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Vocational Interest Profiles in Secondary School: Accounting for Multiplicity and Exploring Associations With Future-Oriented Choices

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Secondary school students in the Netherlands already face future-oriented decisions about their educational careers, which are expected to be informed by their interests in specific vocations or occupations. However, vocational interest assessment tools generally do not account for the possibility that students are interested in multiple vocational domains, potentially challenging students' future-oriented decision-making processes. The present study examines the different combinations of vocational interests that secondary school students have and explores how the both differentiated and nondifferentiated character of these interests' structures is associated with students' educational and career-oriented decision-making processes. A latent profile analysis on six realistic, investigative, artistic, social, enterprising, and conventional interests revealed seven distinct vocational interest profiles across a sample of 358 Grade 9 students, of which 40.8% had a nondifferentiated interest structure (i.e., a low, neutral, or broad vocational interest) and 59.2% had a differentiated interest structure (i.e., a social dominant, enterprising–conventional dominant, realistic–investigative dominant, or artistic–social–enterprising dominant interest). This finding shows that many secondary school students show similar levels of interest across different vocational activities. Additionally, associations between the differentiated and nondifferentiated structure of these profiles and students' educational track choices and career image specificities were examined. Our results extend prior work by showing that having a nondifferentiated interest structure does not necessarily mean that students are more uncertain about their educational or career choice. We suggest that future research can further explore the associations between vocational interest structures and future-oriented decisions.

Educational Impact and Implications Statement
This study shows the importance of accounting for multiplicity of vocational interests in secondary school students. Our results demonstrate how including all six realistic, investigative, artistic, social, enterprising, and conventional dimensions, instead of limiting to Hollands' three-letter code, might help in advising students in a holistic manner about their future-oriented decisions. Additionally, the complex relation between level of profile differentiation and educational choice-making behavior that was demonstrated calls for a more individualized approach in study and career counseling in secondary schools.

Keywords: vocational interests, RIASEC, latent profile analysis, secondary school students

In secondary schools in the Netherlands, students who are 14 to 15 years of age are faced with future-oriented decisions about their educational careers. Such decisions are expected to be informed by the students' interests in particular vocational or occupational activities (Nauta, 2010). However, research suggests that young students may be interested in multiple vocational domains and that these students' vocational interests might substantially develop over time (Holland, 1997; Swanson, 1999). If students are still thinking about who they are as people and who they want to become based on their vocational interests, defining oneself in a future context and choosing a direction for life after secondary school can be challenging (Den Boer & Guldemond, 1996; Holland, 1997; Holmegaard, 2015; Lent, Brown, & Hackett, 1994; Sharp & Coatsworth, 2012). It might be problematic that the vocational interest assessment tools that are used in secondary schools to assist students in their decision-making process generally do not account for the possibility that students may be in a process of developing their vocational interests (Sung, Cheng, & Hsueh, 2017). Instead, the vocational interest theory upon which most of these instruments are based assumes that each student has differentiated interests that correspond to particular personality traits (Holland, 1997).

The present study seeks to gain insight into the different combinations of vocational interests that secondary school students

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show and how the differentiated and nondifferentiated character of these interest structures is associated with students' educational and career-oriented decision-making processes. More specifically, and in line with other recent studies on vocational interests (Leuty, Hansen, & Speaks, 2016; McLarnon, Carswell, & Schneider, 2015; Perera & McIlveen, 2018), a person-oriented approach was used to characterize how students' multiple vocational interests combine into distinct vocational interest profiles. Below, we give a short summary of the theory on vocational interest and the shift that has been made from variable-oriented to person-oriented thinking in the domain of vocational interest theory.

Vocational Interest Theory

Holland's (1997) theory on vocational interest is dominant in the field of vocational counseling, describing how individuals are thought to have six possible types of vocational interests: realistic, investigative, artistic, social, enterprising, or conventional (RIASEC). Individuals classified as "realistic" generally prefer physical activities, working with their hands or machines. Individuals classified as "investigative" prefer activities that involve logical thinking, such as solving problems in math or science. "Artistic" individuals are those who mainly express themselves through acting, dancing, or creating things. Individuals with predominant "social" interests like to work with other people and help others. Individuals categorized as "enterprising" also like to work with others, but they prefer activities such as sales or others with which they can manage or lead people/teams. Finally, "conventional" types prefer routine-based activities, such as administrative work.

The six types are considered to represent stable trait-like individual characteristics that influence behavior through preferences for particular vocational or occupational activities (Van Iddekinge, Putka, & Campbell, 2011, p. 14). Importantly, these RIASEC interests are positioned along the vertices of an equilateral hexagon (i.e., with a circumplex structure), where Hollands' theory assumes that adjacent interest types along the axis of this hexagon correlate more strongly (e.g., R–I, I–A, A–S) than interest types with relatively further distances between one another (Holland, 1997; Nauta, 2010). For example, the higher people score on social vocational interests, the lower they are expected to score on realistic vocational interests, as these are juxtaposed in the hexagon. Prediger's (1982) model, with two bipolar dimensions (people–things and data–ideas) is often presented as underlying the six RIASEC dimensions (e.g., Rounds & Tracey, 1993). These dimensions (people–things and data–ideas) are said to be mutually exclusive: if an individual is interested in working with people (social type), then he or she cannot be interested in working with things (realistic type), and if an individual is interested in working with data (conventional type), then he or she cannot be interested in working with ideas (investigative type).

In summary, the theory behind the RIASEC model proposes that individuals can be "typified" in a unidimensional way, meaning that the higher they score on one dimension, the lower they score on another dimension (Nagy, Trautwein, & Lüdtke, 2010; Nauta, 2010). Based on this model, different tests have been developed that are administered in secondary schools worldwide to help individuals gain insight into their vocational interests and advise them on the direction to take based on these interests (e.g., in Asia, Sung et al., 2017; in Europe, Hirschi, 2009; in the United States, Falco & Steen, 2018). Individuals often receive a three-letter code (e.g., RIA) after taking such a test, of which the first letter in particular determines what educational choice might fit their personality (Armstrong, Fouad, Rounds, & Hubert, 2010). However, as we argue below, this way of counseling students does not take into account the multiplicity of vocational interests, which has been a source of debate in the literature for the past few years (e.g., McLarnon et al., 2015).

