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ORIGINAL RESEARCH

The Moral Reasoning of Genetic Dilemmas Amongst Jewish Israeli Undergraduate Students with Different Religious Affiliations and Scientific Backgrounds

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Abstract The main objective of this study was to shed light on the moral reasoning of undergraduate Israeli students towards genetic dilemmas, and on how these are affected by their religious affiliation, by the field they study and by their gender. An open ended questionnaire was distributed among 449 undergraduate students in institutions of higher education in Israel, and their answers were analyzed according to the framework described by Sadler and Zeidler (*Science Education*, 88(1), 4–27, 2004). They were divided into two major categories: those whose reasoning was based on the consideration of moral consequences (MC), and those who supported their opinion by citing non-consequentialist moral principles (MP). Students' elaborations to questions dealing with values towards genetic testing showed a correlation between the students' religious affiliation and their reasoning, with religious students' elaborations tending to be more principle based than those of secular ones. Overall, the students' elaborations indicate that their main concern is the possibility that their personal genetic information will be exposed, and that their body's personal rights will be violated. We conclude the paper by offering several practical recommendations based on our findings for genetic counseling that is specifically tailored to fit different patients according to their background.

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Introduction

With the scientific and genetic progress of the last three decades, genetic diseases can now be detected before or during pregnancy. This progress can drastically reduce the frequency of hereditary diseases, which makes genetic counseling an important and relevant domain in every society. And yet, the willingness to receive counseling and genetic testing is not always common in every society, and is influenced by the individual's cultural background (Lewis 2002; Raz and Atar 2003; Shaw 2011) and scientific knowledge. Because our society is culturally diverse, genetic counselors are expected to encourage people to make informed decisions that reflect their own personal and cultural beliefs, attitudes and values (National Society of Genetic Counselors 2013).

Informed decisions are defined as those that are "based on relevant information, consistent with the decision maker's values and behaviorally implemented" (Marteau et al. 2001 pp. 99). In light of this definition, cultural factors are of great influence in the decision making process, especially when it comes to issues like genetic testing (Awwad et al. 2008; Ten Have 2001). This means that, in addition to scientific knowledge, cultural background - including religious affiliation - is a vital factor that inspires individuals' decision making and moral reasoning.

Moral reasoning has been defined in various ways. In the context of this study it refers to "individual or collective practical reasoning about what, morally, one ought to do" (Richardson 2014, Introduction). In the field of clinical decision making, including genetics, skills such as knowledge

acquisition, discussion of options, understanding odds, pros and cons, and clarification of patient values are all required for making informed decisions (Boerwinkel et al. 2011; Elwyn et al. 2012; Makoul and Clayman 2006). Our emphasis in this study will therefore be on the subjects' previous scientific knowledge, as well as the religious factors that influence their moral reasoning about genetic issues, and therefore also their decision making.

Theoretical Background

Cultural Influences on Scientific and Genetic Conceptions

Like decision making, comprehension of scientific and genetic information is also affected significantly by cultural influences (Lee et al. 2005; Pivetti and Melotti 2013; Shaw and Hurst 2008). Culture is defined as the totality of beliefs, values, behaviors and communication patterns among members of a cultural group (Parette 1999). Research on the relationship between culture and learning about science has shown that only when students' culture is taken into consideration can there be significant learning and higher achievement (Lee et al. 2005). while integration of religious beliefs into the understanding of science reduces the tension between these domains (Starr 2010). Science education researchers cast culture as a system of implicit and explicit beliefs and values located within entities (e.g., individuals, groups), or a set of dynamic practices constructed and reconstructed through participants' engagement in community activities (Parsons and Carlone 2013).

As a part of our cultural background, our religious beliefs affect our approach to science in general and to genetics in particular. This has been shown in cases as wide ranging as Muslim society in Saudi Arabia (Aqueel 2007). Chinese society in Australia (Ota Wang 2001). Pakistani society in Great Britain (Shaw and Hurst 2008) and religious women in Italy (Pivetti and Melotti 2013). In Israel, where our study took place, differences in religious belief and custom are clearly reflected in differing genetic practices. In the ultra-religious Jewish society, women refrain from doing amniocentesis because of religious restrictions that forbid selective terminations, whereas in secular Israeli society prenatal diagnosis and selective termination are supported, independently of the rabbinical stance (Raz 2009). The rejection of pregnancy termination by many religious communities often prevents participation in genetic testing (Rosner et al. 2009). The National Religious sector in Israel shows a higher percentage of performing genetic tests than the Ultra-Orthodox community, but still lower than in the secular sector (Sher et al. 2003). Thus, in these societies, the "options" raised by the genetic counselor can at times contradict the religious or traditional values of the patient.

Many religious populations that have been investigated believe that only God knows why a given situation occurs. They therefore do not wish to intervene before or during pregnancy, believing the situation to be out of their control anyway (see for instance Ngim et al. 2013; Pivetti and Melotti 2013; Shaw and Hurst 2008). And yet, studies have also shown that there is not always an exact correlation between belief and behavior. Though religious people usually prefer to rely on God, there are cases when - despite the fact that religious rules do not permit termination - some religious people nevertheless choose to do so if their fetus is sick (Raz 2009).

