The structural validity of Holland's and Gati's RIASEC models of vocational interests in Mexican students

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Abstract

Introduction. In John Holland's theory of vocational personalities and work environments, the hexagonal model organizes personal and occupational data, and serves to define the degree of consistency in a personality or job environment configuration, as well as the degree of congruence between a person and their environment. The objective of the present study was to analyze the structural validity of Holland's hexagonal model and Gati's hierarchical model in a sample of 636 Mexican high school students, using scores from the Self-Directed Search (SDS).

Method. To analyze model fit, we used the randomization test of hypothesized order relations (RTOR) and non-metric multidimensional scaling (MDS).

Results. The Social personality type presented the highest mean score, followed by the Enterprising type and then the Artistic and Investigative. The lowest mean scores were seen in the Realistic and Conventional types. In relation to the internal consistency, Cronbach's alpha coefficients were acceptable (.765) to good (.845). The results of the RTOR test indicated that Holland's model showed moderate, significant fit (*CI*=.65) to the observed data, and Gati's model showed high fit (*CI*=.778). The MDS solution for the total sample (*Stress* =.01; *RSQ* =.99) showed that the types were distributed according to the RIASEC order, but their spatial arrangment was a misshapen polygon, with the Investigative type located toward the center of the circle. The analysis of fit by gender and school year did not reveal significant differences (*p*>.05), although there was a higher level of fit with students in their final year than with students in previous grades.

Discussion and conclusions. These results provide empirical evidence of the structural validity of Holland's and Gati's RIASEC models in this student sample. These models can be considered an adequate representation of the vocational interests of these students. The results also provide evidence of construct validity of the SDS scores, which has practical implications for the utility of this instrument in vocational and career guidance.

Key words: RIASEC models; Holland; Vocational interests; The Self-Directed Search (SDS); Mexican students.

Resumen

Introducción: En la teoría de los tipos de personalidad vocacional y ambientes laborales de J. Holland, el modelo hexagonal organiza los datos personales y ocupacionales, y sirve para definir el grado de consistencia en la configuración de la personalidad y ambientes de trabajo, así como el grado de congruencia entre una persona y su ambiente. El objetivo del presente estudio fue analizar la validez estructural del modelo hexagonal de Holland y el jerárquico de Gati en una muestra de 636 estudiantes de bachillerato mexicanos, a través de las puntuaciones proporcionadas en la Búsqueda Autodirigida (SDS).

Método. Para analizar el ajuste de estos modelos se aplicó la prueba de aleatorización de relaciones de orden hipotetizadas (RTOR) y se llevaron a cabo escalamientos multidimensionales (EMD) no métricos.

Results. El tipo de personalidad social presentó la puntuación media más alta, a continuación el tipo emprendedor y después el artístico y el investigador. Las puntuaciones medias más bajas correspondieron a los tipos realista y convencional. En relación con la consistencia interna se obtuvieron coeficientes alfa de Cronbach de aceptables (.765) a buenos (.845). Los resultados de la prueba RTOR indicaron un ajuste significativo moderado (*IC*=.65) del modelo de Holland y un ajuste alto (*IC*=.778) del modelo de Gati a los datos observados. La solución del EMD en la muestra total (*Stress*=.01; *RSQ*=.99) mostró que los tipos se distribuyen según el orden RIASEC, pero la disposición espacial entre ellos forma un círculo deforme porque el tipo investigador se sitúa hacia el centro del círculo. El análisis del ajuste según el sexo y curso escolar no indicó diferencias significativas (*p*>.05), aunque los estudiantes de tercero mostraron un nivel de ajuste más alto que los de primero y segundo de bachillerato.

Discusión y conclusiones. Los resultados aportan evidencia empírica de validez estructural de los modelos de Holland y Gati en la muestra de estudiantes. Estos modelos se pueden considerar una representación adecuada de los intereses vocacionales de estos estudiantes. Los resultados también aportan evidencia de validez de constructo de las puntuaciones del SDS, lo cual presenta implicaciones prácticas sobre la utilidad de este instrumento en la orientación vocacional y profesional.

Palabras clave: Modelos RIASEC; Holland; intereses vocacionales; Búsqueda Autodirigida (SDS); estudiantes mexicanos.

Introduction

Holland's theory of vocational personalities and work environments (Holland, 1973, 1985, 1997) is considered to be one of the most influential in vocational psychology (Armstrong, Hubert & Rounds, 2003; Gottfredson, 1999). Founded on extensive theoretical and empirical research, it forms the basis of several instruments that have been widely used for assessing vocational interests in many countries (Fouad, 2007; Nauta, 2010), including Mexico (Sánchez & Valdés, 2007). The fundamental assumption of this theory is that vocational interests are an expression of the individual's personality. Holland (1973, 1985, 1997) postulated that in U.S. culture, people can be categorized into one or more of the following vocational personality types: Realistic (R), Investigative (I), Artistic (A), Social (S), Enterprising (E), and Conventional (C). Similarly, work environments can also be described in terms of one or more RIASEC types. According to this author, personality and work environment interact with each other, so that the influence is bi-directional.