Multiplicity of Vocational Interest

In recent years, discussions in studies and career counseling literature have emerged regarding the multiplicity of vocational interest structure, reflecting a broader trend from variable to person-oriented approaches in investigating vocational interests (e.g., McLarnon et al., 2015). These discussions acknowledged that individuals may combine multiple vocational interests, which may also translate to different simultaneous vocational directions in terms of RIASEC. Previous research on vocational interests has not accounted for this multiplicity, as these studies have focused on describing relationships among the RIASEC variables (i.e., variable-oriented approach). Tay, Su, and Rounds (2011) were the first to show that individuals can be interested in people (e.g., social) and things (e.g., realistic), thereby bringing the bipolarity principle of the RIASEC model into discussion, triggering further studies to investigate how individuals' interests may combine into distinct profiles (e.g., McLarnon et al., 2015; Leuty et al., 2016). Thus, a switch was made from a variable-oriented to a person-oriented approach on vocational interests, in which individuals are seen as "functioning wholes" and combinations of interests are considered unique to individuals or groups of individuals (Bergman & Trost, 2006; Von Eye & Bogat, 2006). Such a person-oriented approach allows one to trace the heterogeneity across interests of individuals, thus showing how individuals may differ not only in level of interest (low, moderate, high) but also in their combinations of interests (e.g., high interest in the realistic domain, low interest in other domains). In this study, we align with this movement by studying quantitative (level) and qualitative (combinations) differences in vocational interest structures across individuals.

Latent Profiles of Vocational Interests

Latent profile analysis (LPA) is typically used to categorize individuals into quantitatively and qualitatively distinct subgroups that have similar patterns of responses, thereby also being able to model how interests are interrelated (Morin, Morizot, Boudrias, & Madore, 2011). It differs from regular cluster analysis in that it can detect latent or unobserved patterns between variables (i.e., heterogeneity) rather than observed variables (i.e., assuming that different subpopulations can be found across individuals) based on an observed set of variables. Next, the results described by previous studies that have used LPA with vocational interests in mainly college student samples will be discussed.

McLarnon et al. (2015) were the first to use a multivariate, person-oriented approach by applying LPA, providing more insight into the RIASEC interest patterns that might exist across individuals. These authors identified eight distinct interest profiles across college students. They found six profiles that were differ-

entiated, with high scores on some dimensions, namely (a) realistic–artistic–conventional dominant, with individuals scoring relatively high on these dimensions; (b) investigative dominant; (c) realistic–investigative–artistic; (d) entrepreneur, with high scores on the enterprising domain; (e) artistic dominant; and (f) conventional business, with high scores on both the enterprising and conventional domains. They also identified two nondifferentiated profiles, which they labeled as (g) disinterested, with low scores on all interest domains, and (h) neutral, with similar scores around the mean on all interest domains. Several of these profiles also emerged in Leuty et al.'s (2016) analysis of vocational and leisure interests of college students. In total, they identified six distinct profiles. The most prominent difference with findings of McLarnon et al. (2015) was the identification of a social dominant profile, including mostly women. Perera and McIlveen (2018) also identified six profiles in a sample of college students that were similar to profiles identified in prior work, with four differentiated and two nondifferentiated profiles (i.e., low and high interested individuals). Together, these studies show how quantitatively and qualitatively distinct vocational interest structures exist in college students' interest profiles.

To our knowledge, only one previous study has looked at the vocational interest structures of secondary school students with a similar person-oriented approach (Sung et al., 2017). This study has shown that almost half (44%) of the students in their sample was classified as having a nondifferentiated interest profile. As a result of having nondifferentiated interests, Perera and McIlveen (2018) stated, similarly to Tracey and Darcy (2002), that these students might "experience considerable career decision-making difficulty and greater career indecision" (p. 95). The present study adheres to the proposition of Perera and McIlveen (2018) to examine decision-making difficulty by studying the differentiation in the vocational interest profiles of secondary school students using LPA and subsequently exploring how these profiles are associated with their future-oriented decision-making processes.

Vocational Interest Differentiation and Future-Oriented Choices

Research suggests that students with differentiated interest profiles may be more decisive on their future careers (e.g., Hirschi, 2009; Hirschi & Läge, 2007) and more likely to choose specific higher education programs (e.g., Larson, Wu, Bailey, Borgen, & Gasser, 2010; Päßler & Hell, 2012; Ralston, Borgen, Rottinghaus, & Donnay, 2004). Reports show that students with greater realistic interests may be more likely to choose technical and engineering programs than other students, and students with greater investigative and enterprising interests are said to be more prone to choosing math and science programs than other students. Students who score high on the conventional dimension might choose an educational program in computing or information technology. In contrast, individuals with high levels of social or artistic interests are less likely to choose math and science programs. Hence, these associations between interest and choice behavior indicate linearity, whereas linearity can be questioned based on the assumption that individuals might also show similar levels of interest in multiple vocational domains.

According to vocational interest research, students whose vocational interest structures deviate from the RIASEC circumplex structure (e.g., showing high interest on nonadjacent domains, such as realistic and social) are less determined in their educational choices than students with interests in adjacent domains (Tracey, 2008; Tracey & Darcy, 2002; Tracey, Lent, Brown, Soresi, & Nota, 2006). Tracey et al. also showed that high school students adhere to the RIASEC circumplex structure more than middle school students and are also more certain about their future-oriented choices. Experiencing difficulties in making educational choices might also apply to students with nondifferentiated interest structures (Hirschi & Läge, 2007), as these students show lower or higher levels of interest in all vocational domains simultaneously and thus deviate from the assumptions underlying the RIASEC model.

Moreover, vocational interests have been previously described to be different for boys and girls, whereby boys on average score higher on the realistic domain and girls score higher on the social domain (e.g., Su, Rounds, & Armstrong, 2009; Tracey & Robbins, 2005). Nondifferentiated interest structures are found to be more common among boys (Leuty et al., 2016; Sung et al., 2017), and girls on average tend to show higher levels of interest differentiation during adolescence (Fouad & Mohler, 2004; Hirschi, 2009).

These findings with regard to secondary school students' interest structures contrast with counseling practices in secondary schools not only in the Netherlands but also, for example, in Asia (Sung et al., 2017) where vocational interest assessment tools based on the RIASEC circumplex structure are used to guide students in their decision-making processes (Holland, 1997). Not taking into account multiplicity and developing interest structures in educational counseling might be especially worrisome if students already have to make future-oriented decisions at an early age, such as in the Netherlands. Dutch students at the end of Grade 9 have to opt for an educational track (a combination of specific school subjects) as a preliminary step for choosing a higher education program (Nuffic, 2019). After choosing such a track, they specialize in particular school subjects during upper secondary school (Grades 10–12, see Method section). As students with nondifferentiated vocational interests might be exploring a wide variety of future options and thus not have a singular or specific image of their desired career (Den Boer & Guldemond, 1996), this study explores whether students with differentiated and nondifferentiated interest profiles are different in educational decision-making and career image specificity.

