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Development and Initial Validation of a Career Preference Scale (CPS-15F): An Underlying Model of Holland's Theory for Measuring Career Interests

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Abstract

The aim of this study is to develop a career preference scale that requires the study of existing theories of occupational interest evaluation (Strong, Kuder, Holland and Rothwell Miller) while analyzing their structures, their item selection methods and the response methods proposed in this type of construct, This qualitative analysis enabled us to conclude that Holland's method of classifying professional interests is the best suited to the context of the evaluation in order to establish an underlying model of 15 sub-factors making it possible to measure Holland's inter-dimensional relationships and to deduce clear preferences from them on the basis of a suitable structure and response mode, and to interpret the results pertinently thanks to the 24 professional profiles presented in this study. We also studied the psychometric qualities of the career preference scale developed, which was administered to a sample of 628 participants. The validity of the scale was verified empirically by measuring item-test correlations and internal consistency independently for each sub-factor, Fidelity was verified using a test-retest with a sample of 50 participants, while concurrent validity was verified by relating the dimensions of interest to other information (gender and field of study of the students) to check the relationship with the literature. These procedures demonstrated satisfactory psychometric qualities and enabled six items on the scale to be improved for a more relevant assessment and to be used in the school and professional environment.

INTRODUCTION

Vocational interest questionnaires are not widely used in educational and vocational guidance counselling in our country, and there is no evidence to support the validity of Holland's (1997) model of vocational personality types in the Moroccan socio-cultural environment. However, four questions need to be addressed in more detail to justify the approach used to develop a career preference scale: (a) why the Holland model of career interests was chosen, (b) why we are interested in constructing a career preference scale rather than using other instruments valid in other countries, (c) what is our intention in referring to the term 'preferences' rather than interests and (d) how can the reliability of a career preference scale adopting the Holland model actually be verified. Before justifying the choice of Holland's theory, it is particularly important to emphasize the complementary nature of the four approaches (Strong, Kuder, Roth-well-Miller and Holland) (Vrignaud & Bemaud, 2005c).

Although the first interest questionnaire was founded by Strong (1973) and included 110 professional scales, items were selected by identifying those for which the difference in

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response frequency between the general population and the sample of professionals was significant for each profession studied (Vrignaud & Bemaud, 2005a): those of the constitution of samples of professionals which satisfy the constraints of representativeness as well as the difficulties of synthesizing the results of the 110 scales of the questionnaire, for which Strong resorted to Holland's typology to establish methods of structuring the results (Campbell & Holland, 1972).

As for Kuder's interest scales (1948), these are based on a more economical approach by adopting 11 relatively independent categories of interest, and the items selected include activities as stimuli for evaluation. However, the disadvantage of this scale is the ipsative response mode proposed for each triad of activities relating to three different categories among the 11 Kuder categories, so the subject will be forced to choose among these three activities: the one that he prefers, the one that he rejects and the one who is indifferent to him. In fact, the ipsative mode consists of ranking a set of items (or categories) in the same class according to order of preference (Vrignaud, 2005b).

In the case of the Kuder scales, this involves classifying three items in each class, which creates a psychological disadvantage if it is assumed that the subject is not interested in any of the three proposed activities, in which case his response may introduce a bias in the appropriation of the results (Vrignaud & Bemaud, 2005c). But when it comes to classifying all the interest categories in the same class, as in the case of the scale proposed by Rothwell-Miller (Bernaud & Priou, 1994), the disadvantage of the ipsative response mode will be both psychological and psychometric levels, since the subject will find it psychologically difficult to rank the 12 proposed occupations. However, the use of occupations as stimuli is not recommended by Kuder (Vrignaud & Bemaud, 2005a) given that, on the one hand, the subject cannot be questioned about what he or she is supposed not to know, on the other hand, occupations evolve over time and some of them may even disappear or be non-existent in a socio-professional landscape (Moumoula, 2006). From a psychometric point of view, the subject will not be able to keep the same ranking of the 108 occupations during a re-test, which undermines the reliability of such an instrument used to guide the subject's decision-making (Su & Rounds, 2020).

Although the ipsative response mode has these disadvantages, it has just as many advantages for identifying a subject's professional preferences (A is preferred to B) and then concluding which category is more representative. To solve the problem arising from the ipsative mode, we suggest combining this response mode with a three-point Likert scale (for, neutral, against). In fact, this combination will not only identify the weight of the two categories A and B but also gather absolute information concerning the acceptance or rejection of the two previous categories while encouraging 'like' and 'dislike' responses such as those given by Strong (Tétreau, 2005), also adopted in the SDS (The Self-Directed Search, Holland et al., 2013).

The continuum of Strong and Kuder's work (Super, 1964) will subsequently introduce us to Holland's model (1997), which is a continuation of this work and is limited to six categories of dependent interests, while adopting an interpretation method based on professional profiles which facilitates the transition between the profile and the universe of occupations (or training courses) (Vrignaud, 2005a). Holland's structural model makes it possible to synthesize the results by considering the two highest categories to form one type of career profile from the 30 possible types (30 different combinations if two categories are used). This theory subsequently became widely accepted by guidance counsellors (Herr et al., 2004) and was adopted in numerous inventories worldwide, such as the SACII (South African Career Interest Inventory, Morgan et al., 2015) and the GROP (Research Guide for Career Guidance, Roy et al., 2018).

Taking these inventories as an example, we note the use of a five-point Likert scale, ranging from strongly disagree to strongly agree. The question that arises here is whether the

Likert scale alone adequately rank Holland's six categories could. The five-point Likert scale (or more) undoubtedly favors responses that are not very dispersed, since some subjects tend to respond more often towards the extremes, but the most striking thing is that this response mode does not make it possible to establish a profile of preferences with regard to existing categories of professional interests (Tétreau, 2005), and because we can attribute the same value to all the categories, hence the importance of the ipsative mode in interest questionnaires where we are trying to identify preferences between all the categories proposed.

To this end, the term "preferences" becomes more relevant to this type of test, as described for example in the "Kuder Preference Record, Vocational" (Kuder, 1948), despite the fact that the two terms, preferences and interests, reflect the same meaning, except that the term "preferences" stresses the importance of making comparisons between categories in order to identify those that the subject attaches more importance, in addition, the individual's interests coexist in a hierarchy that reveals a preference for certain activities over others (Savickas et al., 2002). In this respect, if the Holland model is to be adopted to design a scale of career preferences, we need to consider how we wish to measure the relationships between the six dimensions relating to the above model, as well as the appropriate methods for verifying their homogeneity.

It is true that Holland's model has a limited number of dimensions, and that the classification proposed 60 years ago still allows us to target all occupations and training courses, but the problem with this model is the study of homogeneity across these six dimensions. Taking the "Realistic" dimension as an example, in previous studies we have obtained low internal consistency indices for this scale, in contrast to the studies presented in the literature.

In fact, the response mode can influence the homogeneity indices of the scales, especially when it comes to expressing preferences using the ipsative response mode. The nature of the response thus becomes absolute, so that the choice of an outdoor activity linked to the "Realistic" category, for example, will not certainly imply the choice of a mechanical activity which comes under the same dimension, whereas Kuder had already adopted two independent categories in this sense, those of "outdoor" and "mechanical", this means that a general interest can represent specific interests (Tétreau, 2005).

On these issues, it is appropriate to design a scale of professional presences which is part of a double objective: on the one hand, to propose a 15-sub-factor model based on Holland's theory, making it possible to accurately measure occupational preferences through the relationships between Holland's six dimensions, while using an 'ipsative-Likert' response mode. The study of internal homogeneity will be carried out independently on all the sub-factors. On the other hand, we would like to propose an integrative questionnaire that can be used in the political context of the post-baccalaureate courses available in Morocco and that provides as much information as possible that will be of benefit to guidance counsellors or to the subjects themselves in interpreting the results obtained.

Holland's model (Link between interests and values and personality)

Holland's model (1997) stipulates the existence of six categories of professional interest (Realistic, Investigative, Artistic, Social, Entrepreneurial, Conventional), so expressing preferences implies that we will be led to make comparisons between the six categories (Picoche & Rolland, 2002), to do this we would be interested in the value system which affirms actions (Château, 1985) and which influences the comparisons made (Vrignaud & Bemaud, 2005c). In real terms, a value is a representation that an individual makes of an objective that goes beyond specific situations and expresses interests (Schwartz & Bilsky, 1990), In the same sense, Super defines interests as the specific activities that make it possible to achieve the values (Tétreau, 2005) hence the complementary nature of the two concepts of interests and values.

