International Journal of Science Education

ISSN: 0950-0693 (Print) 1464-5289 (Online) Journal homepage: http://www.tandfonline.com/loi/tsed20

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To cite this article: Annemie Struyf, Jelle Boeve-de Pauw & Peter Van Petegem (2017): 'Hard science': a career option for socially and societally interested students? Grade 12 students' vocational interest gap explored, International Journal of Science Education, DOI: 10.1080/09500693.2017.1376259

To link to this article: http://dx.doi.org/10.1080/09500693.2017.1376259

Published online: 21 Sep 2017.

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INTERNATIONAL JOURNAL OF SCIENCE EDUCATION, 2017
https://doi.org/10.1080/09500693.2017.1376259

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'Hard science': a career option for socially and societally interested students? Grade 12 students' vocational interest gap explored

Annemie Struyf, Jelle Boeve-de Pauw and Peter Van Petegem

Department of Training and Education Sciences, University of Antwerp, Belgium

ABSTRACT

A key theme in science education research concerns the decline in young peoples' interest in science and the need for professionals in hard science. Goal Congruity Theory posits that an important aspect of the decision whether to pursue hard science for study or as a career is the perception that hard science careers do not fulfil social (working with people) and societal (serving or helping others) interests. In this qualitative study, we explore grade 12 students' perceptions about the social and societal orientation of hard science careers. Furthermore, we investigate the variation in students' social and societal interests. Six focus groups were conducted with 58 grade 12 students in Flanders. Our results indicate that a number of students hold stereotypical views about hard science careers' social orientation, while others believe cooperation with others is an important aspect of hard science careers nowadays. Furthermore, our results show that students believe hard science careers can be societally oriented in the sense that they often associate them with innovation or societal progress. Finally, our results indicate that students may differentiate direct versus indirect societal orientation. These findings contribute to literature regarding social and societal interests and students' perceptions of hard science careers.

ARTICLE HISTORY
Received 11 May 2017
Accepted 2 September 2017

KEYWORDS
Hard science; career perceptions; social and societal interest; RIASEC model; Goal Congruity Theory; qualitative research; focus groups

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Introduction

Over the past decade, a key theme in science education research has been the decline in young people's interest in science (Bøe, Henriksen, Lyons, & Schreiner, 2011; Organisation for Economic Co-operation and Development [OECD], 2008a). Several reasons underlie the importance of placing students' declining interest in science high on the research agenda. One reason is society's need for critical and scientifically literate citizens who are aware of how science and technology increasingly play a role in contemporary society (Osborne & Collins, 2001; Schreiner, 2006). Another reason is the need for professionals in *hard science*, rather than professionals in *soft science* careers (Bøe et al., 2011; OECD, 2008a). The latter covers biology and health issues, while hard science typically includes technology, engineering, mathematics, physics and, to some extent, chemistry (Kjærnsli & Lie, 2011; Schreiner & Sjøberg, 2007). From an economic perspective,

CONTACT Annemie Struyf annemie.struyf@uantwerpen.be
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there is a need for hard science professionals (e.g. scientists, engineers, technicians, computer scientists) in order to maintain economic growth (Schreiner, 2006). From an ecological or social perspective, hard science experts are necessary to tackle society's contemporary problems (e.g. combating environmental degradation and pollution, developing renewable energy, ensuring safe and affordable food) (Carlone et al., 2015; Kjærnsli & Lie, 2011). Whichever argument is placed at the centre of this debate, the issue of declining interest in science and the related decrease in students enrolling in higher science education and hard science careers is pressing, and at the core of policy, practice and research worldwide.

To build scholarly understanding of students' (dis)interest in the pursuit of hard science study or a career, extensive research regarding this topic has been carried out (Bøe et al., 2011). Interestingly, recent studies found different interests between students who pursue a hard science study course or career (*HS-choosers*) and students who do not pursue this (*NHS-choosers*). Different interests are found especially with regard to social and societal orientation (Boeve-de Pauw, Van Petegem & Lauwers, 2014; Diekman, Steinberg, Brown, Belanger, & Clark, 2016). 'Social orientation' is defined as 'working with people', whereas 'societal orientation' refers to 'serving or helping others' (Diekman et al., 2016). In particular, NHS-choosers express more interest in both social and societal orientation in comparison with HS-choosers. The concepts of social and societal orientation are captured by other authors under the concept 'people orientation' (Masnick, Valenti, Cox, & Osman, 2010; Morgan, Isaac, & Sansone, 2001; Su & Rounds, 2015) and 'communal orientation' (Brown, Thoman, Smith, & Diekman, 2015; Diekman, Brown, Johnston, & Clark, 2010; Diekman et al., 2016). In this paper, we differentiate between social orientation, on the one hand, and societal orientation, on the other hand, to maintain each concept's specific nature.

