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How do STEM-interested students pursue multiple interests in their higher educational choice?

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ABSTRACT

Interest in science, technology, engineering and mathematics (STEM) has lately received attention in research due to a gap between the number of STEM students and the needs of the labour market. As interest seems to be one of the most important factors in deciding what to study, we focus in the present study on how STEM-interested students weigh multiple interests in making educational choices. A questionnaire with both open-ended and closed-ended items was administered to 91 STEM-interested students enrolled in a STEM programme of a Dutch University for secondary school students. Results indicate that students find it important that a study programme allows them to pursue multiple interests. Some students pursued multiple interests by choosing to enrol in two programmes at the same time. Most students chose one programme that enabled them to combine multiple interests. Combinations of pursued interests were dependent on the disciplinary range of interests of students. Students who were interested in diverse domains combined interests in an educational programme across academic and non-academic domains, whilst students who were mainly interested in STEM combined only STEM-focused interests. Together these findings stress the importance of taking a multiple interest perspective on interest development and educational choice.

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STEM; interest; educational choice; multiple interest perspective; combination of interests; interest profile

Introduction

Recent studies examining the higher educational choice process of students have mainly focused on the question why students may or may not choose a programme in science, technology, engineering, and mathematics (STEM) (Bøe, Henriksen, Lyons, & Schreiner, 2011; Holmegaard, Ulriksen, & Madsen, 2014). The reason given for considering this particular domain is a growing need for students specialised in STEM in the labour market (Lacey & Wright, 2009; OECD, 2008), and the proportion of STEM students in higher

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education is not expected to be sufficient (OECD, 2006; 2008). The unsatisfactory enrolment patterns in STEM programmes are often explained by the students' lack of interest in STEM, as interest may be the most important factor in choosing what to study (Mikkonen, Heikkilä, Ruohoniemi, & Lindblom-Ylänne, 2009; Holmegaard et al., 2014); choosing a study that is in line with your interests predicts subsequent engagement, predicts on-time degree completion and leads to reduced drop-out rates (American College Testing Program, 2013).

Having an interest in a particular domain does not entail that students will choose a programme in that domain; students interested in STEM often do not pursue a degree in this area (e.g. Jenkins & Nelson, 2005; Krapp & Prenzel, 2011). This article explores how STEM-interested students weigh their interests in choosing what to study by taking a multiple interest perspective. This allows us to acknowledge that students may have multiple interests simultaneously, which may lead to conflict between interests (Hofer, 2010). Consequently, when choosing an educational programme, students have to resolve this conflict by deciding which interest or interests they would like to pursue in a programme.

The role of interests in the higher educational choice

Interest is a construct that combines cognition, motivation, and affect (Renninger & Hidi, 2011), and can be defined as 'the psychological state of engaging or the predisposition to reengage with particular classes of objects, events, or ideas over time' (Hidi & Renninger, 2006, p. 112). In educational context, interest has repeatedly been found to have various positive effects, such as increased study persistence (Allen & Robbins, 2010; Tracey & Robbins, 2006), attention (Hidi & Renninger, 2006; Knogler, Harackiewicz, Gegenfurtner, & Lewalter, 2015), motivation to learn (Harackiewicz, Durik, Barron, Linnenbrink-Garcia, & Tauer, 2008), and deeper levels of learning (Barron, 2006; Hidi & Renninger, 2006). Children already have some well-developed interests in kindergarten (Kasten & Krapp, 1986), and in high school most students have a clear idea of what interests them and what does not (Low, Yoon, Roberts, & Rounds, 2005). Interests are directive for the liking of related subjects and activities and the wish to spend more time and effort on these. Therefore, it is not surprising that interest is one of the most important factors in educational choices of students, including the choice for a higher educational programme (Eccles & Wigfield, 2002; Harackiewicz et al., 2008; Holmegaard, 2015).

Interest is not the only factor that students take into account when deciding which higher educational programme to enrol in. For example, future job possibilities (Holmegaard et al., 2014), student abilities (Eccles & Wigfield, 2002) and programme characteristics (Cabrera & La Nasa, 2000) may affect the choice of programme as well. The relative importance of each of these factors may vary across students, as students go through an idiosyncratic choice process over the course of multiple years (Leach & Zepke, 2005). Moreover, their choice may be affected by external factors: for example, studies show that familial economic and social capital is related to pursuing a programme or not (Cabrera & La Nasa, 2000; Lyons, 2006). Nonetheless, when looking at the common factors on which students base their decisions for a programme on, they consequently designate their interests as the most important factor (Malgwi, Howe, & Burnaby, 2005; Mikkonen et al., 2009). These quantitative studies show interest is mentioned more frequently than other factors and interests score highest on relative importance. Qualitative studies

mainly show students balance their interests and future career possibilities, but often the students' interests are decisive for which programme they choose to enrol in (Archer et al., 2010; Holmegaard, 2015; Holmegaard et al., 2014).

