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**Exploring vocational and academic fields of study: Development and validation of the Flemish SIMON Interest Inventory (SIMON-I)**


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**Abstract** A new, Holland-based interest inventory is proposed and tested intended to facilitate the transition from secondary to tertiary education. Specific interest items were designed to grasp study and training activities that are particularly prevalent during tertiary studies, including an Academic-track-scale developed to assist the choice between academic- (tertiary-type A) versus vocational- (tertiary-type B) oriented programs within the same field of interest. Data from 3,962 students were analyzed to evaluate the instrument. Results of confirmatory factor analysis and randomization test of hypothesized order relations (RTOR) confirmed the underlying circumplex structure of the RIASEC scales. Participants' agreement with the generated interest profiles was generally encouraging. The newly developed Academic-track-scale differentiated successfully between students in academic versus vocational programs. RIASEC and Academic-track descriptions are further complemented by a list of matching study programs, and the validity of these recommendations was evaluated by comparing RIASEC scores of individuals attending these study programs with O*NET database information and expert ratings. It is concluded that the interest assessment and feedback tools presented here are promising instruments to facilitate the transition from secondary to tertiary education.

*Keywords: Interest assessment, academic versus vocational track, vocational choice*

## Introduction

The Organisation for Economic Co-operation and Development (OECD; 2013) reported that 32% of tertiary students fail to graduate. In Flanders, the Dutch-speaking part of Belgium and the regional context for the present study, about 40% of university students succeed in terminating all courses successfully during the first year of tertiary education. These trends are alarming, even more so since first year performance is one of the best predictors of academic retention (de Koning, Loyens, Rikers, Smeets, & van der Molen, 2012; Murtaugh, Burns, & Schuster, 1999).

One of the critical aspects in preventing drop-out and improving success rates is adequate support and information during the study choice process. Students who carefully explore their options are more likely to end up in a program that suits their interests and potential, which in turn will lead to higher retention rates. For example, Germeijs and Verschueren (2007) showed that in-depth exploration of the environment during the study choice process led to a higher commitment to the chosen study program, which eventually resulted in better academic adjustment.

The exploration of personal interests is an important aspect of this self-investigation phase in the study choice process. Nye, Su, Rounds, and Drasgow (2012) showed in their meta-analysis that interests, and especially the fit between individuals and their environment, were strongly related to performance and persistence in academic contexts. It is thus important for people in the process of choosing a study program to explore both their interests and their study options, to end up in a matching program where drop-out will be less likely. In order to accomplish this daunting task, valid and accessible methodologies that encourage this self-exploratory process are required.

**The need for a new interest inventory**

An abundance of interest inventories have already been developed, such as the widely used Self-Directed Search (Holland, 1985b) or the Strong Campbell Interest Inventory (Campbell, 1987). However, there are several reasons that may compel researchers and practitioners to create new instruments, particularly in the context of educational orientation.

First, most of the established interest inventories draw heavily or even exclusively on occupational titles to assess interest profiles. Yet, when students are asked to choose a field of study at the age of 17 or 18 (i.e., the age at which most students enroll in higher education), their ability to self-report on vocational interests through preferences for specific occupational titles may be constrained by a still limited understanding of how the world of work is organized (Grotevant & Durrett, 1980) and what is required in terms of knowledge and skills to adequately perform in different occupations. Moreover, when making this educational decision, students are more concerned with their level of interest in the respective fields of study than with the future job opportunities that might result from their study choice (Malgwi, Howe, & Burnaby, 2005). This is especially true since not all students end up in a job that matches their field of study (see e.g., Wolniak & Pascarella, 2005). It is thus essential that the matching of study programs to personal interests does not solely rely on job titles but also includes items that are related to specific activities prevalent in the study curriculum and practical training of college programs.

Second, most inventories have been developed and validated in the U.S. Since previous research has shown that cross-cultural application of interest inventories is not always without problems (Einarsdóttir, Rounds, Ægisdóttir, & Gerstein, 2002), there is a need for measures that are tailored to the specific regional context. In the current study context (i.e., Flanders), there is a pertinent lack of validated measures that link students' interests to the available higher education programs. Moreover, no tools are available that may aid students in making the decision between pursuing an educational career at the academic or rather at the vocational level (see below).

Third, educational systems are organized substantially different across cultural, national, and even regional boundaries, and interest inventories and their feedback tools should be maximally aligned with these requirements at the institutional level. When making educational choices in Flanders, students need to decide on which study program they want to pursue at the end of secondary education (age 17-18), both in terms of study content or study field (e.g., engineering, law, psychology, foreign languages…) and study level (either academic or vocational track). Previous research has demonstrated that study *fields* can adequately be described and structured using well-established vocational interest models, like John Holland's (Holland, 1997) RIASEC model (De Fruyt & Mervielde, 1996). The choice between study *levels* pertains to the difference between the academic track (organized by universities) and the vocational track (organized by colleges). This also corresponds to the distinction between tertiary-type A (or academic) and tertiary-type B (or vocational) programs as specified in the International Standard Classification of Education (UNESCO, 1997). While the focus in the latter is more on concrete and specialized professional skills and direct entry into the labour market, academic programs are more theoretical and research-oriented leading to a master degree. Moreover, students with an academic background typically occupy supervisory positions and work on more abstract and complex matters, whereas people graduating from vocational programs are more likely to work under supervision on concrete and specific tasks. With very few exceptions, study fields can be studied either at the theoretical or at the more applied level. For example, the academic Psychology program extensively studies the fundamental principles underlying human psychology, hereby considering different theoretical perspectives, whereas the vocationally oriented 'Applied Psychology' program focusses on the practical application of psychological principles. Most tertiary education students (39% of the population) across OECD countries graduate from a type A program nowadays. Still, a significant group of 11% of the population graduates at tertiary-type B level. This proportion can reach as much as 29.67% (New Zealand) (OECD, 2014). Thus, a common shortcoming in existing interest measures is that these have little to say about which track, academic (tertiary-type A) or vocational (tertiary-type B), aligns best with a person's interest profile.

Finally, most inventories fall under copyright restrictions of test publishers (Armstrong, Allison, & Rounds, 2008) and are not publically available, which is a severely constraining factor for secondary education pupils on the verge of selecting a study program. Optimally, secondary education students should have easy and free access to reliable and validated assessment and feedback tools, encouraging the exploration of their interests and corresponding study programs.

The current paper describes the development of a new interest inventory that circumvents these problems. Specifically, the goal of this project is to develop an interest assessment inventory and accompanying feedback tool that is part of the broader SIMON (Study skills and Interest MONitor) project, a Flemish institutional initiative aimed at assisting secondary education pupils in their selection of a higher education program that maximally suits their interests and abilities. In this prospect, the newly developed interest inventory offers several advantages over previously developed scales such as the Self-Directed Search (SDS). Although both instruments aim to promote the exploration of interests in and by respondents using Holland's model as a guiding theoretical framework (see below), there are a number of important differences that should render this new instrument more appropriate to assess students' interests in the specific context described above. First, the new measure could be tailored to a distinct target audience of students in their final year of secondary education, who are all on the verge of selecting a higher education study program. For this target population, the ultimate objective of the interest-assessment consists of improving the match between their personal interests and the available study programs, rather than obtaining a match between interests and work environments in general. As a consequence, the operationalisation of this instrument should be different from the operationalisations adopted when constructing traditional interest inventories, such as the SDS. Specifically, items will be constructed and selected that are a reflection of specific study activities in different programs, on top of the commonly included occupational titles. A second innovation is that this new assessment tool will also encompass an Academic scale, to help students in their choice between academic versus vocational programs.

