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# Adolescents' goal orientations for science in single-gender Israeli religious schools

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## ABSTRACT

Israeli students and their families can choose between state-funded secular, religious, orthodox, and other alternative schools (e.g., Waldorf, Montessori, democratic). Earlier studies showed that the motivation to engage with science differs greatly between Israeli students in secular schools and democratic schools, with these differences being attributed to differences in school culture rather than home influence (Vedder-Weiss & Fortus, 2011, 2012). In this study we extend earlier studies by looking at religious state-funded schools that serve 18% of Israel's Jewish population. These schools provide a unique research environment since from grade 6 they are gender-separated. We examined the science-related mastery, performance-approach, and performance-avoid goal orientations, perceptions of the science teachers, parents, schools, and peers' goal emphases in relation to science of the students in these schools. We compared between students in religious schools (newly collected data) and secular schools (data reported in prior studies), and found that there is a distinct difference between these two populations that is associated with differing attitudes toward gender and science at these schools. This study provides additional evidence for the influence of culture on students' motivation to engage with science, suggests mechanisms by which this influence may occur.

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Motivation; goal orientation; school culture; adolescents; religious schools; parental goals; gender

## Introduction

Unlike previous studies that showed that the motivation to learn science tends to decline during adolescence (Anderman & Young, 1994; Lee & Anderson, 1993; Simpson & Oliver, 1990), Vedder-Weiss and Fortus (2011, 2012) demonstrated that this decline does not occur in Israeli democratic schools<sup>1</sup> and that it appears to be a result of school culture rather than home influence. One of the main features of democratic schools that seemed to promote students' motivation to learn science (or to prevent its decline) was students' autonomy in choosing what and how to learn and the influence they had on their teachers' pedagogical choices. Basu and Barton (2007) also showed that when students encountered science classrooms in which they could choose to engage in activities connected to their visions of their future, they developed a strong, long-term commitment to engage with science.

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This study provides additional evidence for the influence of school culture on students' motivation to engage with science and suggests mechanisms by which this influence may occur. It looks at Israeli adolescents studying in gender-separated state-funded (public) religious schools and investigates their science-related goal orientations, classroom engagement, continuing motivation, self-efficacy, and their perceptions of the goal emphases of their science teachers, parents, schools, and peers in relation to science. By comparing and contrasting the motivational characteristics of boys and girls who study at these schools with those of their counterparts who study at public secular schools (which are not gender-separated), we may identify ways in which differing cultural emphases can influence students' motivation to study science.

## Background

### *Goal orientations*

Over the last two decades, several theories have been elaborated that aim to describe motivation in academic settings and explain the reasons that underlie motivation – for an overview, see Schunk, Pintrich, and Meece (2008). Goal orientation theory is one of the most prominent and widely used of these theories (Ames, 1992). Goal orientations are students' reasons for engaging in or avoiding academic-oriented behaviour. Students' goal orientations are context-sensitive and can be influenced by classroom procedures, practices, and policies (Urda & Schoenfelder, 2006).

Researchers have distinguished between two main types of goal orientations, typically labelled mastery goals and performance goals. Mastery goals are characteristic of people who are focused on *developing* ability, competence and understanding; performance-oriented people focus on *demonstrating* competence, ability, and understanding. Motivational theorists have further divided achievement goal orientations into avoid and approach valences (Elliot & Church, 1997), where students can be focused on developing competence (mastery-approach), obtaining positive judgements of one's competence (performance-approach), avoiding situations where one may not develop competence (mastery-avoid), or avoiding situations where one's competence may be criticised (performance-avoid).

Past studies strongly suggest that performance-avoid goals are associated with maladaptive patterns of engagement; on the other hand, the evidence regarding performance approach goals is not consistent (Senko, Hulleman, & Harackiewicz, 2011). Mastery-avoid goals have received much less attention than mastery-approach goals; they are less well elaborated and have not yet been shown to play a significant role in students' behaviour. On the other hand, there is a plethora of research indicating the central importance of mastery-approach goals (e.g. Anderman & Midgley, 2002; Anderman & Young, 1994; Vedder-Weiss & Fortus, 2013). In the remainder of this article, we will focus on both the approach and avoid valences of performance orientation; we will consider only the approach valence of mastery orientation and for simplicity call it just mastery orientation.

Maehr and his colleagues (Anderman & Maehr, 1994; Kaplan & Maehr, 2007) proposed a model of achievement goal theory in which students' goal orientations are embedded in multiple sociocultural contexts and are a product of prior and current experiences. They suggested that schools are characterised by the emphases the environment

places on different goals. These emphases are a result of, and a contributor to, school culture, which consists of the 'norms, values, beliefs, traditions and rituals that have built up over time' (Peterson & Deal, 1998, p. 28). It includes such things as: how the staff dresses (Peterson & Deal, 1998); what the staff talk about in the teachers' lounge and how teachers decorate their classrooms (Kottler, 1997); which goals, purposes and values are stressed (Maehr & Anderman, 1993); which aspects of the curriculum are emphasised, and teachers' willingness to change their practice (Hargreaves, 1995). Studies that investigated students' perceptions of their school's goal emphases found that the perceived school goal emphases were related to students' personal goal orientations (Anderman & Midgley, 1997; Roeser, Midgley, & Urdan, 1996; Vedder-Weiss & Fortus, 2012).

### ***Religious schools in the Israeli public school system***

Religious schools are often characterised by a culture that sets them apart from non-religious schools. Israeli religious schools have a dual challenge of teaching both secular and religious studies. While they may inform each other, at times, they are in opposition to one another (Platinga, 2014). Most secular studies present models, disciplinary practices and ways of making sense of ourselves and the world around us. On the other hand, religious studies in Israel often involve rituals, strategies for adherence to a set of tenets and doctrines, and the memorisation and analysis of texts written by sages. Indeed, the main criterion for deciding what to include in the Israeli curriculum for biblical studies was what would support students' religious inclinations. Academic knowledge that contradicted or critiqued doctrines and interpretations of the bible made by ancient sages was not included (Yaacobs, 2016). Some religious schools attempt to create a curriculum that is an integration of academic and religious studies, but most have separate religious and academic curricula and separate faculties to teach them (Pomson, 2001). The majority of religious schools in Israel do not attempt to integrate academic and religious studies, with no academic component to religious studies and no religious component to academic studies.