The role of interests in educational choice may be prominent, but is not self-evident. Even as students typically consider their interests when making decisions, they face an increased likelihood of choice dissatisfaction, inferior performance, and paralysis when choosing, mainly due to an abundance of choice (Schwartz, 2009). Students are known to take into account the relative cost of making a specific choice by comparing the opportunities lost if that choice is made (Eccles & Wigfield, 2002). Accordingly, if the range of choices increases, the relative costs of choosing one option might increase, as more opportunities will be lost.

Based on these arguments, we suggest that the role of interest in educational choice is important in a twofold way. On the one hand an educational programme might be more attractive because of the interests it relates to, and on the other hand it might be less attractive because of parallel interests it does not relate to. Therefore, we argue it is important to take into account all interests of an individual. We propose that this multiple interest perspective may explain why even STEM-interested students do not always pursue a STEM programme.

A multiple interest perspective

The idea of a multiple interest perspective appears to be rather new in the literature. For example, interest development theory, describing how interests develop over time as an interactional process between a person and its environment (Renninger & Hidi, 2011), focuses on the development of a single interest. The person-object theory of interest development (POI) (Krapp, 2007) and the four-phase model of interest development (Hidi & Renninger, 2006), provide detailed descriptions of how an interest may develop from a situational interest into an individual interest. Situational interest refers to 'focused attention and the affective reaction that is triggered in the moment by environmental stimuli, which may or may not last over time' (Hidi & Renninger, 2006, p. 113), whilst individual interest refers to a 'relatively enduring predisposition to reengage with particular classes of content over time' (Hidi & Renninger, 2006, p. 115). Although insightful, this theory does not explain how multiple interests may exist within an individual and how these might interact and co-develop. Empirical research neglects the role of multiple interests as well. In science education research, typically only changes in science interests are modelled, often without acknowledging other academic and non-academic interests (e.g. Ainley & Ainley, 2015).

Nevertheless, a trend towards a wider perspective on interest development can be observed. For example, Barron (2006) argues that in order to understand interest development, one should study interests across contexts (e.g. science interest in school, at home, and with peers) instead of studying interests in isolated environments (e.g. science interest in school). Moreover, she suggests that in order to acknowledge the complexity of how interests develop researchers should take into account the interactions between a person's identity, interest and key persons in one's environment.

This trend is also evident in research that focuses on the interest development of STEM-interested students and their choices for a higher educational programme. Several recent studies show that students are more likely to pursue science programmes when they

engage in science-related activities in and out of school, when their science interest is reinforced by teachers, peers, and/or parents and when science is perceived to fit with their identity (Archer et al., 2010; Aschbacher, Li, & Roth, 2010; Bøe et al., 2011). Although these studies suggest that it is important to take into account the different contexts in which an interest is pursued, these studies have not explicitly advanced a multiple interest perspective. Recently, Su and Rounds (2015) and Holmegaard (2015) called for more research on how multiple interests may affect the higher educational process in STEM context.

Hofer (2010) suggests in a theoretical paper that the interaction between multiple interests should be acknowledged to understand interest development. As people cannot pursue all interests due to time constraints, interests may compete with each other. Two interest pursuance strategies can be inferred from Hofer (2010) on how individuals handle competing interests: prioritise one interest or alternate time between interests. A third strategy may be inferred from Hofer and Fries (2016) who state individuals may combine interests into an activity which allows individuals to pursue multiple (otherwise possibly conflicting) interests.

Individuals constantly regulate their behaviour and decide continuously on which activity or interest they spend time (Hofer, 2010; Sansone & Thoman, 2005). Individuals intuitively feel which activity they prefer, without explicitly evaluating which interests this activity may satisfy. When making high stakes decisions on the other hand, individuals may go through a more active reflecting process and weigh more consciously which interests can be pursued (Hofer, 2010).

Pursuance of interests in educational choice

As the higher educational choice of students can be seen as a high stake decision in the life of adolescents (Du Bois-Reymond, 1998), we argue students actively weigh their multiple interests in deciding which programme to pursue. By applying the three interest pursuance strategies to the higher educational choice context we can get more insight in which and how many interests are pursued in programmes. Students can select their most important interest and choose a programme that allows them to specialise in their most preferred interest (*prioritising*), students can enrol in two studies they find interesting simultaneously as this will allow students to alternate interests (*alternating*), or students can try to find a programme that appeals to multiple interests (*combining*).

We postulate students are more inclined to use the combining strategy than the prioritising or the alternating strategy. As one tries to continue with as many interests as possible (Hofer, 2010), the alternating and combining options seem more likely than the prioritising option. Moreover, one tries to minimise relative costs as one chooses. Interests that cannot be pursued in an educational programme are perceived as possible costs and the time investment required for two bachelors is perceived as a possible cost (Eccles, 2009).

The effect of interest profile diversity

When investigating the interest pursuance strategies used when deciding which programme to enrol in, a students' whole range of interests should be taken into account (Hofer, 2010). As this so-called interest profile of a student can be relatively less diverse (e.g. a student who has multiple interests in one domain) or more diverse (e.g. a student interested in multiple domains; Tracey & Robbins, 2006), we can expect differences in the use of the interest

pursuance strategies in deciding which programme to pursue based on how diverse the student is interested. For example, when someone has interests that are all closely related to biology (less diverse interest profile), this particular student may more easily combine multiple interests in a biology programme than a student who aims to pursue the same programme but has interest in biology, history, art, and computers (more diverse interest profile). Therefore, we postulate that the extent to which interests are combined and alternated in a programme is dependent on the diversity of the interest profile of a student.