Decision Making

Throughout our life, we are required to make decisions on a wide range of topics. We are usually not taught to make these decisions, and most are therefore intuitive, influenced chiefly by our own values (Saaty 2000). Researchers have realized that the participation of the public in scientific decisions is crucial, since the public no longer trusts scientists blindly, and areas such as genomics and modified food are giving rise to many ethical and social dilemmas in which the scientists are trying to involve the public (Wilsdon and Willis 2004). As the public gradually becomes more involved, their decision making must also become more informed. To ensure informed decision making on genetic issues, more effort must be invested in presenting the benefits, risks, and limitations of genetic testing, since genetic issues are scientifically complicated, and as a result even genetically educated societies can sometimes show a lack of understanding of the consequences of testing (Haga et al. 2013).

Moral Reasoning

Moral reasoning is a procedure in which one decides what one ought (morally) to do on the basis of one's values. Prior qualitative analysis has revealed that moral considerations can significantly influence the decision making processes (Sadler and Zeidler 2005). People tend to rely on moral factors when making decisions on socio-scientific issues (Bell and Lederman 2003). which means that socio-science issues are linked to moral reasoning. High levels of moral reasoning have been described in terms of cognitive flexibility, or the ability to understand, consider, and weigh multiple frameworks (Endicott et al. 2003). It has been found that participation in formal education, such as higher education, develops moral reasoning (King and Mayhew 2002).

Values are known as one of the components that influence the making of choices between alternative courses of action (Dietz et al. 2005; Kortenkamp and Moore 2001; Oreg and Katz-Gerro 2006; Stern et al. 1999; Stern 2000). For the purpose of our study, values are defined as: the principles people

use to select and justify their actions and to evaluate people and events. The value priorities of individuals are affected by their social experiences, such as religion, gender, education, occupation, and cultural background. In turn, they also influence those individuals' actions in domains such as religion and environment (Schwartz 1992).

When dealing with the moral reasoning of individuals on genetic health issues, and with the values reflected therein, we must be aware of the norms and values at risk in controversial issues such as prenatal diagnostics and pre-symptomatic genetic testing, which confront people with difficult choices (Van der Zande et al. 2012). Since test outcomes are ambiguous and other people (i.e. family members) are also involved, people often base their choices on moral grounds, and not necessarily on scientific knowledge (Van der Zande et al. 2012). High school students have been found to make significant use of moral reasoning when discussing genetic tests (Lindahl 2009). genetic engineering (Sadler and Zeidler 2005) and biotechnology (Dawson and Venville 2009). Students employed moral reasoning by using cognitive rationalistic reasoning at times, and by using emotive reasoning at others (Dawson and Venville 2009; Lindahl 2009; Sadler and Zeidler 2005).

Gender Influences

Since decision making is affected by behavioral characteristics, it is quite likely that gender will be a factor that influences decision making in the context of genetic counseling. Women can have different considerations, values and concerns than men, and are also perceived differently than men in different cultures (Awwad et al. 2008; Inglehart and Norris 2003; Loo and Thorpe 1998; Signorielli 2012). Gender has been found to influence ethical decision making (Beekun et al. 2010; Curtis et al. 2012; Jaffee and Hyde 2000; Rothbart et al. 1986). as well as risk preference (Taylor 2011). with women having been found to be less risk seeking than men (Powell and Ansic 1997). All these differences might influence men and women's elaborations on moral decisions concerning genetic issues.

Objective and Research Questions

The main objective of this study is to shed light on the moral reasoning of undergraduate Israeli students towards genetic issues (with an emphasis on genetic counseling) in relation to their religious affiliation, to their prior scientific knowledge and to their gender. Our research questions are therefore:

1. What is the connection between the **religious affiliation** of undergraduate students and their moral reasoning in relation to genetic issues?

2. What is the connection between **the scientific background** of undergraduate students and their moral reasoning in relation to genetic issues?

3. What is the connection between **the gender** of undergraduate students and their moral reasoning in relation to genetic issues?

Method

Participants

Our study population was composed of undergraduate students from 4 out of the 5 Israeli universities as well as two colleges for teacher training. We focused specifically on undergraduate students because they are at the relevant age for genetic counseling concerning birth defects and genetic diseases.

Our goal in constructing the sample was to achieve a large enough sample of each of our six basic categories (i.e. religious students vs. non-religious ones, life-science studiers vs. non-life-science studiers, male vs. female students). We therefore appealed by email, at the beginning of the 2013 academic year, to lecturers in all Israeli universities and colleges who teach a variety of subjects that are studied at universities. Of these, 50 % were willing to participate and allowed us to distribute the questionnaire in their classes. With those, we arranged a mutually convenient time during the semester to come to their class and distribute our questionnaire. The students were told that the questionnaire was non-mandatory, that their answers were confidential and that its findings would be used for research purposes only. Completing it took approximately 30 min, and was done during the lesson, with one of the researchers present to answer questions. We continued to administer the questionnaire and collect data throughout the 2013 academic year until we achieved a sample that we judged to be sufficiently large and balanced.

The final sample consisted of 449 Israeli undergraduates. We approached 560 students on the whole, of whom 20 % declined to participate. Seventy three percent of the students in the final sample study in universities and the rest in colleges. Fifty seven percent of the students were female, the rest male; 51 % identified themselves as religious or semi-religious and the rest were secular. Fifty four percent studied life sciences (LS) and the rest studied subjects with no connection to genetics, such as economics, education or computer engineering.