The Israeli school system is composed of several independent sub-systems, all state funded (Adler, 1989; Knafo & Schwartz, 2003; Swirski, 1999). There are: Moslem and Christian schools in which instruction is in Arabic, secular Jewish schools, religious Jewish schools, ultra-orthodox Jewish schools, democratic schools, and Waldorf schools. There are almost no private schools in Israel. Parents can choose to which public sub-system they wish to send their children. Most of the non-orthodox Jewish population sends its children to secular or religious state-funded schools. The secular schools serve mainly non-religious students and provide some limited compulsory teaching of the Old Testament, Jewish history and traditions (Adler, 1989). The teachers at secular schools are both secular and religious. Religious schools are supervised by an independent agency within the Ministry of Education that allows them, within limits, to set their own ideological agenda (Swirski, 1999), a privilege not available to most secular schools.

Science education is compulsory in both secular and religious schools, and with few exceptions, both types of schools follow the same curriculum (religious schools are not required to teach about evolution or other religiously sensitive topics). The curriculum is set by a professional committee sponsored by the ministry of Education, with scientists,

science educators, and leading teachers as members. This curriculum is revised every few years. The revision process is often a focus of public debate.

Israeli secular schools are mixed-gender; boys and girls learn together in the same classes, from the first to twelfth grade. Religious schools are mixed-gender with boys and girls studying together until grade 6. From grade 7 onwards, boys and girls study in different schools; boys in schools called Yeshivas and girls in schools called Ulpanas.

In this study, we focused on the goal orientations in science and the perceived goal emphases in science of the educational environment of adolescents studying at Israeli religious public schools. As mentioned earlier, the vast majority of Israeli religious schools do not attempt to integrate academic and religious studies. Religious studies typically have greater esteem in these schools than science, which is often taught because it is required by the state, not because it is as valued by the religious community as a cultural and intellectual endeavour (Tsemach, 2016). Scientific norms and practices are often at odds with the traditions of religious communities, thus requiring religious students to cross cultural borders every time they enter or leave science class (Aikenhead, 1996, 2001), requiring collateral learning as they may struggle to make sense of ways of thinking that contrary to those that are ubiquitous in their lives outside of science class (Aikenhead & Jegede, 1999; Jegede, 1995). These schools provide an opportunity to investigate the combined and interactional effects of gender-separation and religious school culture, as manifested in the separation of religious studies from other academic subjects and the exaltation of religious studies in comparison with the others, may have on students' goal orientations in science. Without looking specifically at goal orientations in science, a study by Dowson, McNerney, and Nelson (2006) indicated that schools and to a lesser extent gender differences, as well as the interaction between the two, significantly influence students' general motivational orientations. Looking at the transition from elementary to middle school, when students move from mixed-gender to gender-separate schools, may help identify the influence gender separation may have on students' goal orientations in science. On the other hand, comparing the entire sequence of grades 5–9 in these religious schools to previously published results from public secular schools in Israel may help identify the role school culture plays in these students' goal orientations in science.

## Gender

There are mixed reports about boys' and girls' interest in and motivation to engage with science. Studies by Gardner (1998) and by Miller, Blessing, and Schwartz (2006) indicated that in general, boys are more interested in science than girls. A study by Liu, Hu, Jian-nong, and Adey (2010) indicated that as Chinese students progress through secondary school, their gender-science stereotyping becomes more pronounced (science is for boys while humanities are for girls), with girls stereotyping more than boy. On the other hand, an analysis by Baram-Tsabari, Sethi, Bry, and Yarden (2009) based on queries sent to MadSci.org, an Internet-based Ask-A-Scientist site, demonstrated a decade-long (2006–1996) dominance of female users among K-12 students. Girls in several developing countries were also found to have the same or more positive attitudes and a greater interest in science than boys (Sjøberg, 2000). Fortus and Vedder-Weiss (2014) demonstrated that

while the fifth grade Israeli girls in secular schools had lower continuing motivation for science than boys, their motivation for extra-curricular science decreased at a slower rate as they matured, so that by the eighth grade, girls and boys had similar levels of continuing motivation for science.

However, in all these reported cases, boys and girls learned together or no information was provided about possible gender-separation in schools, so we assume that all the participants came from gender-mixed classes. Thus, this study provides a unique opportunity to study the interaction between school culture and gender on adolescents' motivation for science.

### **Parental influence**

As stated before, Israeli parents can usually choose in which type of school to place their children: secular, religious, ultra-orthodox, and where available also democratic, Waldorf, and Montessori. Thus, in their choice of school for their children, parents make a statement about: what they value, which educational goals are important to them, with which curriculum they identify, and what kind of school environment they support. In a system where parents can choose their children's school, it is likely that there will be a higher degree of alignment between the goals of the schools and the parents than in a system where no such choice is available. Indeed, many Israeli parents choose to send their children to 'alternative' schools (democratic, Waldorf, or Montessori) because they do not identify with the goals and practices of the traditional schools near their homes (Alfasi, 2014).

Parents are an important source of academic advice, encouragement, standards, assistance, and expectations for their children (Friedel, Cortina, Turner, & Midgley, 2007). Parental involvement in its many and varied forms is an important factor in promoting achievement (e.g. Booth & Dunn, 2013; Henderson, 1987; Henderson & Mapp, 2002). Many studies have found positive relations between parental involvement in schooling and several motivational variables, including engagement and mastery goals (e.g. Schunk et al., 2008). The emotional support and encouragement offered by parents have been linked to the achievement goals children espouse (Gonzalez, 2002; Grolnick, Ryan, & Deci, 1991; Turner et al., 2002; Wentzel, 1998). Children who experience high levels of support and encouragement from their parents are more likely to espouse mastery goals themselves and tend to demonstrate more persistence and effort during difficult learning tasks (Hokoda & Fincham, 1995). Conversely, children who perceive that their parents are disappointed in their performance or who do not believe in their ability to succeed are more likely to exhibit performance-avoidance patterns of behaviour (Heyman, Dweck, & Cain, 1992; Hokoda & Fincham, 1995).

In the domain of science, it has been shown that parents influence their children's motivation to learn science (Breakwell & Beardsell, 1992; Osborne, Simon, & Collins, 2003; Vedder-Weiss & Fortus, 2011). They can also support or undermine their ability to cross cultural boundaries as their children move from everyday traditions and ways of thinking to scientific ways of addressing the world (Aikenhead & Jegede, 1999). Although their influence diminishes as their children mature, students' perceptions of their parents' goal emphases are the most prominent environmental influence on students' goal orientations in science (Vedder-Weiss & Fortus, 2013).

