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Examining predictors of school belonging using a socio-ecological perspective

ORIGINAL PAPER

Examining predictors of school belonging using a socio-ecological perspective

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Abstract
Between the years of 2003–2015, the Programme for International Student Assessment (PISA) has identified a global trend signalling a decline in a sense of school belonging for secondary school students. Research has identified several factors that are positively related to school belonging, such as teacher support and academic motivation. However, little empirical research has been conducted to evaluate the relevant school belonging variables holistically and to assess their socio-ecological levels (e.g., student, microsystem, mesosystem) relative to the student. The purpose of this study is to assess the significant predictive variables within each socio-ecological level regarding school belonging. For this purpose, this study used data collected by PISA in 2015, focusing on data from 309,785 15-year-old students attending 12,668 schools in 52 countries around the world. Hierarchical multiple regression analysis was conducted to a) examine the empirical support for a layered structure of sense of school belonging, b) explore the contributions of variables in each layer of the socio-ecosystem to explain the variability in sense of school belonging and c) examine potential variations in this ability across schools and countries. The models provided support for the existence of such layers but also for some underlying relationships across the variables in the layers of the socio-ecosystem. The study then concludes with a discussion of the implications of the findings for school leaders, teachers and parents with respect to how school belonging approaches and strategies can be absorbed into existing practices and operations at school.

Keywords School belonging · Socio-ecological · Teacher support · Parental support · Motivation · Test anxiety

Highlights
- Student, or individual intrapersonal factors, can have significant impact on a student's perception of belonging.
- The strongest individual factors were collaboration dispositions (i.e., enjoying and valuing cooperation with others).
- Findings suggest a significant negative relationship between school belonging and test anxiety.
- It can be concluded that there are various systemic influences of school belonging.

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Data from the Programme for International Students Assessment (PISA) shows a persistent international trend indicating that at least one in three students feel as though they do not belong to their school (Organisation for Economic Co-operation and Development OECD, 2019). Furthermore, prominent scholars have raised concerns about a loss in our ability to meet this intrinsic need for human connection (Baumeister & Leary, 1995; Putnan, 2000; Twenge et al., 2001). It is clear from the literature that a sense of belonging is beneficial for students. Belonging is associated with high levels of student emotional wellbeing (Arslan, 2018, 2021a; Arslan & Allen, 2021, increased academic performance and achievement (Pate et al., 2017; Reynolds et al., 2017), and good academic skills (Abdollahi et al., 2020; Won et al., 2017). It also has an important impact on psychological wellbeing by reducing the likelihood of mental health problems (Arslan, 2018; Arslan et al., 2020; Markowitz, 2016; Pate et al., 2017), promoting resilience when mental health difficulties are experienced by at-risk youth (Allen & McKenzie, 2015; Oldfield et al., 2018), and diminishing suicidal thoughts and behaviour (Marraccini & Brier, 2017). A proactive and preventive focus on school belonging is thus required. This need provides the impetus for the present paper, which uses the largest data set on school belonging available currently (Organisation for Economic Co-operation and Development OECD, 2017a) to examine a theoretical framework of school belonging (Allen et al., 2016).

A student's sense of school belonging is a complex and multi-faceted construct that can be influenced by a range of factors. Previous research has led to a reasonable understanding of various factors and variables that contribute to increased school belonging. However, empirical studies have not yet provided a comprehensive understanding of school belonging, partly because of the variation in terminology and definitions used to conceptualise the construct (Allen, 2020; Allen & Kern, 2019). Applying a socioecological lens to investigate school belonging within a school context provides insight into the diversity of the possible multiple complex and dynamic influencers that have been identified in research (Allen, Fortune et al., 2021; Allen, Kern et al., 2018; Allen et al., 2016; Bronfenbrenner, 1986). Even through a conceptual perspective, as demonstrated in the *Socio-ecological Model of School Belonging* by Allen et al. (2016), we see that school belonging is influenced by a range of factors, including but not limited to achievement motivation, test anxiety, collaborative disposition, teacher unfairness, parental emotional support, disciplinary climate, and economic, social, and cultural status (Allen, Kern et al., 2018; Korpershoek et al., 2020). However, this theoretical framework has not yet been supported empirically by a comprehensive study. The aim of this paper is to investigate whether a large data set—that collected by PISA—yields further insights into school belonging as a socio-ecological construct. This large data set

offers a unique opportunity to test a diverse range of variables that are related to the different levels of a socio-ecological system. It is untenable to test an entire socio-ecological model, but by using the PISA data set it is possible to explore whether there is preliminary supporting evidence for the concept. This global data set also provides a unique insight into the ways in which we analyse world-wide influences on social belonging, across all participating countries.