**Theoretical background of the newly developed interest inventory**

Holland's (1997) RIASEC interest model served as the guiding taxonomic framework for our new assessment instrument. Although not entirely free of debate and criticism (e.g., Furnham, 2001; Tinsley, 2000), the RIASEC framework is currently the most widely used and researched model to structure interest inventories around the world (D. Brown, 2002; Nauta, 2010). Central in Holland's theory is the assumption that both people and environments can be described in terms of their similarity with six different personality and environment types, i.e., Realistic, Investigative, Artistic, Social, Enterprising, and Conventional (for an excellent description of these types, see for instance Nye et al., 2012). The idea is that the degree of congruence or fit between a person and his or her environment significantly relates to higher levels of achievement and/or satisfaction. Moreover, the six theoretical types can be organized in a hexagonal structure, reflecting the level of psychological similarity between types. That is, adjacent types (e.g., Realistic and Investigative) are most strongly related whereas opposite types (e.g., Realistic and Social) are expected to show the least similarity. Prediger (1982) extended Holland's theory by showing that two dimensions underlie the interest circumplex, namely the People/Things and the Data/Ideas dimensions. In the People/Things dimension, the Things axis is anchored by the Realistic type while the opposite end of the dimension (People) is anchored by Social. The Data-Ideas dimension has the Data axis intersecting the midpoint between Enterprising and Conventional and the Ideas axis intersecting the midpoint between Investigative and Artistic types (Rounds & Tracey, 1993).

Previous research has demonstrated that differences in vocational interests between university programs in Flanders are in accordance with Holland's theory (De Fruyt & Mervielde, 1996). Specifically, students in industrial, bio-agricultural and applied engineering had the highest score on the Realistic scale. Students enrolled in Science and Bioengineering programs scored highest on the Investigative type. Language and history students had highest scores on the Artistic scale while students in psychology and educational sciences programs matched the Social type. Finally, economy, political/social sciences and law students scored considerably higher on the Enterprising scale. Given the widespread acceptance of the Holland model, and its demonstrated relevance in the current context, i.e., the Flemish higher education system (De Fruyt & Mervielde, 1996), the RIASEC model seems particularly appropriate to serve as the conceptual basis of our new interest inventory. There are currently no inventories available in the Flemish community that are specifically designed to explore study interests according to the well-established Holland-model.

**Academic versus vocational study programs**

As a second innovation, we want the newly developed inventory to shed light on the often difficult choice between academic versus more vocationally oriented programs, because there are no specific requirements to enroll in either programs in Flanders. For this purpose, an academic-track-scale was introduced to assess a distinct interest dimension, here referred to as the 'Academic' factor. The idea is that within the six RIASEC interest types, this academic factor should differentiate between students who are more academically versus more vocationally oriented. This implies that students in the academic track share a common interest regardless of their field of study (and corresponding RIASEC profile) as opposed to students in the vocational track. Since the focus in academic programs is more on theoretical and less on concrete professional skills, we expect these students to be more interested in specific academic study activities such as reading scientific literature and designing and conducting research.

An important issue in this regard concerns the relationship between the Academic scale and the existing six RIASEC interest scales. For instance, considerable overlap might be expected with Holland's Investigative type, as this type has a preference for activities such as abstract thinking and analyzing (Holland, 1997). Nevertheless, it is important to note that all fields of study (and corresponding interest types), including primarily Investigative programs can be studied at either type A or type B level (see e.g., OECD, 2011, Table 4.4). Even for Science programs, which are primarily Investigative (De Fruyt & Mervielde, 1996), there is the opportunity to choose between academic versus vocational tracks, and the numbers show that both options attract a considerable population of students. As such, the new Academic factor should not so much be seen as an additional (i.e., seventh) interest type; but rather as an additional interest dimension that differentiates between students within each of the six RIASEC types (and accompanying fields of study). In this regard, this dimension shows some resemblance to Holland's (Holland, 1985a) conception of level of training, and to Tracey and Rounds' (Tracey & Rounds, 1996) idea of a prestige dimension. Specifically, Tracey and Rounds (1996) explain that the typical People/Things and Data/Idea dimensions can be thought of as orthogonal dimensions structuring the field of RIASEC dimensions, while the prestige dimension cuts through this interest circumplex adding a third and independent dimension. Hence, just as there are RIASEC occupational interests that can be sorted from low to high prestige, one can distinguish between RIASEC study interests that are either academic or rather vocational. Moreover, just as the prestige dimension shows some overlap with one of the primary RIASEC interest scales (i.e., Enterprising), the Academic factor can be expected to correlate with Investigative study interests.

**Matching interests to study programs**

Helping students to identify fitting study programs is a two-step process where they (a) gain self-insight into their own study interests and (b) are informed about the interest profiles of the available study programs. Therefore, the newly developed interest inventory presented here is accompanied by a separate feedback tool that links the generated interest profiles to a list of congruent study programs. Importantly, the classification of environments, occupational or educational, in terms of Holland's RIASEC model is a challenging undertaking that can be approached from different angles. Prior work on the classification of environments has mainly focused on describing occupations in terms of the RIASEC dimensions, relying on three different procedures: the incumbent method, the empirical method and the judgment method (see, Rounds, Smith, Hubert, Lewis, & Rivkin, 1999).

In the educational domain, however, conspicuously little attention has been devoted so far to the classification of study environments according to the RIASEC model (Reardon & Bullock, 2004). The current study extends the available literature in this domain by directly comparing the convergence between three different classification methods that can be applied to higher education study programs, i.e. (a) expert ratings, (b) students' mean interest scores, and (c) RIASEC descriptions of equivalent occupations (see further).

In the following section, an overview is given of the construction process that lead to the SIMON Interest Inventory, followed by a summary of the research purposes of the current study.

## Construction and Initial Analysis of the SIMON Interest Inventory (SIMON-I)

In a first stage, an iterative procedure was used to generate the interest items for the new inventory. Items were constructed by three independent experts. Two of these experts can build on extensive experience in vocational interest assessment research, while the third expert has widespread knowledge in educational guidance and student counselling in particular. Items were written to reflect a wide set of activities that are characteristic of the full range of tertiary educational programs organized in Flanders. Based on both original (Holland, 19985, 1997) and more contemporary (Wille, De Fruyt, Dingemanse, & Vergauwe, 2015) descriptions of the six Holland interest types, these activities were subsequently grouped in accordance with the RIASEC framework. Finally, this set of educationally relevant activities was also supplemented with a list of occupational titles that can be liked or disliked. The choice of these occupational titles was inspired by prior taxonomic work in the Netherlands and Belgium on the positioning of professions within the RIASEC structure (Hogerheijde, Van Amstel, De Fruyt, & Mervielde, 1995; De Fruyt & Mervielde, 1997).

The initial item pool consisted of 173 items describing RIASEC activities (88 items) and occupations (85 items). In addition to the six Holland scales, a seventh scale was constructed to assess interest for academic (versus vocationally orientated) programs. Item generation for the 'Academic' scale was based on the assumption that pupils who want to enroll in an academic track must be interested in specific academic study activities, irrespective of their field of interest. Examples of such activities are *reading scientific literature* and *autonomous implementation and evaluation of research activities*. This resulted in a 12-item 'Academic' scale that intends to grasp a 'generic interest for the academic track' as opposed to more vocationally oriented programs. The initial questionnaire hence comprised 100 items measuring preferences for study activities and 85 items indicating occupational preferences.

Upon completion of the assessment module, test-takers would be presented a personalized interest profile summarizing the percentage scores on the six RIASEC scales and the Academic scale, supplemented with a list of matching study programs that they could consider. For this purpose, all available study programs were assigned a two-letter RIASEC code generated by experts in vocational interest assessment and relying on prior empirical work describing the distribution of RIASEC interests across study programs in Flanders (De Fruyt & Mervielde, 1996). We used two-letter codes for study programs instead of the three-letter codes proposed by Holland. The main reason is that RIASEC codes for tertiary education programs in Flanders are yet to be empirically substantiated, and the use of more detailed three-letter codes for matching purposes would still be too audacious.