## Research goal and questions

The aim of this study is to contribute to the understanding of the roles gender and school culture play in shaping adolescents' motivation to learn science. We compared the grade and gender-related trends of the mastery and performance goals for science learning of students' from two different types of public Israeli schools: secular and religious. The questions that guided this study were:

- (1) How do the goal orientations in science of students in Israeli religious and secular schools develop during adolescence?
  - (a) Are the trends of these goal orientations' gender-dependent? If yes, in which ways?
  - (b) Are they school type-dependent? If yes, in which ways?
- (2) How do students' perceptions of the goal emphases in science of the educational environment (school, teachers, parents, and peers) develop during adolescence?
  - (a) Are the trends of these goal orientations' gender-dependent? If yes, in which ways?
  - (b) Are they school type-dependent? If yes, in which ways?
- (3) What role does gender-separation appear to have on students' goal orientations in science?

## Methods

### Sample

The participants in this study were 999 students in grades 5–9 from 6 public religious Israeli schools: 2 elementary schools (grades 5–6, mixed gender), 2 Yeshiva high schools (grades 7–8, boys only), and 2 Ulpana high schools grades (7–9, girls only). In addition, the study drew upon data gathered in previously published studies (Vedder-Weiss & Fortus, 2011, 2012) from 1389 students from 13 public secular schools, 6 elementary schools (grades 5–6) and seven middle schools (grades 7–8), all mixed-gender. All schools served students from middle–high socio-economic backgrounds. The number of religious schools in the sample was smaller than the number of traditional schools due to difficulty gaining access to them.<sup>2</sup> Table 1 presents the number of participants per grade, type of school and gender.

Participation of schools and students was voluntary. In the secular schools, the principal or the head science teacher chose which classes would be sampled. On the other hand, in the religious schools, all the classes were sampled. Since there may have been a desire by the principals of the secular schools to present their schools in a certain light, their choice of classes to be sampled may have led to bias in the data for the secular schools.

### Instruments

Students' data were collected by Likert-type anonymous questionnaires from June 2012 until June 2013. One of the authors distributed the questionnaires, gave instructions for



**Table 1.** Sample distribution.

School Type	Grade	Total	Boys	Girls
Religious	5th	96	72	24
	6th	73	22	51
	7th	381	259	122
	8th	449	268	181
	Total	999	621	378
Secular	5th	229	109	120
	6th	275	133	142
	7th	343	163	180
	8th	342	172	170
	Total	1389	583	612

completing them, was present while students completed it, answered their questions, and collected the questionnaires from each student. The teachers were not present while the questionnaires were completed.

The questionnaire was identical to that used in previous studies, during which it was intensively validated, and was made of 80 Likert-type (Fortus & Vedder-Weiss, 2014; Vedder-Weiss & Fortus, 2011, 2012, 2013); thus it was not re-validated. Table 2 provides the constructs that were assessed and the number of items per construct. All the scales had identical categories: not true at all, not so true, somewhat true, true, and very true. In all scales, no distinction was made between the different science domains.

**Analysis**

An exploratory factor analysis of the data was conducted to re-confirm that the data from the religious schools factorised identically to the data from the secular schools, as published elsewhere (Vedder-Weiss & Fortus, 2011). The data from both school systems were then combined and transformed into continuous variables using polytomous Rasch techniques. This procedure allowed us to verify (Bond & Fox, 2001; Boone, Staver, & Yale, 2014) that the values characterising the students from the secular and religious schools were calibrated on the same metric, that each item’s infit and outfit lay within acceptable values (0.75–1.33), and provided the reliabilities (Cronbach alpha –

**Table 2.** The constructs assessed by the questionnaire.

Construct	No. of items
Personal mastery goals	5
Personal performance approach goals	4
Personal performance avoidance goals	4
Classroom engagement	4
Continuing motivation	13
Perceived parents mastery emphasis	5
Perceived parents performance emphasis	4
Perceived school mastery emphasis	5
Perceived school performance emphasis	5
Perceived teacher mastery emphasis	7
Perceived teacher performance approach emphasis	4
Perceived teacher performance avoidance emphasis	4
Perceived peers mastery goals	4
Perceived peers performance approach goals	4
Perceived peers performance avoidance goals	4



all greater than .70) of the scales. Normality and homoscedasticity were verified for all the constructs, allowing us to use parametric analyses.

Linear regression of the various constructs was conducted to test grade-driven trends, grades being the independent variable. Two-tailed *t*-tests were conducted to compare between various constructs for religious and traditional schools. A power analysis indicated that our sample was large enough to detect differences greater than 0.2 logits (the units of values generated by Rasch techniques) at the  $\alpha = .05$  level with a power of more than 80%.

Results

Examining the changes in the students’ personal mastery, personal performance-approach, and performance-avoidance goal orientation across school types and gender reveals unique trends within these groups – see Figure 1.<sup>3</sup>

With regard to personal mastery orientation, we observe that the scores for both genders were generally higher in secular schools than in religious ones. There was no