Holland (1973) posed a structural hypothesis concerning the relationship between the six types, called the calculus assumption, whereby the types are organized in the RIASEC order in a hexagonal configuration, and the differences between the types are inversely proportional to the theoretical relationships between them. Results from early studies on the hexagonal model concluded that the shape of the relations between the RIASEC types and environments was more consistent with a "misshapen polygon" (Holland, 1985, p. 119). Other authors indicated that the configuration matches the definition of a circumplex (Tracey & Rounds, 1993). Two variations of circumplex structures can be distinguished: a quasi-circumplex model and a circulant model. The former --also called the circular order model or Holland's model-- assumes different distances between adjacent types, while the circulant model is constrained to equal distances between adjacent types (Armstrong et al., 2003; Tracey, 2000). In Holland's theory, the hexagonal model organizes personal and occupational data, and serves to define the degree of congruence between vocational personality type and one's work environment, as well as the level of consistency in a personality or environment configuration (Holland, 1985). Person-environment congruence is a fundamental construct in this theory. Based on the affirmation that people seek for and join work environments that allow them to exercise their skills and abilities, express their attitudes and values, and choose problems and roles that interest them, Holland (1985) established the hypothesis that a high degree of congruence is associated with vocational satisfaction, stability, and achievement.

Regarding consistency, Holland postulated that a high level of consistency in one's personality configuration is related to a more stable, mature vocational identity, while consistency in the environmental profile promotes stability in that vocational choice.

In addition to the circumplex models, some authors have proposed hierarchical structures to describe the relations between the RIASEC types (Gati, 1991; Rounds & Tracey, 1996). Gati (1991) proposed a hierarchical model formed by three groups (RI, AS, EC) in order to solve certain conceptual and empirical problemas that this author found in Holland's hexagonal model. Gati's model predicts that correlations between types that belong to the same group will be higher than between types from different groups.

Research in U.S. populations on the structural validity of RIASEC models has generally found good fit in Holland's model to the data obtained on different vocational interest questionnaires (Armstrong et al., 2003; Tracey & Rounds, 1993). However, research studies carried out in countries other than the United States show quite diverse results. A meta-analysis conducted by Rounds and Tracey (1996) included 76 RIASEC correlation matrices from 18 countries; most of these matrices showed poorer fit to Holland's model than the levels of fit obtained with a U.S. population. Some more recent studies have obtained better fit to the data using Holland's model in participants from different European countries, such as Iceland (Einarsdóttir, Rounds, Ægisdóttir & Gerstein, 2002), Serbia (Hedrih, 2008), Spain (with a sample of persons from Almería; Martínez-Vicente & Valls, 2001), Germany (Nagy, Trautwein & Lüdtke, 2010), Macedonia and Croatia (Hedrih, Šverko & Pedović, 2018); as well as in African countries (Morgan & de Bruin, 2017) and Asian countries like Korea (Tak, 2004) and Taiwan (Tien, 2009). By contrast, other studies have shown low levels of fit in samples from South Africa (du Toit & de Bruin, 2002), Bolivia (Glidden-Tracey & Parraga, 1996), Spain (with a sample of Basque students; Elosua, 2007) and China (Long & Tracey, 2006). Other research studies carried out in Slovenia, Italy, Japan and Croatia presented mixed results depending on participants' gender (Guglielmi, Fraccaroli & Pombeni, 2004; Martončik & Kačmárová, 2018; Tracey, Watanabe & Schneider, 1997) and age (Šverko & Babarović, 2006).

On the other hand, research studies on the fit of Gati's hierarchical model in U.S. populations have found a slightly lower level of fit than with Holland's model (Rounds & Tracey, 1996; Tracey & Rounds, 1993), while most studies carried out in other countries have ob-

tained better fit with Gati's model than with Holland's model (Einarsdóttir et al., 2002; Long & Tracey, 2006; Martončik & Kačmárová, 2018; Nagy et al., 2010; Rounds & Tracey, 1996; Tien, 2009; Tracey & Rounds, 1993).

Not much work has been done on the validity of RIASEC models in Mexican populations. The only research study is from Fouad and Dancer (1992), whose objective was to make a cross-cultural comparison of the RIASEC structure between equivalent samples from Mexico and the United States, based on scores from Strong's Interest Inventory (Hansen & Campbell, 1985). The samples were made up of male Engineering students and engineers from the two countries. The authors analyzed the circular structure of the RIASEC types, the calculus assumption (circular order model) and the more restrictive equilateral hexagon (circulant model) using the technique of multidimensional scaling. The results indicated a circular configuration of the RIASEC types and confirmed the calculus assumption in samples from both countries, although lower fit was found in the group of Mexican students, given that the C and E types presented an inverse order. On the other hand, the circulant model was not fitted to any of the samples from the two countries. Later, Rounds and Tracey (1996) included the two matrices of Mexican samples from the Fouad and Dancer (1992) study in their meta-analysis on cross-cultural validity of RIASEC models and applied the randomization test of hypothesized order relations (Hubert & Arabie, 1987). The results obtained in the student matrix indicated good fit to the Gati model, and poorer fit to the Holland model. With the sample of engineers, both models were found to have poor fit to the observed data.