Obviously, if we know what the subject considers important, we can directly deduce their values (Descombes, 1977). However, the notion of vocational interests implies the use of purely vocational values as stimuli, although these values are considered as the results of interaction between "nature (i.e., genetic)" and "the environment", personality traits are considered only as a product of "nature" (Grankvist & Kajonius, 2015), however the use of some personality traits will also be useful since some additional dimensions of interests have been constructed with the aim of measuring aspects of personality (Vrignaud & Bemaud, 2005b). Holland in this sense had already provided descriptions for the six categories by values and specific personality traits, and the links between these three components have been well described (Ackerman & Heggestad, 1997), which allows to focus on only one built at a time (Armstrong & Rounds, 2010), but the question that arises at this level is whether these descriptions and links remain in force in the Moroccan socio-cultural environment and whether they can be used as stimuli for evaluation and this despite the fact that they do not appear to have been organized within a strict explanatory model (Forner et al., 2006).

In response to this question, further studies were undertaken to investigate the relationships between Holland's career interests, values, and personality in a sample of Moroccan students and to draw conclusions for comparison with Holland's description of the six dimensions of his theoretical model and to judge its validity. The correlation analyses carried out subsequently demonstrated results like those presented in the literature.

As regards the correlations between big-fives and Holland types, we found that the two types 'Realistic' and 'Conventional' are linked to conscientiousness, the two types 'Investigative' and 'Artistic' are linked to openness, while the last type is negatively linked to conscientiousness, and finally the two types 'Enterprising' and 'Social' are linked to extraversion, while the last type is also linked to agreeableness. Concerning the correlations between Holland's values and types: six professional values (Salary, Freedom-Autonomy, Job Security, Prestige, Organization, Problem Solving) were tested on the same sample using the PVI (Professional Values Inventory, Legres & Pemartin, 1986). The prognostic links presented in Table 1 are consistently consistent with the direction predefined by Holland and can be adopted as stimuli for the construction of the career preference scale.

Holland's professional profiles

The measurement of vocational preferences is part of post-baccalaureate educational and vocational guidance activities to help students make vocational decisions. In this respect, preference will always precede decision (Pelletier et al., 1974) since the subject is expected to choose a specific path after ruling out others. Holland's notion of vocational profiles makes it possible to determine the appropriate path for each subject by referring to the system of congruence between the two universes: “profile” and “training”.

The universe of professional profiles adopted in our study is that of the 24 combinations formed by the six Holland categories in the form of code pairs, since two-letter codes are the most widely adopted in many resources such as LAF (The Leisure Activities Finder) and make it easier to find and interpret profiles (Greene et al., 2016).

Table 1. Links between the six Holland categories and professional values

	Type of work	Sa	F-A	J	P	O	P-S
R	Working outdoors, using tools and materials, making physical efforts.					+	
I	Research and studies, Finding solutions to problems, Innovation.		+	-			+
A	Art making, Creation, Imagination.		+	-	+	-	
S	Social work, social assistance, Support, Providing care.			+			
E	Decision-making, Management and leadership, Guidance, and persuasion.	+			+		
C	Office work, Routine tasks, Conscientious work.		-	+		+	-

R: Realistic; I: Investigative; A: Artistic; S: Social; E: Enterprising; C: Conscientiousness; Sa: Salary; F-A: Freedom-Autonomy; J: Job security; P: Prestige; O: Organization; P-S: Problem Solving; “+”: attraction observed; “- “: repulsion observed

Table 2. A congruent universe of profiles and post-baccalaureate courses

P-P		Profile description	Training universe	L
R	Ri	He is a realist who places importance on investigative and problem-solving activities	Environment, Quality and Hygiene, Geology, Mining resources, Veterinary medicine, Dental prostheses, medical dosimetry.	Bac+3 Bac+5
	Ra	He is a realist who uses his artistic skills to create unique works of art.	Interior architecture, Traditional architecture, Carved wood, Leather goods, Clothing development, Graphic industry, Printing.	Bac+2 or more
	Rs	He's an amiable realist, characterized by the value of benevolence.	Rescue and safety, Sports, and health management.	Bac or more
	Re	This is a realist who can undertake a wide range of industrial projects, manage teams, and take on responsibility.	Architecture, Engineering: civil, mechanical, electronic, electromechanical, processes and materials, energy and environment, naval sciences, industrial production (textiles, etc.)	Bac+2
	Rc	He is a conformist realist, who attaches importance to the value of the organization. he generally prefers to engage in simple production tasks and guarantee a stable job.	Topography, Building, Embedded systems, Industrial chemistry, Telecommunications, Automatism, Mechatronics, Electromechanics, Civil engineering, Maintenance, On-board electronics, Infantry and armored vehicles, public safety, Automotive, Cooking, Food industry, River navigation.	Bac+2
I	Ir	He is an investigator interested in tangible realities. He finds his passion for work in open spaces (factories, building sites, fields, on board ship, etc.).	Aeronautics, Aviation, Electronics and telecommunications, Mechanical, electrical, and rural engineering, Applied physics, chemistry and biology, Plants and environment, Agronomy, Forestry and protected areas, Industrial biology, Industrial IT, E-logistics	Bac+5 or more
	Is	He is an investigator who devotes his studies to curing human illnesses and injuries.	General medicine, dentistry, pharmacy, military medicine.	Bac+5 or more
	Ic	He's an investigator who shows an interest in office work.	Computer networks, Data science and big data, Modelling and scientific computing, Information systems, Cyber security, Applied math's, Software and computer systems, Geographic information, Multimedia development and mobile applications, Digital engineering for finance, E-management.	Bac+5 or more
A	Ar	He is an artist who likes to add his personal touch to concrete objects.	Arts: plastic arts, drawing and painting, sculpture and engraving, sound and image professions, scenography, photography, traditional weaving, metalwork, industrial design, and production engineering.	Bac+2 or more
	Ai	He is an artist who use their intellectual skills or imagination to produce written work.	Journalism, Translation	Bac+3 or more
	Ae	He is an artist who uses his art as a means of persuasion and influence.	Industrial or advertising design and graphics, Web design, Interpretation.	Bac+3
	Ac	He is a conservative artist, who respects the norms and rules assigned to her.	Archaeology, Anthropology and museology, Cultural heritage, Heritage design, Writing and production, Software use, Editing, Computer graphics.	Bac+2 or more
S	Si	He is a social who is interested in more complex problems that require a certain intellectual level.	Psychological support, Sociology, Pre-school, Early childhood, Neuropsychology, Socio-educational projects, Nursing, Rehabilitation, Childcare.	Bac+3 or more
	Sa	He is a social that shows interest in various activities of animation.	Cultural activities, socio-cultural activities, tourist activities.	Bac+3
	Se	They are social people with a charisma that enables them to influence and coach a person or a group.	Career guidance, Project support: socio-cultural, socio-professional, tourism, educational technologies, medical advice.	Bac+3 or more
	Sc	This is a social worker who prefers routine tasks that could be administrative in nature.	Aid and social assistance, Teaching professions, Delegation for the protection of persons.	Bac+2 or more
E	Er	He's an enterprising who prefers to work in the field	Management: logistics, industrial, logistics engineering, supply chain management, logistics transport, fisheries, army.	Bac+3 or more
	Ea	He is an enterprising of artistic projects	Film production professions, Audiovisual production professions.	Bac+3 or more
	Es	He is an enterprising of social projects	Management and development of social establishments, town, and country planning.	Bac+5
	Ec	He is an enterprising of commercial projects or any project related to economics and management.	Management: human resources, purchasing, finance, organizations, Management: products, tourism, customer relations, human resources, organizations, Strategic marketing, Commerce and communication, international commerce, Entrepreneurship, Competition analysis.	Bac+5
C	Cr	He is a conventional field worker who is interested in production management or control tasks.	Industrial clerk in animal products, Horticulture, Construction materials, Spare parts, Adding value to agricultural or forestry products, Textile production quality, Environmental quality and safety, Urban environment, Construction management, Health techniques: laboratory, radiology, Logistics techniques and operations.	Bac+2 or more
	Ci	He is a conventionalist who is interested in more complex problems that require a certain intellectual level.	Audit and management control, Air traffic control, Web marketing, Finance and accounting, Magistrate, Court of Cassation, Accounting, finance, and tax techniques	Bac+2 or more
	Cs	He is a conventionalist who is interested in management tasks that involve interaction with people.	Justice for families and children, Secretarial work, Banking and insurance professions, Human resources management, Travel agencies, Justice for: companies, insurance companies, banks, public law, Dental or health assistants.	Bac+2 or more
	Ce	He's a conventional manager or influencer.	Business management, SME/SMI, Commercial and communication assistant, Marketing, Legal or notarial assistant, Customs techniques, Management techniques: quality, tourism.	Bac+2 or more

P-P: Professional Profile; L: Level of training; R/a: Realistic; I/i: Investigative; A/a: Artistic; S/s: Social; E/e: Enterprising; C/c: Conscientiousness; Bac: Baccalaureate

And to design a universe of training, the main objective was to list all the post-baccalaureate training courses that fit these 24 combinations. To do this, we inventoried 700 post-baccalaureate courses available in Morocco, corresponding to 100 public university, executive training, and vocational training establishments. We then assigned them RIASEC code dual degrees by referring to the analyses of Holland's profiles and the job descriptions presented in the Operational register of trades and jobs updated in 2021 (Foubert, 1976).