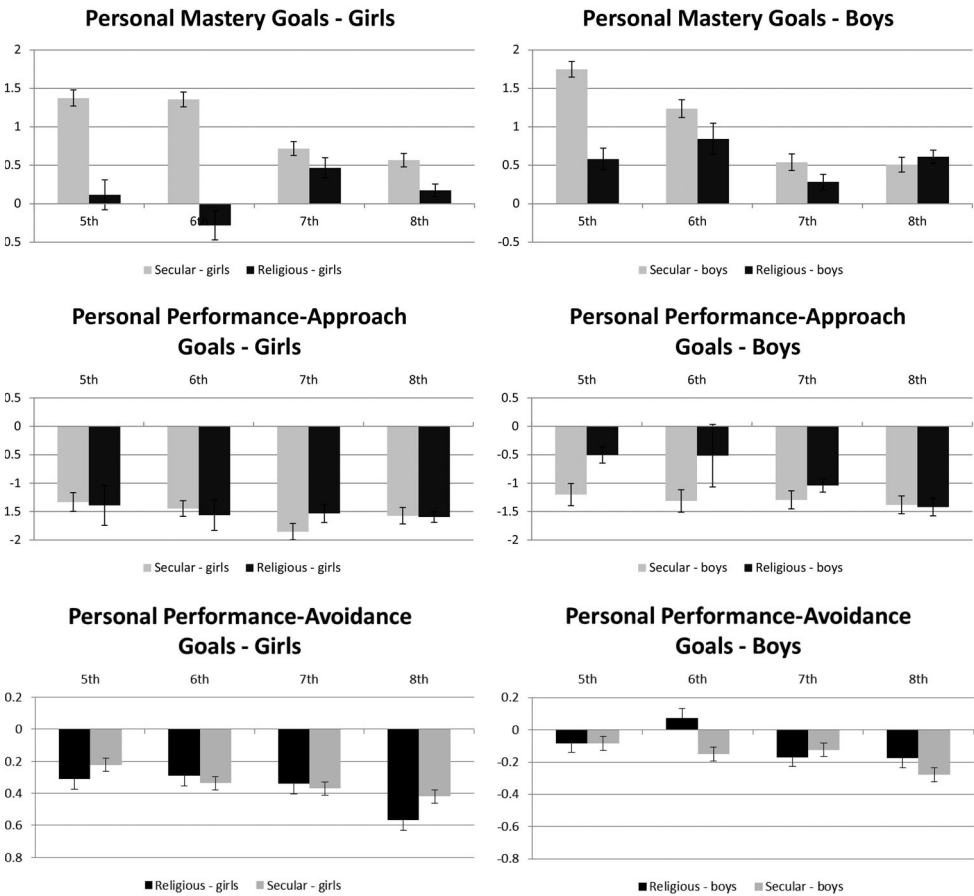


Figure 1. Changes to boys’ and girls’ personal mastery and performance goals.

significant difference between boys and girls in secular schools, but the girls in the religious schools generally had lower mastery orientations in science than boys in these schools.

In the secular schools, there was a negative trend in the students' personal mastery orientation between the fifth grade and seventh grade for both girls and boys (for girls:  $B_{xy} = -.35$ ,  $t = -5.1$ ,  $p < .001$ ; for boys:  $B_{xy} = -.61$ ,  $t = -7.8$ ,  $p < .001$ ). Between the seventh grade and eighth grade, there was no significant change. In the religious schools, there was a decrease in the girls' mastery orientation between the fifth grade and sixth grade (the final year of elementary school), then a positive leap when they moved from elementary to middle school (and from mixed gender to separate gender settings), and then again a decrease between the seventh grade and eighth grade. The boys in the religious schools showed the opposite behaviour: an increase in mastery orientation between the fifth grade and sixth grade followed by a drop during the transition to gender-separated middle school. By eighth grade, both boys and girls returned to their original fifth-grade levels.

With regard to personal performance-approach orientation, there was no significant trend for either girls in either type of school and for boys in traditional schools. There was also no significant difference between the levels of personal performance-approach orientation for these students. There was, however, a steady decline in the performance-approach orientation of boys in religious schools ( $B_{xy} = -.32$ ,  $t = -3.7$ ,  $p < .001$ ), with them beginning at a higher level of performance-approach orientation than the other students, but this declining until by eighth grade they were at the same level as the other students.

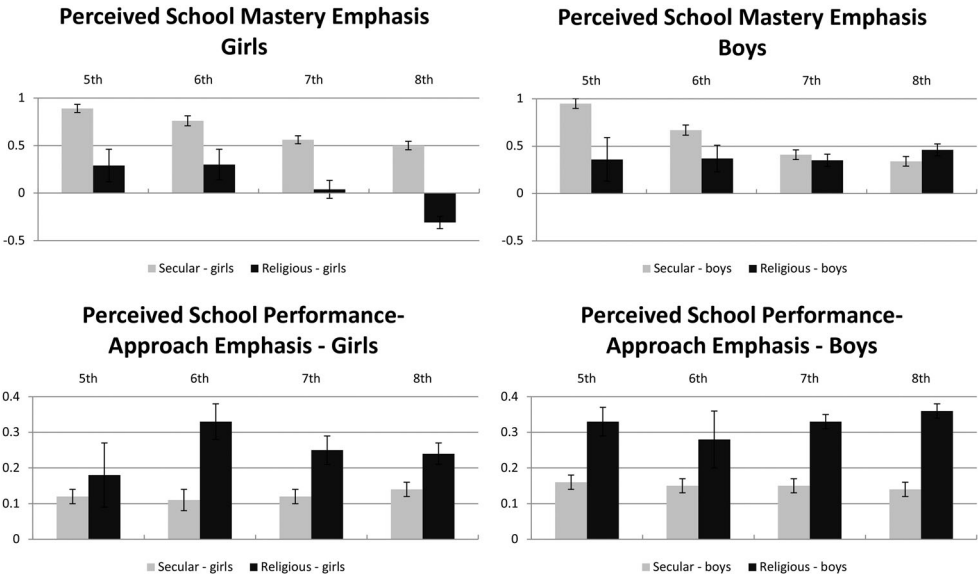
Boys have similar performance-avoidance orientations in both types of schools, as do girls, with boys having higher levels than girls at all ages. There is a steady but statistically insignificant decrease with age, with one exception: there is a leap in religious boys' personal performance-avoidance when they transit in the sixth grade to gender-separated schools, and then a significant decrease in the seventh grade.

The situation is very different with respect to the students' perceptions of their schools' mastery and performance emphasis – see [Figure 2](#).

Prior studies (Vedder-Weiss & Fortus, 2011, 2012) showed that students perceive their schools' mastery emphasis as declining during adolescence. We found a similar negative trend among girls studying in religious schools ( $B_{xy} = -.25$ ,  $t = -4.9$ ,  $p < .001$ ). Regardless of grade, religious girls perceive their schools as emphasising mastery in science less than girls in secular schools. On the other hand, while boys in secular schools also report a declining perception of their schools' mastery emphasis in science, boys in religious schools report no significant change in their perceptions of their schools' mastery emphasis in science during adolescence.

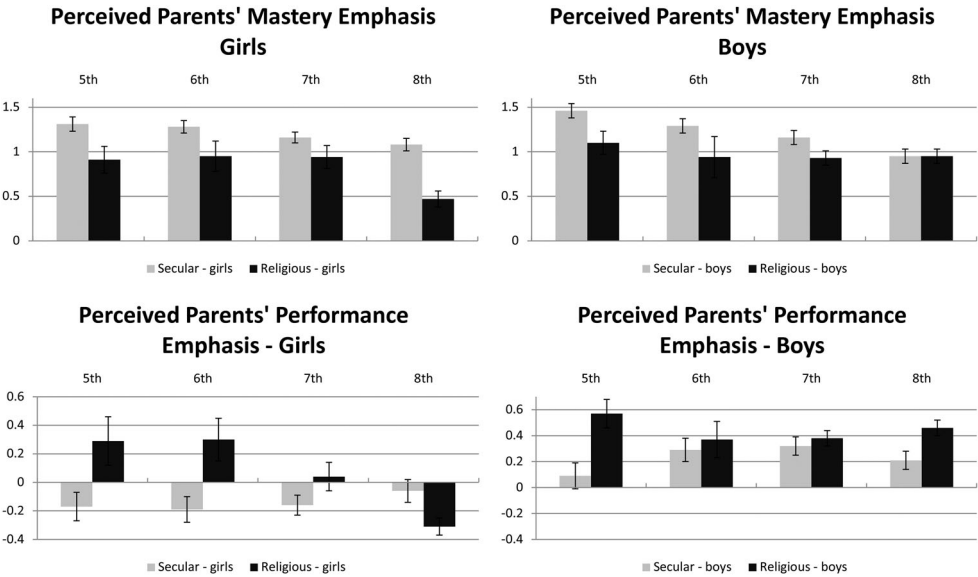
Both boys and girls in religious schools perceive their schools as emphasising performance goals in science much more than students in secular schools, at all grades, with no significant grade-related trends for both genders in both types of school.