The analysis of gender differences in the validity of the RIASEC models has been the object of many research studies, but the results do not allow us to establish any conclusion in this regard. Regarding fit to the Holland model, the meta-analyses carried out in a U.S. population and that have included RIASEC matrices from studies carried out in other countries did not find significant gender differences (Anderson, Tracey & Rounds, 1997; Rounds & Tracey, 1996; Tracey & Rounds, 1993). Neither were such differences found in diverse research studies carried out with students from the United States (Darcy & Tracey, 2007; Tracey & Robbins, 2005), Europe (Einarsdóttir et al., 2002; Nagy et al., 2010), Asia (Long & Tracey, 2006; Tak, 2004; Tien, 2009), Africa (du Toit & de Bruin, 2002) and Latin America (Glidden-Tracey & Parraga, 1996). Other research studies, however, did find gender differences in this model's fit with students from the U.S. (Ryan, Tracey & Rounds, 1996), several European countries (Guglielmi et al., 2004; Martončik & Kačmárová, 2018), South Africa (Mintram,

Morgan & de Bruin, 2019) and Asia (Tracey et al., 1997; Yang, Stokes & Hui, 2005). Most of these studies found this model to show better fit in matrices of women than in matrices of men (Ryan et al., 1996; Hedrih et al., 2018; Martončik & Kačmárová, 2018; Mintram et al., 2019; Tracey et al., 1997; Yang et al., 2005). Regarding fit to the Gati model, the meta-analyses from Rounds and Tracey (1996) and from Long and Tracey (2006) did not find gender differences, nor did the research study by Einarsdóttir et al. (2002). Different results were found in the meta-analysis by Tracey and Rounds (1993), where Gati's model presented better fit in matrices of women than in matrices of men.

Some research studies have analyzed the influence of age in the structure of RIASEC models, with varying results. Šverko and Babarović (2006), Tracey, Lent, Brown, Soresi and Nota (2006), and Tracey and Ward (1998) found greater fit to the Holland model in college students as compared to secondary students; other studies, however, did not find significant differences in fit according to age (Darcy & Tracey, 2007; Long & Tracey, 2006; Nagy et al., 2010; Tracey & Robbins, 2005).

Studying the structure of RIASEC models of vocational interests provides evidence of the validity of the construct that assessment instruments developed from Holland's (1997) theory are seeking to measure. This evidence is particularly necessary for making adequate interpretations when instruments are used in populations other than those for which they were originally intended (American Educational Research Association, American Psychological Association, and National Council on Measurement in Education, 2014). In Mexico, the only research on the structure of RIASEC models is that of Fouad and Dancer (1992), carried out in a sample of participants between the ages of 24 and 34 who had a very specific occupational interest (Engineering), and female participants were not included. These sample characteristics represent a limitation when it comes to generalizing results obtained from this research to other groups of the Mexican population, such as adolescents, women, and people with different occupational interests.

On the other hand, in Mexico there is an adaptation of the Self-Directed Search (SDS) (Holland, Fritzsche & Powell, 2005) that is often used in vocational guidance services (Sanchez & Valdés, 2007), and which has not yet been the object of construct validity studies through analysis of the RIASEC models. This lack of information prompts doubts about ade-

quate score interpretation, specifically about degrees of congruence and consistency, whose interpretations rest on the foundation of the hexagonal model.

Objectives and hypotheses

The objectives of the present study were to analyze the structural validity of two RIASEC models, Holland's circular order model and Gati's hierarchical model, in a sample of Mexican high school students, and to study the differences in validity of these models according to gender and age, using scores provided by the SDS.

Based on results from the Fouad and Dancer (1992) study, the meta-analysis by Rounds and Tracey, and from research studies on this topic conducted in countries other than the United States (Einarsdóttir et al., 2002; Long & Tracey, 2006; Martončik & Kačmárová, 2018; Tien, 2009), significant fit ($p < .05$) to the Holland model is expected, but at a lower level than that found with a U.S. population, and the Gati model will show better fit to the data than the Holland model. No specific hypotheses concerning gender or age differences were established, due to the mixed results of former studies on the influence of these variables.

Method

Participants

The sample comprised 636 students (313 male and 323 female) from four high schools located in Cajeme (Sonora, Mexico) and who were enrolled in first (*n*=188), second (*n*=214) or third year (*n*=234) (comparable to U.S. grades 10, 11 and 12). Age in the total sample ranges from 14 to 19 years (*M*= 16.25, *SD*= 1.05), the mean age in first year was 15.13 (*SD*=.61), in second year 16.13 (*SD*=.59) and in third year, 17.25 (*SD*=.59). Socioeconomic level of the participants' families was medium to low. Intentional, criterion sampling was used (Izcara, 2007); contact was purposely made with the administration of five high schools in Cajeme, four of which agreed to participate in the research. Educational guidance staff at these schools were asked to select groups of students from first, second and third year who were interested in collaborating.