The present study

In the present study we adopt a multiple interest perspective to examine whether STEM-interested students pursue multiple interests when making educational choices. Four research questions are posed to gain more insight in the interest pursuance strategies of students. STEM-interested students are expected to try to pursue multiple interests in their educational choices. This can be achieved either by alternating bachelors they find interesting (choosing a double bachelor degree), or by combining interests in one educational programme. The first research question is: *to what extent do students interested in STEM perceive to alternate or combine interests in the educational programme(s) of their choice?* In line with the presented arguments, it is expected that more students pursue interests in one programme instead of choosing two programmes.

Moreover, we investigate whether interests are combined or alternated between or within domains. The specific research question is: *when making educational choices, to what extent does alternation or combination of interests take place between and within interest domains?* We expect that students mostly combine or alternate interests that lie within the STEM domain, but that combination or alternation between STEM interests and interests from other domains also occurs.

Individual differences exist in interest profile diversity (Tracey & Robbins, 2006). Therefore, we make a distinction between students who are mainly interested in STEM (STEM-focused interest profile) and students who are interested in other domains as well (STEM-plus interest profile). As the combination and alternation of interests across domains is possibly affected by profile diversity, we pose a third research question: *To what extent does interest profile diversity relate to interest alternation and combination tendencies in educational choices of students?* We expect that students with a more STEM-focused interest profile alternate and combine fewer interests across domains, whilst the opposite holds for students with a STEM-plus profile.

Finally, we address a fourth research question: *Is interest profile diversity related to choosing a STEM educational programme for STEM-interested students?* As students with a STEM-plus profile are interested in multiple domains it is expected that these students will more often pick a non-STEM educational programme than students with a STEM-focused interest profile.

Method

The Dutch educational system

Dutch students are tracked in three levels of high school after eight years of primary school. Students are placed either in the secondary vocational education track, general

secondary education track, or pre-university track. Approximately 20% of the students are placed into the pre-university track, which takes six years to complete. Only this programme gives access to university upon completion. Students can specialise in one or two clusters of subjects or so-called educational profiles: Culture & Society, Economy & Society, Nature & Health or Nature & Technology. Everyone who finishes the pre-university track can enrol in university. Most programmes have no requirements or only the requirement that students graduate with a specific educational profile, although some programmes apply selection at the gate.

Participants

Participants were 91 twelfth grade students in their final term of the pre-university track, chose either the Nature & Health or the Nature & Technology educational profile, and were enrolled in the Talent Academy of a Dutch university. The Talent Academy offers students the opportunity to follow school-level STEM courses in university in the last two years of secondary school. These students have a high interest in the STEM, and therefore constitute a suitable sample for the present study. In total, 99 students were enrolled in the Talent Academy in the spring of 2015. Of these, six students did not hand in a response and responses on the main variables were missing for two students. Of the included 91 students in the analyses, there were slightly more female ($n = 50$) than male ($n = 41$) participants and the age of the participants was 16 ($n = 6$), 17 ($n = 60$), or 18 ($n = 25$) years.

Instrument and procedure

Over a period of three years, the Interests of Students with a Talent for Science Questionnaire (ISTSQ) was developed as part of a larger research project (Akkerman & Bakker, 2012–2014). Survey data were considered suitable. First, experience showed that questionnaire administration under Talent Academy students resulted in high response rates and quality responses. Second, questionnaires could be administered during Talent Academy meetings, which allowed us to include all Talent Academy students.

Several questions were added to the ISTSQ to make it more suitable for the present study. Subsequently, a pilot study with eight eleventh grade Talent Academy students was conducted. Students were asked to fill in the questionnaire and to reflect on the clarity of the questions. Based on students' responses, one minor alteration was made.

Measure

Seven questions of the adapted ISTSQ were used for the analyses (Appendix). Students took the whole ISTSQ, but only seven questions were used in this paper as these questions were relevant for answering our research questions. Question 1, 5, 6, and 7 were not part of the original ISTSQ. The questions consisted of both open questions (e.g. perceived combination of interests), and closed questions (e.g. perceived importance of combination of interests, interest profile).

We asked students to list their interests without making use of a categorisation up front. As students vary which aspects of a domain they find interesting, this was the most ecological valid way to measure their interests (Bathgate, Schunn, & Correnti, 2014). Question

2 was subsequently used to categorise the interests of the students ourselves into STEM-focused or STEM-plus interest profiles.

Participants were asked if they had already made a final choice. If a choice was made, the chosen programme was asked for ($n = 64$). If a choice had not yet been made, participants were asked to list the options under consideration and to choose their preferred programme ($n = 27$). If someone explicitly indicated to pursue two bachelor programmes simultaneously this was considered as an indicator of the alternating strategy (question 3). To check whether students actually alternated interests, the interests students pursued in the programme (based on question 4 and 6) were matched with the two programmes a student was planning to enrol in.

