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# Comparing a Fuzzy Hybrid Approach with Invariant MGCFA to Study National Identity

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**Abstract:** National identity studies diverge on several issues, such as the number of factors and their respective items' adscription. Multi-Group Confirmatory Factor Analysis (MGCFA) is the standard method applied to cross-national datasets. Differences between groups can be the result of measurement artefacts. We argue that these problems can be better addressed by an alternative approach that builds a synthetic indicator named Relative National Identity Synthetic Indicator (RNISI), based on a Fuzzy Hybrid Analysis (FHA). The study aims to shed some light on the study of the latent variable national identity by comparing two methodologies: the classic method most often used (MGCFA) and the Fuzzy-Hybrid Approach, which, to our knowledge, has not been previously applied. This empirical study was based on a dataset from across ten countries using two waves (2003 and 2013) of the International Social Survey Programme (ISSP). The FHA results were compared with those obtained by two MGCFA models in which national identity was built as a second-order construct that depends on the ethnic, ancestry and civic first-order latent variables. The comparison lets us conclude that FHA can be considered a valid tool to measure the national identity by groups, and to provide additional information in form of elasticity figures. These figures can be employed to analyse the indicator's sensitivity by group and for each of the items included in the national identity construct.

**Keywords:** national identity; International Social Survey Program (ISSP); ethnic identity; civic identity; ancestry identity; Fuzzy-Hybrid Analysis; TOPSIS



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## 1. Introduction

Modern states, nations and countries vary in the origin and the composition of national population majorities, such as linguistic, ethnic, and religious groups. For this reason, national identities, and the degree of attachment to the nation have been developed very differently in the historical course of each country in which migration and globalization have been affecting the national identity formation [1,2]. Kunovich [3] contended that some nationals could even develop such a strong nationhood identity that it makes them restrictive regarding the foreigners' naturalization process. Based on data from two waves of the International Social Survey Program (ISSP) in 2003 and 2013 for ten countries (Denmark, France, Germany, Ireland, Norway, Portugal, Russia, Spain, United Kingdom, and the United States), the current study analyses the national identity construct with the use of two well-known methodologies: Multi-group Confirmatory Factor Analysis (MGCFA) and a Fuzzy Hybrid Analysis (FHA).

The first method is based on latent constructs, which are unobserved variables that are usually measured indirectly using several items or indicators in a questionnaire. It is an econometric method that needs to be estimated and several assumptions are implicitly made about the error distributions. It also needs to test measurement equivalence for the

analysis of the main differences observed between groups in order to obtain reliable results that are not a consequence of measurement biases [4–7]. On the other hand, the essence of the second method is analytical, and it is mainly based on the properties of the Fuzzy Set Theory (FST). The method is well-known and has been applied to measure latent constructs in many fields such as the hotel industry [8], education [9], supplier selection [10], and Green energy [11]. Martín et al. [12] argued that FST is a good analytical tool to analyse construct formation as researchers could not find a unique objective function to measure latent concepts that are common in social science.

There is already extensive academic literature that has studied nationhood, grounding the concept under different social theories, such as the distinction made between civic and ethnic dimensions that are aligned with the ideas of state and cultural nations. However, Larsen [13] argued that "the distinction is conceptually unclear, too simple to capture the complex nature of perceptions of nationhood and of little relevance for contemporary attitudes to migration (p. 970)".

The measurement of national identity at the transnational level suffers from methodological and comparability problems, which have caused great controversy in the past. The literature widely adopts methodologies that limit the results comparison, such as the MGCFA [14]. For this reason, this study introduced a new methodological approach in the study of National Identity, the Fuzzy-Hybrid Approach, which is more flexible and permits the comparison of the results at national level. Moreover, the paper presented here contributes more to the debate on the study of nationhood from an empirical perspective providing a new methodological approach that has not been commonly used in the field. Consequently, the main goal of the study was to analyse whether the Fuzzy Hybrid Approach is applicable in the field of the social sciences, using the case of nationhood analysis. Additionally, the study aimed to investigate to what extent FHA results are near other robust invariant MGCFA measurements.

The main contribution of the current paper is to show that alternative methods based on fuzzy logic approaches can be used in the field of social science beyond the more traditional methods used in the literature, such as cluster analysis and MGCFA. We apply an FHA approach providing empirical evidence that the well-known FHA can be applied in this field without producing any distortion on the basic results obtained by other classical methods. The main advantage of using FHA is that the method is not constrained by the need of having some regular properties that exist in other methods, such as MGCFA, in which the existence of possible items bias and non-invariance needs to be previously studied.

After this introduction, the next section presents the contextualization of the paper with a national identity literature review. Section 3 describes the dataset used in the study. The methodologies are described in Section 4, introducing first the Multigroup Confirmatory Factor Analysis (Section 4.1), and then the Fuzzy Hybrid Analysis (Section 4.2). Results are described in Section 5. Finally, Section 6 presents the main conclusion of the paper.

## 2. Nationhood as a Construct

Segatti and Westle [15] contended that national identity was studied from two different analytical perspectives: political and sociological. Both depart from the positive force that can create a nation integrating the citizens into a modern political entity. Nevertheless, the approaches differ on the focus of the stakeholders involved in the process. The political approach is focused on the political institutions and the national identity is left in the background, meanwhile the sociological approach considers the characteristics that transcend a national identity into a collective identity. The authors aligned these two approaches with the civic/political and ethnic/cultural ideas of nationhood, and they cast some doubts about whether some dimension makes national identity more or less restrictive.

Sinnot [16] analysed trends from a series of cross-national surveys made over a period of 30 years that included questions about national identity, and in some other instances at various subnational and supranational level. The ISSP was one of them, but also relevant

surveys were the following: the European Values Survey and the World Values Survey. The author provided a categorization of national and related identity in mass public opinion studies according to: "(1) the object of identification (national, subnational, or supranational); (2) the nature of the relationship between the respondent and the object; (3) the nature of the response demanded by the question; and (4) the nature of the scale (if any) used in measuring the response (p. 212)". Regarding the third category, the author distinguished between measures based on a ranking or a rating. With respect to the second category, the author found two main types: identification and proximity. The ISSP national surveys were characterized by ratings in terms of proximity. Wright et al. [17] assessed the validity of national identity measures that were widely used with an emphasis on the effects of measuring the scale items through ratings or rankings. The authors concluded that rating measures can be used to find a national identity typology, and that the results are not constrained by using ratings or rankings in the national identity measurement. Miller and Sundas [18] proposed an index to measure national identity as the subtraction of the mean values on ethnic-cultural items (nativity, living, language, religion, and ancestry) and the mean values on civic items (citizenship, respect and feeling).

The ISSP nationhood construct has been broadly studied using different countries and ISSP waves [3,7,18–28]. Civic and ethnic factors have been underpinned on theoretical approaches on nationalism and citizenship. Medrano [27] suggested that these constructs have been taken for granted and that reliability tests need to be applied to contrast them with other theories such as the Weber's ideas on social closure. In this sense, the author admitted that it is necessary to go beyond the group threat and cultural affinity theories. The Weberian approach distinguishes between citizens who present very restrictive preferences to in-group membership (credential's vision of the nation) and those who are certainly laxer (post national citizens).

Medrano and Koenig [28] contended that the prevailing models of nationhood are intertwined with: (1) flexible and restrictive immigration policies; (2) open and xenophobic societies; (3) assimilationist and multiculturalist integration policies; (4) citizenship models dominated either by jus sanguinis or jus soli; and (5) policies that equate immigrants' rights at the same level of citizenship rights. The authors also argued that, in the early 1990s, there was a shift in social research from nationalism to citizenship, and that a Marshallian focus (civil, political, and economic rights) was substituted by a Weberian focus (inclusion and exclusion of the others—out-group citizens).

Now, we analyse pragmatically how different authors have developed the national identity construct based on ISSP data. In all the cases, the operational definition of national identity was based on the responses given to the question: "Some people say that the following things are important for being truly [country-fellow]. Others say they are not important. How important do you think each of the following is? Citizens, then, rate eight indicators from "not important at all" to "very important". There have been different methods to analyse national identity such as simple average means, single indicators, EFA, CFA, and MGCFA. For example, Pehrson et al. [29] analysed the national identity using 31 countries and ISSP 2003 wave, excluding from the dataset the observations with missing values and those citizens who did not possess the citizenship of the country. The authors did not apply any multivariate analysis and they construct the national identity using three of the items discussed in the nationalism literature: citizenship (civic), language (cultural) and ancestry (ethnic). They preferred to use this approach because EFA provided very inconsistent results regarding the factor structures across the 31 countries.

Exploratory factor analysis (EFA) has been usually first applied to obtain very different patterns of factor composition that ranges from one to three factors. The factors have been mainly named as ethnic and civic. Some studies have analysed different countries or countries with different ethnic groups, so EFA have been performed for different groups, and the results obtained also present many differences: stable results [3,7]—for the pool dataset, same structure with different factor loadings [7]—for different countries and

different structure [24–26,29]. In all the cases, the main differences were caused by the number of countries or by the different ethnic groups that exist in multinational countries.