The Present Study

Our aim is to contribute to theory on vocational interest structures in secondary school students, by providing more insight into the different combinations of vocational interests that secondary school students show. More specifically, we expect to find vocational interest profiles with both a differentiated and nondifferentiated character, with a higher extent of nondifferentiation compared to what prior research reported on college student samples (e.g., Leuty et al., 2016; McLarnon et al., 2015; Perera & McIlveen, 2018). In relation to their future-oriented decision-making processes, we expect that secondary school students with differentiated interests make more specific educational track choices in line with their interests, and are also expected to express more specific career images (i.e., what job they would like to have as adults) than students with nondifferentiated interests. For counsel-

ing practice, findings of our study might inform study counselors on their future use of vocational interest assessment tools based on RIASEC, for example regarding how to guide students with differentiated and nondifferentiated interests in their decision-making process. We seek to answer the following two research questions:

Research Question 1: What combinations of vocational interests do secondary school students have and how are these different for boys and girls?

Research Question 2: How are these vocational interest profiles associated with students' educational track choices and career image specificities?

Method

The Dutch Educational System: Educational Track Choice

In the Dutch educational system, students are enrolled in educational levels according to their ability from age 12 onward. In this study, we focus on the levels of higher general education and preuniversity education. At the end of Grade 9, when these students are approximately 15 years of age, they have to choose an "educational track," which is a combination of school subjects that prepares them in the last two or three years of their upper secondary education for particular higher education study programs. Students have to complete another 2 (for higher general education) or 3 (for preuniversity education) years after they have chosen a particular educational track and before they transfer to research-based universities or universities of applied sciences.

Students can choose the tracks culture–society, economics–society, nature–health, and nature–technology or a combination of these tracks, for example nature–health and nature–technology (i.e., a science–math-based track). In the tracks nature–technology and nature–health, students prepare for their national exams in advanced mathematics, chemistry, and physics, whereas nature–technology students spend more time on these topics than nature–health students, who also follow an advanced grade in biology (see Table 1). The culture–society and economics–society tracks consist of applied mathematics, history, economics (economics–society), and modern languages and music or arts (culture–society). Some school subjects are taught in all tracks, such as Dutch and English. Education in the upper secondary school years in the Netherlands is specifically focused on preparing students for the national exams, in particular for school subjects that are part of their track, but their educational choice also has consequences for the programs they might want to pursue in higher education (see also Table 1). Not all higher education programs are admissible for all tracks.

Participants

The participants were 358 lower secondary school students from Grade 9 of four different schools in the Netherlands. All Grade 9 students (i.e., 14–15 years of age) enrolled in higher general education and preuniversity education at these schools were asked to participate in the study, of whom 45% eventually filled out the questionnaire (39% were boys). This low representation of boys reflects the population in the participating schools,[1] where 44% were girls and 31% were boys, with the sex of the remaining 24% unknown. In total, 62% of the girls enrolled in these educational levels at the participating schools filled out the questionnaire, and 56% of the boys.

The data were gathered in April 2016, around the time that students had to choose an educational track in upper secondary school education (Grades 10 to 11 or 10 to 12). All students participated in this study voluntarily. In accordance to school protocols concerning student participation in research, parents and caretakers were informed by the schools about the content of this study and were assumed to give consent if they did not express any objection to their children's participation. Ethical approval for this study was received from the ethical review board of the Faculty of Social and Behavioral Sciences of Utrecht University (FETC15-045).

Instruments

Vocational interest. We used a translated version of the German *Allgemeinen Interessesen-Struktur-Test*–Revised (AIST-r), containing 60 items, 10 for each of the six Holland interest dimensions (Bergmann & Eder, 2005). This instrument is most frequently used in German-speaking countries, but translated versions are also applied in the Dutch secondary school system to advise students in their educational choices. Each item described an occupational activity (e.g., investigating how something works, writing stories, working with machines, or technical devices), and participants were asked to state how interested they were in each activity on a 5-point Likert scale (from 1 = *not at all* to 5 = *very much*). Example items can be found in Table 2.

The test was translated to Dutch by the first author of this study, with a formal consent of the German publisher of the AIST-r. After the translation, a fellow researcher in our department, who is a native German speaker, back-translated the items to check if the translation by the first author was adequate. Minor suggestions were made for improvement. Consequently, a pilot study was performed with 57 students from the preuniversity level of Grade 10 of one of the participating schools to test whether the items were comprehensible. In addition, the first author made an audio recording of how three randomly chosen students filled out the questionnaire by "thinking aloud," which involves making notes when they had trouble understanding the item. Minor changes were made after the pilot study, for example by adding clarifying examples to the items (e.g., working with a word processor program, such as Microsoft Word).

For the analysis, we used the added scores of the 10 items for each scale, indicating someone's means interest in the RIASEC interest domain. In our sample, the coefficient alpha reliabilities were uniformly acceptable, as depicted in Table 2. The German manual provides information on the reliability and validity of the instrument; the scales have repeatedly been shown to be highly reliable, as the authors (Bergmann & Eder, 2005) reported alphas ranging from .82 to .87, which are comparable to the alphas in Table 2 and strongly correlate with other interest measures based

[1] And also reflects the Netherlands in general, where there appears to be a small overrepresentation of girls in the higher general education and especially preuniversity education levels (Inspectorate of Education, 2019).

Table 1
Overview of the Educational Tracks, the School Subjects That These Tracks Specialize in, and the Higher Education (HE) Programs That Students Cannot Enter or Under Certain Conditions

Educational track	Specialization in subjects	No admission/conditional admission for following HE programs
Culture–society	Applied math, modern languages, music or arts, and history	Chemistry, math, science, computing science, medicine, biology, dentistry, biomedical sciences, veterinary science, astronomy, engineering[a]
Economics–society	Applied math, economics, and history	Chemistry, math, science, computing science, medicine, biology, dentistry, biomedical sciences, veterinary science, astronomy, engineering[b]
Nature-health	Biology and advanced levels of math and chemistry	Medicine, pharmaceutical science, veterinary science, biomedical science, dentistry, computing science, math, science, astronomy, engineering[b]
Nature–technology	Advanced plus levels of math, chemistry, and physics	Medicine, veterinary science, biomedical science, dentistry[b]
Science–math	Advanced plus levels of biology, math, chemistry, and physics	None

[a] No admission possible for these programs. [b] Admissible if student also followed biology (nature–technology) or science/advanced plus math (nature-health).

on the RIASEC dimensions (e.g., self-directed search, Jörin, Stoll, Bergmann, & Eder, 2004).

Educational track choice, career image, sex. In addition to presenting the students with the vocational interest questionnaire, we asked them the following question about their educational track choice: "What educational track did you choose?" In response, they could indicate "(1) culture–society," "(2) economics–society," "(3) nature–health," "(4) nature–technology," "(5) different," and "(6) no idea." After looking through the data, we found out that all students who selected "(5) different" chose a combination between the nature–health and nature–technology tracks (a science–math-based track). We also asked students at the end of the vocational interest questionnaire, "What do you want to be when you grow up?" and to indicate whether they were a boy or a girl.