Instruments

The Mexican adaptation of the SDS Form R (Holland et al., 2005) was applied to assess RIASEC personality types and vocational interests. This form is designed for high school

and college students. The SDS is divided into four sections (SDS scales, how to organize your responses, occupational aspirations and what your personal code means). The SDS scales are made up of 228 items divided into four sections: activities, abilities, occupations and skills qualification. The first two sections contain 66 items each, referring to activities and abilities from each vocational type; for each item you must respond, in the first section, whether you would like to do that activity, and in the second section, whether you consider yourself competent in that ability. The occupations section contains 84 occupations that are characteristic of the RIASEC types, the response consists of indicating whether they interest you or not. Finally, skills qualification is made up of 12 skills, where you must indicate your personal level of competence, as compared to others, on a scale from 1 to 7. The SDS is a self-scoring instrument; the scoring procedure is explained in the section on how to organize your answers. In the sections with activities, abilities and occupations, you must count the number of times that you marked the letter "G" (from the Spanish word for like) and the letter "S" (from the Spanish word for yes), while in the skills qualification section, you must record the number that you marked. The sum of the scores corresponding to each type, from all the different sections, produces a total score for that type, and identifies the individual's personal code. Regarding its psychometric properties, the U.S. version obtained high test-retest reliability coefficients for the total scores (between .76 and .89) and excellent internal consistency indices (from .900 to .940). As for concurrent and predictive validity, a generally high level of agreement was found (54.7%) between the highest scoring code and the code of aspirations.

Procedure

Institutional authorization was requested from the high school administrations in order to carry out the research; this authorization was granted and schools proceeded to indicate the student groups that were interested in participating. A psychologist applied the SDS to the groups during normal school hours, during the 2018-2019 academic year. The study fulfilled the ethical code norms of the American Psychological Association (2017): institutional authorization, student's informed consent, confidentiality, and results returned to participants. Family informed consent was not needed based on norms 8.05 and 9.03 of this code, because instrument application was wholly within the activities of the educational guidance subject.

Data analyses

From the initial sample of 662 students, SDS protocols with questionable validity were eliminated, either because they had unanswered items or double-marked items, and/or because

they were answered in an inconsistent way. SDS scores were recorded in the IBM program SPSS Statistics 21 and were submitted to a double verification procedure. RIASEC correlation matrices were obtained for the total sample, for students by gender, and students by year in school.

The randomization test of hypothesized order relations (RTOR; Hubert & Arabie, 1987), using the RANDALL.R statistical program (Tracey, 1997, 2016), was applied to analyze fit to the data for both Holland's and Gati's models. The RTOR consists of a confirmatory analysis of how well any hypothetic model of order relations is fitted to a correlations matrix. This text provides an exact level of significance (p) of the number of predictions met by the data, compared to the null hypothesis of random reordering, and a correspondence index (CI) that is the number of met predictions less the number that were not met, divided by the total number of model predictions --in Holland's model there are 72 predictions (Tracey, 1997), while in Gati's there are 36 (Gati, 1991). The CI value corresponds to a correlation (Somer's D) that falls between -1 and 1, where higher values indicate better fit (Tracey, 2000). This test is one of the most widely used tests for assessing fit in such models (Darcy & Tracey, 2007; Hedrih, 2008), making it possible to compare our results with those of previous research studies. Rounds and Tracey (1996) established certain values to interpret the CI based on calculating 99% confidence intervals of the data obtained in a U.S. reference sample; the lower limit of the confidence interval in Holland's model was .66 and in Gati's model, .60. Differences in model fit were analyzed according to students' gender and year in school using the test from the statistical program RANDMF.R (Tracey, 2016) for differences in fit between matrices. This test offers the same analysis as the RANDALL.R program, but with entry of two matrices.

In order to obtain a graphic representation each personality type's position with respect to the others, we used the multidimensional scaling (MDS) technique from an exploratory, unconstrained approach. This technique has often been used to evaluate the structure of RIASEC types (Darcy & Tracey, 2007; du Toit & de Bruin, 2002; Einarsdóttir et al., 2002). Participants' total scores on the SDS were converted into Euclidean distance matrices, from which nonmetric scalings were carried out, using the ALSCAL procedure of SPSS 21. This procedure provides Stress goodness-of-fit measurements and the squared correlation coefficient (RSQ). Stress measures indicate the disparity between distances in the solution and the transformed data; values fall between 0 and 1, where a zero value indicates perfect fit between

the distances (of the solution) and the transformed data, and values starting from .05 are usually considered acceptable. On the other hand, the RSQ coefficient is the proportion of variance in the transformed proximities that is explained by the distances (of the solution); values close to 1 indicate good fit and are considered acceptable starting at .6 (Davison & Sireci, 2000; Pérez, 2004).