Table 1 summarises all research questions, the indicators used for alternation or combination strategies, the questions on which analyses were based, the subsequent analyses, and the specific goal of this step. As can be seen from Table 1, three different methods were used as indicators of the combining strategy. First, the extent to which participants perceive to combine interests when asked for their motives to pursue a specific higher educational programme was coded and it was subsequently explored how they perceived to combine multiple interests in a programme (question 4). Second, participants indicated whether or not they perceived a combination of interests in their educational programme (question 5). Third, we asked participants how important they found the perceived combination of interests (question 7).

Data analysis

Sample sizes slightly differ per analysis due to occasional missing values. For each analysis, the sample size is provided in the results section. Data analysis for research question 1 and 2 consisted of calculating descriptive statistics. Prior to calculating descriptive statistics, content analysis of open-ended questionnaire data was conducted.

Content analysis

Inductive content analysis (Elo & Kyngäs, 2008) was used to identify the extent to which students refer to combinations of interests and to determine the domain of an interest. In the open coding phase, inductive codes, derived directly from observations in the data, were developed. In the axial coding phase, similar codes were grouped together leading to axial codes. In this phase, relevant literature and theoretical models were used to guide specification of the final coding scheme. Finally, selective coding was applied to abstract codes to a more general level.

Content analysis of the extent to which students refer to interest as a motive for educational choice. Students were asked to mention motives for choosing a specific programme. Answers were coded and a distinction was made between statements reflecting interest as a motive for educational choice and other motives. Next, statements that reflected interests were split into statements that reflected a combination of interests and statements that did not. Statements that reflected a combination of interest were subsequently explored in more detail to uncover how students perceive to combine multiple interests.

Content analysis of interests to see whether interest alternation or combination tendencies take place between or within interest domains. Responses to two open questions, in which participants were asked to provide an overview of their interests and to state which interests they pursued in the educational programmes of their choice, were used

Table 1. Overview of the research questions, analyses per research question, and the used questions for each analysis.

Research question	Combination or alternation indicator	ISTSQ question (see Appendix)	Analysis	Goal
Do students perceive to alternate or combine interests in educational programmes of their choice?	Combination	Question 4	Content analysis & descriptive statistics	Identifying the number of spontaneously mentioned motives of combining interests
	Combination	Question 5	Descriptive statistics	Proportion of students that perceive a combination of interests in their programme of choice
	Combination	Question 7	Descriptive statistics	Average importance of combining interests in programmes
	Alternation	Question 3, 4, and 6	Descriptive statistics	Proportion of students that choose multiple bachelors and mentioned interests in both bachelors
Does combination and alternation of interests take place between and within interest domains?		Question 1	Content analysis	Creating an overview of the different interest domains
	Combination and alternation	Question 1 and 6	Content analysis & descriptive statistics	Identifying across which domains interests are combined and alternated, and how much each combination and alternation was represented in the data
Does interest profile relate to interest alternation and combination tendencies?		Question 2	Descriptive statistics	Proportion of students that have a STEM-focused profile and that have a STEM-plus profile
	Combination	Question 2 and 6	Binary logistic regression	Identifying whether interest profile is related to interest combination tendencies.
	Alternation	Question 2 and 3	Binary logistic regression*	Identifying whether interest profile is related to interest alternation tendencies
Is profile diversity related to choosing a STEM or non-STEM programme?		Question 3	Content analysis	Identifying which programmes are considered STEM and non-STEM.
	None	Question 2 and 3	Binary logistic regression*	Identifying whether interest profile is related to choosing a STEM or non-STEM programme

Note: Combination or alternation indicator boxes that are empty were not directly related to a research question as this was preliminary work before analyses could be conducted that answered the specific research question. Regressions marked with an asterisk could not run as sample sizes were not large enough.

as data sources for research question 2. The final structure of the interest domains is displayed in Figure 1.

The definition of interest indicates that one can be interested in anything, as long as an interest is linked to a specific object. Participants in our study sometimes referred to more general preferences (e.g. a general preference for creative activities). Based on Schiefele (1991) we decided to consider and include such general preferences as an offbeat form of interest, maintaining a distinction between general preferences and specifically formulated interests.

Specifically formulated interests were divided into three interest domains: (1) non-academic interests, (2) STEM interests, and (3) Humanities and Social Sciences interests. All mentioned distinctions between interests, interest profiles, and programmes related to STEM and interests, interest profiles, and programmes not related to STEM were based on the categorisation of STEM major fields by Maltese and Tai (2010).