Haller and Ressler [24] showed that the two dimensions of national identity (ethnic vs. civic) did not homogeneously exist in 19 European countries using the ISSP 2003 wave. In fact, the authors found that for seven countries the national identity can be studied with only one factor. For the whole sample, two items, citizenship and feeling, presented high load factors in both dimensions, so the authors concluded that the neat political distinction proposed by the theory was not real at all but was only a non-confirmed illusion. They showed that the distinction between some attributes belonged more to their characteristics regarding whether some of them can be either considered as more or less ascribed or can be related to social and political involvement.

After EFA, the most common method applied has been CFA, in which cross-national measurement equivalence has been analysed through MGCFA. Kunovich [3] included 31 countries in the analysis and began by including only one latent construct to extremely differentiate credentialists from those who are post national individuals. In a second model, two latent constructs were analysed to represent ethnic and civic dimensions. Interestingly, the author found that the two factor solutions was mainly due to two indicators, respect (civic dimension) and ancestry (ethnic dimension). The other six indicators were included in both dimensions. The author also used a multilevel regression to show that national identity affects public policy preferences related to immigration, citizenship, assimilation, and foreign policy.

Heath et al. [25] showed that some differences between countries were due to response rates and other features of survey design and that validity of cross-national comparisons can be jeopardized if some of the existing methodological problems are ignored. The authors showed that several items did not mean the same thing in all countries, so there were lessons to be learnt such as non-response bias or measurement errors to make the results comparable at national level. The authors found with surprise that the item related to citizenship presented a significant loading on ethnic and civic factors, and they concluded that the item was the main cause that distorted more the configural equivalence across the two obtained factors (ethnic and civic). The authors concluded that the result could be in part explained by the different naturalization processes that exist in each country [30].

Davidov [5] was the first to apply MGCFA to analyse the cross-national validity and measurement equivalence of the two dimensions of national identity. It is of interest to highlight that one of the indicators used by [29] (ancestry) corresponded to the highest load factor of the ethnic dimension. On the other hand, respect for the political institutions and laws presented the highest load factor for the civic dimension. The authors decided to discard citizenship status because the item loaded on both factors, and, interestingly, both showed a high correlation, which meant that citizens tended to favour both national identity dimensions at the same time. It is unclear why the authors did not decide to include citizenship in both factors in the MGCFA. In any case, the authors found that there was a varying degree of the importance of religion on the ethnic dimension over different countries that showed that this item meant different things when the authors analysed a full scalar equivalent model. The authors found, for example, that religion was a very important item for ethnic identity in Israel.

Wright [20,21] contended that the national identity module was not well-suited to capturing ethnic and civic constructs of national identity as the majority of the items seem to have an ethnic connotation. The author also distinguished between ascribed and achievable items, and selected ancestry and nativity to represent the ascribed dimension, meanwhile, respect for laws and feeling like a national were selected to represent the achievable dimension. The author did not employ EFA or CFA to analyse the national identity and used the normalized score values for each of the items commented above in multilevel regression models to study a number of hypotheses at country level, which were based on the immigrant population growth, multiculturalism, citizenship, social spending policies and unemployment rate.

Sarrasin et al. [19] analysed the equivalence of a number of MGCFA models for the German and French communities in Switzerland. The authors decided to discard "feeling Swiss" from the analysis because it presented a high loading in both dimensions and for both linguistic groups. In the comparison of latent means, the authors did not find any partial scalar model for which the fit indices changes were acceptable.

Hadler & Flesken [23] analysed whether political party manifestos have had an effect on individual national identity formation analysing three waves of ISSP (1995, 2003 and 2013). They conducted EFA and CFA for the pool and each country datasets. The authors found that only nativity, living and religion loaded constantly in the same dimension, so they decided to use these three indicators to measure a univariate construct that was finally named as "preference for restrictive nationhood". The authors did not discuss the equivalence of the MGCFA, but they calculated the dependent variable as the mean value of the respondents' valid answers given to the three items to reduce the number of missing values.

We end this section with a recent study [22], in which the author analyses the relationship between national identity and globalization. The study was only focused on the ethnic identity, and it included items from four cross-national surveys (ISSP 2013 and 2003, the European Values Study (EVS) 2008, and the World Values Survey (WVS) 2005). The dataset contained 190,421 respondents from 74 different countries. Besides the effort made at the scale of the study, the author decided to avoid the comparability issues and used only one item to represent the ethnic identity (ancestry).

## 3. Data

The datasets for ten countries from ISSP 2003 and 2013 waves (ISSP 2003; 2013) were selected to analyse the national identity. We included the eight indicators that analyse the construct of National Identity which are based on the answers given to the importance of each of them for being truly (country) nationals (CN): (1) to have been born in (country); (2) to have the (country) citizenship; (3) to have lived in (country) for most of one's life; (4) to be able to speak the (country) language; (5) to be (religion); (6) to respect the (country's) political institutions and laws; (7) to feel (country nationality); (8) to have (country nationality) ancestry. The terms in parenthesis were accordingly replaced by the respective country names and, in the fifth item by the dominant religion.

The ISSP coding (from 1 = very important, 2 = fairly important, 3 = not very important, to 4 = not at all important) was reversed so that high scores are aligned with the idea that the characteristic was important to be a truly CN. The final sample contained 27,873 citizens (Denmark in 2003, 1322; Denmark in 2013, 1325; France in 2003, 1669; France in 2013, 2017; Germany in 2003, 1287; Germany in 2013, 1717; Ireland in 2003, 1065; Ireland in 2013, 1215; Norway in 2003, 1469; Norway in 2013, 1585; Portugal in 2003, 1600; Portugal in 2013, 1001; Russia in 2003, 2383; Russia in 2013, 1514; Spain in 2003, 1212; Spain in 2013, 1225; United Kingdom in 2003, 873; United Kingdom in 2013, 904; United States in 2003, 1216; United States in 2013, 1274).

According to Tamir (2020), national identity is a topic that is always much discussed on political agendas. For this reason, the analysis was also reproduced according to the various political orientations. Then, the respondents were divided according to the political preference expressed in the questionnaire. There is a question that asked respondents to place themselves in a value from 0 to 10, where 0 indicates far-left and 10, the far right. This study recoded this scale into five different political orientations, far left (0–1); centre-left (2–4); centre (5); centre-right (6–8); and far-right (9–10).

## 4. Methods

As [31] pointed out, researchers are usually confronted with the kind of hypotheses that might be formulated and the models that need to be applied in the analysis of these hypotheses. The profound debate and controversy created in academia is rooted in the legitimacy of applying different statistical methods to data that are commonly used in

different disciplines in which the measurement theory plays a determinant protagonist. The measurement theory, the nature of the research questions, the transformation of variables, and the statistical models are all intertwined while obtaining meaningful results.

Bartholomew, in the discussion of the paper by Hand [31], emphasized that the majority of scientists saw the philosophical debates of little practical importance, and insisted that social measurement needed a much broader foundation. He finally highlighted that social measurement suffers from an inevitable arbitrariness regarding the choice of indicators, the sampling selection, and the model adequacy. In any case, the ultimate test for the social measurement is based on whether the results translate the qualitative idea into quantitative terms. On the other hand, Gower discussed the paper by [31] with a focus in psychometrics and concluded that there are two important issues to handle in developing social measures: (1) how best to combine values on many variables to produce an overall aggregated value; and (2) how to derive a scale or at least an ordering from multidimensional points.

The aim of multidimensional scaling is similar to that of multi criteria decision making (MCDM) which has benefitted greatly from the research related to Fuzzy Logic. MCDM is considered a subfield of operations research that aims to find a synthetic evaluation of multidimensional performance criteria. Mardani et al. [32] found a total of 413 papers published in 150 journals since 1994 that had applied fuzzy techniques in MCDM. From this total, 79 were based on a hybrid method that also applied TOPSIS proposed by [33].

In this study, we compared two well-known methods that have been used in different fields for constructing operational concepts: the latent variable model and the fuzzy hybrid analysis. Both models aim to obtain a construct which is based on the information provided by multiple observed manifests or indicators. Several constructs such as quality of life [34,35], national identity [19,36], or institutional trust [37,38] have been already built in terms of their constituent components using both methods.

### *4.1. Multi-Group Confirmatory Factor Analysis*

Artificial significant mean differences among a set of subsamples (population segments) may be the consequence of various methodological issues such as organization of the survey, item translations that change the meaning across groups or even respondents' response styles [25,39,40]. In such cases, the results could be biased, and the conclusions could mislead users and practitioners. Steenkamp et al. [40] advised researchers to analyse measurement equivalence as a necessary step before comparing or pooling data from distinct groups.