There was a high level of agreement across the three experts for over 95% of the study programs. In less than 5% of the programs, only two out of three experts assigned the same two-letter code, and for these cases a final code was assigned after deliberation. To give one example, the study program "Economy" was assigned the two-letter code "EC", reflecting the primarily Enterprising and Conventional nature of this field of study. Upon completion of the interest inventory, respondents would receive a list of all study programs that matched their personal interest profiles based on the new inventory. This matching procedure used the first three letters of the personal interest profile, linking this to all study programs that either shared the first two letters (irrespective of their sequence), or that had the first and the third letters in common. For example, a respondent with an AIRCES interest profile would receive study programs coded by experts as AI, IA and AR.

This first version, SIMON-I, was administered online to a sample of 295 secondary education students (age 17-18). Students were recruited from four secondary schools that offer a broad range of secondary education programs. Respondents were asked to fill out SIMON-I in the classroom under the supervision of teachers and to give extensive feedback. This feedback consisted of an overall rating (5-point Likert scale) indicating to what extent they agreed with the generated profile (i.e., the interest profile and the proposed study programs). They were also invited to highlight items that were difficult to interpret and to provide further qualitative feedback concerning the assessment.

Based on these data and feedback, a second version of the instrument was developed. In total, 30 of the original items were deleted because (a) they were easily misunderstood or (b) they showed insufficient coherence with other items in the scale as evidenced by an increase in Cronbach's alpha coefficient when the items were deleted. Seven items did not have the highest correlation with the intended scale and were moved to the corresponding scales. For example, the occupational title 'communication manager' was initially included in the Social scale, though was relocated to the Enterprising scale given its empirical association with this interest dimension. Nine additional items were generated to obtain a more complete coverage of the study program portfolio.

The resulting version of the inventory (see Appendix for the English translation of the Dutch SIMON-I) comprised 98 activity items (11 Academic scale items and 87 RIASEC scales items) and 66 occupations (RIASEC scales items). Instructions were clear and concise: respondents were asked to indicate in a yes-no-format whether they would enjoy the activities and professions or not. We opted for a forced-choice format (yes-no) instead of a Likert scale because yes-no interest items are easy to score, quicker to administer and they are equally reliable (Dolnicar & Grun, 2007; Dolnicar, Grün, & Leisch, 2011). Scale scores were converted to range between 0 and 100 and indicated the proportion of 'yes' answers out of the total number of valid answers to both activity and occupation items. This second version served as the basis for further psychometric and structural evaluation.

## Study objectives

Having discussed the rationale and procedure behind the development of SIMON-I, the purpose of the current study is to provide initial evidence for the validity and practical value of this interest assessment tool in secondary education students on the verge of selecting a higher education program. To meet this aim, three central questions will be addressed.

First, given that SIMON-I is based on Holland's model of interests, an important question in the validation process concerns the structural validity of the proposed measure. Therefore, the internal consistencies of the RIASEC study interest scales and the presumed circular structure of the Holland types (Holland, 1997) will be investigated first. Special attention will also be given to possible gender differences in item functioning (i.e., differential item functioning) and in structural validity.

Second, the current study aims to provide initial evidence for the criterion validity of the Academic-track-scale. Specifically, it will be examined whether this scale can adequately discriminate between students in academic versus vocational programs across and within fields of study. Further, given the anticipated overlap with the Investigative interest scale in particular, special attention in this validation process will be devoted to the issue of incremental validity.

Third, the current study presents a validation of the RIASEC study program codes that are used in the SIMON-I feedback tool. Specifically, the expert-rated RIASEC codes for study programs will be compared against (a) the mean interest scores of students in these study programs, further referred to as 'empirical program codes' and (b) occupationally-derived RIASEC codes, referred to as 'O*NET program codes' (see further). The idea behind the empirical program codes is that the interest profile of a study program can be derived from the average interest profile of people enrolled in this particular program. This approach is consistent with Holland's basic idea that the people constitute the environment, and has been used in previous research that attempted to characterize college environments (e.g., Harms, Roberts, & Winter, 2006). In order to have an additional check of the validity of the expert-rated program codes, we also incorporated occupationally-derived RIASEC codes for the study programs which were extracted from O*NET (e.g., for the program 'Clinical Psychology' we used the O*NET RIASEC code for the occupation of 'Clinical psychologist'). O*NET is a U.S. database that contains information on hundreds of occupation-specific descriptors, including RIASEC codes. O*NET ratings were validated by Rounds et al. (1999) and have been used in previous studies on the structural validity of Holland's RIASEC model, also outside the U.S. (Wille, Tracey, Feys, & De Fruyt, 2014). Recall that the O*NET database contains *occupational* RIASEC profiles, and that the aim of the SIMON-project is to construct a measure that aids in the process of *study* choice. Hence, this approach explores the possibility of using occupation-level interest data to approximate the interest profile of corresponding study programs. A correspondence analysis of the three sources of program RIASEC codes (i.e., expert, empirical, and occupational) was conducted for six different study programs. High correspondence of empirically obtained interest scores with O*NET job codes and experts' program codes would provide extra validity for the SIMON-I feedback module.

Finally, we will also evaluate the usefulness and face validity of the SIMON-I output by analysing respondents' level of agreement with their feedback reports. Remember that this feedback report consisted of both an interest profile and a list of study programs that fit with this profile based on matching RIASEC letter codes.

## Method

### Procedure

SIMON-I was administered in an online Dutch version that automatically generated a feedback report consisting of an interest profile (RIASEC scale scores) and a list of corresponding higher education programs. Students across faculties and institutions were invited to fill out the inventory. Respondents were then invited to leave comments and to indicate their agreement with the received report (both the interest profile and the corresponding programs) on a scale from 1 to 5 ("To which extent do you agree with the generated profile?").

**Participants**

To be able to validate the output generated by SIMON-I, data from students in their last year of tertiary education were analyzed, based on the assumptions that students (a) gradually *gravitate* towards college majors that fit better with their interest profiles, and that (b) over time, students are also socialized in such a manner that study environments gradually reinforce and reward certain interest profiles. As a result of these two processes, students in their graduation year are likely to have an interest profile that matches their program (Smart, 1997). Including data from students in their first years of education might distort the results since drop-out as a consequence of mismatch between interests and program is still probable at this stage. Thus, students in their final year of study were recruited across four different educational institutions (one of which offers academic programs and three of which offer programs in the vocational track). In total, 4588 higher education students accessed the assessment platform. Cases with more than 5% of missing values (nine items or more) were deleted, resulting in a final dataset of 3962 respondents. Of these respondents, 92.6% were enrolled in the academic track, 7.4% were enrolled in the vocational track and 68.5% were woman. In general, 50.8% of the student population in Flanders is enrolled in academic programs and 54.8% are female (Ministerie van Onderwijs en Vorming, 2012), which means that our sample is more academic and more female than the general population of students. Given the nature of this research population (all students enrolled in their final year of tertiary education) we can be quite confident that the research participants are a homogeneous group of students aged between 21 and 23 years old.

## Results

**Structural validity**

*Descriptive Statistics and Internal Consistencies of SIMON-I*

Table 1 shows the number of items and the internal consistency of the subscales. Cronbach's alphas in the sample ranged from .83 (Academic scale) to .93 (Social interest scale), which indicated good internal consistency. The underlying People/Things (P/T) and Data/Ideas (D/I) dimension scores were calculated according to the formula provided by Prediger (1982)[1]. This validated formula allows the transformation of RIASEC scores into two dimensions underlying the hexagonal structure of interests by using the Cartesian coordinates. The correlations between SIMON-I subscales and the underlying dimensions are presented in Table 2.