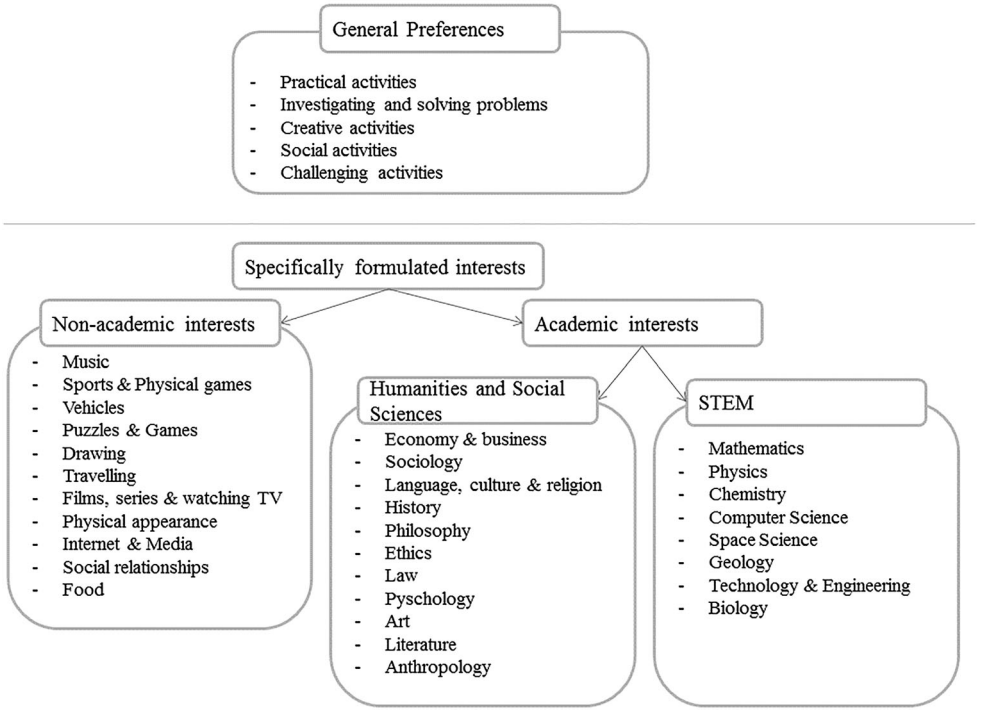

Figure 1. Final code structure of the content analysis of interests. The horizontal line in the middle of the figure represents the distinction between general preferences and specifically formulated interests.

Two participants mentioned an interest in 'humans' when reflecting on their interests. As this statement could be coded in all categories, we decided to exclude these participants from this analysis.

Trustworthiness. Peer debriefing and inter-coder reliability checks were conducted to ensure trustworthiness. Peer debriefing took place to arrive at final codes based on discussions of initial results between the second author, who conducted the content analyses, and the co-authors.

Inter-coder reliability was calculated for the final codes between the second author and an independent researcher in the selective coding phase. Scott's Pi statistic (Scott, 1955) was used as the reliability measure. For the content analysis of interest as a motive for educational choice, and the content analysis of interests, reliability scores of respectively $\pi = .81$, and $\pi = .91$ were obtained, which, according to Krippendorff (2004), is high enough to assure that data are similarly interpreted.

Is interest profile diversity related to alternation or combination tendencies of students?

To answer the third research question IBM SPSS Statistics 22.0 was used. Students were first attributed to a STEM-focused or STEM-plus interest profile, based on whether they were interested in only STEM domains or whether they were additionally interested in domains external to the STEM.

To test if interest profile was related to the tendency to combine or alternate multiple interests between interest domains, binary logistic regression was used. For this analysis, only the specifically formulated interest domains were included, as general preferences

could not be linked to STEM or non-STEM domains. No assumptions were violated for the binary logistic regression between interest profile and combination tendencies. The alternation sample was too small to run statistical tests on ($n = 11$), therefore this binary logistic regression could not be performed.

Is interest profile diversity related to choosing a STEM or non-STEM programme?

To answer the fourth research question, the chosen programmes were coded as STEM programmes or as non-STEM programmes. No further statistical tests could be run on this data as only two students chose to pursue a bachelor not related to the STEM.

Results

Do students perceive to alternate or combine interests in educational programmes of their choice?

Alternation

Out of the 91 students, 11 students were aiming to pursue two bachelors at the same time, whilst 79 students opted for one programme. One student indicated he was not sure whether he would enrol in one or two programmes. All participants opting for a double bachelor perceived interests they could pursue separately in both programmes. Seven participants chose to study twin bachelors by combining mathematics with either physics or computer science. Moreover, one participant chose to study physics and chemistry, another chose to do both biomedical sciences and medicine, and another student chose to pursue electrical engineering and physics. The last student chose a STEM bachelor (biomedical sciences) and a STEM-plus bachelor (liberal arts and sciences).

Combination

Three indicators were used to identify the extent to which students interested in STEM perceive to combine interests in the educational programme of their choice. The first indicator is the extent to which students refer to combinations of interests when using interest as a motive for educational choice, without explicitly asking them to mention interests. Of the 89 participants that responded to this question, 81 students mention interest as motive for choosing a specific programme. Four different interest motives were found. Table 2 presents examples of original data belonging to the different codes and summarises the

Table 2. Frequencies of mentioned motives for choosing a programme.