Results

Table 1 presents the descriptive statistics, internal consistency values and intercorrelations matrix of the total SDS scores in the total sample. Personality type S presented the highest mean score, then type E and afterward A and I. The lowest mean scores were seen in types R and C. Regarding internal consistency, Cronbach's alpha coefficients ranged from acceptable (.765 in type C) to good (.845 in type A). Results from the matrix of intercorrelations between the total scores in the six personality types indicate that all correlation coefficients reached values greater than zero, and most of them were significant, falling between .05 (between types R and S) and .71 (between types E and C), with a predominance of low coefficients. Type R had the highest correlation coefficient with C (.39), its adjacent type in the hexagonal model, and the lowest correlation with its opposite, S (.05). Type I had the highest correlation coefficient with type C (.40), which occupies an alternate position, and the lowest correlation with its adjacent A (.26). Type A obtained its highest correlation coefficient with adjacent S (.44) and its lowest correlation with its opposite, C (.16). Type S had the highest correlation coefficients with its adjacent types in the hexagonal model, A (.44) and E (.41), and the lowest correlation with its opposite, R (.05). Type E also presented the highest correlation coefficients with its adjacent types C (.71) and S (.41), and its lowest correlation was with A (.28), in an alternate position. Finally, type C had the highest correlation with its adjacent E (.71) and the lowest with its opposite, A (.16).

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Table1. *Descriptive statistics, internal consistency values and intercorrelations matrix of total SDS scores in the total sample.*

	M	*SD*	*α*	R	I	A	S	E	C
R	19.60	11.02	.821	-					
I	22.38	10.99	.776	.35**	-				
A	23.64	12.07	.845	.26**	.26**	-			
S	27.61	11.22	.778	.05	.30**	.44**	-		
E	24.97	11.80	.802	.36**	.31**	.28**	.41**	-	
C	19.29	11.27	.765	.39**	.40**	.16**	.32**	.71**	-

Note: R= Realistic, I= Investigative, A= Artistic, S= Social, E= Enterprising, C= Conventional.

**$p<.01$.

Results of the RTOR for Holland's model in the total sample indicated that 59 of this model's 72 predictions were met, and one was a tie. The CI was .65 and the *p* value was statistically significant (.017), so the null hypothesis of random relabeling was rejected. Results obtained in Gati's model indicated that 32 of this model's 36 predictions were met. The CI was .778 and the *p* value was not significant (.067). Concerning this aspect, Tracey and Rounds (1993) indicated that the *p* value never reaches values lower than .05 in Gati's model, even though the fit is perfect, due to the few order predictions that are considered in this model, out of the total possible (105).

Table 2 presents results of the RTOR for each gender and results of the test of difference in fit, for both models. Regarding Holland's model, the fit was significant in the matrix of men (*p*= .017) and in the matrix of women (*p*= .033), and the CI values were .569 and .583, respectively. Results of the test of difference in fit of the comparison between the two matrices indicated a similar number of met predictions in each matrix. The level of significance indicates that there were no significant gender differences in this model's fit (*p*= .483). Regarding Gati's model, results indicated better fit to the matrix of women than to the matrix of men. The test of difference in fit of the comparison between the two matrices showed that there were more predictions met in the matrix of women but not in the matrix of men (9), than the reverse case, that is, predictions met in the matrix of men but not in the matrix of women (4). However, these differences do not reach statistical significance (*p*= .267).

Table 2. *Results of the RTOR of SDS scores in the Holland and Gati models for each gender, and results of the test of difference in fit*

	Men				Women				Test of difference in fit				
	Predictions		CI	*p*	Predictions		CI	*p*	Predictions met			CI	*p*
	Met	Tie			Met	Tie			Both	In 1[a] not in 2[b]	In 2[b] not in 1[a]		
Holland's model	56	1	.569	.017	57	0	.583	.033	46	10	10	0	.483
Gati's model	27	0	.500	.133	32	0	.778	.067	23	4	9	.139	.267

Note: [a] matrix of the sample of men; [b] matrix of the sample of women.

Results of model fit in the three school years are presented in Table 3. Regarding Holland's model, the RTOR results indicate significant fit in the matrices of the three school years, and that there is better fit to the data in the third-year matrix (*CI*=.806) than in the first-year (*CI*=.597) and second-year (*CI*=.528). As for Gati's model, the results indicate better fit than with Holland's model for the first-year matrix (*CI*=.778). For the matrices from second year (*CI*=.556) and third year (*CI*=.806), the levels of fit were similar to those with Holland's model.

Table 3. *Results of the RTOR of SDS scores in the Holland and Gati models, according to year in school*

	First				Second				Third			
	Predictions		CI	*p*	Predictions		CI	*p*	Predictions		CI	*p*
	Met	Tie			Met	Tie			Met	Tie		
Holland's model	57	1	.597	.033	54	2	.528	.017	64	2	.806	.017
Gati's model	32	0	.778	.067	27	2	.556	.067	32	1	.806	.067

Table 4 presents results of the test of difference in fit of the comparison between the matrices of the three school years, in both models. None of the levels of significance of these comparisons was significant. Notwithstanding, in Holland's model one can observe how the third-year matrix presented more met predictions than the matrices from first and second year.

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Table 4. *Results of the test of difference in fit of the comparison between school years in the Holland and Gati models*

	First vs. Second					First vs. Third					Second vs. Third				
	Predictions met			CI	*p*	Predictions met			CI	*p*	Predictions met			CI	*p*
	Both	In 1ᵃ not in 2ᵇ	In 2ᵇ not in 1ᵃ			Both	In 1ᵃ not in 3ᶜ	In 3ᶜ not in 1ᵃ			Both	In 2ᵇ not in 3ᶜ	In 3ᶜ not in 2ᵇ		
Holland's model	49	6	4	-.029	.750	55	1	8	.101	.100	52	1	10	.132	.083
Gati's model	26	4	1	-.088	1.00	30	1	2	.029	.467	27	0	3	.091	.200

Note: ᵃ matrix of the first-year sample; ᵇ matrix of the second-year sample; ᶜ matrix of the third-year sample.