The first part of the questionnaire asked the students about their personal details. We asked the students to circle the religious affiliation that suits them: secular, semi-religious, National religious or Ultra-orthodox (all well-known categories used in everyday discourse to define religious identity in Israel). In this way the sample "self-identified" the students'

religious affiliation. It should be noted that this research was found to be exempt from ethics review since the interview was voluntary, anonymous and did not include any disclosure of health information of any kind.

One important limitation to note in our sample is that it does not include students from Israel's non-Jewish population, which includes Christian and Moslem Arabs, Druze, and Bedouins. Of the students who answered our questionnaire, only 3 % identified themselves as non-Jewish, a percentage far too small to produce accurate results. We therefore omitted them from our sample, and we shall not relate in this study to the non-Jewish Israeli population.

Questionnaire Description

The questionnaire started with a short knowledge test consisting of 6 multiple choice questions (Appendix 1) that are part of the tool developed by Bowling et al. (2008). The questions were chosen from different concepts identified in the Bowling tool as central to genetic literacy. This part of the questionnaire is only intended to clarify the difference, if one exists, between the genetic knowledge of students studying and not studying life sciences.

The main part of the questionnaire included a genetic dilemma with 2 open ended questions (Table 5), and 4 scenarios with statements (Table 6). The participants were asked to state their agreement with each statement and explain their answer in their own words.

Genetic counseling deals not only with factual information but also with ethical problems, so one must be aware of both the interests of individuals and the interests of those who are genetically linked to them. This means that genetic information, and the decision making that revolves around it, have a social aspect (Wert et al. 2003). The ethical problems dealt with in this research are:

1. The role of the right to know versus the right not to know (*addressed in the genetic case and in scenario 2*).
2. The assessment of possible risks and benefits associated with potentially unpredictable and complex diseases (*see scenarios 2, 4*).
3. The extended impact of genetic information beyond the individual, and its effect on the family or even the community (*see scenarios 1, 3*).
4. Predictive prenatal and preconception testing leading to early treatment and prevention of inheritable diseases (*see scenario 4*).
5. The advisability of offering genetic tests for untreatable diseases (some of them late onset diseases, as in *scenario 2*).
6. Informing about diseases for which the individual is at increased risk (*see scenario 3*).

Data Analysis

The answers to the qualitative questionnaire, including the genetic dilemma and 9 open-ended elaborations to statements from 4 scenarios, were categorized according to the method suggested by Sadler and Zeidler (2004) for classifying the moral decision-making of students about genetic engineering dilemmas. Their study collected qualitative data through interviews, dividing the students' responses into 2 major categories: moral consequences (MC) and non-consequentialist moral principles (MP). MC was indicated by "consequentialism, when students justified their positions in terms of expected outcomes" (Sadler and Zeidler 2004 pp. 14). while decisions in the moral principles category were based on "moral standards independent of the consequences" (Sadler and Zeidler 2004 pp. 16). We adopted this basic categorization, used some of the sub-categories which had been written by Sadler & Zeidler and added sub-categorizations that were relevant to the genetic counseling dilemmas raised in our questionnaire.

Questionnaire Validity and Reliability

The questionnaire was validated in several stages. In the first phase a representative sample of 20 full questionnaires was divided into categories by the first author of this article. The categories of these 20 questionnaires were semantically validated (Bauer and Gaskell 2000) by the co-author and by two other independent researchers (Creswell and Miller 2000). All four researchers, two experts in genetics and two experts in science education, each classified the answers into categories on their own. Elaborations that led to any disagreements were discussed until a 90 % agreement on the elaboration categories was reached (Vedder-Weiss and Fortus 2012). At the second stage, the rest of the questionnaires were categorized by the first author, and revised by the co-author according to the final categorization agreed upon. Elaborations that led to any disagreements were discussed until an 85 % agreement on the elaboration categories was reached (Vedder-Weiss and Fortus 2012).

Statistical Analysis

The major student elaborations (MC and MP) were statistically analyzed using the Nominal (=Binary) Logistic Regression model, utilizing significant variables ($p \leq .05$). Our two levels were either an MC or an MP elaboration. The purpose was to determine the impact of multiple independent variables presented simultaneously to verify which of the independent variables (religious affiliation, gender or field of study) differentiates between moral consequences and moral principles elaborations. The type of elaboration - moral consequences (MC) versus moral principles (MP) was the dependent variable

(Tables 1, 2, and 3). In order to account for multiple inferential tests, Holm–Bonferroni method was applied on the results. Nagelkerke's R^2 was calculated to be 0.05 for our models.

Power analysis was calculated by Sensitivity in G*Power 3.1 software, for statements 3, 7 and 8. We found that with a statistical power 0.80, $\alpha = 0.05$, sample of 449 students, when the groups are equal in size, the smallest OR the test could detect is 1.73.

Results

To start our inquiry, it was necessary to evaluate the undergraduates' genetic knowledge. This was essential because our premise is that undergraduate students studying life sciences know more about genetics than other students. This premise proved true, as in all 6 multiple choice questions we asked, a larger proportion of life sciences students answered the questions correctly. In the chi-square test we conducted, in 5 of the 6 questions the significance level was $p \leq 0.001$, and in one question it was $p < 0.05$. The chi-square test's smallest value was χ^2 (1, $N = 465$) = 6.24, $p = .125$; its highest was χ^2 (1, $N = 467$) = 71.03, $p < .0001$, indicating that the life science students showed significantly more genetic knowledge. Moreover, among the life science students, gender and religious affiliation did not significantly influence the students' knowledge, showing that the field of study was the major variable that influenced the students' knowledge. (For a full description of the genetic knowledge questions, see Appendix 1).