Code		Frequencies	Examples in the data:
Interest value	Interest in the whole programme	25	It seems fun and interesting
	Specifically formulated interest or general preference	48	I am very interested in biology It is very creative
	Multiple interests/general preferences	26	I am very interested in biology and chemistry
	Being able to combine interests	32	The combination between biology and something practical appeals to me.
Other		27	I already did a short internship in a veterinarian clinic I believe that with my heart, knowledge and skills I will be a good doctor

Note: Multiple motives were often mentioned by participants, therefore frequencies add up to more than the 89 participants who answered this question.

frequencies of the identified motives. First, interest motives took the form of an *interest in the whole programme*. Second, interest motives reflected a *specifically formulated interest or general preference*. Third, interest motives often appeared to relate to a combination of interests in two ways: *being able to combine interests* referred to cases when a combination of interests was directly mentioned, and *multiple interests/general preferences* referred to occasions when multiple specifically formulated interests or general preferences are mentioned independently of each other.

The statements of the fifty-two students that were categorised in the third category were explored to indicate how students tried to combine multiple interests. Based on these responses we found three different ways in which students tried to pursue multiple interests in one programme. Firstly, students explicitly chose programmes with a curriculum that allowed them to pursue multiple interests. For example, a student mentioned that her interests in the human body and diseases were present in the curriculum of Medicine. Students in this category often mentioned that they specifically aim to enrol in a programme which grants them the opportunities to take interesting elective courses or go abroad, as this allows them to pursue more interests in one programme: 'I chose for this broad bachelor as I do not want to lose these interests right now … I want to be able to try out pursuing at least these interests academically: physics, chemistry, biology, geology, philosophy, and psychology.' Secondly, students frequently mentioned they really wanted to integrate interests and were happy to find a programme in which they could find a specific combination of interests: 'There is a lot of biology and chemistry in this programme: you look from like a chemistry perspective to biological processes … [I am] interested in biology, chemistry, and biochemistry.' Finally, some students stated they aim to choose a specific programme that allows them to combine interests they have in the present with interests that hold future potential. This could be specific job interests (I am interested in becoming a doctor) or just an interest they wish to pursue in later working life: 'I have a lot of interest in mathematics and computer science, I like to program and I would like to do this too in my future.'

The second indicator is the number of students who perceived to combine interests when explicitly asked. In the students' chosen programme(s), 85 of the 90 students perceived a combination of multiple interests. We checked whether students who alternated interests in two programmes also combined interests within one programme. From the responses of the eleven students, it became clear that seven students perceived combinations of interests within one study, whilst it remained unclear for three students whether they only pursued multiple interests across bachelors, or also within one bachelor. Noteworthy is one student who chose two bachelors, yet did not report to perceive a combination of interests across bachelors or within a bachelor. This student chose to pursue both medicine and biomedical sciences and argued that both fall within her broad interest in medicine.

The third indicator is the extent to which students found a combination of their interests in their educational choice important. The mean rating of the importance of combining interests in making their educational choices was 5.81 (SD = 1.13, 95% CI = [5.58, 6.05]), on a Likert scale ranging from 1 (not important at all) to 7 (very important). This shows that participants on average think combining their interests is important.

Does combination and alternation of interests take place between and within interest domains?

Alternation

Out of the 10 students who alternated two programmes in the STEM domain, seven pursued interests only in the STEM domain (e.g. mathematics, physics, and chemistry). One student did not pursue multiple interests as mentioned above. One student pursued interests in the STEM domain with a non-academic interest (mathematics, computer science, and video games) and another student combined interests in the STEM domain with general preferences (mathematics, physics, solving problems, and understanding how the world works). The student who alternated a STEM and STEM-plus programme pursued multiple STEM interests and a Social Science interest (mathematics, biology, chemistry, and anthropology).

Combination

Table 3 summarises the number of combinations that took place between and within the four interest domains (e.g. general preferences, STEM interests, Humanities or Social Science interests, non-academic interests). Of the 85 students who indicated to combine multiple interests in a programme, six did not identify which interests they combined in the programme of their choice. As Table 3 shows, almost all of the 79 students who perceived a combination of interests mentioned at least one STEM interest. Approximately a quarter mentioned at least one interest in Humanities and Social Sciences (e.g. psychology and technology) or at least a general preference (e.g. doing research, biology, and chemistry), and 10 students mentioned a least a non-academic interest in their combinations (e.g. mathematics and video games). In total, 42 students combined interests between at least two interest domains. Other students exclusively combined interests within the STEM domain (e.g. physics, chemistry, and mathematics). A small number of students ($n = 5$) combined interests between three interest domains. For example, a student who chose medicine perceived to combine interests in psychology, travelling, languages, medicine, biology, and philosophy.

Does Interest Profile Relate to Interest Combination Tendencies?

Out of the 87 participants that answered the question regarding interest profile diversity, 58 were placed in the STEM-plus interest profile, whilst 29 participants belonged to the STEM-focused interest profile. General preferences could not be coded to fall in a STEM or non-STEM domain. Consequently, 12 participants had to be excluded from

Table 3. Frequencies of combinations within and combinations between interest domains.

	General preference	STEM	HSS	NCAD	Number of students including the domain in a combination of interests
General preference	12				21
STEM	17	57			74
HSS	1	20	7		21
NCAD	3	10	1	0	10

Note: Only students who mentioned combinations of interests were used in the analysis. HSS: Humanities and Social Sciences; NCAD: Not concerning academic disciplines.

Table 4. Logistic regression of interest profile on the tendency to combine interests between specifically formulated interest domains.