Measurement equivalence is generally based on a group of tests that goes from the least constrained model (configural base scenario) to the most constrained model (full scalar invariance model). Byrne [41] advised first to analyse via an Exploratory Factor Analysis that the structure (number of factors and patterns of salient and non-salient factor loadings) is similar across groups. Unfortunately, the similarity concept is left to researchers' best judgement, and the results regarding the number of factors and the set of indicators included in each of them has varied substantially. Indeed, [7] recommended researchers to discard those items that could distort configural equivalence as these will likely provoke poor adjustment fits in MGCFA. This practice has rendered that the results could not be easily compared as the studies are neither usually based on the same constructs nor the same items are included in their respective reflective or formative specification. This feature is a very restrictive condition that does not exist in FHA.

The rest of the steps for measurement invariance can be directly tested by MGCFA. Therefore, for example, metric equivalence requires item loadings to be equal. This restriction is scarcely met in real applications, especially if many groups are included in the analysis. For this reason, partial metric equivalence was defined when at least the factor loadings across groups of two items per latent construct are equal [41], and many empirical applications are based on partial metric equivalence rather than on full metric equivalence. In any case, the metric equivalence is insufficient when, as in the present case, researchers

want to compare mean differences. The comparison of latent construct means relies on a more restrictive equivalence—the scalar equivalence, in which the item intercepts are added to the item factor loadings across groups in order to be equal. Scalar equivalence means that there is a pattern of similar high and low scores on the set of indicators, and as this is not normal for some indicators which present a high variability among groups, scalar equivalence is not frequently reached with a large number of indicators [40,42]. Similarly, as before, partial scalar equivalence with two indicators per construct is usually addressed, and researchers tend to frequently rely on partial scalar equivalent scores. Nevertheless, although numerous studies rely on partial scalar equivalence models, there exists a certain controversy regarding whether it is necessary or not to have a full scalar invariance model in order to compare meaningfully the latent mean scores. Sarrasin et al. [19] adopted a pragmatic approach and compared the latent civic and ethnic latent construct means using two models: a partial scalar equivalent model and a full scalar equivalent model. The authors finally came up with a recommendation that latent means comparison can be based on a partial scalar equivalent model if the rank order of the means between the full and partial scalar equivalent models does not fluctuate.

### *4.2. Fuzzy Hybrid Analysis*

Most of the social science constructs are based on responses given under a format of Likert or semantic ordinal scales. Both scales are, in general, used to collect information that is intrinsically vague, and cannot be easily transferred as equidistant crisp numbers [43,44]. Respondents usually face a set of statements with a positive or negative connotation regarding the phenomenon under study, and they evaluate them according to the following format: (1) strongly disagree or not important at all; (2) disagree or not very important; (3) uncertain or neutral; (4) agree or important; and (5) agree very much or very important. The complex steps involved in the mental process that respondents use to answer the questionnaire undoubtedly pose the basis to ascertain that, in most of the cases, the information provided is uncertain or vague, and this is at the core of using fuzzy sets as proxies for the information [45–49]. Zimmermann [49] discussed the distinction between the concepts of probability and possibility, in which the latter was connected with that of membership function in a fuzzy set. The concept presents a peculiar way to define proxy meaning at the time of developing expert systems that are applied in different fields of decision analysis such as MCDM.

Fuzzy Set Theory (FST) is not only appropriate to adjust the vague information provided by ordinal semantic scales, but it has also advanced in multiple applications and disciplines since its origin. In MCDM, the development of mathematical models has resolved a number of different empirical applications in many fields such as hotel industry [8], education [9], supplier selection [10], or green energy [11]. The essence of the application of the FST in MCDM, that analyses scale from a multivariate perspective, resides in that there is no unique objective function to measure latent concepts that are common in social science [12].

The academic literature has increasingly extended the field of study of Fuzzy methodology and TOPSIS analysis. Among them, Akram [50–52] has developed fuzzy set models as a powerful tool for representing fuzziness and uncertainty. Additionally, other more sophisticated extensions, such as complex fuzzy sets, complex fuzzy morphisms, and Pythagorean fuzzy ideals, have been proposed in other fields [53–55].

#### 4.2.1. The First Three Steps

The vagueness of the information is introduced with the use of fuzzy sets, which are based on the membership function $\mu_A(x)$, which are used to proxy the relative truth that exist in the statements that $x \in A$ [32,47,48]. Zadeh [47] contended that fuzzy sets provide the perfect framework to deal with problems in which the source of imprecision is related to the absence of accurate and well-defined indicators rather than the presence of random variables. Zimmermann [49] added that "FST provides a strict mathematical framework

(there is nothing fuzzy about fuzzy set theory!) in which vague conceptual phenomena can be precisely and rigorously studied (p. 5)".

The fuzzy sets that are used in our study are Triangular Fuzzy Numbers (TFNs) that will contain the information matrix of the national identity responses. Salih et al. [56] review the studies that use the keywords 'TOPSIS' or 'technique for order preference by similarity ideal solution' and 'development' and 'fuzzy', and the authors concluded that TFNs are still the most common fuzzy sets used by researchers when they deal with uncertainty and vague information. The TFNs are also known as type-1 fuzzy sets. The TFNs' $\tilde{A}$ are usually parametrized with a 3-uple $(a_1, a_2, a_3)$ in which the extremes of the interval represent the thresholds that determine the possible values for the information, and the mid-point expresses the most likely value.

There are different representations that have been used in different applications. Our study will be based on the following representation (1 = (0,0,50); 2 = (30,50,70); 3 = (50,70,90); 4 = (70,100,100)) that has already been used by [57]. The selected TFNs imply that there is less fuzziness when citizens answer that a particular indicator is considered very important to be a [country] national. In the rest of the cases, it is assumed that the vagueness degree is higher. It can also be seen that TFNs are characterized because their possible values belong to the interval [0, 100]. In each of the categories, the information provided is vague as all the consecutive ordinal semantic points are represented by 3-uples that intersect in some interval. For example, the interval (30, 50) is in the intersection of the first two points (not at all important and not very important). As said, the most likely values are 0 and 50, respectively.

Fuzzy Set Logic Algebra facilitates the aggregation of TFNs. Therefore, it is straightforward to calculate the average TFN for a particular population segment that can be determined by some variable of interest [58]. The properties of algebra guarantee that the average of TFNs is also a TFN. In this study, we will examine 143 different sociodemographic segments that have their origin in the categories obtained for thirteen covariates used in the study, and the average TFN can be obtained for each of these segments of interest. Therefore, a matrix (8, 143) of TFN will be the information matrix that will be used in subsequent steps of the method. This matrix is known as the TFN information matrix, and it contains a lot of information which is difficult to analyse at first glance. Therefore, a defuzzification of the matrix is carried out to synthesize the information before applying other methods such as, for example, the technique for order of preference by similarity to ideal solutions (TOPSIS) [8]. For this reason, the method is known as FHA. Therefore, we transform the fuzzy information matrix into a plausible or more credible real number or crisp value information matrix as uncertainty and information vagueness has been adequately handled.

Chen [59] provided a defuzzification method by calculating the weighted average of the 3-uple that represent the respective TFN of the fuzzy information matrix, giving more importance to the value that, according to fuzzy ideas, contains more truth. Therefore, the defuzzified value is obtained as $\frac{(a_1+2a_2+a_3)}{4}$. The method is also known as the centroid method, derived from the ideas of [60]. It turns out to be a simple method, robust and with good properties. Another method that is equivalent to Chen's proposal, is the total integral value method, where the neutrality function is applied to other judgments either optimistic or pessimistic [12,61].

#### 4.2.2. The Last Four Steps

This section will cover the part of the hybrid analysis which is based on TOPSIS. As explained above, after the defuzzification step, a crisp information matrix V with dimension (8, 143) contains the defuzzified value for each indicator and population group. Consequently, it is now possible to determine the positive and negative-ideal solutions that are observed after the aggregation process. During the data curation, it was explained that all the criteria to measure the national identity were chosen in a way in which higher values were associated with stricter national identity formation. Therefore, in TOPSIS parlance, it

can be said that all the criteria can be considered as benefit values [62]. Consequently, the positive ideal solution is obtained by the maximum figures observed in the whole set of groups, and the negative ideal solution is characterized by the minimum figures.

Once the positive and negative ideal solutions are obtained, the fifth step consists of obtaining the Euclidean distances between each observation and the ideal solutions, as a way to compare the relative distance which will be used to calculate the relative national identity synthetic indicator (RNISI) per each observation. The Euclidean distances, $S_j^+$ and $S_j^-$, measure the distances of the aggregated value of each population segment with respect to the positive and negative ideal solutions respectively. Then, RNISI is calculated as a relative index between the distance, with respect to the negative ideal solution, and the sum of the obtained distances with respect to both ideal solutions, that is $\boldsymbol{RNISI_j = \frac{S_j^-}{S_j^+ + S_j^-} \rightarrow [0,1]}$.