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Table 1

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Table 2

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*Evaluation of Circumplex Structure*

To evaluate the circular structure of the proposed RIASEC scales, both confirmatory factor analysis (CFA) (Browne's Covariance structure modelling approach, Browne, 1992) and randomization test of hypothesized order relations (RTOR) (Hubert & Arabie, 1987; Tracey & Rounds, 1993) were applied. The use of these two approaches to test circular structure is in accordance with suggestions by Nagy, Trautwein, and Lüdtke (2010), who also gave an excellent overview of the similarities and differences between these procedures. The circular structure was evaluated for the entire dataset and for men and woman separately.

The CFA tests of model fit were conducted using the CircE-package in R (Grassi, Luccio, & Di Blas, 2010). This package allows the implementation of Browne's approach and also provides a graphical representation of the results. The results of these structural analyses are shown in Table 3. For men, all fit indices indicated good fit of the data with the proposed circular model. For woman, results were mixed. RMSEA (>.08) indicated an unacceptable fit, while the other absolute fit indices SRMR (<.08) and AGFI (>.90) signalled a good fit of data with the proposed circular model. The incremental fit index CFI also indicated unacceptable fit (<.95). In the total sample, only RMSEA indicated unacceptable fit, all other indices showed good fit of the data with the circular model (Hooper, Coughlan, & Mullen, 2008; Tabachnick & Fidell, 2007). Thus, overall, results of CFA showed that the circular structure holds especially for men and for the entire sample. Furthermore, the

[1] The People/Things dimension: (2*R)+(1*I)+(-1*A)+(-2*S)+(-1*E)+(1*C)
The Data/Ideas dimension: (0*R)+(-1.7*I)+(-1.7*A)+(0*S)+(1.7*E)+(1.7*C)

spatial representation confirmed the theoretically expected RIASEC ordering in all samples, including the female sample.

The software package RANDALL (Tracey, 1997) was used to conduct RTOR analyses. Holland's theory postulates that correlations between adjacent scales (e.g., R and I) should be higher than correlations between alternate scales (e.g., R and A) and correlations between opposing scales (e.g., R and S) should be lowest. This results in a total of 72 order predictions, and RTOR evaluates the percentage of predictions that are met based on the available data (Tracey & Rounds, 1993). The result of this test is commonly expressed by a correspondence index (CI) which varies between -1 (no order predictions were confirmed) to +1 (all order predictions were confirmed). Rounds and Tracey (1996) provide benchmarks (CI=.70 for U.S. samples and measures and CI=.48 for international contexts) to compare the magnitude of model-data fit. The results of the current study (see Table 4) indicated good model fit for the total sample (CI = .83, $p$ = .017), as well as for men (CI = .97, $p$ = .017) and woman (CI = .81, $p$ = .017) separately. All CI values exceeded the U.S. benchmarks, which further substantiates that the data in all samples fit the circular order.

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Table 3

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Table 4

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*Gender Differences*

As previous research on Holland's interest dimensions has systematically shown gender differences in RIASEC interest scores (Su, Rounds, & Armstrong, 2009), specific attention was given to these differences and to the possible occurrence of gender bias in the developed scales. To establish whether there is an overall effect of gender on interest scores, discriminant analysis was used because of the interdependence of interest dimensions. In this analysis, all seven interest scales were considered simultaneously. The analysis was complemented with univariate tests to specify the contribution of each interest type, as advised by Borgen and Seling (1978). Discriminant analysis indicated that overall, there are gender differences in scale scores (Wilks' Lambda = .698, Chi square (7) = 1423.71, $p < .01$)). Independent-samples $t$-tests showed gender differences on all seven scales (see Table 5). Specifically, men scored higher on Realistic, Investigative, Enterprising and Conventional interests while woman favoured Artistic and Social interest dimensions. Men also obtained a higher score on the Academic scale compared to woman. The two largest differences between men and woman were found for Social and Realistic interests (Cohen's *d* = -.93 and Cohen's *d* = .86 respectively). This gave rise to a large effect size of 1.06 for the underlying P/T dimension. Men and women also differed on the D/I dimension, albeit to a lesser extent (Cohen's *d* = .40).

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Table 5

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Differential item functioning (DIF) was tested to investigate the extent to which the observed gender differences reflect a real difference between men and woman or whether they are an effect of gender bias in the items of the newly constructed scales. SIBTEST (Shealy & Stout, 1993) was used for this purpose, which is an item response theory based procedure. In this approach, a so called valid subtest is used as an estimate of the target trait being measured and the DIF test evaluates how the items differ in their performance in the two groups that are being compared by conditioning them on the trait level of the examinees. The procedure examines whether the resulting DIF statistic (β) is significantly different ($p < .001$) from 0 and which group (men or women) is being favoured (Einarsdóttir & Rounds, 2009). The results in Table 6 indicate that half of the interest items showed significant DIF. Importantly, for the Investigative, Artistic, Social, Enterprising, Conventional and Academic interest scales, there is an approximately equal number of items that favour men and woman. For the Realistic scale, 4 items favour woman as opposed to 8 items favouring men. Concerning the overall level of DIF, it can be noted that only the Investigative scale has beta values that are considered high (> .200 as in Einarsdóttir and Rounds (2009)).This indicates that although there is gender bias in many of the interest items, this bias does not systematically affect the interest scale scores of one specific group.

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Table 6

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**Criterion validity of the Academic scale.**

Validation evidence for the ‘Academic’ scale was obtained by comparing mean scores on this scale between students enrolled in academic programs with those of students in vocational programs. We conducted these comparisons both across and within different fields of study.

To check whether the ‘Academic’ scale differentiates between academic or vocational interests *across* fields of study, an independent samples *t*-test was performed to assess a global difference in academic interests between respondents from academic programs and those enrolled in vocational programs. A significant difference was observed, $t(3960) = 8.40$, $p < .001$. Students in the academic track had a mean score of 54.24 ($SD = 30.05$), while students in the vocational track scored on average 40.06 ($SD = 27.55$), indicating that the Academic scale was able to differentiate between students in the academic and in the vocational track (Cohen’s $d = .49$). By way of comparison, Cohen’s *d* effect sizes for the six RIASEC scales were -.16, .46, .05, .38, .00 and -.10 respectively.

Because of the relatively high correlation between the Academic scale and the Investigative scale ($r = .58$, $p < .001$), we performed additional analyses to substantiate the added value of this newly developed scale. To this aim, we first performed a new independent-samples *t*-test on the subgroup of respondents whose primary (i.e., highest) interest score was Investigative. The results indicated that even within this subgroup, the Academic scale was able to differentiate between students in an academic ($M = 68.21$, $SD = 26.82$) versus a vocational ($M = 54.00$, $SD = 24.56$) track ($t(716) = 3.14$, $p < .01$). Second, a hierarchical logistic regression analysis predicting the likelihood of enrollment in either the vocational or the academic track, showed incremental predictive validity of the Academic scale over and above Investigative scale scores ($\chi^2(1) = 16.65$, $p < .001$).

Similarly, independent samples *t*-tests *within* the same field of study showed significant differences in Academic scale scores between students enrolled in academic versus those enrolled in vocational programs. For example, ‘Chemistry’ is offered both as a type A and a type B program. Although both programs share the same RIASEC program code (i.e., ‘IR’), there is a significant difference in scores on the Academic scale between students enrolled in the academic track ($M = 76.19$, $SD = 17.65$) and those enrolled in the vocational track ($M = 45.38$, $SD = 27.69$) ($t(33) = -3.79$, $p < .01$). To give another example, a similar difference was found between students from the academic ‘Economical Sciences’ program ($M = 81.36$, $SD = 25.36$) and those from the vocational ‘Company Management’ program ($M = 45.12$, $SD = 26.38$) , ($t(71) = -5.45$, $p < .001$), despite their corresponding RIASEC interest code (i.e., ‘EC’).