This distribution of codes enabled us towards the end to deduce training families for each of Holland's occupational profiles. Table 2 shows the congruence between the two universes of profiles and training, which will not only make it easier to interpret and use the results of the scale designed, but also to determine the points of attraction and repulsion between the six Holland categories which will be used to make comparisons between them and to deduce relevant activities accompanied by stimuli for the construction of the scale items.

According to Table 2, it seems necessary to clarify certain concepts and methodologies to use this congruence for profile interpretation purposes. The first point to discuss is that of the permutation system which refers to the complementarity of two inverse combinations, since Holland (1997) suggests that an individual of type "Ri", for example, can also accept training courses of type "Ir", which explains why the guidance counsellor will be led to discuss with the subject all the training courses presented simultaneously in the two combinations which are appropriate to him.

Admittedly, six combinations are not presented in table 2, including those that only exist in reverse, such as "Ia", "Sr", "As" and "Ca", due to the saturation of the twenty-four other profiles by all the post-bac courses available. In the case where the respondent is of type "Sr", for example, the guidance counsellor can directly suggest to the subject the courses linked to the "Rs" profile.

The second important point to discuss is that the other two combinations, "Ei" and "Ie", do not include any training. This is explained by the fact that the two dimensions "Enterprising" and "Investigative" do not have clear work environments, as in the case of the "Realistic" type, which refers to outdoor work, or the "Conventional" type, which refers to office work, and even the nature of the work cannot be identified for types "E", "I", as in the case of the "Social" type, which refers to social work, and the "Artistic" type, which refers to artistic work.

It can be seen here that types E and I have more statuses that can be linked to Holland's other four dimensions, so obtaining an EI combination in general is interpreted by the fact that the subject is an "enterprising investigator" in an unspecified field of work. In this situation, it is recommended to target the third letter obtained, more precisely, to target one of the four profiles: “EIr”, “EIa”, “Eis” or “EIc”. For example, if the subject obtains the “EIr” profile, the guidance counsellor will suggest to the subject training linked simultaneously to the “Er”, “Re”, “Ir” and “Ri” profiles.

From a theoretical point of view, we note that the two dimensions 'enterprising' and 'investigator' share similarities in terms of certain professional values beyond those presented in the current study; we find, for example, that certain underlying themes of the 'enterprising' dimension, such as the entrepreneur or the politician, focus on their work environment more on their ideas, which enable them to innovate or solve problems, etc. Whereas some investigators mobilize their creative sense and critical thinking to implement projects or to take on greater responsibilities or become agents of change. Some investigators, on the other hand, mobilize their creative sense and their critical mind to develop projects or to take on greater responsibilities or become agents of change. Nevertheless, there is no confirmed relationship of equivalence between these two dimensions, apart from the fact that the dimensions cited are

opposed in terms of Holland's hexagonal structure. For this reason, this study will also examine the Holland structure in Morocco using appropriate methods.

Following the review of previous research on theories of vocational interest development, a few researchers have concentrated on evaluating the hexagonal structure of Holland's model, while few studies have looked at the appropriate methods for measuring vocational preferences with reference to the model cited, and the nature of the items proposed for evaluation. The objectives of this study are therefore to determine the correct structure and response mode for this type of construct, while bringing together the different approaches and evaluation methods that exist in the literature, on the one hand, and on the other, to design a concise test using the value system to generate consistent items that better promote choices, and finally, to concretize the methods for interpreting the evaluation results from any construct measuring vocational interests through Holland's theory.

Table 3. conventional matrix of 15 bipolar sub-factors

R	I	A	S	E	C
RI	IA	AS	SE	EC	--
RA	IS	AE	SC	--	--
RS	IE	AC	--	--	--
RE	IC	--	--	--	--
RC	--	--	--	--	--

R: Realistic; I: Investigative; A: Artistic; S: Social; E: Enterprising; C: Conscientiousness

Table 4. Overall structure of the scale

Sections	Sub-F	P	Column A	Answer modalities					Column B
				Item A	A and B	indifferent	ne. A nor B	Item B	
Exploratory section	XY	Ep	Item 1 of the dimension X						Item 2 of the dimension Y
Confirmatory section	XY	Cp	Item 3 of the dimension X						Item 4 of the dimension Y

Ep: Exploratory proposition; Cp: Confirmatory proposition; XY: example of a sub-factor

METHODS

Development of a career preferences scale

Overall structure of the scale

The scale adopts a model with 15 bipolar sub-factors underlying Holland's theory of professional interests presented in the Table 3 Table 3. conventional matrix of 15 bipolar sub-factors, to measure the relationships between the six dimensions (Realistic, Investigative, Artistic, Social, Enterprising, Conventional). In fact, the final score for one of the six dimensions described will not be calculated independently (by the direct sum of the scores of the items linked to this dimension) but will be calculated as a function of the scores obtained in the sub-factors that correspond to it. Each bipolar sub-factor is written in the form of two disjoint letters that refer to two of Holland's dimensions. The measurement at the level of each sub-factor therefore anticipates an interest expressed by the respondent towards one of the two poles, i.e., preferring one dimension to another or rejecting them both if we assume that the respondent is not interested in any of the activities proposed in this sub-factor.

The scale is made up of a total of 60 items (4 items for each sub-factor) in the form of professional activities divided equally into two columns, named: column A and column B, forming a matrix structure of 30 rows and two columns, with each row containing two opposite items (one is placed in column A and the second in column B) in the form of a proposition where the response is forced by the choice of one of the following modalities: item A, item B, A and B, neither A nor B, indifferent. Although this response mode (Ipsative-Likert) allows the respondent to easily rank the two proposed activities, they can also accept or reject them or

express their neutrality. This combination of ipsative and Likert modes in three points (for, neutral, against) gives a clearer meaning to the choice given to express preferences and at the same time saves response time by expressing an opinion on two items at the same time.

The scale has two sections presented in the Table 4, the first is an exploratory section, delimited by the first fifteen propositions (from the 1st line to the 15th), called exploratory propositions (Ep), where the opposite items are independent of each other. The second is a confirmatory section, starting with the 16th proposition and ending with the last, called confirmatory propositions (Cp).