The MDS technique was carried out in the total sample matrix and also in the matrices of the three school years, in order to obtain more information about differences in fit as a function of this variable in the RTOR test. The results of the goodness-of-fit measures from the MDS (see Figure 1) indicate that the two-dimension solution provides good fit to the data observed. Stress values ranged from .01 in the total sample matrix to .05 in the third-year sub-sample matrix; therefore, there is a minimal to acceptable disparity between the distances of the solutions and the transformed data. The RSQ values range from .99 in matrices of the total sample, and first- and second-year subsamples, to .97 in the third-year subsample matrix, meaning that between 97% and 99% of the variance of the transformed data is explained by the distances in the solutions.
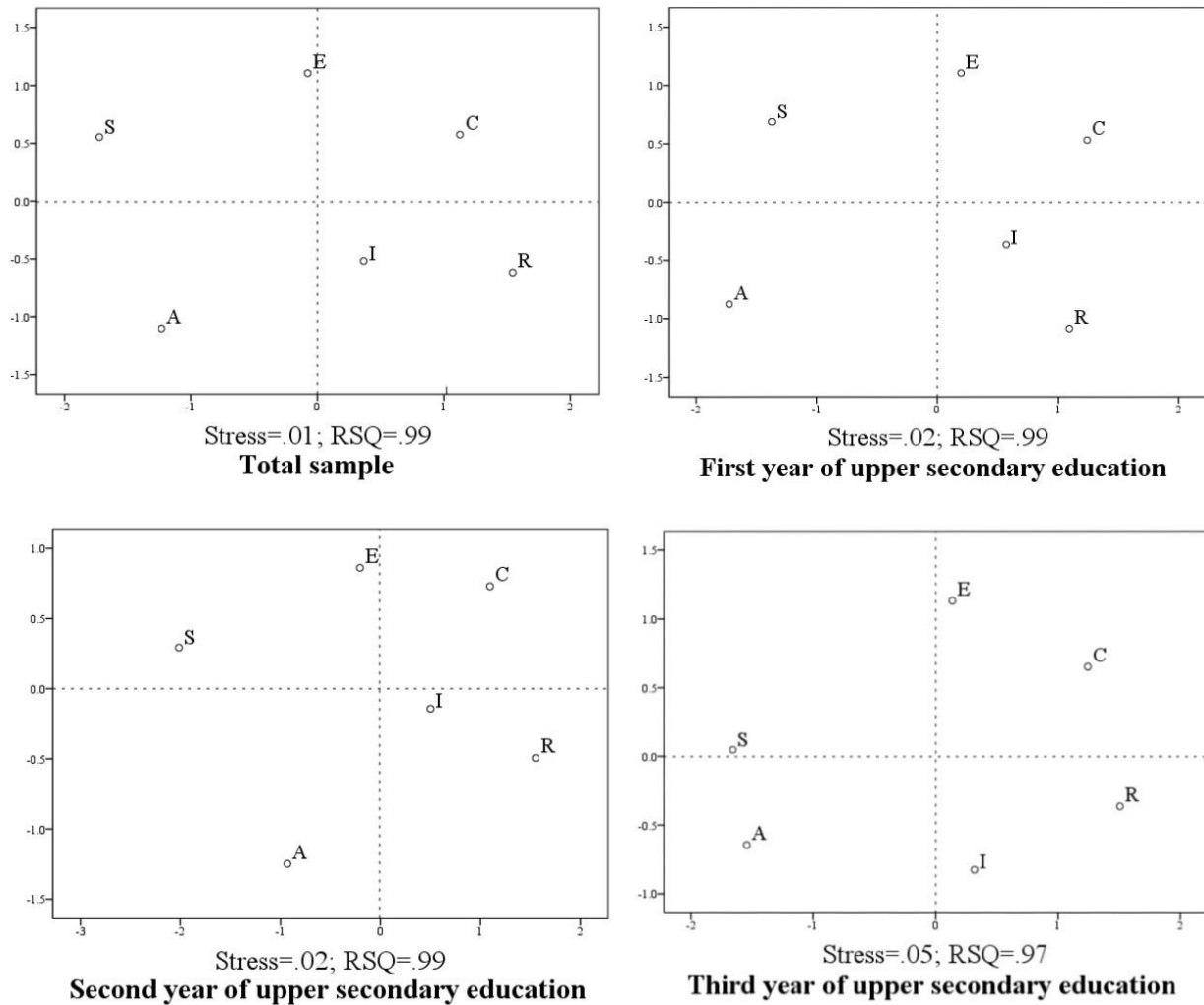
Figure1. *MDS solutions of the SDS scores in the total sample (N=636), in First year (n=188), Second year (n= 214) and Third year of upper secondary school (n= 234)*

