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Rasch model of the bridging social capital questionnaire

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ABSTRACT

Bridging social capital is defined as the connections between individuals who are dissimilar with respect to socioeconomic status and other characteristics. We previously identified an important gap in the literature related to its measurement. We developed and validated a scale to measure bridging social capital to be used in Latinx immigrant populations living in the U.S using Classical Test Theory. The structure of the questionnaire comprised the following sub-scales: Socializing in the work place (5 items); Participation in community activities (16 items); Socializing in community activities (5 items); Contact with similar/different people (7 items); Assistance (17 items); Trust of institutions, corporations and other people (14 items); and Trust of intimate people (3 items). Although basic psychometric validation was performed on our original instrument (e.g., content and construct validity, internal consistency reliability), modern testing theory recommends a more comprehensive set of evaluations, including assessment of data quality, scaling assumptions, targeting, reliability, validity and responsiveness. Rasch measurement theory (RMT) is one of the Modern Test Theory methods that assesses the extent to which rigorous measurement is achieved. In the present work, our objective was to further evaluate the instrument using CTT and to use modern psychometric techniques to further validate the questionnaire and create version 2 (v2) using a new sample (N = 224). We developed a Rasch model of the questionnaire to evaluate item fit statistics, item category thresholds, person separation index (PSI), local dependency, differential item functioning (DIF), unidimensionality and targeting and item locations. Assistance was the most problematic sub-scale of all, as item-to-total correlations ranged from 0.27 to 0.66. There were no disordered thresholds on any item, either examined as part of the overall score or as part of sub-scales. However, the analysis provided evidence of the need to modify some of the sub-scales as there was lack of support for unidimensionality or fit to the Rasch model. The Bridging Social Capital Questionnaire v2 has 61 items (compared to 67 in version 1). Our questionnaire may be suitable for adaptation to other immigrant groups in different countries.

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Introduction

Social capital is defined as the resources accessed through membership in social networks (Villalonga-Olives & Kawachi, 2015). An important distinction is drawn in the literature between bonding and bridging social capital. Bonding social capital refers to connections between members of a network who are similar to each other with respect to social class, race/ethnicity, or other attributes. By contrast, bridging social capital is defined as the connections between individuals who are

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dissimilar (or heterogeneous) with respect to the same characteristics stated above. This distinction is crucial because exchanges that involve reciprocity that can take place in groups with high bonding social capital are inhibited by the totality of resources available within the network (Villalonga-Olives & Kawachi, 2015).

Bridging social capital is likely to be particularly important in immigrant communities, because migrants tend to be socially isolated, especially when they first arrive in their countries of destination. Immigrant groups confront the challenge of accessing resources beyond their own intimate circles. Immigrant communities can draw upon the dense social connections within their own groups for information, instrumental support, and solidarity (bonding social capital). However, by staying within their group, they remain disconnected from opportunities available to the majority of society. Bridging social capital is crucial for the immigrant communities to be connected to opportunities that may facilitate upward social mobility (Lancee, 2010; Tselios et al., 2015). In fact, immigrants with low socio-economic backgrounds highly depend on bridging social capital to access a variety of resources in the new society they live in. These resources can be related to immigration issues, cash-loans, health information or job opportunities. Hence, the ability to access resources from outside the community is linked to better health outcomes (Villalonga-Olives & Kawachi, 2015).

Despite the importance of bridging social capital for immigrants, we identified an important gap in the literature. Many of the studies that measure bridging social capital do not use standard definitions, lack a theoretical framework, or use scales that have not been psychometrically validated. Only a few studies have attempted to measure this concept in the public health field (Barman-Adhikari & Rice, 2014; Enfield and Nathaniel, 2013, 2013, 2013; Maselko et al., 2011; Murayama et al., 2012). In our previous work, we developed a standard definition and conceptualization of bridging social capital (Villalonga-Olives & Kawachi, 2015), developed a questionnaire to measure it in Latinx immigrants living in the US, and provided evidence in support of its validity using classical test theory (CTT) (Villalonga-Olives, Adams, & Kawachi, 2016).

Classical test theory, which was used in our previous work, evaluates the reliability, validity and responsiveness or sensitivity to change of questionnaires and rating scales. Our Bridging Social Capital (BSC) questionnaire version 1 (v1) was developed using a mixed method approach (qualitative evaluations and CTT) and was published in the past (Villalonga-Olives et al., 2016). In the previous work, we developed a set of items grounded on a theoretical model and involved an expert panel for review (Villalonga-Olives et al., 2016). We conducted focus groups in Latinx in several locations (total N = 17 participants) to cognitively test the questionnaire. We assessed preliminary psychometric properties of the questionnaire with CTT with an online sample of Latinx residents in the US (N = 138). More information about this process is available elsewhere (Villalonga-Olives et al., 2016).

However, the literature recommends going one step further to evaluate data quality, scaling assumptions, targeting, reliability, validity and responsiveness (Hobart & Cano, 2009). Rasch measurement theory (RMT) is one of the Modern Test Theory methods that assesses the extent to which rigorous measurement is achieved by examining the difference between the observed scores (responses to items) and the expected values predicted from the data by the Rasch model. It uses a priori criteria to verify measurement properties or to expose and explore anomalies of any rating scale empirically (Cleanthous et al., 2017). Rasch measurement theory, as compared to classical test theory methodologies, considers the assessment of three sources of measurement error: random error, error related to the measure itself, and error associated with the respondents. It is therefore able to consider the extent to which item parameters remain invariant across different groups of patients by the use of Differential Item Functioning (DIF), for instance. Rasch measurement theory can assess the extent to which a measure respects the properties of fundamental measurement, namely that it is a measure that is not derived from other measures, and produced by additive measurement operations (Luce and Tukey, 1964). The objective of the current study is to further evaluate the instrument using CTT and use modern psychometric techniques, as assessed by the use of RMT, to further validate the questionnaire and create version 2 (v2) using a new sample.