In secular schools, both boys' and girls' perceptions of their parents' mastery emphasis in science declined as the students matured – see [Figure 3](#). In religious schools, girls' perceptions of their parents' mastery emphasis in science also declined with age, but boys' perceptions remained constant with no trend. Religious students, both boys and girls, perceive their parents as emphasising mastery in science less than their secular peers do.

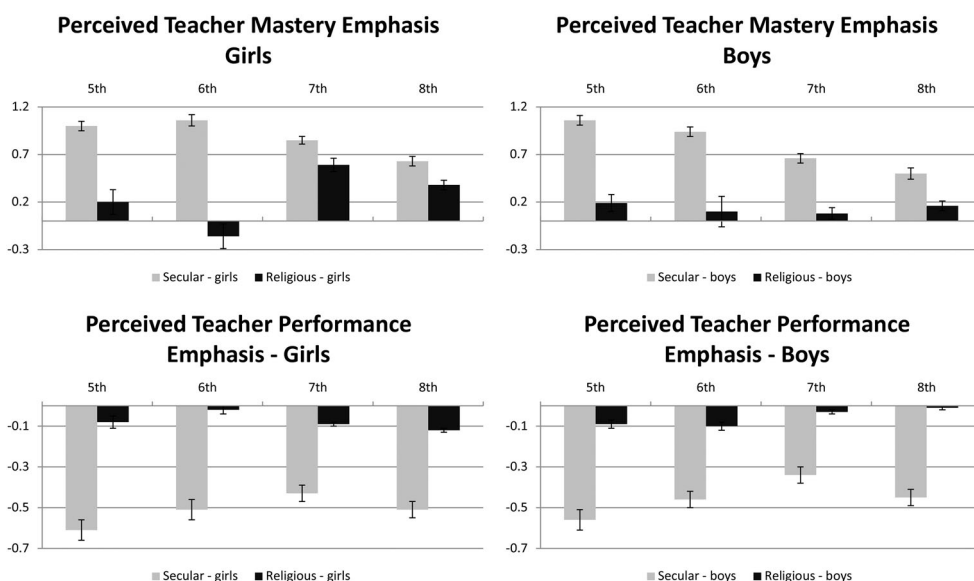


**Figure 2.** Changes to perceived school mastery and performance emphases.

Boys in religious schools perceived their parents as emphasising performance goals more than the boys in secular schools, at all grades tested, with no significant grade-related trends. Secular boys' perceptions of their parents' performance emphasis in science declined through grades. The girls in both types of schools perceived a decline in their parent's performance emphasis in science, as they got older, at lower levels



**Figure 3.** Changes to perceived parents' mastery and performance emphases.



**Figure 4.** Changes to perceived science teachers' mastery and performance emphases.

than boys at secular schools and girls at secular schools at a lower level than girls at religious schools.

The perceptions of science teachers' mastery emphasis was similar for girls and boys in secular schools, with a steady decline over the years (for girls:  $B_{xy} = -.15$ ,  $t = -8.1$ ,  $p < .001$ ; for boys:  $B_{xy} = -.19$ ,  $t = -9.2$ ,  $p < .001$ ) – see Figure 4. Religious boys' perceptions of their science teachers' mastery emphasis did not change as the students matured; religious girls' perceptions of their science teachers' mastery emphasis were different, declining between the fifth grade and sixth grade and between the seventh grade and eighth grade (periods they spent in the same school) but rising between the sixth grade and seventh grade (when they moved from a mixed-gender school to a gender-separate school). For all grades, students in religious school perceived their science teachers as less mastery emphasising than students in secular schools, for both genders.

There were no significant trends in boys' and girls' perceptions of their science teachers' emphasis on performance, in either type of school, with both genders perceiving their science teachers as being more performance oriented in religious schools than in secular schools.

## Discussion

In general, adolescent boys and girls learning in Israeli secular schools have similar goal orientations towards science learning and similar perceptions of the goal emphases in science of their educational environments. The only exception is that boys perceive their parents as emphasising performance in science more than girls. Their personal goal orientations and their perceptions of their schools' and science teacher's goal emphases in science are all similar and display similar age-driven trends.

The situation for boys and girls learning in Israeli single gender religious schools is very different; they are discrepant in several motivational aspects regarding science learning. Most research on single gender education has focused on two issues: (A) the relevance of male–female differences as a rationale for single-gender education and (B) the positive and negative impact of single-gender education (Anfara & Mertens, 2008; Pahlke, Hyde, & Allison, 2014; Rex & Chadwell, 2009). As will be discussed later, it is difficult to assign the differences we found between boys and girls in Israeli religious schools to the fact that their schools are gender-separated rather than to the general religious culture in which this study is embedded, especially since the reason for the gender separation of the schools is religious.

Boys in religious schools seem almost insensitive to the motivational emphases of their environment. Only insignificant changes to their perceptions of their schools', parents' and teachers' mastery emphases were identified, and their perceptions of the performance emphases of the environment were also mostly invariant. So, either their environment relays to them remarkably consistent messages over their school life regarding the importance of learning science or these boys are indifferent to the educational environment's motivational emphases. On the other hand, they are not entirely unmoved; their personal mastery orientation fluctuates a bit, their personal performance-approach orientation steadily declines, and there is a significant decrease in their personal performance-avoidance orientation during the transition from dual-gender classes to single-gender classes.

Girls studying in religious schools show very different motivational characteristics than boys in these schools. Their perceptions of the educational environments' goal emphases clearly change during adolescence. They perceive a clear decrease in their schools' mastery emphasis, a decrease in their parents' performance emphasis, and varying science teachers' mastery emphasis.

Why are religious girls' perceptions of the motivational emphases of their environment dynamic while religious boys' perceptions remain static? Why do not they behave similarly to one another as occurs among girls and boys in secular schools?