Figure 1 presents two-dimension MDS solutions carried out in matrices of the total sample and of the subsamples of the three school years, and Table 5 presents the disparity matrices resulting from each of these solutions. The spatial representations of the total sample and of the third-year sample show the types distributed in the hypothesized RIASEC order; in second and third years, however, types R and I are inverted. In the solutions for the total sample and for first and second year, the spatial arrangement of the types forms a misshapen polygon. In the total sample, type I is located toward the center of the circle, closer to type C (*disparity*= 1.274) than to A (*disparity*= 1.712); and in the first- and second- year solutions, type I is also located toward the center of the circle, equally close to C (*disparity*= 1.072 and 1.199, respectively) and to R (*disparity*= 1.072 and 1.199, respectively). In third year, howev-

er, type I is no longer located near the center, it is distant from type C and the arrangement of the RIASEC types is not so irregular. In any case, each of the solutions shows the six types in differentiated spatial positions, despite observations from the total sample and first- and second-year samples, where type I appears closer to types R and C than to A. In the graphic representation of third year, types S and A become closer, and types S and E become more distant.

Table 5. Disparity matrix from the MDS solutions in the total sample and according to year in school

	R	I	A	S	E	C
Total Sample						
Realistic (R)	-					
Investigative (I)	1.274	-				
Artistic (A)	2.818	1.712	-			
Social (S)	3.471	2.357	1.712	-		
Enterprising (E)	2.357	1.712	2.490	1.712	-	
Conventional (C)	1.274	1.274	2.892	2.850	1.274	-
First year upper secondary						
Realistic (R)	-					
Investigative (I)	1.072	-				
Artistic (A)	2.824	2.358	-			
Social (S)	3.032	2.209	1.592	-		
Enterprising (E)	2.358	1.592	2.762	1.592	-	
Conventional (C)	1.592	1.072	3.282	2.615	1.072	-
Second year upper secondary						
Realistic (R)	-					
Investigative (I)	1.199	-				
Artistic (A)	2.573	1.863	-			
Social (S)	3.650	2.573	1.863	-		
Enterprising (E)	2.224	1.227	2.224	1.863	-	
Conventional (C)	1.199	1.199	2.831	3.139	1.199	-
Third year upper secondary						
Realistic (R)	-					
Investigative (I)	1.274	-				
Artistic (A)	3.034	2.026	-			
Social (S)	3.191	2.026	1.008	-		
Enterprising (E)	2.026	2.026	2.443	2.026	-	
Conventional (C)	1.008	1.743	3.034	3.034	1.008	-

Discussion and Conclusions

The analysis of structural validity of Holland's and Gati's models, using SDS scores in a sample of Mexican students, showed Holland's model to have moderate, significant fit to the observed data, and Gati's model to have high fit. Regarding Holland's model, RTOR results showed a CI of .65, which is interpreted as moderate, falling one point below .66, the lower limit of the confidence interval of this index, as established by Rounds and Tracey (1996) using an U.S. reference sample. The MDS solution in the total sample matrix reflects this moderate fit: types are distributed according to the RIASEC order, but spatial arrangement between them forms a misshapen polygon, due to type I being located near the center of the circle, closer to type C than to type A. On the other hand, RTOR results in Gati's model indicated a CI of .77, which is interpreted as a high value compared to the .60 lower limit of the confidence interval, as calculated by Rounds and Tracey (1996) using an U.S. reference sample.

The hypothesis whereby we expected Holland's model to show poorer fit than what had been found in research studies using a U.S. population, is accepted in part. A moderate level of fit was obtained, slightly lower than the mean (M=.70) obtained in the meta-analysis by Rounds and Tracey (1996) in a reference sample from the U.S. Some later research studies carried out in European countries also found moderate levels of fit with the SDS (Einarsdóttir et al., 2002) and with other questionnaires of interests (Martončik & Kačmárová, 2018). Note that the CI obtained in the present study is higher than the mean (M=.48) calculated by Rounds and Tracey (1996) in their international meta-analysis sample, higher than the CIs found in the matrices of university students (CI =.54, p=.02) and of Mexican engineers (CI=.50, p=.02; Rounds & Tracey, 1996) and higher than those obtained in other studies carried out in Latin American countries like Bolivia (CI= -.11, p=.67; Glidden-Tracey & Parraga, 1996), Brazil (CI of .51 and .57, p=.02) and Paraguay (CI of .56 and .57, p=.02), the latter two forming part of Rounds and Tracey (1996). The fact that Holland's model has better fit in the present study than what was obtained in these other investigations can be explained by the historical moment at which they were carried out. In the 1980s, when most of the studies included in the meta-analysis (Rounds & Tracey, 1996) were carried out, there were greater socioeconomic and educational differences between the countries; in the past two decades, however, development of technology and mass media has triggered an acceleration of globalization, giving rise to greater uniformity in socioeconomic structures and educational models

across countries (Hedrih et al., 2018). In Mexico, the globalization process was reinforced by establishment of the Free Trade Agreement and by entry into the OECD in 1994, which allowed foreign investment and redefined educational policy guidelines. In Mexican states along the border, like Sonora, there is great cultural influence from the United States, and society has adopted the lifestyle of that culture. This socioeconomic and educational context may be configuring the vocational interests of youth according to a U.S. culture-based model of vocational personalities and work environments.