Methods

Study population and setting

The target population for this measure was the Latinx immigrant population living in the US. The sample population was a cohort of first generation immigrant Latinx living in the US, and recruited at a community clinic in Hyattsville, Maryland (Heritage Care Inc) using social media, community activities and community clinics. The questionnaire was completed by participants using the electronic data platform Qualtrics (Couper, 2000; Qualtrics, 2016). We opted for an electronic administration of the measure as the anonymity of communicating via the Internet can help overcome concerns about paper trails or of being identified by directly interacting with interviewers, particularly among undocumented immigrants. A computer was available at Heritage Care Inc. for use by individuals who did not have access to a computer or smartphone. Participants had to be 18 years old or older, born outside the US, residing in the US for at least two years, fluent in English or Spanish. Participants were residents of the Baltimore-Washington DC area. This study was approved by the Institutional Review Board (IRB) of University of Maryland, Baltimore. Informed consent was obtained from all individual participants included in the study. The survey was distributed between February and March of 2018. 224 individuals completed the entire questionnaire, whereas 24 left it uncompleted and therefore were removed from the analysis. 61 participants (27.2%) used the English version of the questionnaire. Each participant received $15.00 for completing the survey. Participants completed the BSC Questionnaire, and additional sociodemographic information such as age, sex, arrival in the US, annual income, education level and country of origin. Additional questions on the healthcare services utilization were also included.

The bridging social capital (BSC) questionnaire V1

Based on theory, bridging social capital should measure relations between individuals who are dissimilar with respect to social identity and power. Accordingly, we developed v1 of the questionnaire aiming to contain the following elements at a minimum: (1) questions that inquire about the ability of individuals to access valued resources outside of their own social milieu; (2) questions that inquire about participation in social groups (e.g., neighborhood associations, hobby groups) whose membership is comprised of people who are dissimilar to the ego with regard to socioeconomic, race/ethnic, immigrant status, or other characteristics; and (3) questions that are more precisely targeted to specific populations – for example, questions that probe the extent to which immigrants can trust others in their neighborhood, figures of authority (e.g. police, the courts, immigration authorities). As a consequence, the Bridging Social Capital (BSC) questionnaire v1 comprises items evaluating the following sub-scales: Socializing in the work place (5 items); Participation in community activities (16 items); Socializing in community activities (5 items); Contact with similar/different people (7 items); Assistance (17 items); Trust of institutions, corporations and other people (14 items); and Trust of intimate people (3 items). In total, there are 67 items. Socializing in the work place and Participation in community activities; Socializing in community activities; and Assistance are part of the *structural* component of our social capital measure. This component refers to the externally observable behaviors and actions of actors within the network, e.g. patterns of civic engagement. Contact with similar/different people and both Trust sub-scales are part of the *cognitive* dimension of the scale. This component refers to people's

perceptions of their social network relations – e.g. the level of interpersonal trust as well as norms of reciprocity within the group. The first, third and fourth sub-scales are specifically focused on *bridging* relations. For example, the first part of the questionnaire asks about doing any work for pay and if answering yes, the respondent answers questions on how often does him/her socialize (i.e. go out for drinks, visit each other's homes) with co-workers who are of a different nationality, speak a different language, have different political opinions and have a different level of education. In this work the Participation in community activities subscale owing to its different construction compared to the other sub-scales do not count for Rasch. In addition, we merge both Trust sub-scales and treat them as one since they measure the same concept. The questionnaire was developed in English and Spanish simultaneously and tested to be used with an online platform.

Statistical analysis

To review v1 of the questionnaire and create v2, we first calculated descriptive statistics to characterize the participants: mean values and standard deviations for continuous variables, and frequencies and percentages for categorical variables. Floor and ceiling effects were calculated per item. Second, CTT assumes that the measure of a person's score is the sum of its true score plus random error. The goal of CTT in this study was to estimate the reliability of the score, or the importance of the random error respective to the total score. Internal consistency reliability was assessed by item-to-total correlation and Cronbach's alpha coefficient (Cronbach, 1951; Nunnally & Bernstein, 1994). Third, to assess the scaling properties and construct validity of the BSC Questionnaire, RMT was used. RMT analysis is a probabilistic modelling technique used to assess whether data accord with model expectations and whether the internal construct validity of the scale is supported (Pallant & Tennant, 2007; Rasch, 1993). RMT analyses were used to assess whether the BSC Questionnaire conformed to RMT model expectations. The data collected for each sub-scale of the conceptual framework is analyzed against the Rasch measurement criteria described below during the item reduction phase. We used the following areas of evaluation:

1) Item fit statistics: Fit to the RMT model was assessed using 1) item-trait interaction (a non-significant (p-value>0.05) chi-square value indicated negligible deviation between observed data and expectations of the model); 2) the residual for each item in the range of -2.5 to +2.5 indicates good fit, and should also have non-significant chi-square values (Bonferroni adjusted significance level of 0.01).
   2)Item category thresholds determined whether response categories were understood by respondents.
   3)Person separation index (PSI): Internal reliability was assessed using the Person Separation Index (PSI) (analogous to Cronbach's alpha when the distribution is normal);
   4)Local dependency: Response dependency was assessed by verifying that the magnitude of residuals between two items' answers are not correlated above 0.3, which could be overestimating reliability estimates.
   5)Differential item functioning (DIF): To assess the extent to which item parameters remain invariant across different groups of respondents we compared item difficulties given the level of the trait across the following: age, sex, location of birth, time arrived in the US, income, level of education and language, using analysis of variance (ANOVA, Bonferroni adjusted significance level of 0.05).
   6)Unidimensionality: We assessed the unidimensionality of each subscale. Unidimensionality of a subs-cale is evident if significant t-tests ($p < 0.05$) comparisons do not exceed 5%.
   7)Targeting and Item locations: The item difficulty and person ability ranges on the same log-odd units scale helped to establish targeting, or the match of respondents' ratings of bridging social capital and the level of bridging social capital measured by the items and response options.

A partial credit Rasch polytomous model was used. SAS 9.4 and RUMM2030 were used to complete the statistical analyses (Andrich et al., 2001; SAS Institute Inc. 2015). The analyses involved an initial evaluation of the Rasch model of the BSC Questionnaire and the subsequent and dynamic deletion of items after performing each test detailed above when considered necessary. In the item deletion process, before making any decision, we went back to the qualitative evaluations performed when developing v1 of the questionnaire, to make sure the items deleted were not the ones that were considered crucial for the immigrants interviewed during the focus groups. In the next section, we give details of this dynamic process of evaluation of the initial BSC Questionnaire (v1) and refinement process with consequent models. Hence, we present the results of the tests performed with the initial questionnaire, the phase of item deletion in subsequent steps and final check of the questionnaire to finally create v2.

Results

Almost 47% of participants were females and 79.5% were younger than 41 years old; 33.9% had arrived in the US 3–5 years ago; 46.4% reported an annual household income of or lower than $49,999 yearly, and 20.5% had not completed high school; while 25.4% had completed

Table 1
Sociodemographic characteristics of participants.

Sociodemographic Characteristics	Mean and Frequency (%) Total n = 224
Age	
18-24	17 (7.6%)
25-30	42 (18.8%)
31-35	56 (25.0%)
36-40	63 (28.1%)
41-45	28 (12.5%)
46-50	8 (3.6%)
51-55	10 (4.5%)
Sex	
Male	119 (53.1%)
Female	105 (46.9%)
Country of origin	
Guatemala	81 (36.2%)
El Salvador	80 (35.7%)
Mexico	63 (28.1%)
Others	24 (10.7%)
Arrival to the US	
1–2 years ago	15 (6.7%)
3–5 years ago	76 (33.9%)
5–10 years ago	52 (23.2%)
More than 10 years ago	43 (19.2%)
Less than a year ago	3 (1.3%)
2–3 years ago	35 (15.6%)
Language	
English	61 (27.2%)
Spanish	163 (72.8%)
Income	
Less than 30,000	29 (12.9%)
30,000–39,999	15 (6.7%)
40,000–49,000	60 (26.8%)
50,000–59,999	66 (29.5%)
60,000–69,999	43 (19.2%)
70,000–79,999	9 (4.0%)
80,000–89,999	1 (0.4%)
90,000–99,000	1 (0.4%)
Level of education	
No education completed	0
Nursery, kindergarten and elementary (grades 1–8)	9 (4.0%)
High school (grades 9–12, no degree)	37 (16.5%)
High school graduate	57 (25.4%)
Some college (1–4 years, no degree)	55 (24.6%)
College graduate	66 (29.5%)

high school and 29.5% had completed college. Twenty-seven percent of the participants responded to the questionnaire in English (Table 1).

Results analyzing data with classical test theory

Table 2 shows the main descriptive and targeting properties of the BSC Questionnaire (Table 2). The presence of potential floor and ceiling

Table 2
Descriptive and targeting properties of the BSC questtionaire.