Table 5. universe of items

Sub-F/SV	P	Column A	Column B
*RI	Ep	1R. I'd like to repair the flaps on certain machines and vehicles.	2I. I'd like to develop working methods based on the experiences of researchers.
	*Cp	3R. I'd prefer to work as a technician in a military machine maintenance workshop.	4I*. I prefer to further my studies in one of the technical fields and come up with innovative solutions.
SV		Innovation and problem-solving are the values that discriminate between the two dimensions, while the choice of a stable job in the military profession regains the balance of the proposition.	
RA	Ep	5 R. I'd like to work in factories, or in open spaces such as farms.	6A. I like the craft industry and I'm passionate about artwork
	Cp	7 R. I'd rather work in factories where the work is well organized according to pre-established rules.	8A. I prefer the artistic professions because they offer a great deal of freedom of expression and autonomy at work.
SV		Organization and freedom-autonomy are the two professional values that make the difference between the two dimensions, and the distinction between them is easy to spot.	
*RS	Ep	9 R. I'd like to operate and handle machinery.	10S. I'd like to help others and give them advice.
	*Cp	11R. I'd rather be busy to understand how a machine works and its energy sources.	12S *. I'd rather be a sports coach, helping people to develop their physical fitness.
SV		Agreeableness is the social value measured by this sub-factor, but sports coaching itself proportionally represents the 'realistic' dimension.	
RE	Ep	13R. I'd like to drive heavy machinery.	14E. I'd like to carry out my own project despite the risk of bankruptcy.
	Cp	15R. I'd prefer to have a stable job in one of the military specialties such as transport or armored vehicles.	16E. I prefer to have my own brand.
SV		The two values - salary and job security - differ explicitly between the two dimensions, with military-type work regaining the balance between the two choices.	
RC	Ep	17R. I'd like to work in the field (on the high seas or at air bases).	18C. I'd like to work in an office in one of the companies.
	Cp	19R. I'd prefer any job where I get to tinker and use equipment.	20C. I'd prefer any work related to the administrative and legal field.
SV		The difference between the two dimensions can be measured by the nature of the work: office work or outdoor work, and the use of concrete materials.	
IA	Ep	21 I. I'd like to enrich my knowledge through the study and analysis of phenomena.	22A. I'd like to write novels and articles in a creative way.
	Cp	23 I. I'd rather be interested in the development of certain scientific theories.	24A. I'd rather be interested in people's cultures and talk about them in articles and reports.
SV		Both dimensions highlight openness to ideas as a value, one related to research and the other to art.	
IS	Ep	25 I. I'd like to study certain sciences, phenomena and behaviors in greater depth.	26S. I would like to teach others what I have learned and help them learn.
	Cp	27 I. I'd prefer to devote years to study and research in order to develop working methods.	28S. I'd prefer to obtain only a diploma that qualifies me to teach my specialty to students.
SV		This factor highlights the ultimate capacity to generate more knowledge in harmony with research to differentiate between the two dimensions, in addition to the agreeability that is measured explicitly in the Ep.	
IE	Ep	29I. I'd like to solve problems logically and rationally.	30E. I'd like to trade by persuading others to buy a particular product.
	Cp	31 I. I'd rather be proud of having brought new knowledge to the world.	32E. I'd rather be proud to have made significant gains from my business.
SV		The generation of knowledge or money, the salary value, determines the 'enterprising' dimension, whereas scientific research reflects the 'investigator' dimension.	
IC	Ep	33 I. I'd like to be sure of the results by using scientific experiments.	34C. I'd like to organize and process documents and paperwork.
	Cp	35 I. I'd rather be proud of my scientific achievements, even if they are difficult to achieve.	36C. I'd rather get an administrative job that doesn't involve difficulties and problems.
SV		The problem-solving value is the main value that makes the difference between the two dimensions.	
*AS	Ep	37A. I'd like to draw, design, and create unusual objects.	38S. I'd like to take part in cultural and early childhood activities.
	*Cp	39A. I would prefer to telework in one of the artistic fields such as computer graphics or motion design.	40S*. I'd prefer to work as a socio-cultural facilitator at events (festivals, trips, etc.).
SV		Contact with people in the workplace is the main value that distinguishes the two dimensions, bearing in mind that socio-cultural work is also an artistic field.	
*AE	Ep	41A. I'd like to take part in the shooting of some films with famous actors.	42E. I'd like to decide what needs to be done and organize the work of others.
	*Cp	43A. I'd prefer to specialize in photography techniques or sound engineering.	44E*. I'd prefer the writing and directing professions to produce films.
SV		This sub-factor offers two choices: Undertake a full artistic project or take part in one of these actions.	
AC	Ep	45A. I'd like to express my feelings through my artistic work and be talked about in the media.	46C. I'd like the administrative professions because they require discipline and organization at work.
	Cp	47A. I'd rather produce famous works of art, even if my income isn't stable.	48C. I'd prefer office work with a limited, stable salary.
SV		Prestige, job stability and organization are the values that distinguish the two dimensions.	
*SE	Ep	49S. I'd like to treat patients with organic diseases.	50E. I'd like to lead dialogues and convince others to act in one way or another.
	*Cp	51S. I'd prefer to be involved in providing medical care in hospitals.	52E*. I would prefer to take part in awareness campaigns to convince people to change their behaviors.
SV		This sub-factor offers two choices: undertake social projects or take part in actions relating specifically to medicine.	
*SC	Ep	53S. I'd like to resolve conflicts using dialogue methods.	54C. I'd like working with figures and analyzing data.
	*Cp	55 S *. I'd prefer to work at the customer reception desk to meet customers' needs.	56C. I'd prefer to work in an office isolated from other people so that I can concentrate properly.
SV		Although the two Cp choices suggest office work, the social dimension is characterized by extraversion and agreeableness.	
EC	Ep	57E. I'd like to deal with difficult, urgent and unexpected situations.	58C. I'd like to work according to simple, predefined administrative procedures.
	Cp	59E. I'd prefer to establish the working rules despite the difficulties I may encounter.	60C. I'd rather follow my supervisor's rules at the office by working a few hours a day.
SV		This sub-factor evaluates two dimensions while maintaining a balance between the two choices: undertaking a project/service or working in a conventional way.	

Sub-F: Sub-factor; SV: selection variables; Ep: Exploratory proposition; Cp: Confirmatory proposition; R: Realistic; I: Investigative; A: Artistic; S: Social; E: Enterprising; C: Conscientiousness; *: Bonus item

The difference between the two sections lies in the nature of the items in the confirmatory section, which this time become dependent on more attractive stimuli with the adoption of a more forced response mode by eliminating the choice mode ("A and B"). Acceptance of the two opposite items at the same time in this section therefore becomes impossible. Each bipolar sub-factor comprises two propositions, one exploratory and the other confirmatory, with a total of 4 professional activities that fall under two of Holland's dimensions.

Universe of items

The scale items were selected by referring to Holland's (1997) description presented in the Table 1 and to the descriptions of the 24 occupational profiles presented in the Table 2, while taking into account the attractions and repulsions existing in each bipolar sub-factor (between two of Holland's dimensions) as a function of the nature of the work and the occupational value system in order to assign good stimuli for each proposition. The Table 3. conventional matrix of 15 bipolar sub-factors 5 shows the 60 items divided into the 15 sub-factors and highlights the selection variables (SV) to clarify the reasons for choosing items in each sub-factor.

The bonus items indicated by (*) are items that come under two dimensions at the same time: an explicit main dimension to which it is attributed, and a secondary dimension adopted to better clarify the context of the item in relation to the opposite item.
The bonus items are six in number (item 4; item 12; item 40; item 44; item 52; item 55) and are found only in the confirmatory propositions (Cp).

Correction of the scale

In general, if the item relating to a given dimension is chosen, it will be given a raw score of 2 points; on the other hand, if it is not chosen, it will be given a score of 0; otherwise, the 3rd indifference modality will be applied, assigning it a single point.

The conversion to the response modality adopted in this scale, which is represented in Table 4, leads to the following compilation: (1) If the "item A" mode is chosen: the item in column A (left-hand column) is counted as 2 points, while the opposite item is counted as 0, (2) If "item B" is chosen: the item in column B (right-hand column) is counted as 2 points, while the opposite item is counted as 0, (3) If "A and B" is chosen: each of the two opposite items is scored 2 points, (4) If "neither A nor B" is chosen: both items are scored 0, and (5) If the "indifferent" option is chosen: the two opposing items each score 1 point.

All the items presented in column A (the items whose dimension acronym is written on the left of the binomial letter signifying the sub-factor) undergo a score transformation before the score of the bipolar sub-factor is compiled (Point 2 is converted to 0 and the converse is true, while point 1 remains stable**)**.

The score of a sub-factor is the sum of the scores of the four items presented in the two propositions (Ep and Cp) after converting the scores of the items in column A. The score of a sub-factor varies from 0 to 8 points, so that 5 scores are possible (0; 2; 4; 6; 8), obtaining the two scores 0 or 2, means that the individual expresses more interest towards the left dimension of the sub-factor, contrary if he obtains 6 or 8, the right dimension is more favorable. A score of 4 means that the individual is hesitating between the two dimensions.