Data Analyses

Latent profile analysis. The analyses for the current study were performed in Mplus 8.0 (Muthén & Muthén, 2017). We conducted an exploratory LPA using a robust maximum likelihood estimator. Our decision to take an exploratory and not a confirmatory approach toward LPA was made based on the argumentation that previous studies (Leuty et al., 2016; McLarnon et al., 2015; Perera & McIlveen, 2018; Sung et al., 2017) reported different results, as well as that our study is focused on a younger age group. We did use the results of previous articles to decide on trying to fit models ranging from 1 to 10 latent profiles. LPA is a person-oriented, statistical modeling technique that aims to uncover unobserved heterogeneity (i.e., latent profiles of vocational interests) in a population (i.e., Grade 9 students) by grouping individuals into meaningful profiles based on the similarities in their responses (Muthén, 2004; Nylund, Asparouhov, & Muthén, 2007). Unobserved heterogeneity means that these profiles must be inferred from the data and cannot be observed (i.e., making them latent profiles). Specifically, LPA can capture the complex interaction of multiple vocational interests and is thus regarded as a suitable method for analyzing vocational interest data as little knowledge exists on the constellation of the RIASEC interests across secondary school students (e.g., McLarnon et al., 2015).

In determining the optimal profile solution, an inclusive approach was used, involving an evaluation of several statistical fit indices and the interpretability of the profiles in the models. First, we looked at the information criteria provided for each model that we fitted, including the Bayesian information criterion (BIC), the sample-adjusted BIC, and the Akaike information criterion. For deciding on the number of profiles (k), we focused on the BIC, as this information criterion is regarded as the best performing (Morgan, 2015; Nylund et al., 2007). For transparency reasons, we also reported the other indices in Table 3. Lower values indicate better

Table 2
Scales, Cronbach's Alpha, and Exemplary Items of the Dutch Version of the Allgemeinen Interessesen-Struktur-Test-Revised for Each Interest Dimension

Interest dimension	α	Exemplary item
Realistic	.79	"Constructing something of metal/wood"
Investigative	.78	"Performing experiments in a lab"
Artistic	.78	"Reading poems and literature and interpreting them"
Social	.87	"Give advice to other people"
Enterprising	.79	"Leading a team"
Conventional	.79	"Making up a data file or processing data"

Note. Exemplary items are translated from Dutch.

Table 3
Latent Profile Analysis Model Fit Statistics

Classes	AIC	BIC	aBIC	Entropy	Log likelihood	BLRT p
2	14,650	14,724	14,663	.76	7,306	.000
3	14,489	14,590	14,508	.78	7,218	.000
4	14,412	14,540	14,436	.81	7,173	.000
5	14,369	14,524	14,397	.80	7144	.000
6	14,325	14,508	14,359	.80	7,115	.000
7	14,286	14,495	14,324	.81	7,089	.000
8	14,272	14,508	14,315	.83	7,077	.012

Note. AIC = Akaike information criterion; BIC = Bayesian information criterion; aBIC = sample-adjusted BIC; BLRT = bootstrap likelihood ratio test.

fit. A bootstrap likelihood ratio test was consequently used to test a k-profile model against a $k - 1$ profile model, where a nonsignificant p value indicates that the k-model does not fit better than the more parsimonious model $k - 1$. Therefore, we then decided to retain the $k - 1$ model (Nylund et al., 2007). In addition to these statistical indices, we looked at the entropy values for the different model solutions. A higher entropy (varying between zero and one) indicates higher classification accuracy, which is traditionally reported as the effect size for latent class analyses (Granado, 2015). A value of 0.8 or higher is generally regarded as an acceptable class separation (Tein, Coxe, & Cham, 2013). Finally, the interpretability and size of the profiles was taken into account for deciding on the optimal solution, where very small proportioned classes (consisting of <2% of the individuals) were regarded as less desirable.

After testing the models and deciding on the optimal profile solution, we included sex and educational track choice as auxiliary variables into the model to examine if profile membership was related to these variables (i.e., using the DCON and DCAT function in Mplus; Asparouhov & Muthén, 2014; Lanza, Tan, & Bray, 2013). This function provides equality χ^2 tests of class-specific means or probabilities of the distal outcome across the latent profiles without including the outcome directly in the LPA model, thereby assuring stability of the initial profile solution (Marsh, Hau, & Wen, 2004). Post hoc comparisons between class-specific means and probabilities were also done to explore whether interest profiles differed in proportion between boys and girls and educational track choice. Odds ratios were reported as magnitude effects of the class-specific probabilities.

Qualitative analysis on career image. We performed a directive content analysis (Hsieh & Shannon, 2005) on the answers to the question, "What do you want to be when you grow up?" in terms of specificity, as we wanted to explore if students with nondifferentiated interest structures are also less specific about their career images. All answers with a reference to indecisiveness (e.g., "I don't know what I want to do" or "I have no idea") were coded 1, all answers with a reference to a broader occupational field (e.g., "I want to do something with economics") were coded 2, and all answers referring to a specific career (e.g., "I want to be a neurosurgeon") were coded 3. In total, 18 students were left out of the analysis because their data related to this question were missing.

Results

Table 4 displays the correlations among the RIASEC interest dimensions. A number of LPA solutions were calculated using an exploratory approach, moving up from one to 10 profiles. We initiated a single-profile solution because we wanted to test whether a general interest factor could be underlying the RIASEC indicators (Johnson & Bouchard, 2009; Tay et al., 2011), because such a factor may explain covariances between the indicators that should be attributed to the differences between the subgroups. Hence, the existence of such a general factor might violate the assumption of conditional independence that is associated with performing an LPA. However, we did not find a single-profile solution to fit the data.

Table 4 presents the results of our LPAs (i.e., depicting fit indices of the two- to eight-profile solutions). Examining the fit indices across the solutions, we determined that a seven-profile solution was optimal. The BIC value was the lowest (BIC = 14,495), and a significant bootstrap likelihood ratio test p suggested improvements of model fit from two to seven profiles, but the eight-profile solution was not a better fit than the seven-profile solution at the $p < .01$ level. Although our model fit results show that the eight-profile solution had higher entropy, this solution consisted of two very small profiles (11 and 14 individuals). These profiles appeared not qualitatively different from the other profiles, making interpretability more difficult than for the seven-profile solution. The entropy of the seven-profile solution is also higher than 0.80, which is deemed acceptable as argued in the method section. Finally, the posterior probabilities for the solution (i.e., the mean probability of classification into a particular subgroup, ranging from 0 to 1), as displayed in Table 5, were high, indicating that the different profiles are distinct from each other and that individuals classified into a profile actually constitute a separate vocational interest profile. Given these data, we thus decided that the seven-profile solution was optimal. Figure 1 visualizes the means of the different profiles, which are also depicted in Table 6.