Also striking are the differences between adolescents of the same gender but in different types of schools. Religious adolescents have a lower mastery orientation towards science than secular adolescents of the same gender, and at almost all grades perceive their schools, parents and teachers all as emphasising mastery less but performance more. In addition, religious boys are more performance-approach oriented than secular boys. What makes religious adolescents' goals in science and their perceptions of the environmental goal emphases in science less mastery-oriented and more performance-oriented than secular adolescents?

Studies have shown that religious values may influence students' learning and motivation (Maehr, 1984). The manner in which you appear to others is of great importance in religious Jewish culture in Israel, in all areas of life not just in education in general or science education in particular. This is explicitly evident in strict dress codes ('Always be clothed in white, and always anoint your head with oil' – Ecclesiastes 9:8) and pressure to conform to rabbinical decrees ('Anyone who shows contempt for the judge or for the priest who stands ministering there to the Lord your God is to be put to death' – Deuteronomy 17:12). Adolescent boys who are able to accurately recite many passages from the bible and the Talmud are publicly recognised as good students with potential for becoming rabbinical scholars (Jacobson, 2004). This is the epitome of

performance. It is traditional in many Israeli religious households for the father to ask the children a question at the start of the Friday evening meal, with a verbal reward for the child that responds correctly, again promoting performance. This emphasis on demonstrating knowledge is apparent in many aspects of public life in Israel where the religious community dominates, such as in the annual international bible contest where competitors are expected to be able to recite entire passages from the Old Testament and identify almost instantly the location of passages in the bible (The Jewish Agency, 2016). Perhaps this emphasis on performance carries over to other areas such as science as well, leading religious adolescents to perceive their environment as emphasising performance in science more than their secular peers?

Although religious girls are expected to perform academically well, there is not the same pressure to excel as there is with boys. Boys are encouraged to aspire to become scholars and to spend a great deal of their lives engaged in religious studies, even as adults (Benor, 2004). The rabbi is the most important figure in the community and the community regularly supports the studies of boys who are seen as having the greatest potential to become rabbis or other learned public figures. On the other hand, the main goal of girls, as viewed by religious communities, is to get married and raise large families (Greenberg, Stravynski, & Bilu, 2004). A 'successful' religious woman is one who is married to a scholar and is raising a large family. Religious families in general have larger families than secular ones (4.3 children on average compared to the secular average of 2.1). Girls are expected to succeed in their studies primarily in order to become educated mothers and compatible partners for the better educated husbands. Thus, the pressure to perform is not as great for girls as it is on boys, leading to more modest levels of personal performance orientation among religious girls than among boys.

Knafo and Schwartz (2003) showed that parents who send their children to religious schools tend to have different value systems from those who send their children to secular schools. They typically place the highest importance on the religious aspects of their children's education, with the other aspects coming a clear second. Indeed, students are accepted to religious school only after passing a test in Talmud and a personal interview. Only after being accepted will students be tested in mathematics and English in order to place them in different levels (Tsemach, 2016). The status of scientific knowledge (and all secular knowledge, such as math, foreign languages, and general history.) in religious communities is much lower than the status of religious dogma and knowledge derived from religious studies. More class hours are dedicated to religious studies than to non-religious studies, and the first hours in the day, when the students are typically most alert, traditionally deal with religious studies (Tsemach, 2016). Religious communities often find science culturally challenging because it sometimes runs contrary to their religious beliefs (Berkman & Plutzer, 2010; Meadows, Doster, & Jackson, 2000). Similarly, secular students often feel challenged by biblical studies (compulsory in Israel) since much of what is presented conflicts with their worldviews and they do not see the importance in biblical studies. For many in the religious community, the main value of science studies is in their potential to open up professions that may provide economic mobility. This gets interpreted by religious adolescents as a message that developing deep understanding, that is, mastery, in science is not all that important or valued, leading to lower perceived levels of mastery emphasis by the environment and lower levels of personal mastery orientation towards science than are typically found among their secular peers.

Religious girls' mastery orientation in science changes with time and follows the same behaviour as their perceptions of the science teachers' emphasis on mastery: a decline from the fifth to sixth grade, a leap during the transition to single-gender class in the seventh grade, and then again a decline in the eighth grade. This pattern is clearly different from their perceptions of the parents' and schools' emphases on mastery in science, which remain constant or decrease, respectively, throughout adolescence. We surmise that against a constant background of low parental and school expectations regarding mastery in science, the science teacher is the only individual who significantly influences religious girls' mastery in science. While science teachers in secular and democratic schools are influential figures on their students' mastery orientation towards science (Vedder-Weiss & Fortus, 2013), their impact is limited because it gets mixed together with varying and sometimes contradicting messages from parents and schools. On the other hand, due to the constancy of the low-level mastery expectations of religious parents and schools, the motivational messages broadcast by science teachers can be clearly heard and distinguished from the background, making the motivational role of science teachers especially important for girls in religious schools.

Other than a constant decrease in their performance-approach orientation to science and a decrease in performance-avoid orientation during the transition to single-gender classes, there are no appreciable trends to religious boys' motivation to engage with science. We hypothesise that the drop in performance-avoidance may be due to the disappearance of girls in the seventh grade, which may relieve some of the boys' fear of being seen as dumb or unknowing (Paechter, 2007). The decrease in performance-approach orientation may be due to an increasing awareness on the part of the boys that although they are expected to perform well, their knowledge in science plays a small role in how they are being evaluated by their environment, and therefore, they focus their attention on issues of greater importance, namely religious studies.

To summarise, the standards and norms underlying Israel religious schools are very different from those in Israeli secular schools, leading to very different motivational patterns. Little difference is seen between boys and girls in gender-mixed secular schools but large differences exist between boys and girls in gender-separated religious schools. This study provides evidence for the strong influence Jewish religious culture in Israel has on religious students' motivation to engage with science, suggests mechanisms by which this influence occurs, and illuminates how gender-separated schools allow the transmission of differing motivational messages to religious girls and boys. It is possible that similar influences operate in other religious communities that operate single-gender schools, such as Moslem or Catholic communities, but this remains to be studied.

## Notes

1. There is no exact definition or requirement for a school to be considered democratic, but most of them share some common characteristics: (1) they are managed by shared decision-making among the students and staff, (2) students can choose which subjects to learn and in general, what to do with their time, (3) there are usually no required classes, and (4) the staff supports students by offering facilitation according to students' interest and needs. (Vedder-Weiss & Fortus, 2011, p. 202)
2. The religious Jewish community in Israel is largely off-limits to researchers, especially to those who do not come from within the community. We were extremely fortunate to be



allowed to enter some of these schools; this was possible only because one of the authors (L.D.) grew up in an orthodox community and was personally acquainted with the heads of the schools that were surveyed. In all cases, our entry was limited to distributing surveys; we were not allowed to have personal contact with any of the students.