The total score for each of Holland's dimensions varies from -20 to +20 over a range of 40 points. However, this score is not calculated by the direct sum of the five bipolar sub-factors within the same dimension, so it is necessary to adopt the general formula indicated below *(1***)** in order to compensate for the score of items whose dimensions have undergone a score transformation, while referring to the conventional writing of the 15 sub-factors adopted in the matrix presented in the Table 3 and taking into account that the acronym of certain dimensions is sometimes placed to the right of the binomial of a sub-factor and sometimes placed to the left

of the binomial of another sub-factor, as in the case of the four dimensions: Investigator, Artist, Social and Enterprising.

$$X = Cs - \sum XY + \sum ZX + Bs \quad (1)$$

The total score of a dimension X is calculated based on a compensation score (Cs) defined in the table 6 and calculated by formula *(2*). The number of sub-factors whose dimension X is written to the right of the letter binomial is multiplied by 8 (the maximum score for a sub-factor) and subtracted from 20 (the maximum total score for a dimension).
The bonus score (Bs) is added to the total score of dimension X without being transformed, depending on the number of items in the indicated dimension.

$$Cs\ (X) = 20 - [(Nbr(YX)) * 8] \quad (2)$$

Table 6. Cs of the six dimensions of Holland

	R	I	A	S	E	C
Nbr (YX)	0	1	2	3	4	5
Cs (X)	20	12	4	-4	-12	-20

Cs(X): Compensation score of X dimension; Nbr (YX): Number of factors written in the form YX; R: Realistic; I: Investigative; A: Artistic; S: Social; E: Enterprising; C: Conscientiousness.

In terms of bonus scores, the 'Realistic' dimension includes two bonus scores for items 4 and 12. The 'Artistic' dimension includes two bonus scores for items 40 and 44, and the 'Social' dimension also includes two bonus scores for items 52 and 55. The formulas for Holland's six dimensions are presented as follows:

$$R = 20 - (RI + RA + RS + RE + RC) + Bs_4 + Bs_{12} \quad (3)$$
$$I = 12 - (IA + IS + IE + IC) + (RI) \quad (4)$$
$$A = 4 - (AS + AE + AC) + (RA + IA) + Bs_{40} + Bs_{44} \quad (5)$$
$$S = -4 - (SE + SC) + (RS + IS + AS) + Bs_{52} + Bs_{55} \quad (6)$$
$$E = -12 - (EC) + (RE + IE + AE + SE) \quad (7)$$
$$C = -20 + (RC + IC + AC + SC + EC) \quad (8)$$

Two indices (index-4; range-riasec) are established to better judge the quality of the response and to clearly interpret an individual's results on this scale.

The index-4 is linked to the sub-factors and is useful for evaluating preferences in each sub-factor independently. Obtaining a score equal to 4 in a sub-factor is a possible case which has several meanings: the individual expresses no interest in the two opposite dimensions or hesitates between them (he chooses dimension X in the Ep and chooses dimension Y in the Cp) or is indifferent in the two propositions. This index is compiled by the formula *(9)* in the form of a percentage, and in this study, we consider that an index-4 greater than 50% is interpreted as high hesitation.

$$Index\ 4 = [(Nbr(sub\ factor) = 4] * 100/15 \quad (9)$$

The range-riasec is an index linked to the interrelationship between Holland's six dimensions and their dispersion on the 40-point scale. If the dimensions are dispersed, then the preferences will be clear and will demonstrate good transitivity. This index is compiled by the formula below *(10*), and we consider that a range-riasec greater than 15 is significant.

$$Range\ riasec = Score\ Max\ (riasec) - Score\ Min\ (riasec) \quad (10)$$

Apparent validation of the scale

The model and the scale items were evaluated and unanimously approved by six expert referees in psychometrics (S.L, K.A, S.Z, H.B, A.G and A.J), exercising their professions as professors in universities and in national guidance training centers. The scale was tested on a sample of ten students to check understanding of the instructions and the psychometric meaning of the items (does the item accurately reflect the dimension being measured not the linguistic meaning).

Administration of the scale

Conditions of administration

In order to obtain data from various Moroccan regions, the scale was administered over a 15-day period in two modes: in person in public secondary schools during collective guidance sessions, and remotely using a Google Forms form, the purpose of the administration and the instructions were highlighted on both versions of the scale (paper, online) and three fields (gender, field of study, email address) were added to the header to collect information related to gender and field of study (the email address was considered for communicating the results of the test).

The scale was administered to a total of 120 students in the final year of the baccalaureate in the classroom, 61 of whom took the test again after a period of 3 weeks between the two administrations. A further 508 data sets were collected using the online administration mode, giving a total of 628 data sets.

Participants

For study reasons, we first cleaned the data to ensure that it was reliable. We therefore opted to use both formulas *(9)(10)* in order to eliminate any bias that might falsify the data (random responses, incomplete responses, etc.). We therefore used only 60% of the data collected for the scale validation study (i.e., 384 data sets), as shown in the Table 7.

Table 7. Percentage of participants by gender and course of study

Cycle of study	Field of study	Male		Female		Total
		Nbr	%	Nbr	%	
high school cycle	Literary field	22	6%	36	9%	15%
	Scientific field	79	21%	133	35%	56%
	Technical field	18	5%	13	3%	8%
	Economic field	16	4%	49	13%	17%
middle school cycle	--	7	1%	11	3%	4%
Total		142	37%	242	63%	100%

The Data Analysis

The results were analyzed using Jamovi statistical software (2022) to check the psychometric qualities of the scale. Internal consistency was checked at the level of each sub-factor independently, subject to discriminant validation (i.e. does the sub-factor make it possible to discriminate clearly between the two opposite Holland dimensions), To do this, the item-test correlations were calculated using the r-Pearson coefficient (i.e. the correlations between the scores obtained for each of the 4 items and the total scores provided by each sub-factor), and the internal homogeneity was calculated using the Macdonald coefficient (ω).

The reliability of the scale was verified by adopting the test-rest, subject to a structural validation (i.e. does the structure of the scale allow the results to be preserved over a given time interval) for this purpose, the r-Pearson coefficients were calculated for the six Holland dimensions between the results of the first and second tests.

As for concurrent validity, this was examined for exploratory purposes by relating the dimensions of interest to other information about the subjects (Vrignaud, 2005) (the subjects' gender and fields of study) to compare the results obtained with those in the literature.

For the "Gender" variable, many researchers have emphasized the differences in interests between the sexes, particularly with regard to the things/people dimension (Rounds & Day, 1999), Lacerbeau (1982) contrasts in this sense scientific, technical and sporting interests (the average for men is higher) with artistic and social interests (the average for women is higher) (Forner et al., 2006), but the application of interest inventory review procedures can reduce gender differences for certain interests (Su & Rounds, 2020).

For the variable (field of study), we classified the fields of study according to interests (Vrignaud, 2005), as follows: the literary field corresponds to the social type, the scientific field corresponds to the investigator and realist types, the technical field corresponds to the realist type, and the economic field corresponds to the enterprising type.

The statistical tests used for this analysis are the t-test for the variable (gender) and the Anova for the variable (field of study), to compare means between groups for each of Holland's six dimensions, and de the data were then visualized in a two-dimensional scale to verify Holland's hexagonal model.

All these analyses were carried out using the raw scores obtained after transforming the scores, and the compilation was carried out automatically using a correction grid programmed with Excel macros.

RESULTS AND DISCUSSION

Correlations item-test

The Table 8 shows the item-test correlations of the 60 items with the 15 sub-factors to which they belong. Each item correlates significantly (p<.001) with the total score of the sub-factor to which it belongs.