Domain		Theoretical and Actual Range	Floor Effect n (%)	Ceiling Effect n (%)	Item-to-total correlation
	Cronbach's Alpha	–	–	–	0.80
Socializing in the work place	1. Are of a different nationality?	1–4	10 (4.0)	33 (13.3)	0.77
	2. Speak a different language?	1–4	9 (4.9)	34 (13.7)	0.64
	3. Are from a different race/ethnic background than you?	1–4	9 (3.6)	32 (12.9)	0.81
	4. Have different political opinions?	1–4	21 (8.5)	7 (2.8)	0.72
	5. Have a different level of education?	1–4	12 (4.8)	23 (9.3)	0.65
Socializing in the community activity	21. Are of a different nationality?	1–4	27 (10.9)	51 (20.6)	0.79
	22. Speak a different language?	1–4	21 (8.5)	71 (28.6)	0.70
	23. Are from a different race/ethnic background than you?	1–4	31 (12.5)	71 (28.6)	0.82
	24. Have different political opinions?	1–4	31 (12.5)	9 (3.6)	0.67
	25. Have a different level of education?	1–4	20 (8.1)	16 (6.5)	0.54
Contact with similar/different people	26. Age	1–4	53 (21.4)	6 (2.4)	0.52
	27. Job	1–4	23 (9.3)	23 (9.3)	0.50
	28. Nationality	1–4	37 (14.9)	27 (10.9)	0.55
	29. Ethnic group	1–4	41 (16.5)	15 (6.0)	0.57
	30. Income	1–4	21 (8.5)	11 (4.4)	0.58
	31. Level of education	1–4	19 (7.7)	15 (6.0)	0.57
	32. Main language spoken	1–4	78 (31.5)	8 (3.2)	0.65
Assistance	33. Can babysit for you in an emergency†	1–3	144 (58.1)	55 (22.2)	0.35
	34. Can lend you money if you need it (eg. at least $500)	1–2	186 (75.0)[a]	38 (15.3)[a]	0.50
	35. Write a good reference/recommendation for a landlord?	1–2	216 (87.1)[a]	8 (3.2)[a]	0.32
	36. Can write a good reference/recommendation letter when you are applying for a job	1–2	206 (83.1)[a]	18 (7.3)[a]	0.42
	37. Can provide advice dealing with immigration authorities (USCIS)	1–2	146 (58.9)[a]	78 (31.5)[a]	0.54
	38. Can serve as a sponsor if you were to apply for a Green Card	1–2	108 (43.5)[a]	116 (46.8)[a]	0.51
	39. Can provide a recommendation to find a good doctor	1–2	197 (79.4)[a]	27 (10.9)[a]	0.44
	40. Provide advice about local schools	1–2	198 (79.8)[a]	26 (10.5)[a]	0.50
	41. Provide advice about preparing income taxes	1–2	152 (61.3)[a]	72 (29.0)[a]	0.66
	42. Can help with small jobs around the house (e.g. painting, home maintenance)	1–2	204 (82.3)[a]	20 (8.1)[a]	0.38
	43. Can give you a ride (airport, mall) if you need it	1–2	212 (85.5)[a]	12 (4.8)[a]	0.41
	44. Can employ you if you need a job	1–2	133 (53.6)[a]	91 (36.7)[a]	0.56
	45. Can find a holiday job for you, a family member or a friend	1–2	162 (65.3)[a]	62 (25.0)[a]	0.54
	46. Can give advice on matters of law (e.g. problems with landlord, boss)	1–2	146 (58.9)[a]	78 (31.5)[a]	0.57
	47. Can do your shopping when you (and your household members) are ill	1–2	209 (84.3)[a]	15 (6.0)[a]	0.27
	48. Can come to visit you from out of town if you become ill or need assistance	1–2	190 (76.6)[a]	34 (13.7)[a]	0.43
	49. Can help you if you need assistance with political issues because he/she is active in a politic party	1–2	66 (26.6)[a]	158 (63.7)[a]	0.35
Trust of institutions, corporations and other people and Trust of intimate contacts	50. The national media	1–4	18 (7.3)	13 (5.2)	0.58
	51. The local media	1–4	23 (9.3)	33 (13.3)	0.56
	52. Local politicians	1–4	11 (4.4)	35 (14.1)	0.51
	53. State politicians	1–4	14 (5.6)	20 (8.1)	0.48
	54. National politicians	1–4	16 (6.5)	24 (9.7)	0.51
	55. Local school authorities	1–4	29 (11.7)	16 (6.5)	0.55
	56. The police	1–4	29 (11.7)	12 (4.8)	0.55
	57. The court system	1–4	45 (18.1)	7 (2.8)	0.52
	58. Health care providers	1–4	38 (15.3)	6 (2.4)	0.44
	59. Corporations	1–4	23 (9.3)	12 (4.8)	0.49
	60. Local businesses	1–4	24 (9.7)	9 (3.6)	0.56
	61. Your current employer	1–5	49 (19.8)	33 (13.3)	0.59
	62. Your coworkers	1–5	67 (27.0)	32 (12.9)	0.57
	63. Trade unions	1–4	5 (2.0)	13 (5.2)	0.44
	64. Local religious leaders	1–5	35 (14.1)	22 (8.9)	0.83
	65. Local community leaders	1–4	15 (6.0)	6 (2.4)	0.52
	66. Your neighbors	1–4	89 (35.9)	3 (1.2)	0.58

[a] Floor and Ceiling effect are not applicable to these items as they only have 2 response categories. We included them nevertheless to have an indication of the distribution of the categorical answers and to compare with other items.

effects were first explored. Ceiling effects were not present for any of the items of the BSC Questionnaire. A floor effect was however present for some items. For items with only 2 response categories, we examined whether they had a large proportion of respondents who answered one response category over another (ranges 75–87% of responses for a single response category). Items 34, 35, 36, 39, 40, 42, 43, 47 and 48 all showed unusual response distributions, prompting further examination of whether there are problems with the other psychometric properties of the measure. We further explored the findings and interpretations of our RMT results with particular attention on these items.

Internal consistency reliability was high, with an overall Cronbach's alpha coefficient of 0.80, indicating excellent internal consistency and beyond the minimum 0.7 level recommended. Table 2 also shows that item-to-total correlations were excellent for most sub-scales. Some sub-scales were a little more problematic, in particular the Contact with similar/different people or the Trust in big institutions, corporations, and other people and the Trust of intimate people sub-scales with item-to-total correlations ranging from 0.44 to 0.65. Assistance was the most problematic sub-scale of all, as item-to-total correlations ranged from 0.27 to 0.66.

Rasch measurement theory

-Item fit statistics and item category thresholds: We further evaluated the scaling properties and construct validity of the BSC Questionnaire using RMT. Table 3 summarizes the RMT analyses (Table 3). Table 3 also shows the improvement in model fit after items were removed from all sub-scales to improve fit to the RMT model. Each row of the table has information on each sub-scale of the BSC Questionnaire. First, we present the results of the tests performed with the initial version of the questionnaire. Then we present the results of the tests performed with the final version of the questionnaire, indicating the items that have been deleted in each sub-scale. No item category thresholds results were disordered for any item. Fit to the RMT model was examined using fit residual mean values between the expected scores and the actual score. A perfect fit would be indicated by a summary mean of zero and standard deviation of ±1. The person-residuals ranged from 0.08 to 1.93 initially (0.84–1.57) for initial models and improved from 0.16 to 0.72 (0.96–2.12) with the final models. Item-residuals ranges were 0.0 (0.36–1.38) throughout the models.