In this way, a particular observation (population-segment) perceives national identity in a stricter way if the relative index is closer to one, and the index can be used to rank all the observations according to the descending order to find which segment is more or less strict with respect to the national identity concept. The logic of the index is clear because the indicator is higher for those segments which are closer to the positive ideal solution and farther from the negative ideal solution.

Finally, the seventh step is used to calculate the elasticities of the index for each population segment with respect to each of the eight criteria included in the national identity formation. The values measure the sensibility of the indicator with respect to changes in the crisp values of each criterion. This information allows us to understand which of the criteria included in the index formation produces more or less changes in the respective indicator. The information also permits to analyse whether some population segments are more or less elastic to some of the criteria. Mathematically, elasticities are calculated as $\boldsymbol{\eta_{ij} = \frac{\Delta\%OTISI_j}{\Delta\%C_i} = \frac{d(OTISI_j)}{d(C_i)} \frac{C_i}{OTISI_j}}$, where $i$ denotes the criterion (1 ... 8) and $j$ the population segment (1 ... 143). In the next section, the results of the study will be presented and compared with those obtained by MGCFA.

## 5. Results

### 5.1. MGCFA

As discussed above, EFAs (principal component factor analyses with a Promax rotation) were performed with R to analyse if similar factor structures were present in the twenty respective population segments obtained from ten countries and two different years. The EFA revealed that the number and content of the dimensions in each region did not have a similar structure across groups, neither in the number of factors, nor in the contents of each factor, or the patterns of salient and non-salient factor loadings. The number of factors ranged from 2 to 4, and the split of the indicators in the factors was not stable, but, in most of the cases, the ethnic and the civic dimensions obtained by previous studies were also obtained. For the pool of the observations, three factors were obtained: (1) the first factor contained the first three indicators to have been born in the country, to have the country citizenship, and to have lived in the country for most of one's life; (2) the second factor contained the indicators 5 and 8 (to practice the majoritarian religion and to have ancestry from the country; and (3) the third factor contained the indicators 4, 6 and 7, which were more related to the civic dimension (to speak the language, to respect the country's political institutions and laws, and to feel country nationality).

Besides the dark prerogatives given by [41], we decided to move on with the analysis of measurement equivalence across the territories under analysis by means of MGCFA using R software. We analysed two different scenarios. First, all the items were assigned to one factor as EFA did not provide any initial similar allocation across countries, and second, we decided to use a second order latent model using the factors obtained for the pool of the data according to the structure provided by the EFA with the pool of observations. The steps discussed above were followed with the idea of being able to compare factor means

across territories and political orientation in case of full or partial scalar equivalent models if those could be achieved.

The adequacy of the model fit was based whenever it was possible following the standard practice in the discipline, that is when: (1) both the comparative fit index (CFI) and Tucker–Lewis index (TLI) were higher than 0.95; and (2) both the standardized root mean square residual (SRMR) and root mean square error of approximation (RMSEA) were lower than 0.05. We depart from these standard values using relatively close values to the reference points mentioned above, as some cases, CFI greater than 0.9 and RMSEA lower than 0.08, were considered acceptable [41]. Meanwhile, the loss and gain in successive measurement invariance steps was based on the differences of the fit indices [39,63]. Thus, equivalence was accepted whenever both the decrease in CFI was equal to or smaller than 0.01 and the increase in RMSEA was equal to or smaller than 0.015 [63,64]. Both studies showed that small changes (between the steps) in CFI and RMSEA reliably indicate that a further step in equivalence is reached. If in any step, the difference of fit indices was outside the recommended values, the constraints on some parameters were relaxed according to the values of the modification indices (MIs) to get a partial measurement invariance equivalent model.

Table 1 shows the initial models that tested configural (pool), configural (group), metric and scalar equivalent models. Unsurprisingly, all the uni-dimensional models presented a very poor adjustment to the data. On the other hand, the initial models for configural (pool), configural (group), metric and scalar models for the 3-factor national identity model presented very acceptable indices for both group variables (country-year and political orientation-year). There were some important differences observed for both group variables. In the first case (country-year), concerning the step of the scalar equivalent models, the differences of CFI did not fall into the acceptance area although the differences 0.014 and 0.027 were not severe, and both models presented a very good fit to the data. On the other hand, for the political orientation-year group, all models presented a very good fit and the differences between the fit indices belong to the acceptance area so they can be considered equivalent.

Therefore, for the case of the territories group, based on MI, equality constraints on item intercepts were released until the fit adjustment was acceptable. Accordingly, intercepts for six items were relaxed, and only for the indicators 1 and 5, the constraints were considered equal. The partial scalar and metric equivalent models are supported by the data, but it is almost never possible to obtain any partial scalar and metric equivalent models. For practical reasons, we also estimated the same structural models for the case of the groups based on political orientation-year and we observed that in both models, the fit adjustment was worse and the changes in CFI were not considered acceptable. Therefore, it can be concluded that territories exhibit very different patterns for national identity, and that partial models in both groups did not result in any fit improvement due to the number of groups and the ordered nature of responses.

The analyses revealed that the intercept of some of the items included in the national identity scale as well as the first order latent variables: ethnic, ancestry and civic were neither equivalent across territories nor across political orientation groups. A non-equivalent intercept indicates a systematic bias, either positive or negative, for measuring the item in each territory. Therefore, researchers should study the possible causes of such results through a better understanding of the particular idiosyncrasies of each country. It is notorious that the specific political debates regarding the naturalization process in each country could reveal further information that could shed light on the issue.

**Table 1.** Fit indices for models that test configural, metric and scalar equivalent models.

| Model | Df | $\chi^2$ | CFI | TLI | RMSEA | SRMR |
|---|---|---|---|---|---|---|
| Configural (pool) | 20 | 8911.5 | 0.847 | 0.786 | 0.133 | 0.076 |
| Configural (MGCFA) | 400 | 7120.4 | 0.891 | 0.848 | 0.116 | 0.054 |
| Metric | 533 | 10,924.1 | 0.832 | 0.823 | 0.125 | 0.104 |
| Scalar | 666 | 27,907.9 | 0.559 | 0.629 | 0.181 | 0.176 |
| Model (3 factors (Ethnic:Ind1–Ind3; Anc:Ind5,Ind8; Civic:Ind4,Ind6,Ind7; Nat.Id (Ethnic, Anc, Civic) | | | | | | |
| Group by country-year | | | | | | |
| Configural (pool) | 17 | 3501.2 | 0.984 | 0.974 | 0.09 | 0.065 |
| Configural (MGCFA) | 340 | 2382.7 | 0.993 | 0.988 | 0.069 | 0.052 |
| Metric | 473 | 6296.7 | 0.979 | 0.975 | 0.099 | 0.081 |
| Scalar | 701 | 14,028.5 | 0.952 | 0.962 | 0.123 | 0.072 |
| Partial.Metric (Ind2 and 7 factor loadings are free) | 397 | 5422.9 | 0.919 | 0.885 | 0.101 | 0.061 |
| Partial.Scalar (Ind1 and 5 intercepts are equal) | 359 | 5422.9 | 0.918 | 0.872 | 0.106 | 0.061 |
| Group by Political orientation-year | | | | | | |
| Configural (pool) | 17 | 3501.2 | 0.984 | 0.974 | 0.09 | 0.065 |
| Configural (MGCFA) | 187 | 3550.2 | 0.985 | 0.975 | 0.089 | 0.066 |
| Metric | 257 | 4524.7 | 0.981 | 0.977 | 0.085 | 0.073 |
| Scalar | 377 | 5261.1 | 0.978 | 0.982 | 0.075 | 0.070 |
| Partial.Metric (Ind2 and 7 factor loadings are free) | 217 | 5299.8 | 0.911 | 0.874 | 0.101 | 0.056 |
| Partial.Scalar (Ind1 and 5 intercepts are equal) | 197 | 5299.8 | 0.911 | 0.861 | 0.107 | 0.056 |

In the analysis of the fits of the subsequent steps, fit indices usually worsen, that is CFI and TLI are lower and RMSEA and SRMR are higher. However, changes in the other direction (i.e., higher CFI and TLI and lower RMSEA and SRMR) are also possible because most fit indices depend also on the number of degrees of freedom. CFI = comparative fit index; TLI = Tucker–Lewis index; RMSEA = root mean square error of approximation; SRMR = standardized root mean square residual.

Table 1 also shows that partial scalar equivalence models fitted the data worse than the full scalar equivalent model. It is still under debate whether the partial equivalent latent variable means are a valid tool to obtain robust results. Byrne et al. (1989) argued that the comparison can be validly made, but [65] was not so convinced regarding this. Meanwhile, [66] and [19] recommended to compare the latent means provided by full and partial equivalent models whenever the Spearman correlation coefficient between the latent variable mean vectors is equal to one, that is the rank order of the means is stable and does not change across the groups. We postpone the comments on the rankings of the latent variable means to the next section in which the results are compared with those obtained from FHA.