Table 8. correlations item-test of the sub-factors

Sub-F		Items				Sub-F		Items			
RI	n° of item	1^{R}	2^{I}	3^{R}	4^{I}	IC	n° of item	33^{I}	34^{C}	35^{I}	36^{C}
	r-Pearson	0.646***	0.675***	0.702***	0.700***		r-Pearson	0.611***	0.629***	0.796***	0.805***
RA	n° of item	5^{R}	6^{A}	7^{R}	8^{A}	AS	n° of item	37^{A}	38^{S}	39^{A}	40^{S}
	r-Pearson	0.570***	0.666***	0.724***	0.755***		r-Pearson	0.629***	0.677***	0.759***	0.751***
RS	n° of item	9^{R}	10^{S}	11^{R}	12^{S}	AE	n° of item	41^{A}	42^{E}	43^{A}	44^{E}
	r-Pearson	0.689***	0.669***	0.808***	0.745***		r-Pearson	0.541***	0.611***	0.638***	0.517***
RE	n° of item	13^{R}	14^{E}	15^{R}	16^{E}	AC	n° of item	45^{A}	46^{C}	47^{A}	48^{C}
	r-Pearson	0.710***	0.729***	0.823***	0.805***		r-Pearson	0.647***	0.692***	0.785***	0.768***
RC	n° of item	17^{R}	18^{C}	19^{R}	20^{C}	SE	n° of item	49^{S}	50^{E}	51^{S}	52^{E}
	r-Pearson	0.627***	0.731***	0.717***	0.756***		r-Pearson	0.722***	0.607***	0.854***	0.803***
IA	n° of item	21^{I}	22^{A}	23^{I}	24^{A}	SC	n° of item	53^{S}	54^{C}	55^{S}	56^{C}
	r-Pearson	0.622***	0.626***	0.773***	0.793***		r-Pearson	0.565***	0.634***	0.776***	0.783***
IS	n° of item	25^{I}	26^{S}	27^{I}	28^{S}	EC	n° of item	57^{E}	58^{C}	59^{E}	60^{C}
	r-Pearson	0.694***	0.569***	0.763***	0.700***		r-Pearson	0.678***	0.617***	0.710***	0.719***
IE	n° of item	29^{I}	30^{E}	31^{I}	32^{E}						
	r-Pearson	0.624***	0.704***	0.832***	0.846***						

Sub-F: Sub-factor; ***p<.001; R: Realistic; I: Investigative; A: Artistic; S: Social; E: Enterprising; C: Conscientiousness

Test-retest reability

The Table 8 shows the correlation coefficients between the two results of the test-retest carried out on a sample of 61 students. The correlation coefficients are significant for all six Holland dimensions (p<.001) and range from 0.708 to 0.82.

Table 9. Test-restest reabilty of six Holland dimensions (N = 61)

	R	I	A	S	E	C
R	0.712***					
I		0.802***				
A			0.741***			
S				0.820***		
E					0.708***	
C						0.773***

***p<.001; R: Realistic; I: Investigative; A: Artistic; S: Social; E: Enterprising; C: Conscientiousness

Internal consistency of 15 sub-factors

The Table 10 shows the Macdonald homogeneity coefficients (ω) (1981) for the 15 sub-factors. 12 sub-factors have acceptable internal consistency (greater than 0.7), while 2 sub-factors (RC; IS) have higher coefficients of between 0.6 and 0.7, and one sub-factor (AE) has low internal consistency.

Table 10. Internal consistency of 15 sub-factors

Sub-F	ω	Sub-F	ω	Sub-F	ω
RI	0.708	IA	0.715	AE	0.475
RA	0.711	IS	0.659	AC	0.716
RS	0.717	IE	0.777	SE	0.765
RE	0.776	IC	0.733	SC	0.712
RC	0.689	AS	0.714	EC	0.709

Sub-F: Sub-factors; "ω": the Macdonald homogeneity coefficients; R: Realistic; I: Investigative; A: Artistic; S: Social; E: Enterprising; C: Conscientiousness

Partial inter-item correlations of the 3 sub-factors

To better analyze the internal consistency of the 3 sub-factors with coefficients below 0.7 (RC; IS; AE), we will proceed to the analyses of the partial inter-item correlations presented successively in Tables 11, 12 and 13.

Partial inter-item correlations for the RC sub-factor

From the Table 11, we can see that item 17^{R} shows a significant correlation (p=0.005 to 0.01) with the two items 19^{R} and 20^{C}, which is less significant than the other significant correlations (p<.001), which means that one of the two items (17^{R} or 20^{C}) needs to be modified.

Table 11. Partial inter-item correlations for the RC sub-factor

		17^{R}	18^{C}	19^{R}	20^{C}
17^{R}	r-Pearson	--			
	P value	--			
18^{C}	r-Pearson	0.470***	--		
	P value	< .001	--		
19^{R}	r-Pearson	0.145**	0.239***	--	
	P value	0.005	< .001	--	
20^{C}	r-Pearson	0.143**	0.348***	0.665***	--
	P value	0.005	< .001	< .001	--

* p < .05, ** p < .01, *** p < .001

Partial inter-item correlations for the IS sub-factor

From the Table 12, we can see that the correlation between the two items 26^{S} and 28^{S} is not significant (p=0.059), which means that one of the two previous items need to be modified.

Table 12. Partial inter-item correlations for the IS sub-factor

		25^{I}	26^{S}	27^{I}	28^{S}
25^{I}	r-Pearson	--			
	P value	--			
26^{S}	r-Pearson	0.327***	--		
	P value	< .001	--		
27^{I}	r-Pearson	0.301**	0.132**	--	
	P value	< .001	0.009	--	
28^{S}	r-Pearson	0.206**	0.096	0.655***	--
	P value	< .001	0.059	< .001	--

* p < .05, ** p < .01, *** p < .001

Partial inter-item correlations for the AE sub-factor

From the Table 13, we can see that the two items relating to the two dimensions do not correlate significantly: (p=0.323) for the "Artist" dimension and (p =0.497) for the " Enterprising" dimension.

The two items 41^{A} and 44^{E} correlated significantly and negatively, and considering that item 44^{E} is a bonus item (it reflects the two dimensions at the same time), it did not clearly differentiate between the two previous dimensions. This means that the four items in this sub-factor need to be revised.

Concurrent scale validation

Independent samples t-test (gender variable)

The two tables (Table 14, Table 15) present the results of the student's t-test applied to Holland's 6 dimensions using two independent samples according to gender (Female = 0; Male = 1). The difference in means is significant for the three dimensions (Realistic; Artistic; Social), although Table 15 shows that female students show more interest in social and artistic occupations, whereas male students prefer more realistic occupations, as well as the results obtained for the 'gender' variable are significant.

Table 13. Partial inter-item correlations for the AE sub-factor

		41^{A}	42^{E}	43^{A}	44^{E}
41^{A}	r-Pearson	--			
	P value	--			
42^{E}	r-Pearson	0.335***	--		
	P value	< .001	--		
43^{A}	r-Pearson	0.051	0.002	--	
	P value	0.497	0.971		
44^{E}	r-Pearson	-0.195***	0.035	0.436***	--
	P value	< .001	0.497	< .001	--

* p < .05, ** p < .01, *** p < .001

Table 14. Independent samples t-test (gender variable)

Holland dimension	Statistics	ddl	p
Realistic	6.238	382	< .001
Investigator	-0.430	382	0.667
Artist	-2.691[a]	382	0.007
Social	-4.522	382	< .001
Enterprising	1.925[a]	382	0.055
Conscientiousness	-0.927	382	0.355

H_a $\mu_0 \neq \mu_1$; [a] Levene's test is significant (p<0.05), suggesting a violation of the condition of equality of variances

Table 15. Group descriptive statistics

Holland dimension	Group	N	Average	Median	Standard Deviation	Standard Error	Differences observed
Realistic	0	142	0.120	0.00	6.79	0.570	M>F
	1	242	-4.017	-5.50	5.95	0.382	
Artist	0	142	-0.401	0.00	5.43	0.456	F>M
	1	242	1.421	1.00	6.91	0.444	
Social	0	142	-0.746	-2.00	7.09	0.595	F>M
	1	242	2.620	2.00	7.01	0.451	

M=Male; F=Female

ANOVA test (field of study variable)

The Table 16 shows the results of the Anova test applied to Holland's six dimensions, using four independent samples relating to the fields of study (Literary field = 1, Scientific field =2, Technical field = 3, Economic field = 4). The difference in means is significant for all four dimensions (realistic, investigative, social, enterprising), as well as the results obtained for the 'field of study' variable are significant.