The genetic dilemma (see Table 4) describing a severe genetic disease raised ethical considerations amongst the students, which were classified as reliant on either MC (moral consequences) or MP (moral principles). Examples of the elaborations of both types for all the statements are shown in Table 5. In this genetic dilemma students were asked: "**What considerations and dilemmas arise from this case, assuming we know that the syndrome causes inherited mental retardation?**"

Sentences such as: "*Should we have children considering our risk for this disease?*" and "*Should I tell my sister so that she will know her consequences?*" reflect a reasoning that relies on moral consequences (MC), while sentences such as: "*The parents might feel guilty for passing the gene, so they should know; or should we leave it to God?*", and "*Is there a duty to report potential patients carrying this gene?*" reflect moral principles (MP) (Table 5).

Scenario 1 includes 2 statements that ask for elaborations regarding early detection of diseases (Table 6, questions no. 1, 2). In statement no. 2: "**Genetic research now allows early detection of diseases. I would not want a genetic survey to inform me that I am at risk for a genetic disease**" we find elaborations reflecting moral consequences (MC): "*There are things that can be done in order to postpone or delay the outbreak of the disease, and maybe I'll even choose to work in research of this disease and find a cure for it*", "*We should know the risk factors in order to have the possibility of avoiding them*", and "*I would like to know so I can make my considerations about having children, marriage etc.*" Examples of students' moral principles (MP) for this statement are: "*It's important to know these things and make a decision accordingly*" and "*I would like to know and make a decision on my own*" (such statements are based on the principle of an individual's right to know and decide about their own body).

Scenario 2 of the questionnaire includes 2 open ended statements (Table 6, questions no. 3, 4) that students were asked to elaborate upon. They address Huntington's disease - a late onset genetic disease that causes the degeneration of brain cells in certain areas of the brain. This degeneration causes uncontrolled movements, loss of intellectual faculties, and emotional disturbance. Huntington's is a dominant genetic disease, and a person who inherits the Huntington's gene will sooner or later develop the disease, usually in their thirties or forties. It is currently incurable, and its effects are irreversible (National Institute of Neurological Disorders and Stroke 2015).

For 3 of the statements in the questionnaire we found significant effects of one or two of the independent variables on

Table 1 Logistic Regression for elaboration no. 3: It is preferable that a person does not know whether he has the gene for Huntington's disease or not

Variable	Odds ratio	95 % confidence interval	*p*-value
Field of studies	.924	.581–1.467	.737
Gender	1.053	.703–1.577	.803
Religious affiliation	1.778	1.125–2.811	**.014**
Gender by field of studies	1.870	.741–4.719	.185
Religious affiliation by field of studies	2.844	1.154–7.006	**.023**
Religious affiliation by gender	.372	.147–.937	**.036**
Constant	.608		.000

Nagelkerke's R2 = 0.052

Significant values are bolded

Table 2 Logistic Regression for elaboration no. 7: The State of Israel should not fund research dealing with diseases such as deafness, which are not life-threatening

Variable	Odds ratio	95 % confidence interval	p-value
Field of studies	.825	.523–1.302	.409
Gender	.991	.663–1.480	.964
Religious affiliation	2.100	1.341–3.286	**.001**
Gender by field of studies	2.155	.865–5.372	.099
Religious affiliation by field of studies	2.123	.869–5.191	.099
Religious affiliation by gender	.718	.288–1.789	.477
Constant	.664		.000

Nagelkerke's R2 = 0.047

Significant values are bolded

the type of elaboration (MC or MP). These statements shall be detailed below. The logistic regression analyses of the other statements, for which no significant affects were found (statements 1, 2, 4, 5, 6, 9), are attached in Appendix 2.

For the statement "**It is preferable that a person does not know whether he has the gene for Huntington's disease or not**", we found a significant interaction (OR, 2.844, $p = 0.023$) between religious affiliation and field of study in the students' elaborations (Table 1). This difference was found to be significant only among the religious students, while among the secular ones there is no difference between the elaborations of LS studiers in comparison to non-LS studiers. Gender alongside religion was also a significant parameter ($p \leq 0.036$) in this statement, suggesting that secular men, as well as religious and secular women, have more consequentialist concerns than religious men, whose ideas are based more on principals.

Examples of elaborations based on consequences (MC) (see Table 4) include: "*He should prepare himself mentally for this in order to be able to deal with the situation.*" Elaborations that were categorized as moral principles (MP) include: "*Knowledge is power. Do not be afraid of it,*" "*If he has this gene he should tell about it when he meets his girlfriend, but if he just wants to do the test, why? Pray on it.*"

Scenario 3 (Table 6) consists of three statements dealing with values towards examining the fetus for deafness, representing a mild disease. Elaborations on the statement: "**The State of Israel should not fund research dealing with diseases such as deafness, which are not life-threatening**" showed significant findings. Although no statistical significance was found in relation to gender or to field of study, religious affiliation was found to be significant in the student's tendency to offer a principle based elaboration (Table 2, $p \leq 0.001$; OR, 2.1; 95 % CI 1.341–3.286), such as: "*the state will do as it pleases; the mother has the right to decide for herself,*" rather than a consequence-based elaboration like "*diseases such as deafness, though not causing death, affect the quality of life of the patients and their families, therefore thorough research has to be done.*"