### *5.2. FHA*

Table 2 shows the Triangular Fuzzy Numbers and the defuzzified values that represent the total sample analysed in the study. Triangular Fuzzy Numbers contain a lot of information that cannot be easily interpreted, and usually, this is a source of tension and stress for readers who are not familiar with fuzzy set theory. Looking at the values of the respective TFNs, all the TFNs overlap. This is not a surprise, as it shows the essence of fuzzy set theory when information is extracted from the uncertainty created by semantic ordinal scales. For this reason, it becomes necessary to defuzzyfy the information with the centroid method. In this way, it can be seen that the average citizen is certainly stricter with respect to 'speak the language' and to 'respect the political institutions and laws', and less strict with respect to 'process the religion of the majority' and to 'have previous national ancestors in the family'. It is interesting to highlight how some populist parties that have

appeared in some countries did not include ethnic markers in their discourse to distinguish the national boundaries on the in-group and insisted on issues such as language and civic values [67,68].

**Table 2.** Triangular Fuzzy Numbers (TFNs) and crisp clarified values for the total sample.

| Criteria | TFN | Crisp Value |
|---|---|---|
| To have been born in (country) | (49.90, 72.17, 86.77) | 70.25 |
| To have the (country) citizenship | (57.31, 82.05, 92.26) | 78.42 |
| To have lived in (country) for most of one's life | (51.56, 74.45, 88.20) | 72.16 |
| To be able to speak the (country) language | (58.84, 84.21, 93.10) | 80.09 |
| To be (religion) | (30.38, 44.86, 72.17) | 48.07 |
| To respect the (country's) political institutions and laws | (58.57, 83.67, 93.18) | 79.77 |
| To feel (country nationality) | (56.98, 81.58, 92.04) | 78.05 |
| To have (country nationality) ancestry | (43.74, 63.82, 82.18) | 63.39 |

Table 3 shows the ideal solutions and the representative segment of the positive ideal solution (PIS) and the negative ideal solution (NIS). The PIS is characterized by countries (United States, Russia and Norway), political orientation (Far right), and education (Primary school). For the sake of exposition, we have preferred to omit the information for the year from the analysis as the picture was mixed. On the other hand, the negative solution is characterized by citizenship (N), religion (Jewish) and country (Ireland). It is not a surprise that those segments formed the NIS vector as they are likely characterized for being migrants, and then they are less strict regarding the formation of the in-group characteristics as they analyse the issue with a larger empathy from the out-group.

**Table 3.** Positive and negative ideal solutions. National identity scale.

| Attribute | Apos | Segment | Aneg | Segment | % var |
|---|---|---|---|---|---|
| To have been born in (country) | 80.78 | Far right (fascist etc.) _ 2013 | 52.97 | Citizen (N) _ 2003 | 53% |
| To have the (country) citizenship | 87.50 | United States _ 2003 | 62.46 | Citizen (N) _ 2003 | 40% |
| To have lived in (country) for most of one's life | 78.85 | Primary school _ 2003 | 59.29 | Jewish _ 2013 | 33% |
| To be able to speak the (country) language | 88.75 | Far right (fascist etc.) _ 2013 | 49.96 | Ireland _ 2013 | 78% |
| To be (religion) | 70.80 | Russia _ 2013 | 19.80 | Jewish _ 2013 | 258% |
| To respect the (country's) political institutions and laws | 88.13 | Norway _ 2013 | 67.94 | Ireland _ 2013 | 30% |
| To feel (country nationality) | 85.86 | Far right (fascist etc.) _ 2013 | 63.81 | Citizen (N) _ 2003 | 35% |
| To have (country nationality) ancestry | 76.39 | Primary school _ 2003 | 31.58 | Jewish _ 2013 | 142% |

Source: Own elaboration.

Regarding the PIS crisp values, we confirmed that the larger indicator is related to 'be able to speak the language', and the lowest value is related to 'the religion from the majority'. On the other hand, the analysis of the NIS values confirmed the trend observed for the whole population regarding that 'the religion' and 'to have previous ancestors' are the least valued indicators to form the national identity concept. It is also interesting

to highlight that the religion item presents the largest variation between both solutions, meanwhile the discrepancy is the least for the respect to the political institutions and laws.

The ideal solutions can be seen as the extreme cases of two separate worlds. The PIS is related to the extreme national identity or nationalism that is rooted in past symbols, memories and values which are usually invented and linked to in-groups [69]. Meanwhile, NIS would be the representative of cosmopolitanism that blurred boundaries and national identities [70]. Brown and Held [4] contended that cosmopolitanism is aligned with the view that humans form the ultimate unit of moral concern, and that nationality, citizenship, or any other communal affiliation are irrelevant. Hobsbawm [71] even argued that nationalism will be less and less important, and predicted that, in time, the world will become supranational.

Once the ideal solutions were obtained, the Euclidean distances between each segment of the analysis and the ideal solutions were calculated. Based on that, RNISI was obtained for each population segment, and it was used to rank what degree of national identity strictness each population segment has.

Table 4 shows the values of national identity indicators obtained from the application of both methodologies: RNISI obtained from FHA, and MGCFA obtained from the full and partial equivalent scalar models. The table also shows the ranking of each of the models. In this way, it was possible to conclude that regarding the national identity: (1) Ireland and Germany in the 2013 wave were the least strict countries under the FHA method, meanwhile under the MGCFA-FS, the positions were taken by France and Norway in 2003; (2) Russia in 2013 and United States in 2003 were the strictest countries under FHA, and United States in 2003 was again the strictest country in the ranking provided by MGCFA-FS method, but the second strictest position remained with Russia but changed from 2013 to 2003; (3) left political orientations were less restrictive than right political orientations under all the ranking methods that were applied; and (4) it seems that the national identity dynamics showed that there was a less restrictive trend by country and political orientation as in 11 out of 15 cases the index in the year 2013 was lower than in the year 2003.

The analysis of the Spearman correlation index between all the indices obtained permitted us to conclude that there was a significant positive association between all the indices under analysis, and, interestingly, the coefficient between MGCFA-FS and RNISI was higher than between MGCFA-FS and MGCFA-PS. Thus, in the debate of whether the partial equivalent latent variable means are a valid tool to obtain robust results, we conclude here that FHA seems to produce more comparable results to the full equivalent scalar model than partial scalar equivalent models. The Spearman correlation coefficient between MGCFA-FS and RNISI for the political orientation (0.94) was much higher than the same coefficient for the country (0.59), so it became evident that the results could depend on the number of groups under analysis. It is well known that a higher number of groups seem to complicate the analysis of MGCFA.

The section ends with the analysis of the elasticity of the index. This analysis helps in the understanding of what indicators are the most and the least sensitive regarding the national identity formation. Table 5 presents the results by country and political orientation, respectively. For the whole sample, national identity is more elastic with respect to religion and less elastic with respect to the fact that citizens should have lived in the country most part of their life. The analysis by country and indicator was used to conclude that national identity by country was more elastic with respect to language and ancestors, and less elastic with respect to living most of the time in the country. Regarding the countries, it seems that Russia in 2003 and 2013, jointly with United States in 2003 were the least elastic segments of all the countries under analysis. The analysis by political orientation and indicators was similar with respect to the fact that national identity was more elastic with respect to language and ancestors. Meanwhile, the analysis by political orientation group concluded that the far-right wing citizens independently of the year of analysis were the least elastic segment, so it seems that they formed a more cohesive group regarding the national identity than the rest of the groups.