**Output evaluation**

*Correspondence analysis of study program RIASEC codes*

The expert-rated study program RIASEC codes that complement the SIMON-I interest profiles were validated by investigating their level of correspondence with (a) the mean RIASEC interest scores of respondents enrolled in these programs (i.e., the empirical program codes) and (b) the O*NET RIASEC codes of occupations corresponding to these study programs. Note that this analysis was restricted to a set of six different study programs that were selected based on (a) the theoretical positioning across the interest circumplex (i.e., one program for each of the six key points of the Holland interest hexagon) and (b) on the highest response rates within the respective interest types: Civil Engineering (Realistic), Bioengineering (Investigative), Languages (Artistic), Clinical Psychology (Social), Economy (Enterprising) and Medical and Health Care Management (Conventional). Corresponding job titles (i.e., biochemical engineer, civil engineer, clinical psychologist, interpreters and translators, economist and medical and health care manager) were searched through O*NET Online and the RIASEC codes for these job titles were retrieved from the O*NET database. To make the comparison between these three corresponding study program codes (i.e., expert-rated, empirical, occupational), a range of congruence indices are available (see e.g., Spokane, 1985). For the present study, we chose to use the C-index (S. D. Brown & Gore, 1994) because of (i) its consistency with Holland’s theory, (ii) its normal distribution, and (iii) the ease of calculation and interpretation. Since experts assigned two-letter codes to programs as opposed to three-letter codes in the O*NET database, we use the modified C-index as proposed by Eggerth and Andrew (2006). This modified C-index allows comparison between Holland code profiles of less than three letters in length and is obtained by sequentially comparing the first and second letters in both codes. Comparison is based on the hexagonal distance between the letters. C ranges between 0 and 18, with higher scores indicating higher congruence. C is symmetrically and normally distributed, with a theoretical population mean of 9. Table 7 summarizes the results of this correspondence analysis.

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Table 7

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Before comparing the empirical program codes with O*NET and expert-generated codes, we inspected the mean SIMON-I interest scores across the six study programs. A one-way multivariate analysis of variance (MANOVA) indicated that, in general, students within a certain program indeed scored higher on the interest domain that corresponds with the theoretical position of that program in the hexagon. Specifically, post-hoc Tukey tests indicated that the highest score on Realistic was found for Civil Engineering ($F(5,1479) = 122.10$, $p < .001$); the highest score on Investigative for Bioengineering ($F(5,1479) = 83.14$, $p < .001$); the highest score on

Artistic was for Languages (*F*(5,1479) = 72.74, *p* <.001); the highest score on Social was for Clinical Psychology (*F*(5,1479) = 214.05, *p* <.001) and the highest score on Enterprising was for Economy programs (*F*(5,1479) = 146.76, *p* <.001). There was only one exception: students in Health Care Management and Policy had higher Conventional scores than students from four programs, but lower scores than students from Economy programs (*F*(5,1479) = 251.07, *p* <.001). In general, these results indicate that SIMON-I meaningfully differentiates between students from theoretically different fields of study.

The agreement between O*NET codes and empirical program codes was significantly higher than the mean of 9 for Languages programs (C = 13.97, *t* = 20.69, *p* < .001), Health Care Management and Policy (C = 12.48, *t* = 9.80, *p* < .001), Bioengineering programs (C = 11.56, *t* = 8.49, *p* < .001) and Civil Engineering (C = 10.95, *t* = 4.35, *p* < .001). The agreement with O*NET RIASEC codes was not significantly different from the mean for Clinical Psychology (C = 8.93, *t* = -.42, *p* = .67). For Economy programs (C = 7, *t* = 14.21, *p* < .001), the agreement was lower than the mean. Since O*NET contains occupational information whereas expert codes were specifically given with study programs in mind, we expected the overall congruence with experts' ratings to be higher. This was confirmed: All C-indexes comparing empirical with expert codes were significantly higher than the mean of 9. Bioengineering and Language programs were assigned the same letter code by experts as by O*NET, and had thus the same C-index. Civil Engineering programs showed slightly lower congruence with the experts code than with the O*NET code (C = 10.54, *t* = 3.49, *p* < .001). Health Care Management and Policy programs (C = 12.14, *t* = 10.13, *p* < .001), Economy programs (C = 14.07, *t* = 29.42, *p* < .001) and Clinical Psychology programs (C = 14.83, *t* = 36.41, *p* < .001) had higher congruence with experts' ratings.

A one-way multivariate analysis of variance (MANOVA) was conducted to test the hypothesis that respondents from different programs scored significantly higher on the interest scale that corresponds to the theoretical position of their study program on the circumplex. In other words: do Civil Engineering students score higher on the Realistic scale, Bioengineering students higher on the Investigative scale and so on. Results and post hoc-tests confirmed this, with the exception of Health Care Management and Policy in which respondents scored significantly higher on the Conventional scale than students from four other programs, but lower than respondents from Economy programs.

*Respondent Agreement with Suggested Feedback*

Respondents were asked to indicate their agreement with the received results (both the interests' profile and the corresponding programs) on a 1 to 5 scale (ranging from "*I completely disagree"* to "*I completely agree"*). 1367 respondents indicated their agreement with the interest profile and 1358 respondents evaluated the suggested study programs. 75% of the respondents indicated to agree with the presented interest profile (score 4 or 5); 16.2% agreed moderately (score 3) and only 8.8% did not agree (score 1 or 2) with this part of the feedback report. The mean agreement score was 3.86 ($SD$ = .91). Regarding the proposed study programs, 55.5% of the respondents agreed (score 4 or 5); 21.9% agreed moderately (score 3); and 22.6% did not agree (score 1 or 2) with their feedback report. The mean agreement score was 3.41 ($SD$ = 1.08). We also explored whether these agreement scores were related to any of the interest scales measured by SIMON-I. Students who scored highest on the Social scale were most satisfied ($M$ = 4.07); while those who scored highest on the Realistic scale were least satisfied ($M$ = 3.67) with their interest profile. Agreement with the proposed study programs was not related to any of the interest scores. Overall, these results indicate that most respondents tended to agree with the profile that was generated by SIMON-I.

## Discussion

The aim of this study was to document and validate SIMON-I and its feedback tool. SIMON-I is a new and freely available interest measure tailored to a target audience of students on the verge of selecting a higher education study program. The accompanying feedback tool aims to facilitate this choice process by providing respondents with a list of study programs that are matched to their interest profiles. SIMON-I also introduces a new academic-track-scale that deals with the often difficult choice between academic (tertiary-type A) versus vocational (tertiary-type B) programs. Overall, our findings speak for the validity and usefulness of SIMON-I and its feedback tool in the context of educational guidance and counseling.

One of the features that makes Holland’s interest model so appealing for test developers pertains to its structural assumptions (Nauta, 2010). Specifically, the well-defined position of the six personality and environment types across the interest circle enables the analysis of person-environment congruence, an element that is highly relevant for both career researchers and practitioners. The structural validity of SIMON-I was confirmed in the present study by evaluating the underlying circumplex structure using both CFA and RTOR. With CFA, several fit indices showed a good fit of the data with the circular ordering, especially in the male sample. RTOR revealed good fit of the data with the circular structure in all samples.

Our findings regarding gender differences in interest scores are largely in line with those reported by Su et al. (2009), showing that men generally scored higher on Realistic and Investigative interests compared to women obtaining higher scores on Artistic and Social interests. Two findings in the present study, however, diverged from Su and colleagues’ meta-analysis. First, SIMON-I did not reveal significant gender differences for Conventional interests, while Su et al. (2009) found women to score significantly higher on this scale. Second, contrary to the null findings reported by Su et al. (2009), SIMON-I did reveal significant differences between men and women in terms of Enterprising interests (i.e., men scoring higher), reaffirming earlier work in this area (e.g., Betz & Fitzgerald, 1987). Consistent with Su et al. (2009), the largest gender differences were found for the 'People/Things' dimension with men favouring working with things and woman preferring working with people. These findings can further be considered in the context of a broader field of research dedicated to the structural (in)variance of interest models across gender. Previous studies on this topic have been inconclusive (Beinicke, Pässler, & Hell, 2014), with some reporting structural invariance across gender (e.g., Darcy & Tracey, 2007; Nagy et al., 2010), and others providing evidence for gender differences in the underlying structure of interests (e.g., Hansen, Collins, Swanson, & Fouad, 1993). In the present study, even in the female sample, several fit indices showed good fit of the data with the circular model. Also, the spatial representations confirmed the theoretically expected RIASEC ordering. Moreover, the CI values found with RTOR in this study exceeded U.S. benchmarks and CI values established previously in a Flemish population of higher education students that were assessed with a translation of Holland's Self-Directed Search. Specifically, Wille et al. (2014) used the Dutch authorized adaptation of the SDS to measure vocational interests in final year higher education students and observed a CI of .69 for this instrument. This could suggest that SIMON-I, with a CI of .83 for the total sample, is better at capturing the circular order of interests compared to the SDS in Flemish higher education students.