The interest gap between HS-choosers and NHS-choosers regarding social and societal orientation is the starting point of this study. The question arises as to whether students are holding realistic perceptions regarding hard science careers' social and societal orientation, or whether students' social and societal interests vary. In this study, this social and societal interest gap will be explored.

Vocational interests: Holland's RIASEC model

Interest is commonly defined as comprising of two different components: situational interest and individual interest (Dierks, Höffler, Blankenburg, Peters, & Parchmann, 2016). The first emerges as a momentary psychological state as a result of one's interaction with the environment. The latter refers to a person's enduring and often stable disposition. Individual interest is the most important aspect regarding educational or vocational choices (Hidi, 2006; Renninger, 2000). It is a critical predictor for choice of study and career choice (Boeve-de Pauw, Van Petegem, & Lauwers, 2014; Morgan et al., 2001; Su & Rounds, 2015).

A commonly studied typology used to categorise individual interests in a vocational context is Holland's RIASEC model (acronym of *Realistic*, *Investigative*, *Artistic*, *Social*, *Enterprising* and *Conventional*) (see e.g. Dierks et al., 2016; Holland, 1997; Su & Rounds, 2015). Each of the six categories captures a specific individual interest and

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corresponding features in work environments (Holland, 1997; Su & Rounds, 2015). In the context of this paper, the RIASEC model is very relevant as it is also applicable within a science context specifically. Dierks et al. (2016) used this model to categorise interest profiles in science-related activities. Moreover, the *social* (S) category within this model captures both *social* (working with people) and *societal* (serving or helping others) vocational interests.

Most importantly, Holland's theory asserts that the preference for a certain study area or career will be greater if there is congruence between a person's individual interests and the individual's perception that a certain work environment will match these interests (Holland, 1997; Nauta, 2010). Thus, with regard to such a person–environment fit theory, individuals identify career options by assessing the compatibility of these occupations with their self-image (Gottfredson, 1996). This process is closely interwoven with an individual's identity construction (Bøe et al., 2011; Holmegaard, Madsen & Ulriksen, 2014; Schreiner & Sjøberg, 2007).

The role of perceptions about hard science careers' social and societal orientation

A recent person–environment fit theory, which specifically focuses on social and societal vocational interests, is the Goal Congruity Theory (Diekman & Steinberg, 2013; Diekman et al., 2016). This theory posits that an important aspect of the decision whether to pursue a hard science course of study or career is the perception that hard science careers do not fulfil social and societal interests (Diekman & Steinberg, 2013). Diekman et al. (2010) found evidence for the assumption that hard science careers are perceived to be less likely to afford social and societal interests. A study of Masnick et al. (2010) on American students' attitudes about science careers found similar results. American students believe science careers and technological occupations to be less 'people-oriented' compared to other popular career choices (Masnick et al., 2010). Nevertheless, 'people orientation' is not defined in the latter study; thus, it is not clear if this concept includes both social and societal orientation. A number of studies that investigated students' educational choices in depth indicate that students associate hard science professions with stereotypical views regarding its social orientation (Clarke & Teague, 1996; Cleaves, 2005; Holmegaard, Madsen, et al., 2014), such as 'to be stuck in an office with just a computer' (Clarke & Teague, 1996, p. 243).

Interestingly, Brown et al. (2015) found that perceiving hard science careers as affording greater social and societal orientation is associated with greater interest in hard science careers. A study of Steinberg and Diekman (2016) indicates furthermore that learning environments can impact perceptions about hard science professions' social and societal orientation. Individuals who report greater social and societal experiences in their education are more likely to perceive hard science careers as socially and societally oriented (Steinberg & Diekman, 2016).