	No combination between interest domains		Combination between interest domains
STEM-plus interest profile	26		23
STEM-focused interest profile	20		6
Final model	B (SE)	Odds Ratio	OR 95% CI
Constant	−1.386* (0.456)		
Interest profile	1.081* (0.543)	2.949	[1.010, 8.605]

Note: Model $R^2 = .055$ (Cox & Snell), .075 (Nagelkerke); $n = 75$, *significant at .05 level

this analysis. As illustrated in Table 4, the likelihood to combine interests between specifically formulated interest domains is significantly higher for students with STEM-plus interest profiles (23 out of 49) than for students with STEM-focused interest profiles (6 out of 26).

Discussion

The present study adopted a multiple interest perspective to investigate whether STEM-interested students pursue multiple interests when making educational choices. We investigated whether students interested in STEM perceived to combine or alternate multiple interests in the educational programme(s) of their choice. Moreover, we studied whether combination and alternation of interests take place between or within interest domains. Furthermore, we explored to what extent interest profile was related to combination tendencies between interest domains. Finally, we investigated whether interest profile diversity could be linked to students choosing a STEM or non-STEM programme.

Of the 91 students, 81 mentioned interest as a motive when asked for the main reason why they chose a specific programme. These findings support the results of Mikkonen et al. (2009) who found that ones' interest is the most important factor in choosing a higher educational programme. Moreover, most of these 81 students perceived that they were able to combine multiple interests in their programme of choice. Taken into account that participants were not asked to reflect on a specific motive for their programme of choice, this is considered to be strong evidence for the usage of the combining strategy when students have to decide which interests to pursue in a programme. When explicitly asked, more than 90% of the students perceived to combine multiple interests. Moreover, students on average thought it was important to be able to combine multiple interests in the programme of their choice. Based on these results, we conclude that STEM-interested students try to combine multiple interests in the educational programme(s) of their choice.

When looking more specifically at how students combined multiple interests, based on an exploration of the aforementioned motives of combining interests in a programme, students were mostly trying to fit separate interests in one programme. Students favoured programmes with possibilities to select interesting electives and minors, as these programmes allowed them to pursue multiple interests simultaneously. Others explicitly mentioned they are pursuing a new integrated interest in a programme which combines multiple of their current interests. A small proportion of the students combined current

interests with future interests (e.g. I am interested in becoming a doctor, and I like medicine and biology). As these are first explorative results, future research can test the validity of these results, by examining more in-depth which interests students have, and how and why they pursue specific interests and not others.

Several students used the described alternating strategy by pursuing a double bachelor. More than 10% of the students chose to alternate programmes. This is considered to be a reasonably high proportion, although this strategy is used far less than the combining strategy. When students use the alternating strategy, this strategy is often jointly used with the combining strategy. These students perceived to combine multiple interests in one programme, which they alternated with another programme that fitted one or multiple of their other interests (e.g. mathematics and problem solving combined in a mathematics programme alternated with an interest in physics in a physics programme). Participants were considered talented, as they were already enrolled in university courses in high school. This may explain why alternation happened quite frequently. Talented students may not experience the high costs that less talented students may perceive when considering a double bachelor, as they have been found to study faster and more efficiently (Coleman, Micko, & Cross, 2015).

To discover how interests are combined and alternated across domains, content analysis of students' interests was conducted. Four main interest domains were identified, being (1) general preferences, (2) non- academic interests, (3) STEM interests, and (4) Humanities and Social Sciences interests.

Results illustrate students combine or alternate interests predominantly within the STEM domain. Looking more detailed at the combining of interests in a programme across domains, STEM interests were often combined with Humanities and Social Sciences interests or, a bit less common but still substantial, with non-academic interests. Additionally, students frequently combined STEM interests with general preferences. These results indicate that in making educational choices, students may combine multiple interests in specific topics and activities across domains with their more general preferences for certain characteristics of activities and environments.

Furthermore, differences exist in how students with a STEM-focused or STEM-plus interest profile combine multiple interests when choosing an educational programme. Students with a STEM-focused profile primarily combine interests within the STEM domain in the programme of their choice. Students with a STEM-plus profile combine multiple interests across domains in the programme of their choice.

Although students with a STEM-plus profile were more likely to combine interests across domains than students with a STEM-focused profile, students with a STEM-plus profile were not more likely to choose a non-STEM programme. Only two of the 91 students interested in STEM chose non-STEM programmes. This may be explained in multiple ways. First, students with a STEM-plus profile may have been more inclined to choose a broad educational programme within the STEM domain (e.g. health & life sciences) than students with a STEM-focused profile. Choosing a broad programme allows students to combine interests across STEM and non-STEM domains (e.g. psychology and biology). As we had no measure of the broadness of an educational programme, future research may indicate the viability of this postulation. Second, participants were already enrolled in a pre-university programme that encourages students to transition to a STEM programme. When students participate in such extracurricular activities

related to STEM, they may have already decided before enrolling in the pre-university programme to pursue a STEM programme (Aschbacher et al., 2010; Cleaves, 2005).