On the other hand, results obtained with Gati's model allow us to accept the hypothesis that this model would show better fit than Holland's model. This difference in fit between the two models is consistent with the results of related research studies carried out in countries other than the United States (Einarsdóttir et al., 2002; Long & Tracey, 2006; Martončik & Kačmárová, 2018; Nagy et al., 2010; Rounds & Tracey, 1996; Tien, 2009; Tracey & Rounds, 1993). The different level of specification between these two models explains this result. In Holland's model, a greater number of predictions between the RIASEC types (72) are considered; while in Gati, only 36 predictions are considered, most of which are also considered in Holland's model (Einarsdóttir et al., 2002; Long & Tracey, 2006).

Analysis of model fit according to gender did not show any significant differences; in other words, the way that women and men from our sample represent the relationship structure between the RIASEC types is similar. RTOR test results indicated significant fit of Holland's circular order model to data in the matrix of men and in the matrix of women, at a moderate-low level; the level of fit was similar in the two matrices, and the test of difference in fit was not significant. This result falls in line with the group of research studies that did not find gender differences with Holland's circular order model in samples of students from the United States and other countries (Anderson et al., 1997; Darcy & Tracey; 2007; du Toit & de Bruin, 2002; Einarsdóttir et al., 2002; Glidden-Tracey & Parraga, 1996; Long & Tracey, 2006; Nagy et al., 2010; Rounds & Tracey, 1996; Tak, 2004; Tien, 2009; Tracey & Robbins, 2005; Tracey & Rounds, 1993). Similarly, Gati's model did not produce a significant result in the test of difference in fit, even though the matrix of women showed better fit to the model than did the matrix of men. This result is consistent with results obtained in the meta-analysis by Tracey and Rounds (1993).

Regarding differences in fit between the different school years, no significant differences were found. However, the RTOR results in Holland's model showed that the matrix of third-year students presented high fit (*CI*= .806), in contrast to students from first and second year, whose levels of fit were significant but moderate to low (*CI*=.597 and *CI*=.528, respectively). The MDS solutions by year in school reaffirm these differences in fit. The spatial representations in first and second year of upper secondary were similar, corresponding to misshapen polygons. In these two groups, the RIASEC types did not appear in the hypothesized order (types R and I are interchanged) and type I is located closer to C than to A, indicating that these students perceive the activities, occupations and skills in types I and C to be similar -- a result also found by Martončik and Kačmárová (2018) with 14-year-old Slovak students. By contrast, the MDS solution for third-year upper secondary students shows a RIASEC arrangement that looks more like a circle and follows the hypothesized order. This result indicates a possible evolutionary trend of RIASEC structure fit to the sample; this is consistent with results from research studies by Šverko and Babarović (2006), Tracey et al. (2006) and Tracey and Ward (1998). In the third year of upper secondary education, students find themselves transitioning out of the stage of exploration; now they begin to make decisions based on a better knowledge of themselves, of their vocational interests and of the vocational roles in the job market (Super, 1990). In educational guidance classes, these students carry out vocation-related activities, unlike earlier school years that focus on other areas of training (*Secretaría de Educación Pública*, 2009). Some of these activities help students explore their vocational interests and learn about the educational and job offerings in their environment. These elements may have helped increase these students' level of fit to Holland's model.

In conclusion, the results obtained here offer empirical evidence of the structural validity of Holland's and Gati's RIASEC models in a sample of Mexican students in upper secondary education, using their SDS scores. These models can be considered an adequate representation of the vocational interests of these students. Keeping in mind that we obtained a significant, moderate fit to Holland's model and that it has a greater level of specification, we consider that this model can offer broader and more accurate information about relations between the RIASEC types than does the Gati model (Einarsdóttir et al., 2002; Long & Tracey, 2006).

One of the limitations of the present study is the type of sampling used, which limits generalization of our results to other age groups and populations in Mexico. Research is needed that has broader and more representative samples, guaranteeing the stability of the results, and encompassing other age groups, in order to confirm whether the fit of the Holland model follows an evolutionary trend in Mexican population. A second limitation of this study is that only two RIASEC models were analyzed, the Holland and Gati models, neither of which take into account the level of work-related prestige, an important aspect in the perception of vocations. In this line, Tracey and Rounds (1996) proposed the spherical model of vocational interests, which includes the construct of work-related prestige, and Tracey (2002) designed the Personal Globe Inventory to assess vocational interests according to this model. Future research studies could address the translation and adaptation of this instrument and analyze the validity of the spherical model in Mexican populations.

As for implications of these results, they have contributed to our knowledge about the cross-cultural validity of RIASEC models, in students from a country with little research on this topic. Moreover, we contribute new evidence of the construct validity of the SDS adaptation for Mexico, further establishing the utility of this instrument in vocational and career guidance. This adaptation of the SDS seems to be a useful instrument for assessing these students' vocational personality types, degree of type consistency, and degree of congruence between their personality type and their work environment.

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