**Table 4.** Relative national identity synthetic indicators (RNISI), MGCFA-FS, MGCFA-PS.

| Population Segment | RNISI | Rank | MGCFA-FS | Rank | MGCFA-PS | Rank |
|---|---|---|---|---|---|---|
| **Country (Year)** | | | | | | |
| Denmark (2003) | 0.6854 | 5 | 0 | 8 | 0 | 12 |
| Denmark (2013) | 0.5513 | 15 | −0.1599 | 12 | −0.1806 | 15 |
| France (2003) | 0.5134 | 18 | −0.6305 | 20 | −0.3672 | 20 |
| France (2013) | 0.5380 | 16 | 0.1553 | 5 | −0.2679 | 19 |
| Germany (2003) | 0.5190 | 17 | 0.0615 | 7 | 0.0632 | 8 |
| Germany (2013) | 0.5111 | 19 | −0.3238 | 18 | −0.1932 | 17 |
| Ireland (2003) | 0.6108 | 10 | −0.2464 | 17 | 0.2807 | 5 |
| Ireland (2013) | 0.4997 | 20 | −0.1703 | 13 | 0.0360 | 9 |
| Norway (2003) | 0.5853 | 12 | −0.5625 | 19 | −0.1880 | 16 |
| Norway (2013) | 0.5690 | 14 | −0.0714 | 10 | −0.1983 | 18 |
| Portugal (2003) | 0.7838 | 3 | 0.2637 | 4 | 0.3274 | 4 |
| Portugal (2013) | 0.6409 | 9 | −0.1710 | 14 | −0.0095 | 13 |
| Russia (2003) | 0.7815 | 4 | 0.2888 | 2 | 0.3326 | 3 |
| Russia (2013) | 0.8279 | 2 | 0.2868 | 3 | 0.4218 | 1 |
| Spain (2003) | 0.6477 | 7 | −0.2116 | 16 | 0.1314 | 6 |
| Spain (2013) | 0.5768 | 13 | −0.1358 | 11 | −0.0337 | 14 |
| Great Britain (2003) | 0.6026 | 11 | −0.2105 | 15 | 0.0234 | 10 |
| Great Britain (2013) | 0.6424 | 8 | −0.0272 | 9 | 0.0226 | 11 |
| United States (2003) | 0.8491 | 1 | 0.6072 | 1 | 0.3402 | 2 |
| United States (2013) | 0.6641 | 6 | 0.0705 | 6 | 0.0940 | 7 |
| **Political Orientation (Year)** | | | | | | |
| Far left (2003) | 0.5765 | 8 | 0.1083 | 6 | −0.0273 | 8 |
| Far left (2013) | 0.4713 | 10 | −0.2005 | 10 | −0.2514 | 10 |
| Left, centre left (2003) | 0.6186 | 7 | 0 | 8 | 0 | 7 |
| Left, centre left (2013) | 0.5196 | 9 | −0.1073 | 9 | −0.2057 | 9 |
| Centre, liberal (2003) | 0.6956 | 5 | 0.1059 | 7 | 0.1257 | 4 |
| Centre, liberal (2013) | 0.6750 | 6 | 0.1212 | 5 | 0.1180 | 5 |
| Right (2003) | 0.7292 | 3 | 0.1711 | 3 | 0.1494 | 3 |
| Right (2013) | 0.7070 | 4 | 0.1529 | 4 | 0.0581 | 6 |
| Far right (2003) | 0.7829 | 2 | 0.3897 | 2 | 0.3145 | 1 |
| Far right (2013) | 0.7912 | 1 | 0.5536 | 1 | 0.2136 | 2 |

RNISI: Relative national identity synthetic indicator obtained from FHA. MGCFA-FS: National identity indicator obtained from MGCFA full equivalent scalar model. MGCFA-PS: National identity indicator obtained from MGCFA partial equivalent scalar model.

**Table 5.** Elasticities of RNISI by country and political orientation.

| Population Segment | Born | Citizenship | Living | Language | Religion | Civic | Feeling | Ancestors |
|---|---|---|---|---|---|---|---|---|
| **Country** | | | | | | | | |
| Total | 0.3449 | 0.3397 | 0.2378 | 0.4425 | 0.4688 | 0.2967 | 0.2946 | 0.4461 |
| Denmark (2003) | 0.3402 | 0.3379 | 0.2401 | 0.2866 | 0.4564 | 0.2041 | 0.2334 | 0.3942 |
| Denmark (2013) | 0.3508 | 0.3546 | 0.2572 | 0.5221 | 0.4052 | 0.2833 | 0.3045 | 0.4679 |
| France (2003) | 0.3144 | 0.3426 | 0.2376 | 0.5510 | 0.2868 | 0.2948 | 0.3102 | 0.4439 |
| France (2013) | 0.3059 | 0.3129 | 0.2246 | 0.4826 | 0.2914 | 0.2515 | 0.2707 | 0.4066 |
| Germany (2003) | 0.3541 | 0.3630 | 0.2596 | 0.5970 | 0.4241 | 0.3040 | 0.3107 | 0.5035 |
| Germany (2013) | 0.3520 | 0.3676 | 0.2660 | 0.6240 | 0.4140 | 0.3166 | 0.3132 | 0.4712 |
| Ireland (2003) | 0.2056 | 0.2254 | 0.1667 | 0.3877 | 0.3233 | 0.2578 | 0.2142 | 0.2850 |
| Ireland (2013) | 0.3529 | 0.3300 | 0.2365 | 0.3256 | 0.3743 | 0.2304 | 0.2817 | 0.5148 |
| Norway (2003) | 0.3236 | 0.3031 | 0.2285 | 0.4120 | 0.3632 | 0.2273 | 0.2764 | 0.4246 |
| Norway (2013) | 0.3228 | 0.3076 | 0.2292 | 0.4402 | 0.3556 | 0.2235 | 0.2732 | 0.4227 |
| Portugal (2003) | 0.2232 | 0.4130 | 0.1668 | 0.4540 | 0.3540 | 0.4291 | 0.2853 | 0.2271 |
| Portugal (2013) | 0.3286 | 0.3416 | 0.2318 | 0.4276 | 0.4488 | 0.3288 | 0.2687 | 0.4028 |
| Russia (2003) | 0.1881 | 0.3625 | 0.0806 | 0.4618 | 0.3651 | 0.4793 | 0.1971 | 0.2475 |
| Russia (2013) | 0.1630 | 0.3849 | 0.0582 | 0.4591 | 0.0873 | 0.5060 | 0.2633 | 0.0965 |
| Spain (2003) | 0.2758 | 0.3647 | 0.2071 | 0.4929 | 0.4431 | 0.3362 | 0.3195 | 0.3792 |
| Spain (2013) | 0.3382 | 0.3509 | 0.2330 | 0.4777 | 0.4158 | 0.3183 | 0.3101 | 0.4576 |

**Table 5.** *Cont.*

| Population Segment | Born | Citizenship | Living | Language | Religion | Civic | Feeling | Ancestors |
|---|---|---|---|---|---|---|---|---|
| **Country** | | | | | | | | |
| Great Britain (2003) | 0.3298 | 0.3452 | 0.2526 | 0.4605 | 0.4499 | 0.3135 | 0.3320 | 0.4665 |
| Great Britain (2013) | 0.2889 | 0.3100 | 0.1897 | 0.3412 | 0.4318 | 0.2712 | 0.3022 | 0.4212 |
| United States (2003) | 0.2887 | 0.0474 | 0.0502 | 0.1225 | 0.1943 | 0.2064 | 0.1806 | 0.6134 |
| United States (2013) | 0.3487 | 0.2379 | 0.2437 | 0.3497 | 0.4298 | 0.2461 | 0.2733 | 0.4742 |
| **Political Orientation** | | | | | | | | |
| Far left (2003) | 0.3645 | 0.3772 | 0.2546 | 0.5141 | 0.4530 | 0.3192 | 0.3136 | 0.4881 |
| Far left (2013) | 0.3541 | 0.3976 | 0.2851 | 0.7240 | 0.3780 | 0.3466 | 0.3638 | 0.5316 |
| Left, centre left (2003) | 0.3569 | 0.3486 | 0.2466 | 0.4516 | 0.4580 | 0.2865 | 0.3077 | 0.4621 |
| Left, centre left (2013) | 0.3607 | 0.3785 | 0.2683 | 0.5955 | 0.3874 | 0.3188 | 0.3332 | 0.4895 |
| Centre, liberal (2003) | 0.3393 | 0.3313 | 0.2343 | 0.4153 | 0.4735 | 0.2938 | 0.2775 | 0.4356 |
| Centre, liberal (2013) | 0.3318 | 0.3199 | 0.2244 | 0.4929 | 0.4735 | 0.3077 | 0.2911 | 0.4350 |
| Right (2003) | 0.3091 | 0.2958 | 0.2289 | 0.4103 | 0.4883 | 0.2711 | 0.2616 | 0.3911 |
| Right (2013) | 0.3159 | 0.2501 | 0.2032 | 0.2556 | 0.4706 | 0.1812 | 0.2244 | 0.4148 |
| Far right (2003) | 0.1488 | 0.2147 | 0.1535 | 0.6048 | 0.3939 | 0.3049 | 0.1906 | 0.1359 |
| Far right (2013) | 0.0702 | 0.1509 | 0.1004 | 0.1076 | 0.5185 | 0.0795 | 0.0592 | 0.1708 |

Born = to have been born in (country); Citizenship = to have the (country) citizenship; Living = to have lived in (country) for most of one's life; Language = to be able to speak the (country) language; Religion = to be (religion); Civic = to respect the (country's) political institutions and laws; feeling = to feel (country nationality); Ancestors = to have (country nationality) ancestry.

## 6. Conclusions

The national identity measurements at cross-national level suffers from methodological and comparability issues that has caused a big controversy in the past. Issues about non-response bias and measurement errors [25], as well as equivalence invariance [19] suppose an important threat that lead to biased and inconsistent results. We argue here that stratagems, such as discarding items from the scale that obscure the invariance equivalence, other than being helpful in some cases, might also bring some unwanted penalties, for example, some items might only be important for some countries or minorities. We agree with [25] regarding that there is not any miraculous rule, and that each method needs to be investigated by its own benefits and costs.