A multiple interest perspective in research on interests

The present study builds on the idea of Hofer (2010) that conflicting interests may affect interest continuation, and thereby interest development. In response to such a conflict, one can use the strategies of prioritisation, alternation, and combination. The present study has focused on possible alternation and combination strategies of pursuing interests in the higher educational choice and found that STEM-interested students tend to pursue and perceive to combine multiple interests in the educational programmes of their choice.

Based on the number of students who perceive to combine or alternate multiple interests when making a choice for a higher educational programme, we argue that a multiple interest perspective is useful when studying interests. At the very least, the present study indicates that interest development theory (e.g. Hidi & Renninger, 2006; Krapp, 2007) should take interaction between multiple interests into account.

We recommend future research to take a longitudinal approach to investigate how interests develop over time in relation to other interests and to study why specific interests are pursued in critical choices whilst others are not, with explicit recognition of how other factors might influence the interest pursuance of students in a programme (e.g. future goals, peer and parent influence; Holmegaard, 2015). Future research may also focus on why students prefer to combine, alternate or prioritise an interest and how this may depend on other factors that influence the choice process and the affordances of programmes to pursue multiple interests in them. On the one hand, such research has the potential to add to already existing interest development theories (e.g. Hidi & Renninger, 2006), as this type of research may show why some interests continue to develop, whilst others decline. One the other hand, this kind of research may add to theory conceptualising the role of interests in making choices.

The multiple interest perspective taken has furthermore illustrated that students with a strong interest in STEM often have STEM-plus interest profiles. As students with STEM-plus interest profiles may combine more interests across domains this may affect what kind of programmes they choose. This does not suggest that having a STEM-plus profile is directly related to not choosing STEM programmes, as our data showed. Nonetheless, these students may be more inclined to choose a non-STEM programme as the interests that can be pursued in that programme may be considered more important than their STEM interests (Aschbacher et al., 2010). Future research with other high school students, who are not yet enrolled in extra-curricular STEM subjects, may give more clarity whether students with a STEM-plus profile are more inclined to choose non-STEM programmes than students with a STEM-focused profile.

Limitations and concluding remarks

Our sample of STEM-interested adolescents may be considered a specific talented group as they were enrolled in challenging STEM courses. Moreover, due to small sample sizes of students who alternated programmes and who chose programmes not related to STEM, some statistical analyses were not feasible. Therefore, we suggest repeating this study

with a broader group of students, to see whether our findings are validated in other high school populations. Moreover, it might be interesting to discover whether similar combination or alternation tendencies are present in other age groups that have to make other transitions (e.g. from postsecondary education to the first job).

Furthermore, as students had to list their interests in the questionnaire, one can question whether their list of interests is complete. Although we have instructed them to be as complete as possible and students mentioned on average their most important six or seven interests, an interview may have given a more complete picture of the students' interests. Future research may investigate the interest pursuance strategies by interviewing students as a way to validate our results. Moreover, these interviews may go beyond our results by answering why students consider specifically these interests and why they consider using a specific interest pursuance strategy.

Although a substantial proportion of participants actively pursued non-academic interests in their programmes of choice, it should be noted that interests can be continued in out-of-school contexts as well. In future research, a focus on how interests that are not pursued in the educational choice develop may contribute to a better understanding of how multiple interests are pursued across multiple contexts.

Even though our findings should be validated in other samples, our results tentatively show how counsellors can support students who are making the higher educational choice. As students aim to combine multiple interests in a programme, counsellors may reflect with students on the range of interests they have and encourage them to explore how interests may fit in higher educational programmes. Important to note is that students should be stimulated to take all of their interests into account as students may be able to pursue their academic and non-academic interests in a programme.

In order to understand how interests develop and how interests are pursued in educational programmes, research has to become more and more holistic in design. Not only should researchers study how multiple interests are pursued, researchers should also examine across which contexts interests are pursued. We think the present study is a humble step forward by showing how a multiple interest perspective proved useful to gain insight into interests' role in educational choices of STEM-interested students.

Disclosure statement

No potential conflict of interest was reported by the authors.

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Appendix. Questionnaire Items

In the following, items of the ISTSQ-questionnaire used in the present study are presented. As data collection took place in the Netherlands, the items presented here are a translation of the original questionnaire.

1 What are you interested in? (Try to be as complete as possible)
2 The following corresponds to me:
    a I have a broad range of interests
    b I am very interested in STEM, but not really in other knowledge areas
    c I am very interested in one or two knowledge areas, namely:
    d Other, namely:
3 Do you already know which educational programme you want to attend after secondary school (and after a hypothetical gap year)?
    a Yes, namely:
    b No:
        i I consider the following programmes:
        ii If I would have to choose now, my preference would be: (choose a programme, even if you find this hard):

The following questions concern the educational programme you have chosen, or you would choose at this moment

4 Why do you / would you choose this educational programme?
5 Do you expect to be able to combine multiple of your interests in this programme?
6 If yes, which interests? (Try to be as complete as possible)
7 In choosing an educational programme, I find being able to combine multiple of my interests:
    1 (not important at all) – 2 – 3 – 4 – 5 – 6 – 7 (very important)

Note: If you're interested in the whole ISTSQ, please contact us.