Hard science careers' social and societal orientation

Hard science occupations originally fell within the *Investigative* (activities connected to intellectual tasks) and *Realistic* (activities connected to practical tasks) dimension

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of Holland's RIASEC model (Dierks et al., 2016; Holland, 1997; Su & Rounds, 2015). However, this focus on solely intellectual and practical activities no longer represents the broader contemporary spectrum of hard science-related activities (Dierks et al., 2016). Several researchers highlight the importance of *social orientation* for the vast majority of hard science professions in today's workplace, where teamwork is an important part of daily reality (Scutt, Gilmartin, Sheppard, & Brunhaver, 2013; Seat, Parsons, & Poppen, 2001). Collaboration and communication skills are important for twenty-first-century engineers and scientists (Seat et al., 2001). Darling and Dannels (2003, p. 1) emphasise the importance of oral communication for engineers as, 'engineering practice takes place in an intensely oral culture and while formal presentations are important to practicing engineers, daily work is characterized more by interpersonal and small group experiences'. Also, science includes different social activities. It is no longer the 'prototypical individual working in a lab with goggles and a lab-coat' (Dierks et al., 2016, p. 239). Scientists are often involved in multi-disciplinary research projects or collaborate with industries or public institutions (Dierks et al., 2016). Hara, Solomon, Kim, and Sonnenwald (2003) stress the importance of such collaboration for scientific research, as it is characterised by constantly evolving technologies and highly specialised domains of expertise. An individual scientist can rarely provide all the knowledge and resources necessary to cope with complex research problems. Hard science careers are also highly *societally oriented*, as they can have a great deal of impact on tackling contemporary social and ecological problems. Furthermore, it has become evident that hard science professionals need to consider not only technical needs during the development of new products and processes but also social and ecological needs. The success of a new product or process is no longer guaranteed, even when it is perfect from a technical point of view (Stroeken & De Vries, 1995).

Aim of the present study

The current study explores how grade 12 students in Flanders (the Dutch-speaking community of Belgium) perceive hard science careers' social and societal orientation. Furthermore, this study explores the social and societal interests of these students. Flemish students in the 12th grade are facing the transition to higher education or the labour market. The focus in this study is on both HS-choosers and NHS-choosers, as well male as female, from classes with and without a strong focus on hard science. This leads to the following research questions:

- What perceptions do grade 12 students hold regarding hard science careers' social and societal orientation?
- In which way do social and societal vocational interests vary between grade 12 students?

The purpose of the first research question is to investigate if students have clear and nuanced perceptions about contemporary hard science careers' social and societal orientation. The aim of the second research question is to explore the concepts of social and societal interest, based on how grade 12 students express these interests.

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Method

Focus groups

In order to gain deeper insight into (1) grade 12 students' perceptions about the social and societal orientation of hard science careers and (2) the variation in grade 12 students' social and societal vocational interests, the required data were essentially qualitative. Focus groups were chosen as the most appropriate qualitative data gathering method to answer our research questions. The fundamental aim of this methodology is to explore the range of attitudes, values and beliefs that are commonly held within a certain population (Vaughn, Schumm, & Sinagub, 1996). In comparison to one-to-one interviews, the group context in a focus group offers a degree of support and security. The moderator stimulates individual respondents to share their ideas and to discuss with other group members in a non-threatening, relatively naturalised context (Kitzinger, 1995; Osborne & Collins, 2001). This can help individual respondents to explore and clarify their ideas in a way that would be harder to access in a one-to-one interview (Kitzinger, 1995). In total, six focus groups were conducted. The group size of each focus group ranged from 5 to 12 students, which is an appropriate group size (Osborne & Collins, 2001).

Participants and research context

Participants in this study were Flemish grade 12 students, aged 17–18 years old. Students who obtain their secondary education diploma are free to choose their field of study in higher education. There is no common government-run exam in Flanders, except for medicine and dentistry (Buyse, Lievens, & Martens, 2010).

Grade 12 students were sampled from four schools in Flanders, of which three schools were located in smaller urban areas. To provide a sample of students with different study and career aspirations, focus groups were held with randomly selected students in classes with and without a strong focus on hard science. Two focus groups were conducted with students from a science and mathematics track, two with students from an industrial sciences track and two with students from a commercial educational track.

Altogether, 58 students, of whom 37 were male, participated in the focus groups. All students planned to pursue study in higher education. Twenty-seven respondents were HS-choosers and 25 students were NHS-choosers. The six remaining students had not yet decided whether to pursue a hard or non-hard science study or career. Students were classified as HS-chooser or NHS-chooser based on their responses to an open-ended question about which higher education course or profession they planned to pursue. These responses were categorised using the classification of 'hard science' occupation of Kjærnsli and Lie (2011), which is based on the International Standard Classification of Occupations (ISCO-88) (see annex 10 in OECD, 2008b). Kjærnsli and Lie (2011) grouped the occupations below as 'hard science' occupations (the numbers refer to ISCO-88 codes):

(1) 2100–2149: Physical, mathematical and engineering science professionals
(2) 3110–3119: Physical and engineering science professionals
(3) 3133 and 3193: Medical, optical and electronic equipment operators (Kjærnsli & Lie, 2011, p. 134).