Table 16. ANOVA test (field of study variable)

Holland dimension		Square Sum	ddl	Mean Squares	F	p
Realistic	Field of study	1237	3	412.3	10.1	< .001
	Residues	14721	362	40.7		
Investigator	Field of study	938	3	312.7	4.99	0.002
	Residues	22693	362	62.7		
Social	Field of study	748	3	249.3	4.77	0.003
	Residues	18928	362	52.3		
Enterprising	Field of study	853	3	284.5	6.99	< .001
	Residues	14742	362	40.7		

Table 17. Post-hoc comparisons (realistic type)

Level of study	-Level of study	Mean Difference	Standard Error	ddl	t	p^{tukey}	Differences Observed
1	-2	-1.19	0.945	362	-1.26	0.590	--
	-3	-3.35	1.419	362	-2.36	0.087	--
	-4	3.16	1.152	362	2.75	0.032	L>E
2	-3	-2.16	1.226	362	-1.76	0.294	--
	-4	4.35	0.904	362	4.82	< .001	S>E
3	-4	6.51	1.392	362	4.68	< .001	T>E

Comparisons based on estimated marginal means; L= Literary field; S= Scientific field; T= Technical field; E= Economic field

Table 18. Post-hoc comparisons (investigator type)

Level of study	-Level of study	Mean Difference	Standard Error	ddl	t	p^{tukey}	Differences Observed
1	-2	-3.375	1.17	362	-2.8769	0.022	S>L
	-3	-0.459	1.76	362	-0.2608	0.994	--
	-4	-0.113	1.43	362	-0.0790	1.000	--
2	-3	2.916	1.52	362	1.9153	0.223	--
	-4	3.262	1.12	362	2.9062	0.020	S>E
3	-4	0.346	1.73	362	0.2004	0.997	--

Comparisons based on estimated marginal mean; L= Literary field; S= Scientific field; T= Technical field; E= Economic field

The post-hoc test adopted, presented in Table 17, shows that students enrolled in the economics field are less interested in realistic-type work, and although students enrolled in the technical field have the highest statistical mean, the differences in means with the other two fields are not significant, which proves the interest of students belonging to the scientific and

literary fields also towards the realistic type. The post-hoc test adopted, presented in Table 18, shows that students enrolled in the science field are more interested in investigator-type work than students in the literature and economics fields. The post-hoc test adopted, presented in Table 19, shows that students enrolled in the literary field are more interested in social work than students enrolled in the other fields.

Table 19. Post-hoc comparisons (social type)

Level of study	-Level of study	Mean Difference	Standard Error	ddl	t	p^{tukey}	Differences Observed
1	-2	3.5612	1.07	362	3.3234	0.005	L>S
	-3	5.1324	1.61	362	3.1902	0.008	L>T
	-4	3.6286	1.31	362	2.7782	0.029	L>E
2	-3	1.5712	1.39	362	1.1300	0.671	--
	-4	0.0675	1.03	362	0.0658	1.000	--
3	-4	-1.5037	1.58	362	-0.9527	0.776	--

Comparisons based on estimated marginal mean; L= Literary field; S= Scientific field; T= Technical field; E= Economic field

The post-hoc test adopted, presented in Table 20, shows that students enrolled in the economics field are more interested in entrepreneurial work than students enrolled in the two fields of literature and science.

Table 20. Post-hoc comparisons (enterprising type)

Level of study	- Level of study	Mean Difference	Standard Error	ddl	t	p^{tukey}	Differences Observed
1	-2	0.419	0.946	362	0.443	0.971	--
	-3	-0.184	1.420	362	-0.129	0.999	--
	-4	-3.683	1.153	362	-3.195	0.008	E>L
2	-3	-0.603	1.227	362	-0.491	0.961	--
	-4	-4.103	0.905	362	-4.534	< .001	E>S
3	-4	-3.500	1.393	362	-2.513	0.060	--

Comparisons based on estimated marginal mean; L= Literary field; S= Scientific field; T= Technical field; E= Economic field

Data visualization

Visualizing the data on a two-dimensional scale is a crucial step in verifying Holland's inter-dimensional relationships through the correlation matrix presented in the table 21 and using principal component analysis, in order to compare the structure obtained with that of Holland's hexagonal model.

Table 21. correlation matrix of six Holland dimensions

		R	I	A	S	E	C
R	r-Pearson	--					
	P value	--					
I	r-Pearson	-0.151**	--				
	P value	0.003	--				
A	r-Pearson	-0.226***	-0.223***	--			
	P value	< .001	< .001				
S	r-Pearson	-0.223***	-0.396***	-0.060	--		
	P value	< .001	< .001	0.241	--		
E	r-Pearson	-0.279***	-0.138**	0.074	-0.229***	--	
	P value	< .001	0.007	0.150	< .001	--	
C	r-Pearson	-0.154**	-0.300***	-0.417***	0.081	-0.270***	--
	P value	0.002	< .001	< .001	0.115	< .001	--

* p < .05, ** p < .01, *** p < .001; R: Realistic; I: Investigative; A: Artistic; S: Social; E: Enterprising; C: Conscientiousness

Table 22. Eigenvalues of components

Eigenvalue (N=384)				Eigenvalue (N=628)			
Component	Eigenvalue	% of Variance	Cumulative %	Component	Eigenvalue	% of Variance	Cumulative %
1	1.6531	27.551	27.6	1	1.6055	26.758	26.8
2	1.4686	24.477	52.0	2	1.4185	23.642	50.4
3	1.1463	19.104	71.1	3	1.1641	19.401	69.8
4	0.9835	16.391	87.5	4	1.0103	16.839	86.6
5	0.7339	12.232	99.8	5	0.7813	13.021	99.7
6	0.0147	0.245	100.0	6	0.0203	0.339	100.0

The Table 22 presents the principal component analysis carried out using Jamovi's PCA Plot module, and the two figures (Figure 1 and Figure 2) present the contributions of the variables using the representative sample for the study (N=384) and using the total sample (N=628) in order to compare the two structures obtained and to further approve the result.

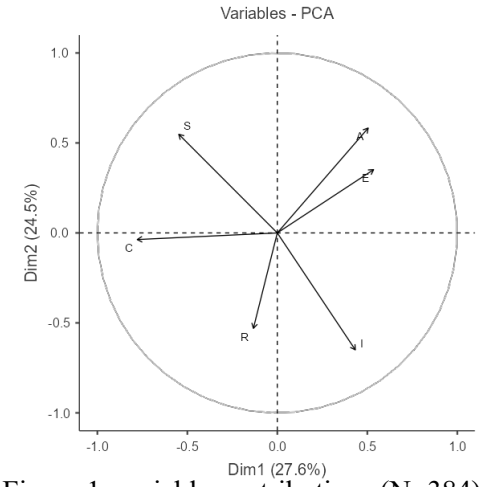

Figure 1. variable contributions (N=384)

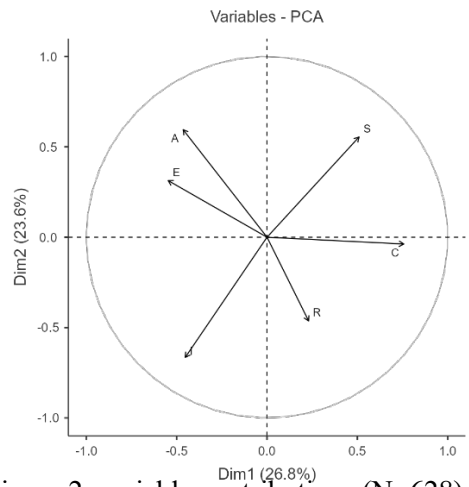

Figure 2. variable contributions (N=628)

From figures (Figure 1 and Figure 2), we can see a similarity between the two structures obtained, with the 6 dimensions distributed in the same way, but different from that presented in the hexagonal structure of Holland (1997), where we find the 6 dimensions distributed according to the acronym "RIASEC", In the figures above, the E dimension (Enterprising) is placed between the two dimensions A (Artist) and I (Investigator), which affects the succession of the 6 dimensions, although the two dimensions S (Social) and (Conventional) are adjacent. As we can see, the two dimensions E (Enterprising) and A (Artist) are closely linked in the two structures presented.

Discussion

The scale (CPS-15F) was developed to give a more concrete picture of an individual's professional interests, through a structure that facilitates choice and discriminates between the dimensions adopted, using a clear response modality (ipsative-Likert). The validation of the structure of the scale verified through the test-retest justifies the role of the response modality, which favors the conservation of choices, unlike a 5-point Likert scale, or the ipsative modality with more than 2 choices. The students expressed their choices freely and without any constraint thanks to the modality adopted, with a passing that does not exceed 15 minutes.

The adoption of 15 sub-factors, whose validity and internal consistency have been verified, has made it possible to prioritize Holland's 6 dimensions while promoting clearer preferences through a system of comparison. 30 items were used to explore preferences, while

the other 30 items confirmed them. Validity and internal consistency were checked at the level of each sub-factor independently, and for several reasons, although the items within the same Holland dimension do not necessarily reflect the same nature of work, the comparison system adopted in this scale focuses on the attraction and repulsion variables concerned by each sub-factor independently, which affects the homogeneity of the items within the same Holland dimension. Inter-item analyses were carried out for the 3 sub-factors showing low internal consistency. This method made it possible to identify the items that needed to be revised following the initial validation of the scale. For this reason, we suggest proposing new 6 items presented in the Table 23, which are also presented in the latest version of this scale in Appendix A.