-PSI: The Chi-square probability of the item to trait interaction estimated the invariance of the scale. The PSI, an analogous coefficient to Cronbach's alpha ranged from 0.68 to 0.82 for most final models, indicating moderate and high reliability. The Assistance sub-scale had a lower reliability of 0.45.

-DIF: In the considerations for item fit, we examined whether groups of respondents responded to questions differently either by consistently or inconsistently answering the same responses (DIF). Uniform and Non-Uniform DIF was assessed for sex, age group, where a participant was born, when a participant arrived to the US, income, level of education and language using analysis of variance (ANOVA, alpha = 0.05). None of the final versions of the sub-scale created DIF.

-Local dependency and Unidimensionality: Local dependency was also considered for the elimination of potential items by assessing for unidimensionality and response dependency. The unidimensionality of the BSC Questionnaire was assessed using independent t-tests between subsets of items identified by a principal component analysis of the residuals. Table 3 shows that from 4.4% to 12.27% *t*-tests were statistically significant initially which reduced to 0.64%–4.91% for the models after item deletion. The mean *t*-test value and 95% CI supported acceptable unidimensionality for each sub-scale of the BSC Questionnaire. Detailed information on the process of item removal is available in the Appendix (see Appendix 1 and 2).

-Targeting and Item locations: Figs. 1–5 show the person-item threshold distribution of the different sub-scales of the BSC Questionnaire. In all figures, we can see the person threshold distribution to the item threshold. There is one of the extremes of the scale where the items or the person threshold exceed the range covered by corresponding person or item threshold ranges. The Assistance sub-scale is the sub-scale where these thresholds overlap the least, with more than 60% of the respondents at an ability level that is not measured by any item.

As a result of all steps of the analysis with the deletion of the items that did not fit the Rasch model, in the final step the BSC Questionnaire v2 has 61 items (compared to 67 in version 1) and is shown in Appendix 1 and 2. The final score in each sub-scale is the sum of the responses, where a higher score indicates higher bridging social capital.

Discussion

To create the BSC Questionnaire v2 we used a rigorous process of development and evaluation following qualitative and classical test theory methodologies as well as modern psychometric techniques. The

Table 3
Summary Rasch fit statistics and psychometric criteria of the BSC Questionnaire. Statistics are shown for V1 and V2 of the questionnaire.

Analysis	Item Residual	Person Residual	Chi-Square		Reliability (PSI)	% of t tests significant (95 CI)
	Mean (SD)	Mean (SD)	χ^2 (df)	*p*		
Socializing in the workplace v1	0 (0.46)	0.28 (1.56)	21.02 (10)	0.02	0.71	4.40 (1.92–12.07)
Socializing in the workplace v2 (deleted item 3)	0 (0.49)	0.21 (1.43)	12.23 (8)	0.14	0.68	1.26 (-0.75–4.75)
Socializing in the community activity v1	0 (0.36)	0.08 (1.42)	21.29 (10)	0.02	0.68	5.06 (2.59–13.39)
Socializing in the community activity v2 (deleted item 25)	0 (0.40)	0.16 (1.57)	9.90 (8)	0.27	0.76	0.64 (-0.96–2.95)
Contact with similar/different people v1	0 (0.68)	-0.64 (1.17)	23.05 (14)	0.06	0.67	12.27 (11.79–28.22)
Contact with similar/different people v2 (item 31)	0 (0.68)	-0.72 (1.18)	24.59 (12)	0.05	0.68	1.26 (-0.75–4.75)
Assistance v1	0 (1.38)	1.93 (1.27)	51.0 (32)	0.02	0.53	4.05 (1.30–10.70)
Assistance v2 (deleted item 49)	0 (1.34)	-0.55 (2.12)	26.58 (30)	0.65	0.45	2.36 (-0.36–6.35)
Trust of institutions, corporations and other people and Trust of intimate contacts v1	0 (0.68)	0.42 (0.84)	64.84 (34)	<0.01	0.81	12.27% (11.78–28.22)
Trust of institutions, corporations and other people and Trust of intimate contacts v2 (Deleted items 62 and 64)	0 (0.73)	0.44 (0.96)	31.55 (30)	0.39	0.82	4.91 (2.59–13.39)

SD: Standard deviation; χ^2:Chi-square, df: degrees of freedom, PSI: Person Separation Index, CI: Confidence Interval.
*No response dependency was observed.