Consequently, students in this study were considered as HS-choosers, if they were to pursue a study course or career in the field of hard science. Students who aspired to study or pursue an occupation that could not be classified as a hard science were considered to be NHS-choosers (Table 1).

Procedure

Focus groups were conducted at the end of the school year 2014–2015, between May and June, and were moderated by the first author. A passive informed consent form was given in advance to the students and their parents, so they could decide whether or not to participate. During the introduction to each focus group, the researcher asked an active informed consent question to each participant.

The nature of the focus group was semi-structured. An interview guide was developed, including questions about educational and vocational interests and students' perceptions of hard science careers. The focus group started with the moderator's explanation of the general content, the confidentiality of the data and some focus group rules. Next, students presented themselves and talked about their choice of study for the upcoming year, their career aspirations and their most important reasons and interests for making these choices. Special attention was given to students' social and societal vocational interests. Two statements were used as a starting point of the discussion. The first statement covered social vocational interest: 'I want a profession which allows me to have a lot of social contact with others.' The second statement concerned societal vocational interest: 'I want a job through which I can help others and/or society.'

After this, students were asked to share their opinions and perceptions of hard science careers. The concept 'hard science profession' was made clear to the students as 'a profession in the field of science, technology, engineering and mathematics. Examples of hard science professions are a scientist, engineer, technician or computer scientist.' Students made associations with hard science careers by brainstorming. Then, there was a deeper discussion of students' perceptions regarding hard science careers' social and societal orientation. Students shared their opinions about two statements shown by the researcher: 'In technical and scientific professions you do not have much contact with other people' and 'Science and technology are important for society.'

Analysis

Each focus group lasted for approximately one hour and was audio recorded. Next, the focus group data were analysed thematically using the six-step approach of Braun and Clarke (2006) (see also Holmegaard, Madsen, et al., 2014; Holmegaard, 2015). As a first

Table 1. Overview of focus groups and participants' aspirations.

Focus group (FG)	Educational track	HS-choosers	NHS-choosers	'Hesitating' students
FG1-SM	Science and Mathematics	2	9	0
FG2-SM	Science and Mathematics	5	4	3
FG3-IS	Industrial Sciences	10	0	1
FG4-IS	Industrial Sciences	8	0	0
FG5-C	Commercial	1	4	0
FG6-C	Commercial	1	8	2

Note: SM: Science and Mathematics; IS: Industrial Sciences; C: Commercial.

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step in the analysis process, focus group data were transcribed and the process of (re)reading began to enable more familiarity with the data. Simultaneously, notes of the initial ideas and reflections evoked by some fragments in the transcript were taken. From the second step in the analysis, the qualitative data analysis software Nvivo 10 was used to support the further analysis process. In this phase, initial codes were generated across the whole data set. Third, all the codes in the data set were gathered under broader codes that reflected key themes within the interview (e.g. students' vocational interests, students' associations with hard science careers, students' perceptions towards hard science careers' social orientation). Fourth, these themes were reviewed in relation to the coded fragments and the entire data set, resulting in a thematic map of the analysis. Fifth, the specifics of each theme were refined. Some themes were divided into smaller sub-themes. Sixth, vivid quotes of some respondents were selected and further analysed, relating back to the research questions and the literature (Braun & Clarke, 2006). The quotes reported in this paper use pseudonyms to protect the respondents' privacy.

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Results

Based on the analysis of the focus groups, students' perceptions about hard science careers' social and societal orientation will be discussed first. Next, the focus will be on the students' social and societal interests, how they expressed these interests and how they comprehend them.

Students' perceptions about hard science careers' social orientation

A number of students perceived certain hard science careers as having a low social orientation. This perception reflects stereotypical views.

Thomas:	Those [mathematicians] are nerds, who spend so much time on their own.
Interviewer:	Nerds who spend so much time on their own … ?
Thomas:	Yes, that is the way I see them. They prefer to sit inside and be alone, instead of other things.

(FG1-SM)

As a consequence, these stereotypes may lead students who have a strong social vocational interest away from hard science careers. One of the respondents did not see herself in future as a scientist, due to the perception that this is an 'isolated' profession. Instead, she imagined her 'future self' as a person who has a social career with lots of variety, which does not fit her perception of a scientist.