Table 4
Descriptive Data (i.e., Correlations) for Each Interest Dimension

Interest dimension	1	2	3	4	5
1. Realistic					
2. Investigative	.72**				
3. Artistic	−.01	.03			
4. Social	−.27**	−.06	.42**		
5. Enterprising	−.02	.00	.30**	.39**	
6. Conventional	.20**	.25**	.21**	.21**	.60**

** $p < .01$.

Interpretation of the Seven Interest Profiles

We assigned a label to each of the seven profiles depicted in Figure 1. Profile 1 (n = 40) was labeled as "low vocational interest," as its members demonstrated low means on the RIASEC dimensions. Profile 2 was named "social dominant" (n = 82), as high scores on the social dimension dominated this profile. Profile 3 was labeled as "enterprising–conventional dominant" (n = 42), as high scores on the enterprising and conventional dimensions characterized this profile. Profile 4 was named "realistic–investigative dominant" (n = 31), as its members demonstrated high scores on both the realistic and investigative dimensions and low scores on the other indicators. Profile 5 (n = 57) was labeled "artistic–social–enterprising dominant," with high scores on these three indicators. Profile 6 (n = 92) encompassed the largest number of individuals and was thought to represent individuals with "neutral vocational interest," indicated by average scores on all interest dimensions, whereas Profile 7 was labeled as "broad vocational interest" (n = 14), as individuals belonging to this profile had above average scores overall (in terms of the answering scale) and were thus broadly interested. In sum, students' vocational interests in this sample combined into both differentiated profiles, with individuals that were more interested in one, two, or three adjacent RIASEC domains specifically (59.2% were classified as social dominant, enterprising–conventional dominant, artistic–social–enterprising dominant, and realistic–investigative

Table 5
Classification Posterior Probabilities for the Seven-Profile Solution

	Profile						
Profile	1	2	3	4	5	6	7
1	**.89**	.09	.00	.01	.00	.00	.00
2	.04	**.88**	.01	.00	.03	.04	.00
3	.01	.04	**.82**	.00	.08	.05	.01
4	.02	.00	.00	**.81**	.00	.17	.00
5	.00	.05	.04	.00	**.84**	.06	.01
6	.00	.03	.02	.04	.02	**.88**	.01
7	.00	.00	.01	.00	.07	.03	**.89**

Note. Boldface numbers indicate the mean probabilities for being classified into a profile.

dominant) and nondifferentiated profiles, with students showing similar interest in three or more RIASEC domains (40.8% were classified as showing low, neutral, or broad vocational interest). Table 6 displays the means and confidence intervals of the RIASEC domains across the profiles that we detected in the data.

Interest Profile Membership, Sex, Educational Track Choice

We continued our analysis by including "sex" and "educational track choice" as auxiliary categorical/continuous variables. Table 7 presents the statistical results of the analyses. The overall (Wald's) chi-squared test for the equality of means/probabilities was significant for both sex, $\chi^2(6) = 214.335$, $p < .001$, and educational track choice, $\chi^2(30) = 2{,}083{,}970.739$, $p < .001$, showing that individuals across the identified profiles differ on these variables. Below, we discuss the relational patterns that we identified across these auxiliary variables and the grouping indicators (i.e., RIASEC variables).

Sex Differences

Approximately one quarter of the girls in our sample (27.4%) were classified into a nondifferentiated profile, whereas for the boys this was almost two thirds (61.8%). In total, approximately one in two boys (45%) was classified to the neutral vocational interest profile, showing no preferences for one RIASEC domain over another. The probability that an individual classified as such was a boy was 76%. Furthermore, in the realistic–investigative dominant profile, over 60% were boys. In contrast, girls were mostly classified as having social dominant interests (33% of all girls). Almost exclusively, this profile had girls classified to it (96%), as was the case for the artistic–social–enterprising class (97%). These profiles did not differ significantly in proportion of girls and also did not differ from the broad vocational interest profile (where also 66% were girls). However, there were significantly more boys classified into the other profiles (i.e., the enterprising–conventional dominant, realistic–investigative dominant, and low, and neutral vocational interest profiles).

Educational Track Differences

Our results show that there was a higher probability that individuals classified under a differentiated profile chose a specific educational track compared to individuals classified under a nondifferentiated profile, who seemed more divergent in the educa-

