabulary, Arithmetic, Comprehension, and Similarities; and 3 performances: Picture Completion, Picture Arrangement, and Digit Symbol). For each person the level of verbal intelligence (VIQ), performance intelligence (PIQ), and intelligence (IQ) was determined.

Mean IQ in our sample of 123 students is 104.6 (SD = 9.87) with a minimum of 83 points and a maximum of 133 points. Results for verbal IQ (VIQ) are M = 104.7, SD = 9.26, Min = 88, Max = 131 and for performance IQ (PIQ) are M = 102.7, SD = 13.88, Min = 68, Max = 145.

Differences between gender are in favour of females (IQ = 2.04; VIQ = 1.63; PIQ = 1.23) but are not statistically significant.

Appendix 2. Differences in acceptability of GMOs between genders. N = 123; N males = 71; N females = 52) (codes for a1 - a17 = see **Table 1**). M = Male; F = Female).

Code	Gender	Mean	SD	F	Sig
a1	M	3.54	1.329	5.844	.017
	F	2.94	1.364		
a2	M	3.00	1.134	8.463	.004
	F	2.40	1.107		
a3	M	2.15	1.009	4.280	.041
	F	1.79	.915		
a4	M	2.10	.943	2.245	.137
	F	1.85	.894		
a5	M	3.00	1.183	3.947	.049
	F	2.58	1.144		
a6	M	2.69	1.036	5.818	.017
	F	2.25	.947		
a7	M	3.32	1.318	3.869	.051
	F	2.85	1.349		
a8	M	2.63	1.447	.552	.459
	F	2.44	1.364		
a9	M	2.52	1.217	.980	.324
	F	2.31	1.130		
a10	M	4.11	1.225	7.548	.007
	F	3.46	1.393		
a11	M	2.42	1.104	2.664	.105
	F	2.12	.922		
a12	M	3.23	1.416	.246	.621
	F	3.10	1.445		
a13	M	2.07	1.005	1.793	.183
	F	1.83	.985		
a14	M	3.49	1.351	3.905	.050
	F	3.02	1.260		
a15	M	3.76	1.325	3.448	.066
	F	3.31	1.351		
a16	M	3.66	1.121	2.832	.095
	F	3.31	1.197		
a17	M	3.51	1.217	7.289	.008
	F	2.88	1.323		
Total	M	51.21	12.557	8.776	.004
	F	44.42	12.550		

Structure of the questionnaire

To establish students' emotions towards GMOs, parts of a questionnaire from a previous study were used (Šorgo et al. 2011), where the main task was to find the relation between emotions and acceptance of GMOs. A set of ten basic emotions was used (Fear, Anger, Joy, Disgust, Sadness, Shame, Contempt, Guilt, Surprise and Interest), as defined by Izard et al. (1993); these were chosen as being easily comprehensible to students. For the questionnaire, statements related to potential real life situations were formulated (Appendix 1). The general introduction was as follows:

Table 2. Descriptive statistics of emotions expressed toward GMOs (N = 123).

Emotions	Min	Max	Mean	SD
Interest	11	50	32.69	8.305
Surprise	14	50	30.89	8.134
Fear	10	38	22.41	6.991
Anger	10	41	18.70	7.746
Joy	10	37	18.50	5.694
Disgust	10	35	16.89	6.640
Sadness	10	47	16.20	6.955
Contempt	10	37	15.93	6.961
Guilt	10	43	13.84	5.749
Shame	10	36	13.45	5.375
Total	**121**	**339**	**199.50**	**45.876**

We will present potential situations where you could make contact with genetically modified organisms (GMOs). We are interested in establishing the strength of your emotional response to such contact. On the list are ten basic emotions, but we have provided two blank fields where you can add additional emotions of your choice. We ask you to indicate the strength of your response by circling the appropriate numbers in the table. Values: 1-5: 1 = no response; 5 = maximal response.

Thus, the score would be 100 for someone for whom GMOs in any form or usage did not trigger any emotions at all and 500 for someone who responded with maximum emotional response for all ten listed usages of GMOs.

Acceptance of GMOs was evaluated with a closed questionnaire, where respondents were asked to circle an answer on a 17-item list of different existing or potentially-existent GMOs and in this way to express their opinions about GMOs. The same basic list was used in previous studies where connections between knowledge about and attitudes toward GMOs were investigated (Šorgo and Ambrožič-Dolinšek, 2009; Šorgo and Ambrožič-Dolinšek, 2010). Five answers (5-completely unacceptable; 4-unacceptable, with exceptions; 3-don't know, do not have an opinion; 2-acceptable with limits; 1-completely acceptable) were provided. Thus, the score would be 17 for someone for whom all items were acceptable and 85 if all items were completely unacceptable. The questionnaire had a reliability level, expressed as Cronbach's alpha, of 0.903, which can be recognized as excellent.

Data analysis

The data analysis was carried out with the statistical software SPSS® 18.0. Descriptive statistics, Pearson Correlation, One way ANOVA and regression analysis were used to interpret the data.