Interviewer: Do you see yourselves becoming scientists in future?

All:	(Laughing)
Sara:	Anyway not in a lab.
Interviewer:	Why not in a lab?
Sara:	It seems quite boring to me to be in your lab everyday, standing there in your lab coat and doing the same experiment everyday. I would not like that. It is also a bit unsocial, working in your little den, as I see it. I would prefer to do something social.

(FG1-SM)

In contrast to these perceptions, most respondents in the focus groups believed that most hard science professionals, such as engineers, technicians and scientists, need to cooperate regularly with others. When students made associations with hard science careers, they often mentioned 'teamwork' or 'being social' as important skills for such careers. Furthermore, students did recognise and understand the value of teamwork and cooperation for hard science careers. They believed that teamwork is necessary in order to solve complex research and design problems. In this sense, they are holding a view that matches today's workplace of engineers and scientists. As the next quote illustrates, students who were following an industrial sciences track in particular could express their arguments for the necessity of hard science careers' social orientation well.

Frank: I wrote down 'problem-solving skills' and 'working in a team'.
George: Also a 'go-getter', because you are confronted with problems which are not directly solvable. Then you really need to hold on and not give up.
Interviewer: So that you need to keep on searching.
Frank: Yes, and that will also be better in a team, if you cooperate with some people.

(FG3-IS)

However, students who were following a science and mathematics track stated that they had only recently developed a more accurate image about hard science professions' social orientation.

Anna: I actually always thought that these technical professions and engineers were always alone: busy behind their computer, and yeah maybe from time to time in a meeting … I still have this idea a bit, but I understand that it is less than I thought. I really had the idea that it was much more lonely.
Interviewer: What do the others think about that?
Denise: I had this idea especially about professions in computing science.

(FG2-SM)

A discussion about hard science careers' social orientation in comparison with other professions appeared in one focus group. These students expressed the belief that every profession has its moments of isolation and that there is no difference regarding hard science careers' social orientation compared to other professions. One student argued that hard science professions are less socially oriented compared to other professions, for example, in the healthcare sector.

Catarina: But every profession has moments, … A teacher for example; one moment he's sitting in front of the class, social contact. Then later on he has to correct assignments, which will take hours alone behind a desk. I think that you have both in each profession.
Interviewer: So that you have just a kind of variety?
Catarina: Yes, if you go to work in the healthcare sector, yes then you will have of course more contact with people.
Maryam: But also there, you may even have to do administration and stuff, so …
Catarina: And as a writer you are also often writing behind you desk.

(FG2-SM)

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Students' perceptions about hard science careers' societal orientation

All students in each focus group agreed with the statement that science and technology are important for society. They often associated hard science careers with 'innovation', 'societal progress', and thus as an important aspect of society's future or economy. Students often mentioned, in their examples, the instrumental value of hard science: e.g. the role of hard science in developing new things, games, computers, machines and cars.

Sara: You need science and technology for everything, really for everything.
Joe: Otherwise this school would not be standing here for example. Calculations were made for that.
John: Practically everything. Otherwise we would be still busy making a fire in the cave.
Joe: For almost everything we do electricity is needed, and if there are no people like that [hard science professionals] and something breaks down, then we would be thrown back to the Middle Ages.
John: Ranging from medical aspects to the environment.

(FG5-C)

In contrast with the quote above, students rarely illustrated the relevance of hard science in meeting society's social and ecological needs spontaneously. Only one other respondent mentioned explicitly that engineers help society, by searching for solutions for environmental problems.

Few students mentioned perceptions of the negative effect of hard science in society. One respondent made the remark that hard science is good for society when it is used in the right way.

Richard: Yes, science and technology are important for society, but you have to take into consideration the right use of science and technology. Once they developed an atom bomb and that was not really pleasant.

(FG3-IS)

Despite the fact that these students found hard science careers important for society, some students made the remark that hard science careers' social orientation depends upon the job content.

Interviewer: Do you have the feeling that you can help people in the job you will do or not?
William: A little bit. It depends what. If you are for example an industrial engineer and you end up somewhere in a company that is doing something for people, or you just develop luxury products; that's a big difference.