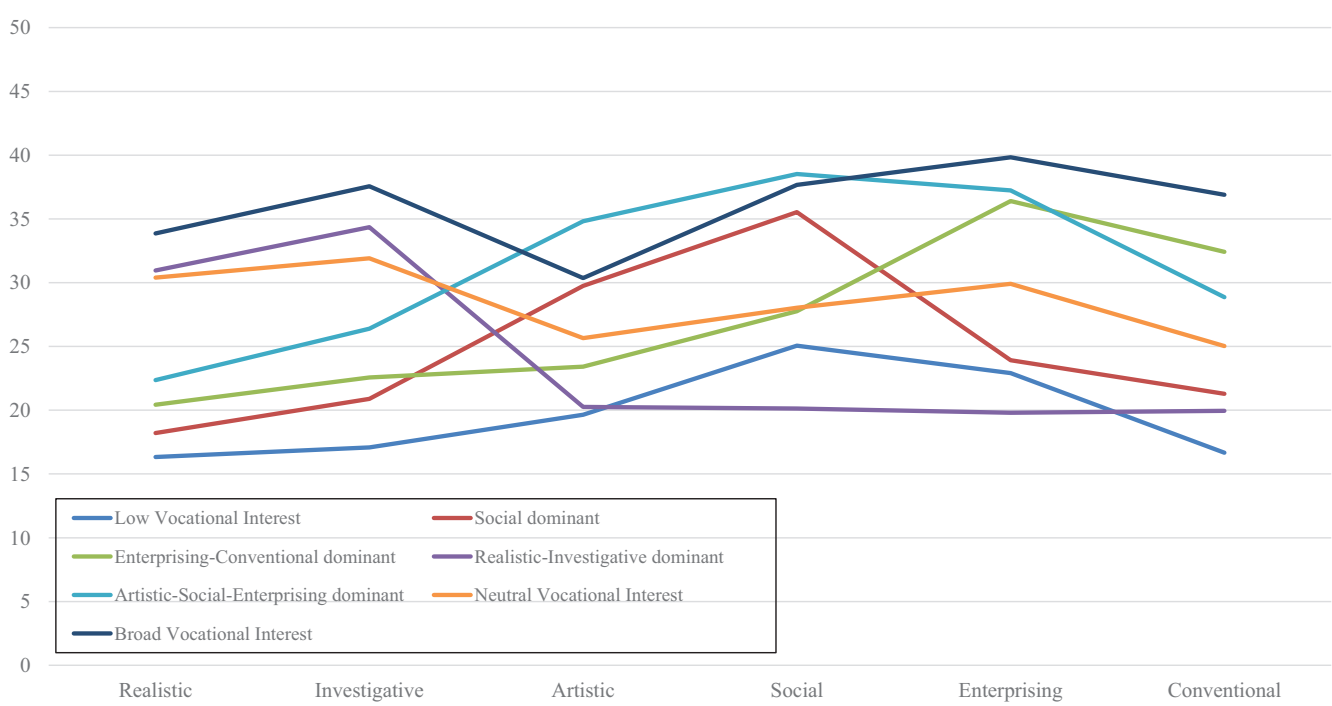

Figure 1. Estimated means of the RIASEC interest dimensions across the seven different vocational interest profiles. See the online article for the color version of this figure.

Table 6
Means and Variability Within Groups Shown by the Confidence Intervals (5–75%) for Each Interest Dimension

Interest dimension	All (minimum and maximum)	Low vocational interest (n = 40)	Social dominant (n = 82)	Enterprising–conventional dominant (n = 42)	Realistic–investigative dominant (n = 31)	Artistic–social–enterprising dominant (n = 57)	Neutral vocational interest (n = 92)	Broad vocational interest (n = 14)
Realistic	23.75 (10–46)	16.33 [8.3, 19.7]	18.21 [10.2, 21.5]	20.43 [12.4, 23.8]	30.95 [22.9, 34.3]	22.36 [14.3, 25.7]	30.40 [22.3, 33.7]	33.86 [25.8, 37.2]
Investigative	26.18 (10–47)	17.08 [9.2, 20.3]	20.88 [12.9, 24.1]	22.57 [14.6, 25.8]	34.35 [26.4, 37.6]	26.39 [18.5, 29.6]	31.91 [24.0, 35.2]	37.56 [29.6, 40.8]
Artistic	26.77 (10–49)	19.64 [9.2, 23.9]	29.74 [19.3, 34.2]	23.42 [13.0, 27.7]	20.26 [9.8, 24.5]	34.82 [24.4, 39.1]	25.65 [15.2, 29.3]	30.36 [19.9, 34.6]
Social	30.68 (10–50)	25.06 [14.2, 29.5]	35.53 [24.7, 40.0]	27.77 [16.9, 32.2]	20.13 [9.3, 24.6]	38.52 [27.6, 43.0]	28.03 [17.2, 32.5]	37.66 [26.8, 42.1]
Enterprising	30.40 (10–50)	22.91 [14.9, 26.2]	23.92 [21.2, 32.5]	36.40 [28.4, 39.7]	19.80 [11.8, 24.0]	37.24 [30.0, 40.5]	29.91 [21.9, 33.2]	39.83 [31.8, 43.1]
Conventional	24.79 (10–43)	16.67 [10.3, 19.3]	21.28 [14.9, 23.9]	32.41 [26.1, 35.0]	19.95 [13.6, 22.6]	28.86 [22.5, 31.5]	25.03 [18.7, 27.6]	36.90 [30.6, 39.6]

Table 7
Equality Tests of Sex and Educational Track Choice (Probabilities, Odds Ratios in Parentheses) Across the Seven Profiles

Auxiliary variables	Social dominant		Enterprising–conventional dominant		Realistic–investigative dominant		Artistic–social–enterprising dominant		Low vocational interest		Neutral vocational interest		Broad vocational interest	
Sex														
Boy	[b] 0.04 (0.03)	1.00	[ac] 0.51 (0.19)	1.00	[acd] 0.63 (0.15)	1.00	[be] 0.03 (0.03)	1.00	[a] 0.47 (0.12)	1.00	[acdf] 0.76 (0.10)	1.00	[abcdef] 0.34 (0.18)	1.00
Girl	0.96 (0.03)	11.31	0.49 (0.19)	0.49	0.37 (0.15)	0.30	0.97 (0.03)	18.42	0.53 (0.12)	0.53	0.24 (0.10)	0.16	0.66 (0.18)	1.00
Educational track														
Culture–society	[b] 0.33 (0.08)	1.00	0.02 (0.02)	1.00	[c] 0.00 (0.00)	1.00	[ab] 0.16 (0.07)	1.00	[a] 0.12 (0.06)	1.00	[cd] 0.04 (0.03)	1.00	[cd] 0.00 (0.00)	1.00
Economics–society	0.22 (0.08)	0.18	0.95 (0.04)	17.75	0.00 (0.00)	0.00	0.35 (0.09)	0.57	0.48 (0.12)	1.05	0.15 (0.07)	0.94	0.00 (0.00)	1.00
Nature–health	0.39 (0.10)	0.00	0.00 (0.00)	0.00	0.28 (0.18)	0.83	0.27 (0.07)	0.00	0.29 (0.12)	0.00	0.28 (0.12)	0.00	0.32 (0.19)	1.00
Nature–technology	0.00 (0.00)	0.00	0.03 (0.03)	0.00	0.68 (0.20)	3.03	0.01 (0.04)	0.00	0.06 (0.04)	0.00	0.34 (0.15)	0.00	0.22 (0.20)	1.00
Science–math	0.03 (0.03)	0.00	0.00 (0.00)	0.00	0.04 (0.04)	0.08	0.12 (0.05)	0.00	0.00 (0.00)	0.00	0.17 (0.06)	0.00	0.46 (0.18)	1.00
"No idea"	0.03 (0.04)	0.14	0.00 (0.00)	0.00	0.00 (0.00)	0.18	0.09 (0.04)	0.70	0.04 (0.04)	0.50	0.02 (0.04)	0.58	0.00 (0.00)	1.00

Note. Similar subscripts for sex and educational track choice indicate that means across the profiles are equal, that the odds ratio is always 1 for the first category in each class, and that the odds ratios are always 1 for all categories of the last class (online tutorial; Muthén & Muthén (n.d.)).

tional track choices they made. In general, we found that the proportions of individuals with nondifferentiated interest profiles ranged across the educational tracks between 34% (students choosing a culture–society track) and 81% (students choosing the science–math track). This is probably due to the many individuals of the broad vocational interest profile choosing the science–math track (46%), which is characterized by its advanced science education.