Social scientists working on national identity have argued that it is difficult to take for granted the number of factors and the respective indicators that should be included in each of the factors. To our knowledge, the univariate factor obtained in the current study as a second order latent variable has not been analysed by previous studies. Consequently, social science research on national identity has fallen victim to what can be named as a multi-dimensional methodological trap in which authors have felt comfort presenting the correlation degree between the ethnic, civic and cultural latent variables. Nevertheless, this approach has also created several controversial issues that have obscured potential trends in the field. In this sense, FHA can also be applied to analyse whether the results of factor latent variables with less indicators based on MGCFA are more or less like those obtained by FHA. The additive and difference scores of ethnic and civic national identities proposed by [3] can also be analysed using FHA to see whether the results are also robust.

In the past, researchers have focused on the validity and reliability of the scale, so the ideas and rules applied to build the national identity construct have been constrained by these issues, and as previously said, the indicators and dimensions have been subject to controversy. Building on a well-grounded method (FHA) that has been applied successfully in different fields to construct synthetic indicators that are based on multiple items, this study compares the national identity construct (RNISI) with the results obtained by a MGCFA. The results of both methods are compared to see to what extent the indicators are affected by two covariates: country-year and political orientation-year. The ISSP 2003 and 2013 waves were used to collate the information for ten different countries: Denmark, France, Germany, Ireland, Norway, Portugal, Russia, Spain, Great Britain, and the United States.

The paper analysed only ten countries because the introduction of other countries caused the instability of the model estimated by MGCFA. In contrast, FHA, as a deterministic model, does not need to be adjusted and the results show a good adjustment to the full scalar model. Nevertheless, reaching the full scalar model is always difficult and unlikely, therefore partial scalar models are often adopted. This result leads to the conclusion that the FHA can be an adequate tool to analyse national identity and that it provides robust results without the need of major structural changes to the models. Consequently, a new frontier is open to social scientists when they deal with the study of latent variables, such as national identity. Indeed, FHA for its deterministic nature is more flexible than other structural equation models because they are not so constrained to restricted adjustment properties.

In sum, FHA can be a beneficial tool to conduct research on national identity and other antecedents and determinants in social science, such as attitudes towards immigrants and patriotism. It is not easy to assess that FHA is a viable method for analysing other ordinal social science constructs when an application is only based on the nationhood construct. Several other applications across different topics and scales, such as self-reported health or factual knowledge in ordinal items, should be studied to promote the use of FHA in social science. Other interesting lines for future research might be based on the analysis of individual national identity models that show how to go beyond the existing traditional research on nationalism, such as fuzzy clustering methods or latent class models. These methods could benefit the understanding of the complex interplay between nationhood concepts and attitudes towards immigrants.

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## References

1. Sidanius, J.; Feshbach, S.; Levin, S.; Pratto, F. The interface between ethnic and national attachment: Ethnic pluralism or ethnic dominance? *Public Opin. Q.* **1997**, *61*, 102–133. [CrossRef]
2. Staerklé, C.; Sidanius, J.; Green, E.G.T.; Molina, L.E. Ethnic minority-majority asymmetry in national attitudes around the world: A multilevel analysis. *Political Psychol.* **2010**, *31*, 491–519. [CrossRef]
3. Kunovich, R.M. The sources and consequences of national identification. *Am. Sociol. Rev.* **2009**, *74*, 573–593. [CrossRef]
4. Brown, T.A. *Confirmatory Factor Analysis for Applied Research*; Guilford Publications: New York, NY, USA, 2015; ISBN 146251779X.
5. Davidov, E. Measurement equivalence of nationalism and constructive patriotism in the ISSP: 34 countries in a comparative perspective. *Political Anal.* **2009**, *17*, 64–82. [CrossRef]
6. Davidov, E.; De Beuckelaer, A. How harmful are survey translations? A test with Schwartz's human values instrument. *Int. J. Public Opin. Res.* **2010**, *22*, 510. [CrossRef]
7. Reeskens, T.; Hooghe, M. Beyond the civic–ethnic dichotomy: Investigating the structure of citizenship concepts across thirty-three countries. *Nations Natl.* **2010**, *16*, 579–597. [CrossRef]
8. Kumar, M. Evaluation of the intuitionistic fuzzy importance of attributes based on the correlation coefficient under weakest triangular norm and application to the hotel services. *J. Intell. Fuzzy Syst.* **2019**, *36*, 3211–3223. [CrossRef]
9. Di Nardo, E.; Simone, R. A model-based fuzzy analysis of questionnaires. *Stat. Methods Appl.* **2019**, *28*, 187–215. [CrossRef]
10. Rashidi, K.; Cullinane, K. A comparison of fuzzy DEA and fuzzy TOPSIS in sustainable supplier selection: Implications for sourcing strategy. *Expert Syst. Appl.* **2019**, *121*, 266–281. [CrossRef]
11. Mohsin, M.; Zhang, J.; Saidur, R.; Sun, H.; Sait, S.M. Economic assessment and ranking of wind power potential using fuzzy-TOPSIS approach. *Environ. Sci. Pollut. Res.* **2019**, *26*, 22494–22511. [CrossRef]

12. Martín, J.C.; Moreira, P.; Román, C. A hybrid-fuzzy segmentation analysis of residents' perception towards tourism in Gran Canaria. *Tour. Econ.* **2020**, *26*, 1282–1304. [CrossRef]
13. Larsen, C.A. Revitalizing the 'civic'and 'ethnic'distinction. Perceptions of nationhood across two dimensions, 44 countries and two decades. *Nations Natl.* **2017**, *23*, 970–993. [CrossRef]
14. Indelicato, A.; Martín, J.C. Two Approaches to Analyze Whether Citizens' National Identity Is Affected by Country, Age, and Political Orientation—A Fuzzy Eco-Apostle Model. *Appl. Sci.* **2022**, *12*, 3946. [CrossRef]
15. Westle, B.; Segatti, P. *European Identity in the Context of National Identity: Questions of Identity in Sixteen European Countries in the Wake of the Financial Crisis*; Oxford University Press: Oxford, UK, 2016; ISBN 0191047112.
16. Sinnott, R. An evaluation of the measurement of national, subnational and supranational identity in crossnational surveys. *Int. J. Public Opin. Res.* **2006**, *18*, 211–223. [CrossRef]
17. Wright, M.; Citrin, J.; Wand, J. Alternative measures of American national identity: Implications for the civic-ethnic distinction. *Political Psychol.* **2012**, *33*, 469–482. [CrossRef]
18. Miller, D.; Ali, S. Testing the national identity argument. *Eur. Political Sci. Rev.* **2014**, *6*, 237–259. [CrossRef]
19. Ariely, G. The nexus between globalization and ethnic identity: A view from below. *Ethnicities* **2019**, *19*, 763–783. [CrossRef]
20. Hadler, M.; Flesken, A. Political rhetoric and attitudes toward nationhood: A time-comparative and cross-national analysis of 39 countries. *Int. J. Comp. Sociol.* **2018**, *59*, 362–382. [CrossRef]
21. Haller, M.; Ressler, R. National and European identity. *Rev. Française Sociol.* **2006**, *47*, 817–850. [CrossRef]
22. Heath, A.; Martin, J.; Spreckelsen, T. Cross-national comparability of survey attitude measures. *Int. J. Public Opin. Res.* **2009**, *21*, 293–315. [CrossRef]
23. Lewin-Epstein, N.; Levanon, A. National identity and xenophobia in an ethnically divided society. *Int. J. Multicult. Soc.* **2005**, *7*, 90–118.
24. Medrano, J.D. Nation, citizenship and immigration in contemporary Spain. *Int. J. Multicult. Soc.* **2005**, *7*, 133–156.
25. Medrano, J.D.; Koenig, M. Nationalism, citizenship and immigration in social science research. *Int. J. Multicult. Soc.* **2005**, *7*, 82–89.
26. Sarrasin, O.; Green, E.G.T.; Berchtold, A.; Davidov, E. Measurement equivalence across subnational groups: An analysis of the conception of nationhood in Switzerland. *Int. J. Public Opin. Res.* **2013**, *25*, 522–534. [CrossRef]
27. Wright, M. Diversity and the imagined community: Immigrant diversity and conceptions of national identity. *Political Psychol.* **2011**, *32*, 837–862. [CrossRef]
28. Wright, M. Policy regimes and normative conceptions of nationalism in mass public opinion. *Comp. Political Stud.* **2011**, *44*, 598–624. [CrossRef]
29. Pehrson, S.; Vignoles, V.L.; Brown, R. National identification and anti-immigrant prejudice: Individual and contextual effects of national definitions. *Soc. Psychol. Q.* **2009**, *72*, 24–38. [CrossRef]
30. Rogers Brubaker, C. *Citizenship and Nationhood in France and Germany*; Harvard University Press: Cambridge, MA, USA, 1992; Volume 129.
31. Hand, D.J. Statistics and the theory of measurement. *J. R. Stat. Soc.* **1996**, *159*, 445–473. [CrossRef]
32. Mardani, A.; Jusoh, A.; Zavadskas, E.K. Fuzzy multiple criteria decision-making techniques and applications—Two decades review from 1994 to 2014. *Expert Syst. Appl.* **2015**, *42*, 4126–4148. [CrossRef]
33. Hwang, C.-L.; Masud, A.S.M. *Multiple Objective Decision Making—Methods and Applications: A State-of-the-Art Survey*; Springer Science & Business Media: Berlin/Heidelberg, Germany, 2012; Volume 164, ISBN 3642455115.
34. Moya, A.; Navarro, E.; Jaén, J.; González, P. Fuzzy-description logic for supporting the rehabilitation of the elderly. *Expert Syst.* **2020**, *37*, e12464. [CrossRef]
35. Suárez, L.; Tay, B.; Abdullah, F. Psychometric properties of the World Health Organization WHOQOL-BREF quality of life assessment in Singapore. *Qual. Life Res.* **2018**, *27*, 2945–2952. [CrossRef]
36. Radziszewska-Zielina, E.; Śladowski, G. Supporting the selection of a variant of the adaptation of a historical building with the use of fuzzy modelling and structural analysis. *J. Cult. Herit.* **2017**, *26*, 53–63. [CrossRef]
37. Coromina, L.; Peral, E.B. Comparing alignment and multiple group CFA for analysing political trust in Europe during the crisis. *Methodology* **2020**, *16*, 21–40. [CrossRef]
38. Martín, J.C.; Román, C.; Viñán, C. An institutional trust indicator based on fuzzy logic and ideal solutions. *Mathematics* **2020**, *8*, 807. [CrossRef]
39. Cheung, G.W.; Rensvold, R.B. Evaluating goodness-of-fit indexes for testing measurement invariance. *Struct. Equ. Model.* **2002**, *9*, 233–255. [CrossRef]
40. Steenkamp, J.-B.E.M.; Baumgartner, H. Assessing measurement invariance in cross-national consumer research. *J. Consum. Res.* **1998**, *25*, 78–90. [CrossRef]
41. Byrne, B.M. *Structural Equation Modeling with AMOS: Basic Concepts, Applications, and Programming*; Lawrence Erlbaum: Mahwah, NJ, USA, 2001.
42. Selig, J.P.; Card, N.A.; Little, T.D. Latent variable structural equation modeling in cross-cultural research: Multigroup and multilevel approaches. In *Multilevel Analysis of Individuals and Cultures*; Psychology Press: London, UK, 2015; pp. 93–119, ISBN 0203888030.