Findings regarding gender differences in interest scales also raise the question of gender fairness in interest inventories (Pässler, Beinicke, & Hell, 2014). The results of differential item functioning tests performed on SIMON-I indicated that many of the interest items indeed showed bias. Nevertheless, this bias was not systematically directed against either men or woman in any of the scales. We are aware of the potential problems associated with confirming gender differences as a result of gender-biased interest scales. Therefore, data from additional samples will be used in future work to further explore whether there is a need to replace items (especially in the Realistic and Investigative domains) to obtain more gender-fair interest scales.

The process of matching people to environments based on their interest profiles requires not only that personal interests are mapped (e.g., using an interest inventory) but also that environments are summarized in terms of their most prevalent interest-related characteristics. One of the objectives of SIMON-I was not only to determine students' RIASEC interest profiles, but at the same time to link this to a set of study programs with matching interest codes. In the absence of an existing classification scheme to describe study programs in terms of their most prevalent RIASEC characteristics, the current project departed from program expert ratings. In support of these ratings, data from six study programs showed that these expert-rated RIASEC program codes demonstrated good congruence with the average interest profiles of the students in these study programs, as indicated by significantly higher C-indexes than the theoretical mean. Importantly, a systematic comparison of students' interest profiles across programs showed that, with only one exception, SIMON-I meaningfully differentiates between students in such a way that interest scores mirrored the theoretical position of the programs in the hexagon. Further, the present study also included occupational RIASEC interest codes as an additional benchmark for the proposed study program codes. Using the interest codes of occupations that are closely aligned with study programs, we were able to demonstrate good levels of congruence for the study fields of *Languages*, *Health Care Management and Policy*, *Bioengineering* and *Civil Engineering*. This thus indicates that the interest profiles of these study programs, as determined by the experts, showed strong resemblance (in terms of the RIASEC letter code) with the prescribed interest profiles of corresponding occupations, as listed in the O*NET system. There was moderate agreement between expert and occupational codes for *Clinical Psychology*. The lowest congruence was found for *Economy* programs (C=7). This result parallels findings of Harrington, Feller, and O'Shea (1993), who also established low similarity between empirical program codes and occupational codes in an Economics program. This suggests that there may be a discrepancy between the interest profile of students enrolled in Economics programs and that of people who are employed as economist.

In addition to these psychometric evaluations, we were also interested in the way students perceived the interest profiles that were generated by SIMON-I. After all, this kind of interest assessment is primarily a process of self-exploration (Holland, 1997), and the surplus for test-takers is that they are presented with (a) structured feedback on personal motives that otherwise may risk to remain unnoticed (under the form of the RIASEC interest profile), and (b) concrete study advice (i.e., a list of possible study programs that align with their personal interests). Knowing that such information is well-accepted by test-takers is important because this may heighten the chances that the feedback is actually being taken seriously. Our findings showed that the majority of respondents indeed tended to agree with the interest profile (91.2%) and with the corresponding programs (77.4%) they received. These results are even more optimistic compared to recent work by Sverko, Babarovic, and Medugorac (2014) who reported that 56.3% of their university student sample found that the advice generated by their interest instrument described them well and another 37.5% was neutral. Although only a minority of the respondents in the present study did not agree with their feedback reports, further use and analyses of SIMON-I need to address this.

Finally, with SIMON-I we also introduced a new methodology helping students choosing between fields of study at either the academic or the vocational level. For this purpose, an additional interest scale was developed intended to measure what was labelled the ‘Academic factor’. The underlying idea was that embarking on an academic track requires sufficient interest in study activities that are typical for all study programs at this level. In support of this new scale, results indeed indicated mean differences in scores on the ‘Academic’ scale between students enrolled in academic programs and those in vocational programs, confirming that this scale differentiates between students with more or less interests that are closely aligned to the academic track. Moreover, the analyses also showed that this Academic scale is also distinct from the conceptually related Holland Investigative interest scale. Where the Investigative scale measures the interest in a specific category of study fields where the focus lies on the analysis of physical, medical, or (bio)chemical data and processes, the Academic scale taps into preferences for academic study activities, irrespective of a specific field of interest. For example, the item ‘*engrossing in a certain subject in order to write a research paper*’ refers to an academic activity that is important across all academic programs, ranging from Language (Artistic), and Psychology (Social) majors to Bioengineering (Investigative) study programs.

**Limitations and Directions for Future Research**

A number of limitations of this work should be acknowledged. First, the profiling of study programs needs more attention. As for now, an expert judgment method was used, by which vocational interest model experts generated RIASEC profiles of study programs. Although this judgment method has proven to be a reliable and valid method to describe study programs (Rounds et al., 1999), subject matter experts from all programs can provide supplementary and perhaps more fine-grained information in the future. Likewise, it would be of great value to add an ‘incumbent method’ (Rounds et al., 1999) to assign Holland codes to programs. This implies the use of the empirically established scores per program to refine the profiles generated by experts. Some study programs only had moderate agreement with the proposed RIASEC codes. The mechanisms that are accountable for this moderate agreement require further inquiry.

Second, more work is also needed on the Academic scale. Although there are general score differences between students in the academic and the vocational track, it is still necessary to test whether these differences apply to all fields of study. It is not unthinkable that students in specific vocational programs are more ‘Academic’ than students in particular academic programs. This requires more data from students enrolled in vocational programs.

Finally, continued data gathering and analyses are warranted for the examination of additional psychometric test requirements, such as test-retest reliability and concurrent and predictive validity. For example, convergent validity evidence could be examined through simultaneous assessment of SIMON-I and widely used interest inventories such as the Self-Directed Search (Holland, 1985). This might also shed light on the added value of SIMON-I. In the longer-run, the secondary education samples should be followed to investigate the validity of SIMON-I to predict study program choice and performance results.

**Conclusion**

SIMON-I circumvents important limitations of previously developed measures. It is a promising tool that encourages the exploration of study options when making a vocational choice, be it academic or more vocationally oriented. It is expected that this careful exploration of options will boost student success and retention and thus facilitate a smooth transition between secondary and higher education.