The likelihood of choosing the culture–society track was highest for students classified under a social dominant profile (33%), who also had a high probability of choosing a nature–health track (39%). There was a tendency for students with an enterprising–conventional dominant profile to opt for the economics–society track (95%), and the students who were realistic–investigative dominant showed an overall tendency for choosing the nature–technology track (69%). Of the individuals with high scores on the artistic–social–enterprising dimensions, 35% and 28% opted for economics–society and nature–health, respectively. As can be deducted from Table 8, the probabilities for choosing specific tracks were more equally spread out for the nondifferentiated interest profiles, especially for the neutral vocational interest profile. The probabilities for choosing a specific track ranged between 15 and 33% in this group, with the exception of the culture–society track for which the probability for choosing was only 4%. For the group of students with lower scores on all dimensions (i.e., the low vocational interest profile), we found that the highest probability (48%) existed for choosing an economics–society track, although 29% chose a nature–health direction. No significant differences were found between groups for the low vocational interest profile and the social/enterprising–conventional dominant profiles, as well as for the broad vocational interest profile and the neutral vocational interest/artistic–social–enterprising dominant profiles.

Career Image Specificity

An analysis of the career images of 340 students revealed that the largest proportion of students (42.1%, $n = 143$) was indecisive about their future careers (e.g., "I don't know what I want to do when I grow up, or what I want to study"). Approximately one third (31.2%, $n = 106$) had a broad idea about what they want to be (e.g., "something with animals" or "something technical"), and the smallest proportion of students (26.7%, $n = 91$) referred to a specific career (e.g., "a veterinarian for horses," "an accountant," or "a nurse"). In relation to the vocational interest profiles that were previously identified, we found that students with a nondifferentiated interest structure were not necessarily less specific about their career image than students with a differentiated interest structure (see Table 8). Almost 50% of the students who were classified as having broad vocational interest expressed a specific idea about what they wanted to do later in life.

Furthermore, almost half of the students with a low vocational interest had a broad idea about their future careers. In contrast, the neutral vocational interest students were generally indecisive about their future careers. In addition, almost half of the students with a specific interest in the enterprising–conventional and the artistic–social–enterprising dominant domains answered that they did not have a clear idea about their future careers, as well as over 30% and 40% of the realistic–investigative and social dominant individuals, respectively. Students who were classified as having a broad vocational interest were even relatively the most specific about what their vocations should be compared to all other subgroups.

Table 8
Percentages of Students Who Expressed an Unclear, Broad, or Specific Career Image Across the Different Vocational Interest Profiles

Vocational interest profile	Unclear, %	Broad, %	Specific, %
Differentiated			
Social	38.96	33.77	27.27
Enterprising–conventional	48.72	30.77	20.51
Realistic–investigative	33.33	40.00	26.67
Artistic–social–enterprising	48.21	30.36	21.43
Nondifferentiated			
Low	32.50	45.00	22.50
Neutral	47.06	21.18	31.76
Broad	30.77	23.08	46.15

Discussion

During secondary school, students already make future-oriented decisions (Germeijs & Verschueren, 2007). In the Netherlands, students even have to make a consequential educational choice at the end of lower secondary school (age 14–15) that impacts their potential access to higher education programs. Some educational tracks (i.e., nature–health, nature–technology, and especially the science–math based track) offer the possibility to access more and different programs than others (i.e., culture–society and economics–society). Yet, making such a choice might be challenging if students are exploring their interests in multiple vocational or occupational activities, as has been proposed in prior research (e.g., Perera & McIlveen, 2018; Tracey & Darcy, 2002). Secondary school students might show similar levels of interest across vocational domains, for example by showing nondifferentiated interest in all RIASEC domains simultaneously (e.g., Tracey, 2008). At the same time, study and career counseling practices often use vocational interest assessment tools based on the assumption that all individuals have differentiated interest structures (e.g., high interest in realistic and a low interest in social).

The current study investigated this problem by providing insight into both the differentiation and nondifferentiation of secondary school students' vocational interest structures and how nondifferentiation might be associated with their future-oriented choices with regard to choosing an educational track and future career. We used a person-oriented approach to investigate what combinations of RIASEC interests students showed. With LPAs, we identified seven "vocational interest profiles" (i.e., subgroups) that reflect a combination of quantitative and qualitative differences across students in overall level of interest (i.e., low, moderate, high) and the shape (i.e., combinations of interests) of the profiles. Below, we first outline our results with respect to the different vocational interest structures that were identified (Research Question 1), after which we explain how a differentiated and nondifferentiated interest structure was associated with educational track choices and career image specificities (Research Question 2). Note that the latent profiles discussed below need to be interpreted as relative to the other profiles, in that for example if an individual scores high

on all RIASEC domains (i.e., is classified to the broad vocational interest profile) this is always compared to the other students in our sample.

Our results of the LPA indicated that secondary school students possess combinations of interests with either a differentiated (59.2%) or nondifferentiated (40.8%) interest structure, showing differences across individuals both in level (i.e., high, moderate, and low) and in combinations of interests. We found that individuals with a differentiated interest profile were students characterized as social dominant, realistic–investigative dominant, enterprising–conventional dominant, and artistic–social–enterprising dominant, which are subgroups that have also been identified in prior work (Leuty et al., 2016; McLarnon et al., 2015; Perera & McIlveen, 2018; Sung et al., 2017). The nondifferentiated profiles included individuals with a Low, Neutral, or Broad Vocational Interest. One in four girls and two out of three boys uniformly showed high, moderate, or low levels on all six domains, aligning with previous work on junior high students by Sung et al. (2017), who found that 44.6% of the students did not have pronounced interests in one domain over another, and they also reported that two or three times as many boys were classified into the nondifferentiated profiles. Other studies by Leuty et al. (2016), McLarnon et al. (2015), and Perera and McIlveen (2018) also found groups of college students who were characterized as having "nondifferentiated interests" but not as many as we or the study by Sung et al. (2017) on secondary school students found.

We can conclude from these findings that a large proportion of secondary school students shows a combination of vocational interest domains, indicating multiplicity. Our research confirms that interests in specific vocational or occupational activities may combine in more complex and interactive ways than are assessed by tools based on the RIASEC circumplex theory. As was stated by McLarnon et al. (2015) while studying college students, students with nondifferentiated interest structures may feel challenged in making future-oriented choices, as they are exploring multiple vocational interests and might not have a clear image of a specific career (see also Perera & McIlveen, 2018). However, as we discuss next, our results show no straightforward relationship between vocational interest and future choice-making.

We found that students who were classified under a nondifferentiated interest profile, especially the students with a neutral vocational interest, were more divergent in their choices than students with dominant interest in particular domains. More specifically, we found that the students with an enterprising–conventional dominant profile mostly chose the economics–society track, and the students with a realistic–investigative dominant profile a nature–technology track. Hence, these students chose an educational track that is coherent with their dominant vocational interest or interests and are prepared for higher education programs in line with these interests; the economics–society track prepares students for higher educational programs in management and economics, and the nature–technology track prepares students for technical and engineering programs. This coherency between interest and choice indicates that vocational interests of secondary school students do relate to educational choice, as it does for college students' choices of majors (e.g., Päßler & Hell, 2012), particularly for individuals with dominant interests in one or few domains.