(FG4-IS)

Students' social and societal interests

Social interest

NHS-choosers, who were often in a science and mathematics or commercial educational track, often mentioned social orientation as one of their most important vocational interests. HS-choosers, in contrast, mentioned other interests prompting them to opt for a hard science study course in higher education or a hard science career: content interest, practical-oriented interest and extrinsic interests (e.g. high salary, job security). However, most HS-choosers agreed with the statement, 'I want a profession which allows me to have a lot

of social contact with others.' Many HS-choosers and NHS-choosers indicated that they did not want to end up alone behind a desk. Nevertheless, this statement caused confusion for many of the HS-choosers. While answering the statement, they began to imagine whether social contact in their future hard science career was possible or necessary, instead of reflecting on their own interest. They stated that social orientation is self-evident, and that it is nearly impossible to have no social contact in a professional work context. This illustrates that HS-choosers did not necessarily find social orientation unimportant, but they seemed to consider social interest as secondary in comparison to other interests.

William:	You have to deal with your colleagues.
Bjorn:	But it also depends which profession you will enter, because most of the time you will have people working for you. For example, you need to tell them what to do, like improving the security.
Interviewer:	But how important is this for you personally?
Bjorn:	It depends in which sector you are working.
William:	It is important to be able to communicate.
Max:	That you are not sitting there alone the whole day.

(FG4-IS)

For a few respondents, social orientation in their future career was unimportant or even not favourable. A student, from a commercial educational track, mentioned a preference for as few people as possible in her future occupation: 'I do not like fuss, I prefer to be on my own.' This implies that the perception of an occupation as being highly socially oriented may be a threshold for certain students when deciding to pursue such a career.

Societal interests

NHS-choosers in the focus groups often spontaneously mentioned societal interest next to social vocational interest. Examples of the study or career aspirations of these students are medicine, pharmaceutical sciences, obstetrics and teaching. For some of these students, helping people or children is a childhood dream.

Interestingly, some students made a distinction between directly helping people and indirectly helping people. A discussion in the focus group between two respondents, who both placed value on societal interest, illustrates this. One of these students aspired to a future career that allows a direct social contact with her patients, while the other student preferred to help people indirectly.

Lenore:	I maybe would like also to … I don't know of course, to do research about new medication or something like that. But I would also like to have personal contact with this person, to help that specific person get better.
Cindy:	I would personally prefer to do something for the whole of society, yes, in general.

(FG1-SM)

Helping people indirectly was satisfying enough for the respondent who sought to pursue study in the medical sciences. The other student argued that she perceived hard science careers' societal orientation as more 'indirect', which did not match her own 'direct' societal-oriented interest. Actually, she aspired to 'social orientation' within 'societal orientation' as the latter and the next quote illustrate.

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Lenore: I find it in a way more indirect [engineering]. I also just want social contact and I think you also have this as a scientist, but that is just with your colleagues talking about your job. While if you are, for example, a doctor, you can talk with people about private things.

(FG1-SM)

HS-choosers rarely mentioned societal interest spontaneously. After being shown the statement, 'I want a job through which I can help others and/or society', one HS-chooser mentioned that reflecting on the social orientation of a future career is actually important for him.

Other HS-choosers and NHS-choosers did not necessarily place value on the social orientation of their future career. They perceived social orientation in a profession more as something self-evident. One HS-chooser argued that he did not like 'to see other people put down'. Other students had simply not reflected on this before, as it is not their priority or main interest.

Anouk: I don't know, I would like to do that [helping people/ society], but I don't really know it for sure yet … It is not that I am now really like 'I want to make the world a better place'. I just want to decide first what I am going to study and after that I can still do something with it.

(FG5-5C)

Thomas: I think most of us, or at least me, would rather choose based on what they like to do. It is positive if you help society with it, but I do not think that someone will specifically say 'Ah I want to help society, so I am going to do that [study/ occupation].

(FG1-SM)

Discussion

This study explored Flemish grade 12 students' perceptions about hard science careers' social and societal orientation. The aim was to investigate whether students who are facing the transition to higher education have nuanced or accurate perceptions. Furthermore, the aim was to obtain more insight into social and societal interests. Therefore, we aimed to explore the social and societal interest gap between HS-choosers and NHS-choosers.

Students' perceptions about hard science careers' social and societal orientation

Based on the analysis of the focus groups, we found that students' perceptions about hard science careers' *social orientation* vary. In line with previous studies on students' educational choices (Clarke & Teague, 1996; Cleaves, 2005; Holmegaard, Madsen, et al., 2014), the results in this study suggest that stereotypical views regarding hard science careers' social orientation also exist among students in Flanders. A number of Flemish grade 12 students in the focus groups perceived hard science careers as 'isolated'. As the data suggest, these stereotypes may lead students who have strong social interests away from such careers. This is a matter of concern, within the context of society's need for hard science professionals. Furthermore, students need accurate information about occupations to make a well-considered choice of study.