Table 23. Items modified following analysis

Sub-F	Replaced item	New suggested item
RC	19R. I'd prefer any job where I get to tinker and use equipment.	19R. I'd prefer any job where I get to travel and use equipment.
IS	28S. I'd prefer to obtain only a diploma that qualifies me to teach my specialty to students.	28S. I'd prefer to devote years teaching students my favorite specialty.
AE	41A. I'd like to take part in the shooting of some films with famous actors.	41A. I would like to be present behind the scenes of certain television programs when they are filmed.
AE	42E. I'd like to decide what needs to be done and organize the work of others.	42E. I'd like to manage a team and organize their work
AE	43A. I'd prefer to specialize in photography techniques or sound engineering.	43A. I'd prefer to specialize in photography techniques or sound engineering so that I can take part in film shoots.
AE	44E*. I'd prefer the writing and directing professions to produce films.	44E*. I'd prefer to specialize in writing and directing, to manage an artistic team and distribute their roles.

Sub-F: Sub-factor; *Item bonus; R: Realistic; I: Investigative; A: Artistic; S: Social; E: Enterprising; C: Conscientiousness

It is also important to stress that the internal consistency coefficients obtained could not exceed a certain threshold (0.8 as an example) since the response modalities are different in the two exploratory and confirmatory sections, and taking into account that the scores of items belonging to column A undergo transformations, responses generated using the modality (neither A nor B) will have a negative impact on the internal consistency of the sub-factor.

Apart from the validation of the structure of the scale, the concurrent validation of the scale using the two variables (gender and field of study) showed good consistency with what was present. The students' choices of Holland types corresponded to their fields of study, although gender as a variable made the difference between the "Realistic" and "Social" types of work, since girls tended to choose more social-type occupations and boys tended to choose more realistic-type occupations.

Holland's hexagonal structure was verified in response to the hypothesis that the two dimensions "Investigator" and "Enterprising " share similarities in terms of certain professional values. According to Jung's bipolar typology, Holland's hexagonal model had two bipolar dimensions, namely that the first dimension is formed by four types: the two types of Investigator and Artist are idea-oriented while the two opposite types Enterprising and Conventional are number-oriented, and the remaining two types that form the second dimension, Realist and Social, the first is object-oriented while the second type is people-oriented. The results of this study show, on the contrary, that the enterprising type of this era has become an agent of change thanks to the ideas it has deployed. Nevertheless, an investigator will always be able to make his own proposals thanks to the research carried out and the solutions proposed, so Holland's model remains a relevant classification for all the functions

and professions of the 21st century, but the nature of the work and society's needs in terms of profiles are anchoring new professional values in the dimensions studied.

Appendix A: CPS-15F

The test below will help you to discover your own professional interests. You will find 30 propositions, each of which comprises two opposing items. You will be asked to choose one of the 5 answer modalities proposed by putting a cross (X) in the appropriate box. From the 16th proposition, the modality (A or B) will be cancelled, and you will only have the choice between the 4 remaining modalities.

Sub-F	P	Column A	Modality of answer: Item A / A and B	Indifferent	Neither A nor B	Item B	Column B
RI	P1	I'd like to repair the flaps on certain machines and vehicles.					I'd like to develop working methods based on the experiences of researchers.
IA	P2	I'd like to enrich my knowledge through the study and analysis of phenomena.					I'd like to write novels and articles in a creative way.
SE	P3	I'd like to treat patients with organic diseases.					I'd like to lead dialogues and convince others to act in one way or another
AC	P4	I'd like to express my feelings through my artistic work and be talked about in the media.					I'd like the administrative professions because they require discipline and organization at work.
RS	P5	I'd like to operate and handle machinery.					I'd like to help others and give them advice.
IE	P6	I'd like to solve problems logically and rationally.					I'd like to trade by persuading others to buy a particular product.
SC	P7	I'd like to resolve conflicts using dialogue methods.					I'd like working with figures and analyzing data.
RA	P8	I'd like to work in factories, or in open spaces such as farms.					I like the craft industry and I'm passionate about artwork
IS	P9	I'd like to study certain sciences, phenomena, and behaviors in greater depth.					I'd like to teach others what I have learned and help them learn.
RE	P10	I'd like to drive heavy machinery.					I'd like to carry out my own project despite the risk of bankruptcy.
IC	P11	I'd like to be sure of the results by using scientific experiments.					I'd like to organize and process documents and paperwork.
AE	P12	I'd like to be present behind the scenes of certain television programs when they are filmed.					I'd like to manage a team and organize their work
RC	P13	I'd like to work in the field (on the high seas or at air bases).					I'd like to work in an office in one of the companies.
AS	P14	I'd like to draw, design, and create unusual objects.					I'd like to take part in cultural and early childhood activities.
EC	P15	I'd like to deal with difficult, urgent, and unexpected situations.					I'd like to work according to simple, predefined administrative procedures.
RI	P16	I'd prefer to work as a technician in a military machine maintenance workshop.	please do not tick in these boxes				I prefer to further my studies in one of the technical fields and come up with innovative solutions.
IA	P17	I'd rather be interested in the development of certain scientific theories.					I'd rather be interested in people's cultures and talk about them in articles and reports.
SE	P18	I'd prefer to be involved in providing medical care in hospitals.					I would prefer to take part in awareness campaigns to convince people to change their behaviors.
AC	P19	I'd rather produce famous works of art, even if my income isn't stable.					I'd prefer office work with a limited, stable salary.
RS	P20	I'd rather be busy to understand how a machine works and its energy sources.					I'd rather be a sports coach, helping people to develop their physical fitness.
IE	P21	I'd rather be proud of having brought new knowledge to the world.					I'd rather be proud to have made significant gains from my business.
SC	P22	I'd prefer to work at the customer reception desk to meet customers' needs.					I'd prefer to work in an office isolated from other people so that I can concentrate properly.
RA	P23	I'd rather work in factories where the work is well organized according to pre-established rules.					I prefer the artistic professions because they offer a great deal of freedom of expression and autonomy at work.
IS	P24	I'd prefer to devote years to study and research to develop working methods.					I'd prefer to devote years teaching students my favorite specialty.
RE	P25	I'd prefer to have a stable job in one of the military specialties such as transport or armored vehicles.					I prefer to have my own brand.
IC	P26	I'd rather be proud of my scientific achievements, even if they are difficult to achieve.					I'd rather get an administrative job that doesn't involve difficulties and problems.
AE	P27	I'd prefer to specialize in photography techniques or sound engineering so that I can take part in film shoots.					I'd prefer to specialize in writing and directing, to manage an artistic team and distribute their roles.
RC	P28	I'd prefer any job where I get to travel and use equipment.					I'd prefer any work related to the administrative and legal field.
AS	P29	I would prefer to telework in one of the artistic fields such as computer graphics or motion design.					I'd prefer to work as a socio-cultural facilitator at events (festivals, trips, etc.).
EC	P30	I'd prefer to establish the working rules despite the difficulties I may encounter.					I'd rather follow my supervisor's rules at the office by working a few hours a day.

CONCLUSIONS

The development of a scale for measuring vocational interests that meets students' needs in terms of educational and career guidance is a necessity that has certain peculiarities, namely whether the population of such a country tends to take tests, and to give accurate answers that reflect their profiles. It is also important to make a proper selection of the items according to the educational offers proposed, while adopting clear and discriminating stimuli, and drawing up a list of training courses (and training establishments) classified by Holland's professional profiles will enable the results recorded to be interpreted pertinently. While in other constructs measuring personality traits we use the term social desirability as an index, the professional interest constructs are designated by the differentiation index (spelled in the present study: range-riasec), in addition to the hesitation index (spelled in the present study: index-4) to better judge the quality of the responses recorded, which was properly developed in this study. This scale will be the subject of several other experiments to better approve its validation. Nevertheless, it is recommended that it be digitized in the form of a certified application for

non-commercial use to facilitate the process of correcting and interpreting the results for students.

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AUTHOR CONTRIBUTION STATEMENT

MZ contributed to conceptualization, collecting data, data analysis and manuscript writing. SL contributed to conceptualization, data analysis and manuscript revision.

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