At the same time, our findings indicate that a differentiated interest structure does not necessarily imply that students were also specific about their future career aspirations. We found that students with a dominant interest in the enterprising domain were relatively indecisive about their career aspirations, whereas students with a low or broad vocational interest more often reported to have broad or specific career aspirations. On the other hand, students with a neutral vocational interest in all RIASEC domains were relatively indecisive about their future careers, which is in line with what was posited by previous research on college students, showing that students who did not show a pronounced interest in adjacent RIASEC domains were generally more vocationally uncertain (Tracey, 2008; Tracey & Darcy, 2002). These findings show that students with nondifferentiated interest profiles do not necessarily experience more difficulty in thinking about their future career than students with a differentiated interest structure, which is opposed to what was posited by Perera and McIlveen (2018) based on their empirical findings.

Limitations

The results of this study need to be interpreted in light of some limitations. A first limitation concerns our reliance on the reliability and validity of the AIST-r to measure the RIASEC scales. Most prior research used a similar approach for constructing vocational interest scales (e.g., McLarnon et al., 2015). However, future research might consider building a measurement model in Mplus to deal with possible issues, such as items loading on multiple RIASEC indicators, similar to Perera and McIlveen (2018).

Second, the context of this study was quite specific, in that the Dutch educational system uniquely incorporates educational tracks into upper secondary education, where students specialize in particular combinations of school subjects in preparation for higher education. Although the profiles we found align with results from other studies, associations between vocational interests and choice behavior are difficult to generalize to other samples that do not have to make such a consequential choice at age 14 or 15.

Third, although the overall sample size was sufficient (n = 358), especially compared to other recent person-oriented research on vocational interests (e.g., Leuty et al., 2016), our sample was drawn from student populations of only four schools in the Netherlands. This raises the question of whether or not similar subgroups would be found across different secondary student samples. As student populations are relatively homogeneous in the Netherlands, students being tracked into different educational levels based on cognitive ability, we expect that for students from similar educational levels (i.e., higher general education and preuniversity) similar subgroups would be found. Yet, seeing as some of the latent profiles that we distinguished also consisted of a small number of students (e.g., the vocationally broad profile), future research should include students from more schools as well as include students from lower educational levels.

A fourth limitation might be that the students in our sample were too young to have a realistic idea about their future career possibilities, not yet having any experience in the world of work, and therefore they might have answered the question "what do you want to be when you grow up?" based on their association with heroes, role models, or other imaginary aspects (Howard & Walsh, 2010). Finally, we might have affected some students' vocational interest development as we assessed their RIASEC interest profiles one time before the present study was carried out. They were

assessed in November 2016, after which we reported back on their three-letter code (i.e., dominant interests, Holland, 1997), explaining what occupations/vocations might be in line with that code. Students might have remembered this when filling out the questionnaire again in April 2016, or they might have been triggered to further explore educational programs in these directions.

Theoretical and Practical Implications

Our results with regard to students' nondifferentiated interest structures might be interpreted to show that in secondary school, vocational interests might still be developing toward more differentiated structures (Hirschi, 2009; Holland, 1997; Swanson, 1999), for example because these students do not yet have a clear understanding of the working world (Johnson & Bouchard, 2009). It has been argued that if these students spend time on further exploring possible vocational/occupation environments, they might develop a more pronounced interest in one or two RIASEC domains (Hirschi, 2009). To examine if this is the case, future research should focus on the longitudinal stability of the vocational interest structure. Our study included only one measurement moment where it would have been interesting to examine if the interest profiles remain the same after transitioning to upper secondary education. For example, the number of students classified into the nondifferentiated profiles might decrease over time if they progress into upper secondary education and develop a clearer image of self (Hirschi, 2009). Hence, within and between-person longitudinal research on vocational interest profiles is needed.

An alternative explanation for the identified low, neutral and broad vocational interest profiles is that vocational interest assessment tools based on the RIASEC model do not fully capture the complexity of students' interest structures (e.g., Akkerman, Vulperhorst, & Akkerman, 2020). Students might endorse more specific interests than afforded by the vocational/occupational preferences measured by these tools, or they might experience other interests, for example in other "postmodern" vocational activities (as was also argued by McLarnon et al., 2015) or the leisure domain (Leuty et al., 2016). Future research should explore this proposition by investigating these students' interests in a more open-ended manner as part of their everyday lives (Slot, Akkerman, & Wubbels, 2019; Slot et al., 2020), to gain a more holistic understanding of how these adolescents combine and develop their multiple lifelong interests in deciding on their future (Akkerman & Bakker, 2019). Such an approach might involve open questioning about lifewide interests, such as what adolescents like to spend their time on in daily life and why and how adolescents experience interests in school or at home in relation to their past, present, and future.

This more open and holistic approach is important to consider for future research, also with regard to the association between interest and choice behavior. Whereas previous research (e.g., Perera & McIlveen, 2018) has often posited a direct relationship between having specific interests and making a choice in line with these interests, we have shown that the link between interest and choice might be more complex. In line with a recent study by Lykkegaard and Ulriksen (2019), it can be argued that students' ideas about their futures are not stable and that students are continually reconsidering their future careers as they also take into consideration their ideas about who they are and want to be later in life outside of academia or work (Vulperhorst, Van der Rijst, & Akkerman, 2019). As a result, their individual educational trajectories are hard to predict, and an assessment of vocational interests in secondary school might not be appropriate as applied tools cannot account for the possibility of exploring multiple interests. At the same time, educational track choice has been part of the Dutch educational system since 1999 (Dutch Educational Council, 2011). Therefore, we strongly advise educational practice to develop instruments or methods that do account for interest multiplicity.

Conclusion

In conclusion, the current study has found seven vocational interest profiles with different levels and shapes of differentiation that are consistent with previous work, although a higher proportion of students with nondifferentiated interest structures was demonstrated. Furthermore, we built upon prior work by showing that nondifferentiation does not necessarily mean that students experience difficulty in thinking about their desired education or occupations. We have provided suggestions for future research to further explore the associations between vocational interest structures and choice-making behaviors across the different interest subgroups. We thus confirm prior work by showing the added value of using a person-oriented approach in studying vocational interests, as such an approach gives more detailed insight into the different interest levels and combinations of interests that secondary students possess. Practically, our results demonstrate how including all six RIASEC dimensions, instead of limiting to Hollands' three-letter code, might help in advising students in a holistic manner about their future-oriented decisions.

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