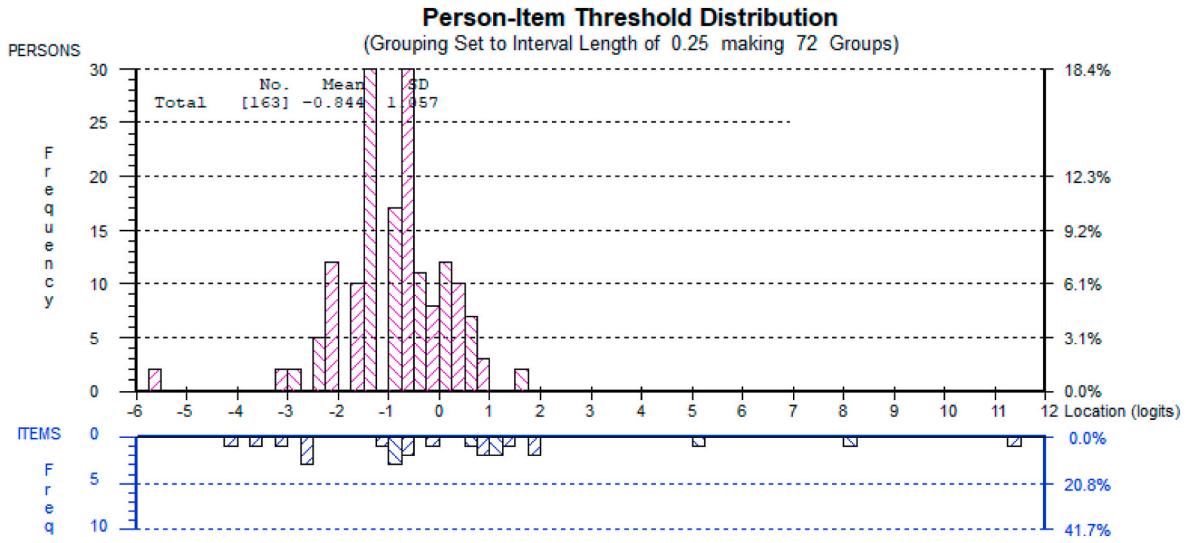

Fig. 1. Socializing in the work place.

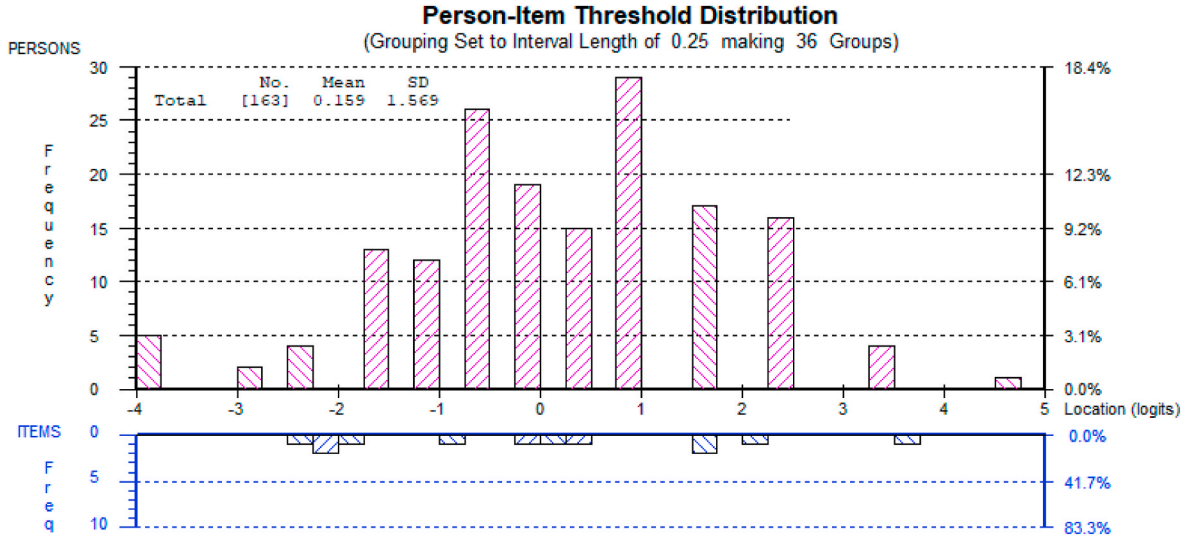

Fig. 2. Socializing in the community activity.

BSC Questionnaire v2 has fewer items, with a final total of 61 items: Socializing in the work place (4 items); Participation in community activities (16 items that do not count for Rasch); Socializing in the community activities (4 items); Contact with similar/different people (6 items); Assistance (16 items); Trust of institutions, corporations and other people (13 items); and Trust of intimate people (2 items).

Classical Test Theory psychometric analyses showed that the 67-item BSC Questionnaire (V1) demonstrated high internal reliability (α = 0.80), beyond the minimum 0.7 level recommended. Although many sub-scales showed moderate to high internal consistency, certain sub-scales were problematic, such as the Contact with similar/different people or the Trust in big institutions, corporations, and other people and Trust of intimate people sub-scales with item-to-total correlations ranging from 0.44 to 0.65. Assistance was the most problematic sub-scale of all, as item-to-total correlations ranged from 0.27 to 0.66. A likely cause for this finding is that the Assistance sub-scale uses binary response options (yes, no) and contained several items with unusually high proportion of respondents who favoured one of the response categories over another (with frequency ranging from 58 to 86% in certain cases). During the focus groups, we checked that the items included were relevant for Latinx immigrants and that binary response options looked appropriate. However, respondents in the survey may have had very different characteristics than the ones included in the focus groups. We believe respondents that have been in the US for a long time and those with higher levels of education address this sub-scale in a very different way than respondents that do not have these characteristics. Thus, the characteristics of the sample that responded the questionnaire affected the results. In addition, the questions asked in this section apply to immigrants but are very different in nature. Hence, assuming it is a single sub-scale can be problematic.