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In contrast to these findings, most grade 12 students in the focus groups have a more accurate and realistic view regarding hard science careers' social orientation. A number of students, for example, did not believe that hard science careers are necessarily less socially and societally oriented than other professions, such as teachers or writers. This is interesting, as in the study of Masnick et al. (2010) teachers and writers were perceived as people-oriented by American students, while hard science careers were perceived as not people-oriented. Furthermore, participants in this study often mentioned 'teamwork' or 'being social' as important aspects or skills for hard science careers. These perceptions match the reality of hard science careers' activities nowadays. Students from the industrial sciences track, in particular, could express their arguments for the necessity of hard science careers' (e.g. engineering) social orientation well. This may be due to the fact that these students have already had more experiences with social and societal activities in their education (e.g. working in groups on an 'engineering project') (see Steinberg & Diekman, 2016), compared to their counterparts in a science and mathematics or commercial track. Students in the science and mathematics track reported that they had recently gained more accurate perceptions about hard science professions (e.g. engineering, computer science). They stated that information sessions regarding different study choices and occupations helped them to gather more accurate information about hard science careers. Consequently, such information sessions may help students to create more accurate images of hard science professions' social and societal orientation.

Rebecca: I absolutely did not know in the 11th grade what an engineer does for example.
Cindy: It is only since the 12th grade that we have got an idea about it. There are always student who know already what they want to study, but really knowing what these studies are about … It's also because our minds were busy with it, everyone was like 'oh, I want to know already what this is all about', because it is all coming closer.

(FG1-SM)

Anna: I think that it is just because recently we have been busy with this choice of study, and we also visited these different study options, and then you see people who are busy with it. Then you realize that those stereotypes are actually less true.
Maryam: Yeah, they break down when you see who is standing there.

(FG2-SM)

Although it was not the focus of this study, our results not only show the impact of information sessions, but they also underscore the importance of role models, such as parents, in shaping accurate and nuanced perceptions about hard science careers' social orientation. Across the focus groups, students, who have clear and nuanced perceptions about hard science professions and their social orientation, refer to role models like parents or other family members, who have a hard science career.

Alfred: My dad works in the IT-sector and he has days that he is just strumming behind his computer, and he has to do things. And other days he is also busy all the time discussing with other people. But it really depends on what is needed … Sometimes he's sitting the whole day behind his computer, and sometimes he walks around and he goes to a meeting with other people or there are other people who come to ask him 'what did you do?' … And then he has to show what he has already done.

Barbara: Yes, my parents also have to go to a lot of conferences. Then you come automatically into contact with other people from all over the world who are talking about the same thing.
Interviewer: And what are your parents doing?
Barbara: They need to work with engineers etc. They studied mathematics, but … they actually have to make applications.

(FG2-SM)

Students' beliefs about hard science careers' *societal orientation* are mostly positive, in the sense that they believe that these professions create progress for society. Nevertheless, a few students mentioned the role of hard science careers in combating social and ecological problems. This finding supports the work of Osborne and Collins (2001) who conducted focus group discussions with 16-year-old pupils in London about their views of the role and value of science education. In their comments, students expressed the general value of science in society, often illustrated with examples of its instrumental value, for example the use of washing machines.

The results suggest that helping students to create a clear view about hard science careers and their social and societal orientation at an earlier stage of their process of study choice would be useful, as some students had only recently developed an accurate image of hard science careers and their social and societal orientation. As the results in this study have shown, close role models, such as parents, can impact students' perceptions through the information they provide. Nevertheless, schools can also have a greater role in providing accurate information about hard science careers' social and societal orientation. Teachers can, for example, visit hard science professionals' work places with their class or can invite hard science professionals to their school.

In addition, schools can highlight the social and societal orientation of hard science careers through the education they provide. This may arouse the interest of students who have strong social and societal interests. Schools can therefore implement (hard) science programmes that apply social and societal activities in science. Although science education programmes may vary in content, scope and strategy they often provide opportunities through facilitating collaborative student work and by applying hard science to solve 'real-world' problems (e.g. Diekman et al., 2016; Goovaerts, De Cock, & Dehaene, 2016).