Scenario 4 (Table 6) deals with preimplantation genetic diagnosis (PGD), an examination of embryos in vitro to look for signs of inherited disease before their introduction into the mother's womb. Statement no. 8 says: "**I think such examinations have future ethical dangers**." Significant differences can be seen in Table 3 in the type of elaboration based on religious affiliation ($p \leq 0.005$; OR, 2.325; 95 % CI 1.293-4.184), with religious students relying significantly more on moral principles. Students' gender was found to be significant as well ($p \leq 0.017$; OR, 1.901; 95 % CI 1.121-3.224), with women relying more heavily on moral principles than men. Elaborations categorized as MC (see Table 4) are for example: "*now it's genetic diseases, tomorrow it will be eye color or height.*" Elaborations categorized as MP are for example: "*Basically there's a kind of 'social Darwinism' in the sense that only the best survive. This presents an ethical dilemma.*"

Table 3 Logistic Regression for elaboration no. 8: I think PGD examinations have future ethical dangers

Variable	Odds ratio	95 % confidence interval	p-value
Field of studies	.859	.478–1.544	.612
Gender	1.901	1.121–3.224	**.017**
Religious affiliation	2.325	1.293–4.184	**.005**
Gender by field of studies	.969	.310–3.032	.957
Religious affiliation by field of studies	1.198	.402–3.571	.746
Religious affiliation by gender	.448	.139–1.448	.180
Constant	.235		.000

Nagelkerke's R2 = 0.051

Significant values are bolded

Table 4 The genetic dilemma and questions that followed it

Keren is in the first trimester of her pregnancy. She comes to the clinic for genetic counseling and says she has a brother with mental retardation. Her mother always told her that her brother's birth probably occurred with an abnormal supply of oxygen, and therefore he was mentally retarded. Keren is interested in doing all possible tests to determine whether the fetus has a risk of mental retardation. She also asks that the tests she conducts will remain strictly confidential, and that her family should in no way be aware of the genetic testing conducted, certainly not her 30-year-old sister, who is not married yet. She is tested and found to be a carrier of a gene that causes mental retardation. Happily, the fetus is normal. She is aware that her mother and sister might also be carriers of this gene, but does not want to share the fact that she performed genetic tests, and what their results were.

A. In your opinion, what ethical questions arise from this case?

B. What considerations and dilemmas can rise from this case, assuming we know that the syndrome causes inherited mental retardation?

In addition to the major categories MC and MP, each of the students' elaborations was also divided into sub-categories. This analysis showed us that students elaborate mainly with moral consequences regarding exposure or knowledge of medical information or regarding preparation for the future. The main moral principles we noted were the ones dealing with rights to medical privacy, parental rights or the severity of the disease. Another interesting finding is that elaborations dealing with religious principles were found in a very small percentage (less than 5 %) of all the elaborations throughout the questionnaire, even among the religious students, who made up nearly 50 % of the research population. The findings of this fine grain analysis are not shown since its results were not necessary for the conclusions and practical implications of this research.

Discussion

The goal of this study was to probe the values of Israeli undergraduate students towards genetic issues. The study focuses on female and male religious and secular Jewish students, some of them with a firm background in genetic education, since they are students of life science, and some with less or no genetic knowledge, since they are currently studying subjects with no connection to genetics. Our aim was to analyze their moral considerations towards several aspects of genetic testing, using elaborations to reflect their values. In using the phrase "moral considerations," we are referring to factors related to an individual's determination of what is right, good, and virtuous (Sadler and Donnelly 2006). Moral considerations include formal systems of thought within moral philosophy, as well as values reflecting one's participation in religious traditions (Sadler and Donnelly 2006). This range of definition is large, but in this way it is possible to include the various moral realities that individuals bring into socioscientific and other real-world contexts (Sadler and Zeidler 2004).

The main division of the moral considerations elaborated by students in this research is between moral consequences (MC) and non-consequential moral principles (MP). The main difference between these two is that students demonstrating consequentialism in their considerations justified their positions in terms of expected outcomes, and an analysis of the potential benefits and disadvantages of particular genetic testing dilemmas. Moral principles, on the other hand, are considerations in which students made normative ethical considerations that judge the morality of an action based on the action's correspondence to the rules the individual believes in. These principles were based on moral standards, independent of the consequences that might result, for example, from taking or not taking a test, or from terminating or not terminating a pregnancy (Sadler and Zeidler 2004). Our use of this model proved appropriate, since it successfully revealed the students' thoughts and opinions, and allowed us to "zoom into" their main moral concerns.

Sadler and Zeidler (2004) found that no observable differences emerged as a function of any of the groups they tested. In their research, both male and female students displayed examples of all of the subcategories described. Likewise, no systematic differences emerged between the reasoning patterns displayed by students of different scientific backgrounds. One possibility to explain the differences is Sadler & Zeidler's small sample, in which these differences are not echoed. In our research we found some differences in the type of elaboration, due to religion, gender or field of study. These effects were not always consistent and need further exploration.

The moral considerations analyzed in this research can serve as indicators of the genetic literacy of the students and of their willingness to perform genetic tests, and may also be a predictor for their future behavior in the domain of genetic testing and genetic counseling. Moral considerations such as consequences and principles are types of elaborations that we can expect to get from university students who are mature enough to analyze according to these ethical considerations (Sadler and Zeidler 2004). The scenarios presented in this research also provided the students with various contexts, constituting a platform for dealing with decision-making in the genetic counseling domain and raising ethical considerations such as consequences and principles.