RESULTS

The acceptability of GMOs is a complex issue and cannot be explained when someone is measuring acceptability by treating different kinds of GMOs as one group. In measuring the acceptability of GMOs, it can be recognized from Table 1 that GMOs should be treated as separate organisms based on their utility. Detailed analysis of the differences in acceptability between different kinds of GMOs was not the first intention of this study; nevertheless, in brief, the most acceptable organisms are: i) Plants with the ability to synthesize medicinal substances (V3); ii) Microorganisms with the ability to synthesize medicinal substances (for example insulin) (V4), and iii) Plants used for producing biofuel (V13). Three of the most unwanted are: i) Animals for food consumption having meat with improved characteristics (for example, meat with low fat or with more intense colour) (V10); ii) Plants for human food with improved quality characteristics (for example, prolonged cold storage, more intense coloration, etc.) (V15); and iii) Genetically modified viruses designed for the transfer of genes between organisms (V16). These findings confirm results from other studies and references within them (*e.g.*

Grunert et al. 2003; Ronteltap et al. 2007; Christoph et al. 2008; Šorgo and Ambrožič-Dolinšek, 2009; Šorgo and Ambrožič-Dolinšek, 2010) that the acceptability of GMOs not used for food consumption is higher than for GMOs used for food, and the acceptability of GM plants is higher than that of GM animals.

Appendix 3. Differences in emotions expressed towards GMOs by gender. N = 123; N males = 71; N females = 52; M = Male; F = Female).

Emotions	Gender	Mean	SD	F	sig
Fear	M	24.51	6.639	17.022	.000
	F	19.56	6.479		
Interest	M	30.73	7.675	10.033	.002
	F	35.37	8.455		
Sadness	M	17.51	7.169	6.232	.014
	F	14.40	6.285		
Anger	M	20.11	7.494	5.813	.017
	F	16.77	7.737		
Joy	M	17.46	5.752	5.817	.017
	F	19.92	5.346		
Disgust	M	18.06	6.443	5.325	.023
	F	15.31	6.638		
Contempt	M	16.82	6.848	2.786	.098
	F	14.71	6.997		
Surprise	M	30.25	7.677	1.016	.315
	F	31.75	8.722		
Guilt	M	14.21	6.033	.708	.402
	F	13.33	5.353		
Shame	M	13.41	4.713	.009	.926
	F	13.50	6.214		
Sum-Tot-(Abs)	M	203.07	42.952	1.020	.315
	F	194.62	49.602		

Differences in the acceptance levels of GMOs between male and female students are statistically significant overall ($F (1, 120) = 7.289$, $p = .004$) and in 10 of 17 cases (Appendix 2). In all cases acceptance of GMOs is higher among females. Lower acceptance among males comes as a surprise because it contradicts other studies (*e.g.*, Magnusson and Hursti, 2002; Ekborg, 2008; Ozel et al. 2009) where males show greater acceptance of GMOs, or no difference was found (Usak et al. 2009). Because of the structure of the questionnaire, we were unable to explain this finding but speculate that these lower levels of acceptance among males occurred because the majority of the males in the sample are psychology students. Using regression analysis, with study track and gender as predictors and acceptance as the criterion variable, it was calculated that study track significantly predicted acceptability $\beta = -.261$, $t (120) = -2.13$, $p = .035$, while the similar finding for gender did not reach statistical significance ($p = .540$) in this model. This finding calls for further studies.

Table 3. Correlations between IQ, VIQ, PIQ, sum of emotions expressed and acceptance of GMOs among females (N = 52).

	IQ	VIQ	PIQ	Emotions
Emotions	-.352*	-.315*	-.261	
Acceptance	-.165	-.220	-.056	.261

*Correlation is significant at the 0.05 level (2-tailed).

Emotions can affect acceptability as a precursor of opinions and prejudices. Based on collected sums of scored toward 10 potential situations dealing with contact with different kinds of GMOs, it can be recognized that the highest scores were given to interest and surprise (Table 2). As the most often

reported emotion toward GMOs, fear is on average rounded 10 scores behind interest. These results can be interpreted as showing that interest is triggered by the wish to know more and to collect more information (Finucane, 2002; Laros and Steenkamp, 2004; Stewart and McLean, 2005). Surprise is harder to interpret but can be connected with the knowledge that GMOs in Slovenia cannot be released in open fields and with the awareness that their usage in the pharmaceutical industry is low, so they can be regarded as novelty with which people have little contact or of which they were unaware. Females show higher response on the scales of both emotions (Appendix 3), probably because of their greater acceptance of GMOs. Fear, anger and disgust received much lower scores, but higher in males than females. Guilt and Shame can be excluded from studies concerning GMOs because in the general population the response was very low, with the exception of some individuals who express high values. These results confirm findings from a study performed on 564 students from secondary schools and from universities in 2009 (Šorgo et al. 2011). In this study it was additionally shown that different GMOs triggered different level of emotion, an issue which this study does not intend to verify.