3. The existence of negative values is an artefact of Rasch analysis. The probability that a student will choose a certain value on an item, for example, one measuring an aspect of performance-approach orientation, is related to the difference between the student's level of performance-approach orientation and the 'difficulty' of the item, that is, the level of performance-approach orientation it measures. Thus, what are important are not the absolute values of the items' 'difficulties' or the students' levels of performance-approach orientation, but the differences between them. The mean 'difficulty' of all the items is set at zero. Thus, having a negative performance-approach orientation only means that one's level of performance-approach orientation is lower than the mean 'difficulty' of all the items measuring various aspects of performance-approach.

## Disclosure statement

No potential conflict of interest was reported by the authors.

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## References

- Adler, C. (1989). Israeli education addressing dilemmas caused by pluralism: A sociological perspective. *Education in a Comparative Context*, 4, 21–44.
- Aikenhead, G. S. (1996). Science education: Border crossing into the subculture of science. *Studies in Science Education*, 27(1), 1–52. doi:10.1080/03057269608560077
- Aikenhead, G. S. (2001). Students' ease in crossing cultural borders into school science. *Science Education*, 85(2), 180–188.
- Aikenhead, G. S., & Jegede, O. J. (1999). Cross-cultural science education: A cognitive explanation of a cultural phenomenon. *Journal of Research in Science Teaching*, 36(3), 269–287.
- Alfasi, R. (2014). *Characterizing of science teaching in Israeli Waldorf education in grades 6–9* (PhD). Weizmann Institute of Science, Rehovot, Israel.
- Ames, C. (1992). Classrooms: Goals, structures, and student motivation. *Journal of Educational Psychology*, 84, 261–271.
- Anderman, E. M., & Maehr, M. L. (1994). Motivation and schooling in the middle grades. *Review of Educational Research*, 64(2), 287–309.
- Anderman, E. M., & Midgley, C. (1997). Changes in achievement goal orientations, perceived academic competence, and grades across the transition to middle-level schools. *Contemporary Educational Psychology*, 22(3), 269–298.
- Anderman, E. M., & Midgley, C. (2002). Methods for studying goals, goal structures, and patterns of adaptive learning. In C. Midgley (Eds.), *Goals, goal structures, and patterns of adaptive learning* (pp. 1–20). Mahwah, NJ: Lawrence Erlbaum.
- Anderman, E. M., & Young, A. J. (1994). Motivation and strategy use in science: Individual differences and classroom effects. *Journal of Research in Science Teaching*, 31(8), 811–831.
- Anfara, V. A., & Mertens, S. B. (2008). Do single-sex classes and schools make a difference? *Middle School Journal*, 40(2), 52–59. doi:10.1080/00940771.2008.11461673
- Baram-Tsabari, A., Sethi, R. J., Bry, L., & Yarden, A. (2009). Asking scientists: A decade of questions analyzed by age, gender, and country. *Science Education*, 93(1), 131–160.

- Basu, S. J., & Barton, A. C. (2007). Developing a sustained interest in science among urban minority youth. *Journal of Research in Science Teaching*, 44(3), 466–489.
- Benor, S. (2004). Talmid Chachams and Tsedeykeses: Language, learnedness, and masculinity among Orthodox Jews. *Jewish Social Studies*, 11(1), 147–170.
- Berkman, M., & Plutzer, E. (2010). *Evolution, creationism, and the battle to control America's classrooms*. Cambridge, MA: Cambridge University Press.
- Bond, T. G., & Fox, C. M. (2001). *Applying the Rasch model: Fundamental measurement in the human sciences*. Mahwah, NJ: Lawrence Erlbaum.
- Boone, W. J., Staver, J. R., & Yale, M. S. (2014). *Rasch analysis in the human sciences*. New York, NY: Springer.
- Booth, A., & Dunn, J. F. (2013). *Family-school links: How do they affect educational outcomes?* New York, NY: Routledge.
- Breakwell, G. M., & Beardsell, S. (1992). Gender, parental and peer influences upon science attitudes and activities. *Public Understanding of Science*, 1(2), 183–198.
- Dowson, M., McInerney, D. M., & Nelson, G. F. (2006). An investigation of the effects of school context and sex differences on students' motivational goal orientations. *Educational Psychology*, 26(6), 781–811.
- Elliot, A. J., & Church, M. A. (1997). A hierarchical model of approach and avoidance achievement motivation. *Journal of Personality and Social Psychology*, 72(1), 218–232.
- Fortus, D., & Vedder-Weiss, D. (2014). Measuring students continuing motivation for science learning. *Journal of Research in Science Teaching*, 51(4), 497–522.
- Friedel, J. M., Cortina, K. S., Turner, J. C., & Midgley, C. (2007). Achievement goals, efficacy beliefs and coping strategies in mathematics: The roles of perceived parent and teacher goal emphases. *Contemporary Educational Psychology*, 32(3), 434–458.
- Gardner, P. L. (1998). *The development of males' and females' interests in science and technology*. Paper presented at the second conference on interest and gender kiel, Germany.
- Gonzalez, A. R. (2002). Parental involvement: Its contribution to high school students' motivation. *The Clearing House: A Journal of Educational Strategies, Issues and Ideas*, 75(3), 132–134. doi:10.1080/00098650209599252
- Greenberg, D., Stravynski, A., & Bilu, Y. (2004). Social phobia in ultra-orthodox Jewish males: Culture-bound syndrome or virtue? *Mental Health, Religion & Culture*, 7(4), 289–305. doi:10.1080/13674670310001606496
- Grolnick, W. S., Ryan, R. M., & Deci, E. L. (1991). Inner resources for school achievement: Motivational mediators of children's perceptions of their parents. *Journal of Educational Psychology*, 83(4), 508–517.
- Hargreaves, D. H. (1995). School culture, school effectiveness and school improvement. *School Effectiveness and School Improvement*, 6(1), 23–46.
- Henderson, A. T. (1987). *The evidence continues to grow: Parent involvement improves student achievement*. An Annotated Bibliography. National Committee for Citizens in Education Special Report: ERIC Clearinghouse on Assessment and Evaluation.
- Henderson, A. T., & Mapp, K. L. (2002). *A new wave of evidence: The impact of school, family, and community connections on student achievement*. Annual synthesis 2002. Austin, TX: National Center for Family and Community Connections with Schools.
- Heyman, G. D., Dweck, C. S., & Cain, K. M. (1992). Young children's vulnerability to self-blame and helplessness: Relationship to beliefs about goodness. *Child Development*, 63(2), 401–415. doi:10.1111/j.1467-8624.1992.tb01636.x
- Hokoda, A., & Fincham, F. D. (1995). Origins of children's helpless and mastery achievement patterns in the family. *Journal of Educational Psychology*, 87(3), 375–385.
- Jacobson, D. B. (2004). *Psychological and religious change of orthodox Jewish boys during a post-high school year of study in and Israeli Yeshiva* (PhD). Rutgers, New Brunswick, NJ.
- Jegede, O. J. (1995). Collateral learning and the eco-cultural paradigm in science and mathematics education in Africa. *Studies in Science Education*, 25(1), 97–137. doi:10.1080/03057269508560051