Table 5 Examples of students' elaborations. For each one examples of moral consequences (MC) and moral principles (MP) and are given

Statement	Elaborations using moral consequences (MC)	Elaborations using moral principles (MP)
A. What ethical questions arise from the described case?	1. Keren is not willing to tell her family the test results, and it could harm her in the future.	1. Is it ethical to keep it a secret and not to update her sister?
	2. Should she tell her sister, because she may fear to get married?	2. Is it okay to conduct tests like these and intervene?
B. What considerations and dilemmas can rise from this case, assuming we know that the syndrome causes inherited mental retardation?	1. Whether to have children considering the risk?	1. Should she tell her parents or maybe she should leave it to God?
	2. Whether to tell her sister so she will know her consequences?	2. What's the attitude towards an abnormal child?
1. I would inform my brothers and sisters of a DNA test result indicating I carry an inherited disease.	1. If I am a carrier, it makes sense that they are carriers also, and if it is a serious illness, I want them to know and to do everything to avoid it.	1. It's better that they know they might carry the same disease.
	2. This can influence their choice of partner.	2. Each one will decide what to do with the knowledge.
2. I would not want a genetic survey to inform me that I am at risk for a genetic disease.	1. There are things you can do in order to delay the onset of the disease, and may even choose to engage in the study of this disease and find a cure for it.	1. I do not want to live in fear.
	2. There may be a chance to reduce the risk of disease with the correct nutrition.	2. I want to know
3. It is better that a person does not know whether he has the gene for this disease (Huntington's disease) or not.	1. Although currently there is no cure, it is possible to develop a drug and so the person needs to know so he can catch upon the new discoveries.	1. Knowledge is power. Do not be afraid of it.
	2. He should prepare himself mentally for this in order to be able to deal with it.	2. If you just want to do a test, why? Pray on it.
4. In late onset diseases, such as Huntington's disease, the disease should be examined prenatally. The fetus should be examined in amniocentesis, even if the examination endangers the pregnancy.	1. Yes, because I think maybe you can treat it.	1. Do we really want to avoid the life of a person due to the knowledge that he will die at a younger age?
	2. If we discover the disease, maybe we will be able to prevent it in the future.	2. If the test can kill the fetus I think we should not do it.
		3. This fits people who have little faith. What God wants the baby to become will happen.
5. If the genetic examination discovers that the fetus is deaf, it is recommended to have a termination.	1. A deaf person can live and function superbly and can be treated by advanced devices.	1. Coping with deafness is difficult but possible. If it is an experience that God has given you, you should accept it.
	2. This can cause great suffering to the baby and those around him and to the next generation as well.	2. Each family decides for itself, and according to its' conscience. Every child is a life.
6. The deafness genes should be examined and the family should deal with the results per its discretion.	1. At least they know what they are heading towards.	1. Everyone has the right over their own body. The mother can decide whether to have a termination.
	2. If in another month a cure for deafness will be found, the parents will go crazy.	2. That termination of pregnancy in case of such a defect is unethical in my opinion.
7. The State of Israel should not fund research dealing with diseases such as deafness, which are not life-threatening.	1. Maybe if they research it, they will even find a cure.	1. The option should exist for those who want it.
	2. Diseases such as deafness, although not causing death affect the quality of life of patients and their families, and therefore thorough research on the subject has to be made.	2. A disease you can live with, there's no reason to stop the pregnancy.
8. I think such examinations (prenatal genetic diagnosis) have future ethical dangers.	1. Now it's genetic diseases, tomorrow eye color or height.	1. It's actually a kind of "social Darwinism" in the sense that only the best survive. This presents an ethical dilemma.
	2. I agree, in the future we will choose specific things that decrease the genetic variation.	2. If you can have only healthy children, it is something that everyone wants and that's OK.

Table 5 (continued)

Statement	Elaborations using moral consequences (MC)	Elaborations using moral principles (MP)
9. Every available genetic examination should be performed on the fetus, to rule out the maximal number of diseases a child might be born with.	1. Some illnesses have far-reaching implications for the future of the fetus and family. 2. It reduces the likelihood of future diseases.	1. Maybe leave something to God? 2. Sounds dangerous, like in Sparta.

Religious Affiliation Among Jews as an Influencing Factor

We focused specifically on religious affiliation as a central variable, since studies have shown that there is a relationship between religion and ethical decision making processes in ethical situations (Nucci 2001; Wagner and Sanders 2001). Faith and religion have previously been shown to be influential on questions of the meaning and essence of life (Alvarado et al. 1995; Atkinson and Malony 1994; Williams et al. 1991). Likewise, studies done on religion and health have shown that certain religious beliefs can interfere with the timely seeking of medical care, and may delay diagnosis and treatment, since religious believers rely at times on faith rather than traditional medical care (Koenig et al. 2012). These discoveries go some

Table 6 The 4 scenarios and statements for which elaborations were requested

Scenario 1: Genetic research now allows early detection of diseases.
1. I would inform my brothers and sisters of a DNA test result indicating I carry an inherited disease.
2. I would not want a genetic survey to inform me that I am at risk for a genetic disease.