In this study, students' perceptions were investigated at one moment in time. Future research can specifically focus on how students' perceptions about hard science careers' social and societal orientation evolve. Some students suggested that their ideas about hard science careers' social and societal orientation developed or changed over time. Mapping this developing process qualitatively would give more insight into factors that impact students' perceptions about hard science careers' social and societal orientation. Investigating this process would be especially valuable to test the effectiveness of educational interventions that aim to improve students' perceptions about hard science careers' social and societal orientation.

Students' social and societal interests

NHS-choosers in the focus groups often mentioned social and societal interest as an important vocational interest, while HS-choosers mentioned other interests, such as practical interest. When we explored social and societal interest explicitly, HS-choosers did not

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express the view that they found this interest unimportant, but they expressed it more as something self-evident. A possible explanation is that a profession's social and societal orientation can be seen as a person's basic psychological need for satisfaction of relatedness (Brown et al., 2015; Diekman et al., 2010; Morgan et al., 2001; Ryan & Deci, 2000). However, there was one student who particularly expressed a preference for having the least possible social orientation in her future career. The differences in social and societal interests between HS-choosers and NHS-choosers, on the other hand, could be partly explained by the fact that NHS-choosers are more likely to be female (Diekman et al., 2016). Women are more socially and societally oriented, in contrast to men who are more interested in working with things (Eccles, 1994; Morgan et al., 2001; Su & Rounds, 2015; Su, Rounds, & Armstrong, 2009).

Interestingly, the results also show that students can express a very specific 'direct' or 'indirect' *societal interest*. Some students preferred to help or serve other people in a direct way (e.g. a doctor who helps a patient during a visit), while other students preferred to help others in an indirect way (e.g. developing new medicines). Thus, students with a 'direct' societal interest will be probably less likely to pursue a hard science career. We also found evidence that the concept of social orientation, on the one hand, and societal orientation, on the other hand, may be perceived by students as two different concepts which do not necessarily overlap.

> Maryam: You can help society and people, but you may not necessarily come directly into contact with people during your work. Because if Anna ends up behind her computer, it may be possible that she is helping other people. It does not necessarily mean that someone is sitting beside her while she is on the laptop, whom she can have contact with all the time. Thus I don't know, I find that something else.
>
> (FG2-SM)

These findings give greater support to the proposal of dividing the concepts in future research into (1) social and societal orientation/interest and (2) 'direct' and 'indirect' societal interest. The 'social' dimension of Holland's RIASEC model, for example, focuses more on directly helping others (Dierks et al., 2016), while it would be valuable to broaden this dimension to 'indirectly' helping others. Splitting up these different concepts would also enrich Goal Congruity Theory.

A limitation of this study is that students' individual social and societal interests could not be linked to their individual perceptions regarding hard science professions' social and societal orientation. Due to the nature of the focus group method, it was not always clear during the transcription of the focus groups which participant had made particular statements, as the focus groups were not videotaped. This study served as an explorative study. Future research can conduct one-to-one interviews or surveys, in order to link the concepts, individual interests and individual perceptions, to each other. This would enable the further investigation of whether individuals who value social and societal interest may be led away from hard science careers.

Conclusion

The present study found that Flemish grade 12 students' perceptions about hard science careers' social and societal orientation vary. A number of students in the focus groups

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expressed stereotypical views and believed hard science careers to be 'isolated'. In contrast to these findings and earlier findings, most grade 12 students held nuanced and realistic perceptions about hard science careers' social and societal orientation. Furthermore, this study found that NHS-choosers expressed more social and societal interest. Although HS-choosers found social and societal interests not unimportant, but rather found self-evident. Evidence was also found that students may distinguish social orientation, on the one hand, and societal orientation, on the other hand, and express an interest in 'directly' versus 'indirectly' helping others. These insights can contribute to and enrich Holland's RIASEC model, Goal Congruity Theory and related literature on students' perceptions about hard science careers' social and societal orientation.

Acknowledgement

The authors thank Prof. Dr Vincent Donche and Prof. Dr Mieke De Cock for their valuable reflections and feedback on an earlier version of the manuscript.

Disclosure statement

No potential conflict of interest was reported by the authors.

Funding

We wish to express our gratitude to the agency for Innovation by Science and Technology (IWT) for funding the project STEM@School and thereby making this study possible.

ORCID

Annemie Struyf http://orcid.org/0000-0002-9668-1271
Peter Van Petegem http://orcid.org/0000-0002-4078-7800

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