Correlation analysis between IQ, VIQ, PIQ, total scores for emotions expressed and acceptability of QMOs (all results are not presented) shows that the highest and statistically significant correlation $r (121) = .258$, $p < .001$ is between the level of emotions and willingness to accept. Correlations between IQ, VIQ and PIQ and emotions are not statistically significant. The highest correlation is between PIQ and emotions $r (121) = -.123$, $p = .174$ and PIQ and acceptability $r (121) = -.127$, $p = .160$. Correlations between IQ, VIQ, PIQ and separate emotions are not statistically significant.

For males, correlations between IQ, VIQ, PIQ, total scores for emotions expressed and acceptability of QMOs are not statistically significant. The highest correlation $r (69) = .231$, $p = .053$ is between total emotion scores and acceptability. Among intelligence quotients, the highest correlation is between VIQ and emotions $r (69) = .199$, $p = .096$. Among individual emotions, a statistically significant correlation can be found between VIQ and disgust $r (69) = .289$, $p = .014$ and VIQ and contempt disgust $(69) = .238$, $p = .046$.

In the female sample, statistically significant correlations between IQ, VIQ and total scores for emotion expressed emerge (Table 3), showing that higher IQ and VIQ are connected with lower emotional response. PIQ shows the same trend toward emotions, but the correlation is not significant. Correlations between IQ, VIQ, PIQ and acceptance of GMOs are not statistically significant (Table 3). The correlation between emotions and acceptability is low and not significant.

Additional insight is gained by analysis of the correlations between separate emotions and intelligence quotients (Table 4). IQ is negatively correlated with fear, disgust, sadness, shame, contempt, guilt and surprise to a statistically significant degree; VIQ with fear, disgust, shame and guilt; PIQ with joy, shame and guilt. On the other hand, anger, fear, disgust and contempt are the emotions that are largely part responsible for the acceptability levels of GMOs. All four can be loosely declared as negative emotions. Joy and the interest, as positive emotions, seem to lower the rejection of GMOs, but correlations are low and not statistically significant.

Table 4. Correlations between IQ, VIQ, PIQ, individual emotions and acceptance of GMOs among females (N = 52).

	IQ	VIQ	PIQ	Acceptance
Fear	-.280*	-.294*	-.121	.432**
Anger	-.261	-.272	-.146	.466**
Joy	-.244	-.084	-.290*	-.142
Disgust	-.333*	-.274*	-.266	.391**
Sadness	-.239	-.251	-.155	.223
Shame	-.391**	-.283*	-.349*	.156
Contempt	-.288*	-.255	-.229	.348*
Guilt	-.363**	-.363**	-.325*	.195
Surprise	-.213	-.239	-.108	-.002
Interest	-.042	-.025	-.036	-.137

*Correlation is significant at the 0.05 level (2-tailed).

**Correlation is significant at the 0.01 level (2-tailed).

DISCUSSION

The present study, even though performed on a small sample, opens more questions than it provides answers and can be regarded as a pilot study giving potential directions for future inquiry. It can be summarized that studies seeking answers about the acceptability of GMOs as general category will yield no practical answers. Each potential usage of GMOs must be investigated individually, and the transferability of findings about acceptability from one GMO to another is rather low. Findings about correlations between declarative knowledge about GMOs and acceptability are mixed (Šorgo and Ambrožič-Dolinšek, 2009; Šorgo and Ambrožič-Dolinšek, 2010). The high level of interest, as a possible precursor to active efforts to find information, is only marginally connected with acceptance levels of GMOs, showing that interest can be triggered by both positive and negative attitudes toward GMOs. The connection between study track and acceptability of GMOs remained unclear. Such connections should be investigated in a larger study. The implications could be important (Knight and Paradkar, 2008; Knight and Gao, 2009; Bett et al. 2010) because of biased recruitment of gatekeepers to GMOs from different study streams; moreover as recognized by (Devos et al. 2009), knowledge will not be the crucial factor in deciding whether GMOs will be allowed in one or another EU country.

Differences in the levels of acceptance between the sexes differ from study to study, as presented in the introduction, and in the present study go in favour of females. These differences are affected by several factors, among which negative emotions are predominant.

The finding that females with greater intelligence are more positive about genetically modified organism is yet another gender related difference connected to the intelligence, emotional intelligence and personality factors described in the introduction. This characteristic could be further explained by a recent study by Jaušovec and Jaušovec (2010), which showed that in contrast to males, females displayed a more pronounced relationship between strategic emotional intelligence (the ability to understand and manage emotions), the personality factor of conscientiousness, and verbal intelligence. This is similar to the finding of the present study indicating a stronger relationship between the sum of expressed emotions and acceptance of GMOs and verbal intelligence.

These research findings call for larger scale studies with random sampling to cover a broader population; additionally, emotional quotient (EQ) should be included as one of the predictors.

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