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Table 1

*Descriptive statistics, internal consistencies and number of items of the SIMON interest inventory subscales*

| | Activities | | | | Occupations | | | | Total | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *N* items | *M* | *SD* | α | *N* items | *M* | *SD* | α | *N* items | *M* | *SD* | α |
| R | 14 | 16.97 | 22.51 | .87 | 9 | 20.12 | 24.12 | .79 | 23 | 18.21 | 21.87 | .91 |
| I | 15 | 38.52 | 21.98 | .74 | 14 | 27.50 | 24.37 | .83 | 29 | 33.27 | 21.64 | .88 |
| A | 13 | 34.62 | 26.79 | .83 | 13 | 29.83 | 27.69 | .86 | 26 | 32.35 | 25.95 | .91 |
| S | 18 | 45.71 | 28.85 | .89 | 10 | 37.26 | 29.67 | .83 | 28 | 42.80 | 28.11 | .93 |
| E | 13 | 57.91 | 39.61 | .88 | 11 | 29.63 | 27.15 | .83 | 24 | 37.88 | 27.42 | .92 |
| C | 14 | 30.19 | 27.06 | .86 | 9 | 18.19 | 23.06 | .79 | 23 | 25.53 | 23.72 | .90 |
| Ac | - | - | - | - | - | - | - | - | 11 | 53.20 | 30.10 | .83 |

Table 2

*Scale and dimension intercorrelations*

| | R | I | A | S | E | C | Ac | D/I | P/T |
|---|---|---|---|---|---|---|---|---|---|
| R | 1 | ,48** | ,17** | -,19** | ,22** | ,31** | ,25** | -.03 | .62** |
| I | | 1 | ,23** | ,08** | ,01 | ,15** | ,58** | -.42** | .36** |
| A | | | 1 | ,39** | ,22** | -,02 | ,18** | -.46** | -.42** |
| S | | | | 1 | ,12** | -,04* | -,02 | -.17** | -.78** |
| E | | | | | 1 | ,66** | ,20** | .67** | -.15** |
| C | | | | | | 1 | ,25** | .70** | .25** |
| Ac | | | | | | | 1 | -.10** | .13** |
| Data/Ideas | | | | | | | | 1 | .09** |
| People/Things | | | | | | | | | 1 |

Note. ** Correlation is significant at the 0.01 level (2-tailed).
D/I = Data/ideas. A negative correlation with D/I indicates a positive relation with the Ideas dimension.
P/T = People/Things. A negative correlation with P/T indicates a positive relation with the People dimension.

Table 3

*Overview circumplex goodness of fit indices*

| | RMSEA | 90% CI RMSEA | SRMR | AGFI | CFI | *df* | *p* |
|---|---|---|---|---|---|---|---|
| Men | .05 | .04-.07 | .02 | .98 | .99 | 2 | 20 |
| Woman | .10 | .09-.12 | .06 | .93 | .94 | 3 | 20 |
| Total | .10 | .09-.11 | .06 | .93 | .95 | 4 | 20 |

*Note.* RMSEA = root mean square error of approximation; CI = confidence interval; SRMR = standardised root mean square residual; AGFI = adjusted goodness-of-fit statistic; CFI = Bentler comparative fit index; *df* = degrees of freedom; P = parameters.

Table 4: Randomization test of Hypothesized Order Relations

| Group | Predictions: Met | Predictions: Tied | Correspondence Index | *p* |
|---|---|---|---|---|
| Men | 70 | 2 | .97 | .017 |
| Woman | 65 | 0 | .81 | .017 |
| Total | 66 | 0 | .83 | .017 |

Table 5

*Gender mean differences in interests: mean, standard deviation, univariate F and Cohen's d*

| | Men *M* (*SD*) | Woman *M* (*SD*) | *F* (1,3960) | *d* |
|---|---|---|---|---|
| R | 31.03 (25.78) | 12.30 (16.79) | 489.78* | 0.86 |
| I | 36.76 (23.15) | 31.66 (20.72) | 28.52* | 0.23 |
| A | 27.55 (24.05) | 34.56 (26.49) | 33.21* | -0.28 |
| S | 26.90 (22.48) | 50.14 (27.40) | 148.27* | -0.93 |
| E | 45.21 (28.42) | 34.50 (26.28) | 21.61* | 0.39 |
| C | 32.22 (25.51) | 22.45 (22.18) | 81.27* | 0.41 |
| Ac | 61.27 (28.92) | 49.47 (29.91) | 7.35* | 0.40 |
| Data/Ideas | 22.30 (101.53) | -15.78 (89.21) | 59.32* | 0.40 |
| People/Things | 4.49 (90.72) | -90.63 (88.57) | .89* | -1.06 |

* p < .001

Table 6

*Number and percentage of items showing DIF for the SIMON-I scales*

| | Scale *N* | Differential item functioning (ß) | | | | | |
|---|---|---|---|---|---|---|---|
| | | *N* items showing DIF | % items showing DIF | Favour woman | | Favour men | |
| | | | | *N* | *M* (ß) | *N* | *M* (ß) |
| R | 23 | 12 | 52 | 4 | 0,161 | 8 | -0,127 |
| I | 29 | 14 | 48 | 7 | 0,255 | 7 | -0.252 |
| A | 26 | 19 | 73 | 9 | 0,132 | 10 | -0,121 |
| S | 28 | 11 | 39 | 5 | 0.115 | 6 | -0.124 |
| E | 24 | 12 | 50 | 7 | 0.125 | 5 | -0.138 |
| C | 23 | 9 | 39 | 4 | 0.128 | 5 | -0,099 |
| Ac | 11 | 7 | 64 | 4 | 0.124 | 3 | -0,160 |

table

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Table 7

*Comparison of mean SIMON RIASEC codes across study programs with O*NET RIASEC codes*

| **Theoretical position** | **O*net job title** | ***N*** | **Field of study/Major** | **R** *M* (*SD*) | **I** *M* (*SD*) | **A** *M* (*SD*) | **S** *M* (*SD*) | **E** *M* (*SD*) | **C** *M* (*SD*) | **O*NET** | | **Experts** | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | **Code** | **Mean C-index** | **Code** | **Mean C-index** |
| R | Civil engineer | 82 | Civil Engineering | 49.98 (24.75) | 41.16 (23.66) | 25.66 (24.25) | 19.46 (20.93) | 40.16 (24.96) | 31.62 (24.15) | RI | 10.95* | IR | 10.54* |
| I | Biochemical engineer | 224 | Bioengineering | 38.40 (24.4) | 52.82 (19.24) | 24.69 (22.42) | 25.04 (22.19) | 35.72 (24.72) | 26.54 (20.76) | IR | 11.56* | IR | 11.56* |
| A | Interpreters and translators | 233 | Languages: Interpreter, translator, multi-Linguistic Communication and Languages | 8.06 (12.51) | 23.64 (17.96) | 55.74 (22.83) | 46.18 (24.34) | 33.87 (24.66) | 14.06 (15.77) | AS | 13.97* | AS | 13.97* |
| S | Clinical Psychologist | 351 | Clinical Psychology | 8.71 (12.57) | 30.82 (19.90) | 40.55 (26.90) | 69.48 (18.73) | 25.78 (22.00) | 11.08 (13.60) | IS | 8.93 | SA | 14.83* |
| E | Economist | 475 | Economy: Applied Economic Sciences, Economic Sciences, | 22.64 (22.59) | 23.88 (17.74) | 23.69 (21.82) | 25.93 (22.21) | 65.06 (21.97) | 53.66 (22.58) | IC | 7.00 | EC | 14.07* |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Business Administration | | | | | | | | | | |
| C | Medical and health care managers | 120 | Health Care Management and Policy | 16.40 (19.70) | 34.59 (21.05) | 27.77 (24.78) | 52.72 (23.55) | 57.51 (22.21) | 48.12 (24.07) | EC | 12.48* | SE | 12.14* |

Note: * C-index significantly higher than the population mean (which is 9 as the C-index is normally distributed).