Psychometric analyses using RMT were used to evaluate the scaling properties and construct validity of the BSC Questionnaire. There were no disordered thresholds on any item, either examined as part of the overall or as part of sub-scales. However, the analysis provided evidence of the need of modifying some of the sub-scales as there was lack of support for unidimensionality or fit to the RMT model. We identified sub-scales that did not fit the Rasch model, suggesting the need for modification. First, the set of 5 items used to evaluate Socializing in the work place and Socializing in the community activity are the same items asking for socializing characteristics but asked in different contexts. In both sub-scales, item 3 (from a different race/ethnic background) and 25 (from a different education level) were removed due to poorer fit as well

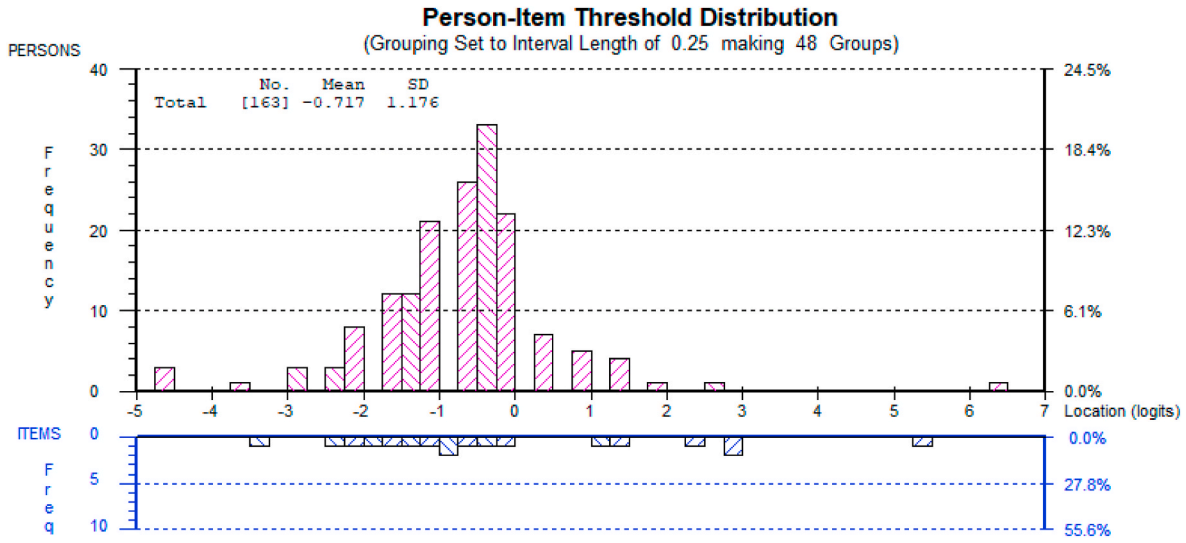

Fig. 3. Contact with similar/different people.

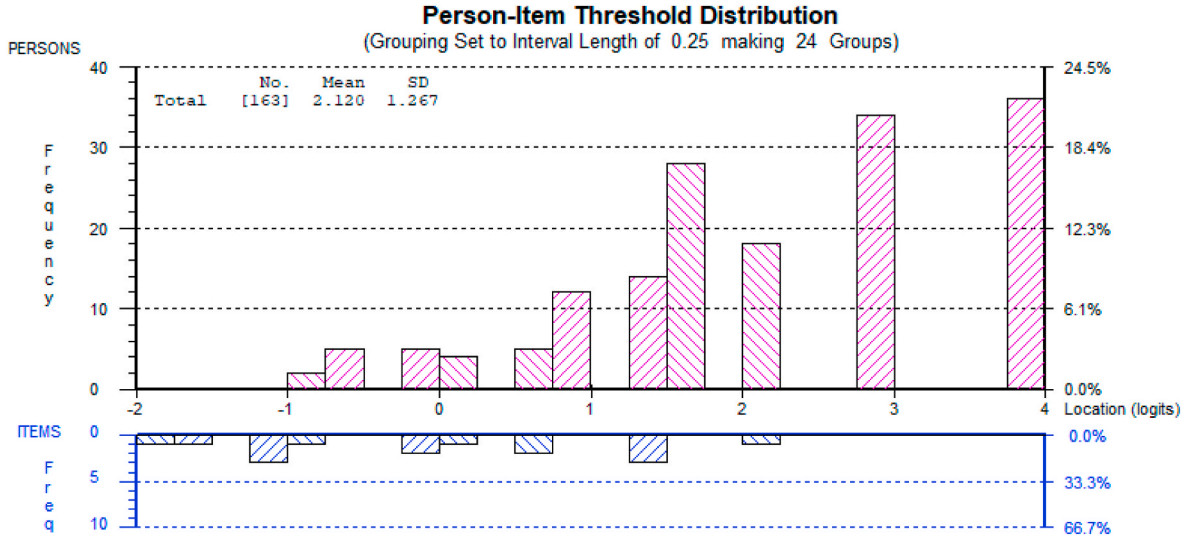

Fig. 4. Assistance.

as DIF by level of education and language for several items. The resulting Socializing in the work place sub-scale had a low reliability index of 0.66, and the resulting Socializing in the community sub-scale had no response dependency nor DIF. We deleted item 3 on Mixing with people from a different race/ethnic background because in the initial qualitative evaluations when developing v1 of the questionnaire we saw this item had some conflict with the item Mixing with people with a different nationality and was confusing. Despite keeping both items in the first version of the questionnaire, these tests confirmed that one of them should be deleted. In addition, some population groups that have not been born in the US have some difficulties to understand the concept of race because it is a social construct especially relevant in the US.