Scenario 2: Huntington's disease is a genetic disease caused by a dominant gene mutation. Symptoms begin in adults (usually from the age of 40. Until then there are no signs of illness). The disease is fatal after a period of suffering.
3. It is preferable that a person does not know whether he has the gene for this disease or not.
4. In late onset diseases, such as Huntington's disease, the disease should be tested prenatally. The fetus should be examined in amniocentesis, even if the examination endangers the pregnancy.

Scenario 3: Deafness is a syndrome that can be caused by mutations. It is now possible to examine a fetus prenatally for mutations causing deafness.
5. If the genetic examination discovers that the fetus is deaf, it is better to have a termination.
6. The deafness genes should be examined and the family should deal with the results at its own discretion.
7. The State of Israel should not fund research dealing with diseases such as deafness, which are not life-threatening.

Scenario 4: Nowadays there is a method (PGD) enabling examination of an inherited disease existing in the family, in embryos in vitro, before their introduction into their mother's womb. In this method, only healthy embryos are inserted into the womb.
8. I think such examinations have future ethical dangers.
9. Every available genetic examination should be performed on the fetus, to rule out the maximal number of diseases a child might be born with.

way towards explaining our findings that some differences between students' elaborations were related to their religious affiliation.

In Israel, differences in religious belief and custom are clearly reflected in differing genetic practices, with some sectors rejecting participation in genetic testing due to their religious beliefs (Raz 2004; Rosner et al. 2009; Sher et al. 2003; Zlotogora 2002). Moreover, Jewish religious students, especially those who do not study life sciences, have been found to place less trust in genetic tests than secular students do (Siani and Assaraf 2015). An understanding of the differences between various religions and the beliefs associated with them will help us understand the manner in which individuals relate to the tension between faith and science (Dickerson et al. 2008). Because genetic counseling can sometimes contradict religious positions, it is necessary (if such counseling is to be successful) to understand the impact of religion on the process of decision making in the context of genetic counseling (Weil 2001). In Southeast Asia for example, researchers have indicated the importance of reflecting the culture and context-specific nature of genetic counseling and consultation encounters, and cited the counselees' religion as a major influence (Zayts et al. 2013). In our research as well as in others (Pivetti et al. 2012). the importance of religion does not emerge openly in the participants' discourse, though it influences the positions expressed on termination, and consequently the attitude towards genetic testing.

Gender as an Influencing Factor

In addition to religious affiliation among Jews, we found that gender had some measure of influence on the moral considerations of students. In most cases, the influence of gender on ethical decision making was found to be inconsistent - significant in one context but not in another (Byrnes et al. 1999; Curtis et al. 2012). This was reflected in our study as well. When dealing with a late onset genetic disease, men showed a more principle based approach than women, perhaps because women's role as primary caregivers and their involvement with childbearing leads them to take a more practical, consequence-based approach (Shiloh 1994; Tibben 1993). On the other hand, in the context of future ethical considerations, women tended to be more concerned with moral principles, which may reflect their concern with genetic procedures that are only performed on women. We can therefore

conclude that gender has a mixed pattern of influence on moral considerations and is a less influential factor than religious affiliation, in which the pattern was a bit more consistent.

Field of Study as an Influencing Factor

The moral considerations of life sciences learners in comparison to non-learners did not differ distinctly in most parts of the questionnaire. Since formal scientific background has been shown to have an influence on students' negotiation of socioscientific issues (Hogan 2002; Tytler 2012; Zohar and Nemet 2002). and since types of values broaden as a result of studying a certain discipline (Solli et al. 2014). we thought that our students' elaborations might be impacted by their genetic knowledge. However, we did not find the pattern we expected, and we did not find that prior scientific knowledge had an influence on the students' elaborations when dealing with most of the genetic issues in the questionnaire.

That said, we did find a difference in the context of late onset diseases, where the Jewish religious students who study life sciences tended towards a more consequentialist approach than religious students who do not, perhaps because they are more aware of these kinds of diseases and their genetic and psychological meaning (Evers-Kiebooms et al. 2000). Yet another explanation might be that these religious students' science education has made them less concerned with their religious principles by broadening their scope to include additional considerations. Finally, it might mean that the religious non-LS students are more concentrated on their principles and less conscious of the consequences that the genetic situation might bring.

The Issue of Pregnancy Termination

Genetic counselors are trained to present information and facilitate their patients' decision making without letting their own religious or moral beliefs influence them in any particular direction (Woltanski et al. 2009). This requirement relates to all aspects of the counseling, including the delicate issue of termination (Stephens et al. 2010).

Three of the statements in the questionnaire deal with examining the fetus for genetic disorders that involve the possibility of termination, which is a complex issue with many uncertainties, and as such produces differing interpretations and rulings in Judaism (Schiff 2002). Although there is a fundamental agreement on the distinct Jewish attitude against termination, circumstances do affect this general agreement, for instance if the pregnancy endangers the life of the mother (Stephens et al. 2010). Some lenient Jewish scholars permit termination for any "major defects" that might occur in the unborn child, and defects that make the mother and the family anxious about the future (Gordis 1978). The more stringent consensus position of most Orthodox scholars is to oppose

termination even for fatal disorders. Though this consensus exists, some religious scholars, like Waldenberg and Yisraeli, do allow termination if a fatal disease is detected in the fetus (Schiff 2002). An interesting innovation is that in all of the statements that dealt with the option of terminating the pregnancy in this research, there is no significant difference between the religious and secular students' elaborations, even though it is an issue that is known to be problematic in Judaism. A partial explanation for this finding might be that nowadays the Jewish religious population in Israel is highly integrated into secular society (Herman et al. 2014). The religious sector works in all places: in the high-tech industry, in the army, in the communication system and so on, and sees itself as a part of the general society, as well as observant of religious rules. The finding relating to termination could be a reflection of this relatively new "Westernization" that the religious sector is heading towards, and of the influence of the secular society with whom they work, study and live closely.