43. Lalla, M.; Facchinetti, G. Measurement and fuzzy scales. In Proceedings of the XLII Riunione Scientifica, Trento, Italy, 9–13 October 2004; pp. 351–362.
44. Marasini, D.; Quatto, P.; Ripamonti, E. Inferential confidence intervals for fuzzy analysis of teaching satisfaction. *Qual. Quant.* **2017**, *51*, 1513–1529. [CrossRef]
45. Bellman, R.E.; Zadeh, L.A. Decision-making in a fuzzy environment. *Manag. Sci.* **1970**, *17*, B141–B164. [CrossRef]
46. Zadeh, L.A.; Fu, K.S.; Tou, J.T. The Concept of a Linguistic Variable and its Application to Approximate Reasoning. *Learn. Syst. Intell. Robot.* **1975**, 1–10. [CrossRef]
47. Zadeh, L.A. Fuzzy sets. *Inf. Control* **1965**, *8*, 338–353. [CrossRef]
48. Zadeh, L.A. Fuzzy logic = computing with words. In *Computing with Words in Information/Intelligent Systems 1*; Springer: Berlin/Heidelberg, Germany, 1999; pp. 3–23.
49. Zimmermann, H.-J. *Fuzzy Set Theory—And Its Applications*; Springer Science & Business Media: Berlin/Heidelberg, Germany, 2011; ISBN 9401006466.
50. Akram, M.; Kahraman, C.; Zahid, K. Extension of TOPSIS model to the decision-making under complex spherical fuzzy information. *Soft Comput.* **2021**, *25*, 10771–10795. [CrossRef]
51. Akram, M.; Luqman, A.; Alcantud, J.C.R. Risk evaluation in failure modes and effects analysis: Hybrid TOPSIS and ELECTRE I solutions with Pythagorean fuzzy information. *Neural Comput. Appl.* **2021**, *33*, 5675–5703. [CrossRef]
52. Akram, M.; Ali, G. Hybrid models for decision-making based on rough Pythagorean fuzzy bipolar soft information. *Granul. Comput.* **2020**, *5*, 1–15. [CrossRef]
53. Imtiaz, A.; Shuaib, U.; Alolaiyan, H.; Razaq, A.; Gulistan, M. On structural properties of ζ-complex fuzzy sets and their applications. *Complexity* **2020**, *2020*, 1–13. [CrossRef]
54. Imtiaz, A.; Shuaib, U.; Razaq, A.; Gulistan, M. Image development in the framework of ξ-complex fuzzy morphisms. *J. Intell. Fuzzy Syst.* **2021**, *40*, 4425–4437. [CrossRef]
55. Razaq, A.; Alhamzi, G. On Pythagorean fuzzy ideals of a classical ring. *AIMS Math.* **2023**, *8*, 4280–4303. [CrossRef]
56. Salih, M.M.; Zaidan, B.B.; Zaidan, A.A.; Ahmed, M.A. Survey on fuzzy TOPSIS state-of-the-art between 2007 and 2017. *Comput. Oper. Res.* **2019**, *104*, 207–227. [CrossRef]
57. Saayman, M.; Martín, J.C.; Roman, C. There is no fuzziness when it comes to measuring service quality in national parks. *Tour. Econ.* **2016**, *22*, 1207–1224. [CrossRef]
58. Buckley, J.J. Ranking alternatives using fuzzy numbers. *Fuzzy Sets Syst.* **1985**, *15*, 21–31. [CrossRef]
59. Chen, S.-M. Evaluating weapon systems using fuzzy arithmetic operations. *Fuzzy Sets Syst.* **1996**, *77*, 265–276. [CrossRef]
60. Kaufmann, A.; Gupta, M.M. *Fuzzy Mathematical Models in Engineering and Management Science*; Elsevier Science Inc.: Amsterdam, The Netherlands, 1988; ISBN 0444705015.
61. Martín, J.C.; Martín-Domingo, L.; Lohmann, G.; Spasojevic, B. The role of travel patterns in airport duty-free shopping satisfaction: A case study from an Australian regional airport. *J. Air Transp. Manag.* **2019**, *80*, 101691. [CrossRef]
62. Behzadian, M.; Khanmohammadi Otaghsara, S.; Yazdani, M.; Ignatius, J. A state-of the-art survey of TOPSIS applications. *Expert Syst. Appl.* **2012**, *39*, 13051–13069. [CrossRef]
63. Chen, F.F. Sensitivity of goodness of fit indexes to lack of measurement invariance. *Struct. Equ. Model. Multidiscip. J.* **2007**, *14*, 464–504. [CrossRef]
64. Byrne, B.M.; Stewart, S.M. Teacher's corner: The MACS approach to testing for multigroup invariance of a second-order structure: A walk through the process. *Struct. Equ. Model.* **2006**, *13*, 287–321. [CrossRef]
65. Beuckelaer, A. De Comparison of Construct Mean Scores Across Populations: A Conceptual Framework. In *Measurement and Multivariate Analysis*; Springer: Tokyo, Japan, 2002; pp. 175–182.
66. Chen, F.F. What happens if we compare chopsticks with forks? The impact of making inappropriate comparisons in cross-cultural research. *J. Pers. Soc. Psychol.* **2008**, *95*, 1005. [CrossRef]
67. Moffitt, B. Liberal illiberalism? The reshaping of the contemporary populist radical right in Northern Europe. *Political Gov.* **2017**, *5*, 112–122. [CrossRef]
68. Antonsich, M. International migration and the rise of the 'civil'nation. *J. Ethn. Migr. Stud.* **2016**, *42*, 1790–1807. [CrossRef]
69. Guibernau, M. Globalization and the nation-state. In *Understanding Nationalism*; Polity: Cambridge, UK, 2001; pp. 242–268.
70. Beck, U. *The Cosmopolitan Vision*; Polity: Cambridge, UK, 2006.
71. Hobsbawm, E.J. *Nations and Nationalism since 1780: Programme, Myth, Reality*; Cambridge University Press: Cambridge, UK, 2012; ISBN 1107604621.