Immigrant communities, especially when they first arrive in their countries of destination, can be socially isolated and tend to mix with other people that are similar to them (e.g. other immigrants and/or people from the same country of origin). With that, they can build connections in the new place they live in, but lack other important connections a person needs to make when living in a new country. Mixing with other people with similar backgrounds or people from the same country of origin can result in a disconnection from the new norms of the society they live in, especially when they arrive. This can have bad consequences. For example, immigrants tend to have less access than US citizens to commercial insurance or to have less information about public insurance through Medicaid (Khullar & Chokshi, 2019). The problems to navigate a new health care system involves the lack of use of health services. Protecting the wellbeing of immigrants when arriving to the US, especially their offspring, is particularly important for the future health of the US. The problem is that this population faces unique socioeconomic and health-care challenges (Khullar & Chokshi, 2019). One first step to change this problem is to be able to evaluate if immigrants have a lack of bridging social capital. If they do have this lack of bridging social capital, one can expect a disconnection from opportunities available to the majority of society. The problem we have observed when developing this work is that measuring bridging social capital in immigrant populations is very challenging. When we developed the first version of the questionnaire we involved immigrant participants from different countries of origin in qualitative evaluations to ensure content validity. However, differences in the Spanish language in Latin America, cultural diversity and variety of backgrounds are examples of actors that play a role when answering the same items of a questionnaire. As we have observed, several factors can be a threat for the validity and reliability of a questionnaire when targeting a population with different

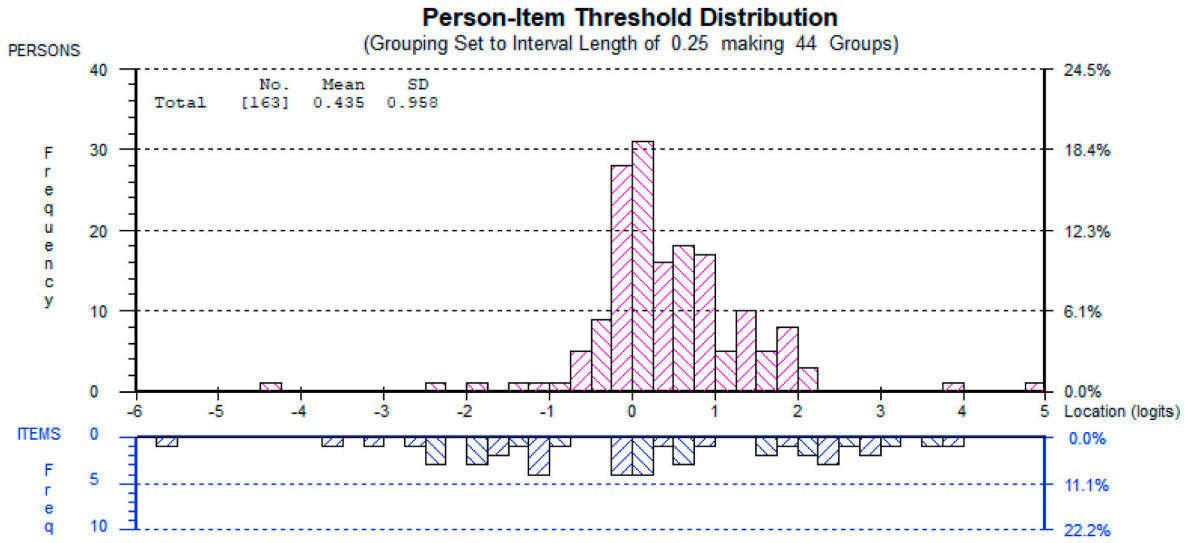

Fig. 5. Trust of institutions, corporations and other people and Trust of intimate contacts.

origins. For this reason we deleted highly problematic items that were acting differently depending on respondent characteristics. Hence, we believe the item deletion process followed in this study makes version 2 of this questionnaire a valid and realiable tool to measure bridging social capital in immigrants from Latin America living in the US.

This study does have some limitations. Although the BSC Questionnaire has been improved and is demonstrated to be a valid and reliable measure, there was selection bias. Almost 50% of respondents had partially completed or completed university education. This was higher than the general Hispanic population of the US. Additional studies are needed in other settings and with more varied populations, including Hispanics from other regions of Latin America that are highly represented in certain States, for instance Cubans in Florida. A final limitation to the interpretation of these results is based on the theoretical underpinnings of the concept being measured, viz., bridging social capital. A noted observation was that certain items were skewed in favor of a high floor effect. From a statistical perspective however, the items with a high floor effect or distribution would have no discrimination because all the values would lean towards more ethically acceptable responses. It would be of interest to compare results across samples recruited from communities where assistance is lower to verify whether the issues observed in this study would be repeated. This study has however important strengths. The development of the questionnaire involved mixed methods, with a previous conceptual model and different rounds of focus groups to ensure content validity. For this paper, we went back to the materials of the qualitative evaluations before making changes and the final questionnaire presented in this study involved a rigorous process of qualitative evaluations, expert involvement, classical test theory and modern psychometric techniques.

The outcome of this study has been the test of all sub-scales of the questionnaire using the Rasch measurement model to be used independently. Through mixed methods psychometric research, we created a revised version of the questionnaire that fits the Rasch measurement theory model, although a few sub-scales still persist with a few shortcomings, namely in terms of response dependency or DIF. The qualitative and quantitative findings support the use of the questionnaire in measuring overall bridging social capital in Hispanic immigrants. Further research, in particular qualitative rounds with other sources of Hispanic immigrants would help improve the measure for future research.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.ssmph.2021.100791.

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