- Kaplan, A., & Maehr, M. L. (2007). The contributions and prospects of goal orientation theory. *Educational Psychological Review*, 19(2), 141–184.
- Knafo, A., & Schwartz, S. H. (2003). Parenting and adolescents' accuracy in perceiving parental values. *Child Development*, 74(2), 595–611.
- Kottler, J. A. (1997). *What's really said in the teachers' lounge: Provocative ideas about cultures and classrooms*. Thousand Oaks, CA: Corwin Press.
- Lee, O., & Anderson, C. W. (1993). Task engagement and conceptual change in middle school science classrooms. *American Educational Research Journal*, 30(3), 585–610.
- Liu, M., Hu, W., Jiannong, S., & Adey, P. (2010). Gender stereotyping and affective attitudes towards science in Chinese secondary school students. *International Journal of Science Education*, 32(3), 379–395.
- Maehr, M. L. (1984). Meaning and motivation: Toward a theory of personal investment. In R. E. Ames & C. Ames (Eds.), *Research and motivation in education* (Vol. 1, pp. 115–144). San Diego, CA: Academic Press.
- Maehr, M. L., & Anderman, E. M. (1993). Reinventing schools for early adolescents: Emphasizing task goals. *The Elementary School Journal*, 93(5), 593–610.
- Meadows, L., Doster, E., & Jackson, D. F. (2000). Managing the conflict between evolution and religion. *The American Biology Teacher*, 62(2), 102–107.
- Miller, P. H., Blessing, J. S., & Schwartz, S. (2006). Gender differences in high-school students' views about science. *International Journal of Science Education*, 28(4), 363–381.
- Osborne, J., Simon, S., & Collins, S. (2003). Attitudes towards science: A review of the literature and its implications. *International Journal of Science Education*, 25(9), 1049–1079.
- Paechter, C. (2007). *Being boys; being girls: Learning masculinities and femininities*. Columbus, OH: McGraw-Hill Education.
- Pahlke, E., Hyde, J. S., & Allison, C. M. (2014). The effects of single-sex compared with coeducational schooling on students' performance and attitudes: A meta-analysis. *Psychological Bulletin*, 140(4), 1042–1072.
- Peterson, K. D., & Deal, T. E. (1998). How leaders influence the culture of schools. (realizing a positive school climate). *Educational Leadership*, 56(1), 28–31.
- Platinga, A. (2014). Religion and science. In E. N. Zalta (Ed.), *The Stanford encyclopedia of philosophy*. Stanford, CA: Stanford University. Retrieved from <https://plato.stanford.edu/entries/religion-science/>
- Pomson, A. (2001). Knowledge that doesn't just sit there: Considering a reconception of the curriculum integration of Jewish and general studies. *Religious Education*, 96(4), 528–545.
- Rex, J., & Chadwell, D. (2009). Single-gender classrooms. *School Administrator*, 66(8), 28–33.
- Roeser, R. W., Midgley, C., & Urdan, T. C. (1996). Perceptions of the school psychological environment and early adolescents' self appraisals and academic engagement: The mediating role of goals and belonging. *Journal of Educational Psychology*, 88(3), 408–422.
- Schunk, D. H., Pintrich, P. R., & Meece, J. L. (2008). *Motivation in education: Theory, research and application*. Upper Saddle River, NJ: Pearson.
- Senko, C., Hulleman, C. S., & Harackiewicz, J. M. (2011). Achievement goal theory at the crossroads: Old controversies, current challenges, and new directions. *Educational Psychologist*, 46(1), 26–47.
- Simpson, R. D., & Oliver, J. S. (1990). A summary of major influences on attitude toward and achievement in science among adolescent students. *Science Education*, 74(1), 1–18.
- Sjøberg, S. (2000). *Science and scientists: The SAS-study: Cross-cultural evidence and perspectives on pupils' interests, experiences and perceptions*. Retrieved from [http://folk.uio.no/sveinsj/SASweb.htm#\\_Toc483975197](http://folk.uio.no/sveinsj/SASweb.htm#_Toc483975197)
- Swirski, S. (1999). *Politics and education in Israel: Comparisons with the United States*. Philadelphia, PA: Falmer Press.
- The Jewish Agency. (2016). *The world Bible Quiz*. Retrieved from <http://www.jewishagency.org/partnership2gether/program/31611>
- Tsemach, S. (2016). *Studies in Israeli religious schools*. Personal communication.

- Turner, J. C., Midgley, C., Meyer, D. K., Gheen, M. Q., Anderman, E. M., Kang, Y., & Patrick, H. (2002). The classroom environment and students' report of avoidance strategies in mathematics: A multimethod study. *Journal of Educational Psychology*, 94(1), 88–106.
- Urdu, T., & Schoenfelder, E. (2006). Classroom effects on student motivation: Goal structures, social relationships, and competence beliefs. *Journal of School Psychology*, 44(5), 331–349.
- Vedder-Weiss, D., & Fortus, D. (2011). Adolescents' declining motivation to learn science: Inevitable or not? *Journal of Research in Science Teaching*, 48(2), 199–216.
- Vedder-Weiss, D., & Fortus, D. (2012). Students' declining motivation to learn science: A follow up study. *Journal of Research in Science Teaching*, 49(9), 1057–1095.
- Vedder-Weiss, D., & Fortus, D. (2013). School, teacher, peers and parents' goals emphases and adolescents' motivation to learn science in and out of school. *Journal of Research in Science Teaching*, 50(8), 952–988.
- Wentzel, K. R. (1998). Social relationships and motivation in middle school: The role of parents, teachers, and peers. *Journal of Educational Psychology*, 90(2), 202–209.
- Yaacobs, A. (2016, September 20). *The Israeli curriculum in Biblical studies*. Personal communication.