Conclusions

The most prominent conclusions of our analysis can be summed up in the following points:

1. On the whole, the students' type of elaboration relates to the specific statement they were asked to elaborate, but nevertheless, certain patterns of elaboration can be seen.
2. In several statements throughout the questionnaire, we found that Jewish religious students are concerned more with moral principles, relating less to the consequentialist issues of the genetic situations and their implications.
3. Gender also has a mild influence, and showed a mixed pattern of moral reasoning with no certain preference amongst women or men to reasoning which is consequence or principle based.
4. The students' field of study seems a little less significant than religion in influencing their elaborations.
5. Jewish religious students do not show significant measures of concern about religious considerations in their moral reasoning.

Practical Implications

Genetic counseling is a complex challenge because many issues have to be taken into consideration, such as the patient's attitudes, knowledge and values towards the counseling process and towards genetic testing. Patients' past exposure, experiences or prejudices towards genetic counseling and genetic diseases must also be taken into consideration. The promotion of decision making in the domain of genetic testing must be tailored to each target population according to its

background, based on their relevant exposure to and knowledge of the domain (Peters and Petrill 2011). In light of our own findings, we wish to offer practical recommendations for genetic counseling that are specifically tailored to fit different patients according to their background:

a. In a genetic counseling session it is advisable to clearly ask about religious barriers, in order to get a full picture of the patients' considerations. A discussion about their spiritual and religious beliefs can provide reassurance, comfort and strength that might alleviate some of the patients' distress during genetic the counseling session (Seth et al. 2011). Despite the fact that our students' elaborations revealed little concern for religious considerations, these considerations are not necessarily unimportant to the students, and they may still be exerting a latent influence on their decision making. In this study, it seems that the Jewish students' religious affiliation influenced the type of their elaborations. We did not ask the students explicitly to write elaborations that rely on their religious opinions, (as Seth et al. 2011 suggest). and this may be a reason for the lack of elaborations with religious grounds. Openly discussing the religious opinions of those being counseled would make for a more efficient counseling session, and help determine the relevance of their spiritual and religious beliefs to their eventual decision (Seth et al. 2011).

b. When consulting a non-consequentialist patient, the genetic counselor can emphasize the consequences of the genetic situation so that the patient will be able to take as much information as possible into account, and thus make informed decisions according to his beliefs and values.

Study Limitations

Since this questionnaire was distributed among undergraduate students, it is in effect adapted for – and reflective of - young people of medium and high socioeconomic status. Our research population therefore does not reflect all of the Israeli Jewish population, and the questionnaire should be modified if needed for a variety of populations, as has previously been done with a questionnaire testing informed choice (Dormandy et al. 2007). This modification would make the questionnaire available to diverse populations, enabling a comparison of the moral considerations of citizens from different cultures (Zeidler et al. 2013).

In addition, the fact that the participants answered the questionnaire while at the university campus is a limitation of the study. Their response might be affected by social desirability since they may think that as students they are expected to be more liberal, and to relate to universal codes rather than their own moral considerations when asked about moral issues.

Perhaps the same population would have reflected its doubts more intensively in a different setting.

The volunteer sampling is another study limitation, since perhaps the students that are particularly interested in genetic topics were the ones who were willing to answer the questionnaire, while others who were less aware of these topics did not answer it at all. This limitation may have tilted the results.

In future research using this model, we suggest the use of the genetic quiz (attached in Appendix 1) as a predictor of the genetic knowledge of the student either in place of or in addition to the status of the student as a life-science major or not. This genetic quiz would give a more detailed picture of the impact of genetics knowledge and be a better predictor with less measurement error. A limitation of this study is that we did not use this approach and for that reason we might have made errors in predicting the genetic knowledge of our students.

Finally, though moral reasoning considerations have been shown to influence decision making (Bell and Lederman 2003; Sadler and Zeidler 2005). our study, which was based on a series of hypothetical scenarios, did not actually witness the transition from reasoning to decision making. More research is needed in order to further analyze the mechanisms and factors that influence moral reasoning, and to determine whether and how this reasoning ultimately translates into moral decision making.

Research Recommendations

Religious commitment is a very personal issue, which has not been investigated from a personal angle in this research. In order to gain better insight into the students' attitudes and values, in-depth interviews can be held with students to add further clarity and context to what they mean by each of their elaborations. These interviews could include explicit questions regarding religious considerations, and issues that have not yet been fully analyzed can be focused on more carefully.

In addition to the religious aspect, the interviews would also cover the personal and familial health experiences and perceptions of the interviewee, factors that play a central role in how individuals remember, interpret, and respond to disease risk information (Gordon et al. 2012; Kaufman et al. 2012). A more complete understanding of the reasons for decisions about whether to have genetic testing or not, which we would hopefully achieve through the interviews, would help counsellors to better communicate with women and couples, and better assist them in making informed decisions about genetic testing (Pivetti et al. 2012).

Human Studies and Informed Consent   All procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2000 (5). Informed consent was obtained from all individual participants included in the study.

Animal Studies   No animal studies were carried out by the authors for this article.

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