Appendix A

English translation of the SIMON-I questionnaire

**Part 1: Activities**

Mark the YES column for activities you enjoy to do or activities you would like to try. Mark the NO column for activities you would not like to do. If you really don't know what the activity implies, skip the item.

| | Activity | YES | NO | SCALE |
|---|---|---|---|---|
| 1 | Developing electronic systems | | | R |
| 2 | Analysing the grammatical structure of a sentence | | | I |
| 3 | Helping people with speech disorders | | | S |
| 4 | Recruiting a job candidate | | | E |
| 5 | Monitoring the quality standards for food safety and hygiene | | | C |
| 6 | Analysing and interpreting research results | | | Ac |
| 7 | Repairing malfunctioning electrical equipment | | | R |
| 8 | Carrying out laboratorial analyses | | | I |
| 9 | Designing a poster for an exhibition | | | A |
| 10 | Helping others with their personal problems | | | S |
| 11 | Organising a conference | | | E |
| 12 | Preparing financial reports | | | C |
| 13 | Reading English language scientific articles* | | | Ac |
| 14 | Being responsible for the maintenance of IT hardware | | | R |
| 15 | Analysing statistics | | | I |
| 16 | Designing webpages | | | A |
| 17 | Developing council prevention campaigns | | | S |
| 18 | Presenting new policy propositions | | | E |
| 19 | Collecting quantitative and qualitative data | | | I |
| 20 | Engrossing in a certain subject in order to write a research paper | | | Ac |
| 21 | Develop new methods for industrial production | | | R |
| 22 | Treating diseases in animals | | | I |
| 23 | Editing the sound and images for a movie | | | A |
| 24 | Formulating education and training policies | | | S |
| 25 | Drawing up the budgets | | | C |
| 26 | Doing the follow up on building sites | | | R |
| 27 | Analysing x-rays/brain scans | | | I |
| 28 | Fit out a show room | | | A |
| 29 | Sport guidance for children, the elderly, … | | | S |
| 30 | Formulate a theory about the differences between population groups | | | I |
| 31 | Monitor quality standards | | | C |
| 32 | Writing clear and logically structured texts | | | Ac |
| 33 | Maintaining airplanes | | | R |
| 34 | Investigating the impact of historical people | | | A |
| 35 | Composing a work of music | | | A |
| 36 | Providing guidance for victims | | | S |
| 37 | Selling a product or service | | | E |
| 38 | Calculating prices | | | C |
| 39 | Distinguishing main issues from side-issues in a text | | | Ac |
| 40 | Installing and maintaining computer servers | | | R |
| 41 | Designing an advertising folder | | | A |
| 42 | Providing information about the assistance for the poor | | | S |
| 43 | Drawing up an organisational business or policy plan | | | E |
| 44 | Checking bank transactions | | | C |
| 45 | Starting studying without being asked for | | | Ac |
| 46 | Developing windmill parks | | | R |
| 47 | Prove a theorem | | | I |
| 48 | Analysing text structures | | | A |
| 49 | Giving travel advice | | | S |
| 50 | Negotiating contracts | | | E |
| 51 | Drawing up a contract | | | C |

| | | | | |
|---|---|---|---|---|
| 52 | Looking up sources to give an idea a scientific basis | | | Ac |
| 53 | Investigating chromosomal defects | | | I |
| 54 | Writing scenarios | | | A |
| 55 | Holding tests, questionnaires and in-depth interviews | | | S |
| 56 | Screening the administration | | | C |
| 57 | Reading texts that include formulas, calculations and tables | | | Ac |
| 58 | Working on a drilling rig | | | R |
| 59 | Turning an idea into a film | | | A |
| 60 | Giving care to patients | | | S |
| 61 | Restructuring an organisation or company | | | E |
| 62 | Checking the compliance of regulations | | | C |
| 63 | Drawing conclusions from a mathematical table | | | Ac |
| 64 | Excluding alternative explanations through experiments | | | I |
| 65 | Designing the layout of a hospital | | | A |
| 66 | Advising youngsters regarding their vocational choice | | | S |
| 67 | Exploring new economic markets | | | E |
| 68 | Drawing up the annual report | | | C |
| 69 | Detecting mistakes in arguments | | | Ac |
| 70 | Setting up a festival stage | | | R |
| 71 | Developing a new medicine | | | I |
| 72 | Writing a review | | | A |
| 73 | Giving training in communication skills | | | S |
| 74 | Starting up an enterprise | | | E |
| 75 | Investigating a cost structure | | | C |
| 76 | Setting up, carrying out and evaluating an own research project | | | Ac |
| 77 | Creating a technical drawing | | | R |
| 78 | Putting theories in their historical and social context | | | I |
| 79 | Creating an art piece | | | A |
| 80 | Giving health advice | | | S |
| 81 | Giving health and parenting education | | | E |
| 82 | Calculating expenses | | | C |
| 83 | Disassembling electrical appliances | | | R |
| 84 | Comparing cultures | | | A |
| 85 | Guiding minority groups on the job market | | | S |
| 86 | Conducting a meeting | | | E |
| 87 | Drawing up a timetable | | | C |
| 88 | Measuring a lane | | | R |
| 89 | Supporting and following up foster families | | | S |
| 90 | Attracting sponsors | | | E |
| 91 | Standing in front of a classroom | | | S |
| 92 | Leading a team | | | E |
| 93 | Managing a database | | | C |
| 94 | Collecting soil samples | | | R |
| 95 | Beginning a herbarium (a plant collection) | | | I |
| 96 | Counseling underprivileged people | | | S |
| 97 | Formulating a treatment plan | | | S |
| 98 | Studying the physical endurance of athletes | | | I |

**Part 2: Occupations**

Mark YES for professions you would like to practice or that you would like to try. Mark NO for professions you would not like to do. If you think a little bit, you probably know most professions. If you really don't know what a profession entails, skip the item.

| Nr | Occupation | YES | NO | SCALE |
|---|---|---|---|---|
| 1 | Industrial designer | | | R |
| 2 | Civil engineer | | | I |
| 3 | Fashion designer | | | A |
| 4 | Policy advisor in political and international relations | | | E |
| 5 | Recruitment and selection advisor | | | E |
| 6 | Damage expert | | | C |

| | | | | |
|---|---|---|---|---|
| 7 | Agricultural technician | | | R |
| 8 | Teacher | | | S |
| 9 | Business economist | | | C |
| 10 | Accountant | | | C |
| 11 | Electrical engineer | | | R |
| 12 | Biologist | | | I |
| 13 | Art/music teacher | | | A |
| 14 | Speech therapist | | | S |
| 15 | Bank manager | | | C |
| 16 | Landscape architect | | | R |
| 17 | Physicist | | | I |
| 18 | Editor | | | A |
| 19 | Student counselor | | | S |
| 20 | Tax supervisor | | | C |
| 21 | Neurologist | | | I |
| 22 | Policy advisor art and culture | | | A |
| 23 | Educator | | | S |
| 24 | Marketing manager | | | E |
| 25 | Safety advisor | | | C |
| 26 | Construction manager | | | R |
| 27 | Historian | | | I |
| 28 | Director | | | A |
| 29 | Communication manager | | | E |
| 30 | Manager (of a company) | | | E |
| 31 | Judge | | | C |
| 32 | Forester | | | R |
| 33 | Researcher | | | I |
| 34 | Graphic designer | | | A |
| 35 | Psychologist | | | S |
| 36 | Lawyer | | | E |
| 37 | Notary | | | C |
| 38 | Mathematician | | | I |
| 39 | Art historian | | | A |
| 40 | Social worker | | | S |
| 41 | Politician | | | E |
| 42 | Pilot | | | R |
| 43 | Pharmacist | | | I |
| 44 | Linguist | | | A |
| 45 | Divorce mediator | | | S |
| 46 | Journalist | | | A |
| 47 | Structural engineer | | | R |
| 48 | Lab assistant | | | I |
| 49 | Photographer | | | A |
| 50 | Nurse | | | S |
| 51 | Advertising campaign manager | | | E |
| 52 | Chemist | | | I |
| 53 | Tax specialist | | | C |
| 54 | Architect | | | R |
| 55 | Artist | | | A |
| 56 | Educational scientist | | | S |
| 57 | Librarian | | | A |
| 58 | Philosopher | | | I |
| 59 | Representative | | | E |
| 60 | Geneticist | | | I |
| 61 | Interior designer | | | A |
| 62 | Estate agent | | | E |
| 63 | Physiotherapist | | | S |
| 64 | Meteorologist | | | I |
| 65 | Sales manager | | | E |
| 66 | Statistician | | | I |

* item specific for students from non-English speaking countries