Why We Need to Investigate School Belonging

Belonging is a fundamental need that represents a powerful and innate drive that begins shortly after birth (Allen, Gray et al., 2021; Allen, 2020; Baumeister & Leary, 1995; Lieberman, 2013). It is often conceptualised to relate to social interactions and interpersonal relationships (Baumeister & Leary, 1995), however, more recent and broader definitions of belonging also consider the intrapersonal, temporal, cultural, environmental, and geographical contexts and experiences related to belonging (Allen, Kern et al., 2021). Baumeister and Leary (1995) postulated that without a sense of belonging in at least one domain of a person's life, the likelihood of negative behavioural and psychosocial outcomes is quite high. For decades now, researchers have linked a strong sense of school belonging to a plethora of academic and psychosocial outcomes for youth, including academic achievement, motivation, emotional wellbeing, and internalizing problems (e.g., Allen et al., 2018; Arslan, 2018, 2021b; Arslan & Duru, 2017; Goodenow & Grady, 1993; Pittman & Richmond, 2007). However, few studies have examined, either theoretically or empirically, which factors impact or predict a strong sense of school belonging using a socio-ecological lens.

Theoretical Framework

Bronfenbrenner's (1979) ecological model of human development has been connected to this construct of belonging by previous research (Allen et al., 2016; Allen, Vella-Brodrick et al., 2018). Specifically, Allen and colleagues (2016) adapted Bronfenbrenner's (1979) model and applied it to the construct of school belonging. In their proposed model, Allen et al., (2016) identify a school system as a society with its own values and culture. Starting from this idea, they apply Bronfenbrenner's (1979) theoretical framework to the school system. Allen and colleagues (2016) place the student at the centre of the model and assert that their sense of belonging is either fostered or hindered by their experience with different layers of the school society. While borrowing from the systems-based terminology of Bronfenbrenner's (1979) model (i.e.,

microsystem, mesosystem, exosystem, and macrosystem), Allen et al. (2016) redefine and refocus each level to reflect systems within educational spaces.

At the student level, Allen et al. (2016) include personal characteristics, such as emotional stability and academic motivation. They define the microsystem as the level of support the student receives from their teachers, parents and peers. The mesosystem includes school policy, practices, extracurricular activities, staff development and other factors at work under the roof of a specific school. The next level, the exosystem, includes influences acting on a specific school, such as school, neighbourhood, and extended family. The last level reflects a broader societal influence, including factors such as history, social climate, legislation and governmental influences on education (Allen et al., 2016). The present study adopts the social-ecological model of school belonging proposed by Allen et al. (2016) to examine the following variables of best-fit offered by PISA (Organisation for Economic Co-operation and Development OECD, 2019): achievement motivation, test anxiety, collaborative disposition, teacher unfairness, parental emotional support, disciplinary climate, economic, social, and cultural status and the countries' affiliations to the OECD. Each of these variables have been found to be strongly associated with school belonging in the literature (Allen et al., 2018; Korpershoek et al., 2020).

Although a multi-level approach can be used to explain school belonging, it should be noted that, at its core, the belongingness hypothesis (Baumeister & Leary, 1995) highlights the importance of interpersonal relationships and belongingness to groups for positive psychological outcomes. Thus, when applying this hypothesis within the school context, it is probable that, across the different levels of the socio-ecological framework, positive interactions with classmates, teachers, and a sense of belongingness to school would be more likely to improve the experience of academic achievement and student well-being. This is evident in Allen et al.'s (2018) meta-analysis of 51 previous studies, which included 67,378 secondary school students and identified a range of factors that relate to a sense of school belonging. The strongest factor that emerged for a student's sense of belonging was the relationship students had with their teachers. Students reported a greater sense of belonging when they felt they had teachers who respected and valued them, who were perceived as being fair, who were available for academic and social support, who promoted positive relationships with students by showing they cared, and who encouraged mutual respect all of which is in line with the assumptions of the broader literature (e.g., Allen et al., 2018; Allen & Kern, 2017; Allen, Slaten et al., 2021). Parents and peers were also found to be important in the aforementioned analysis (Allen et al., 2018). Although conflict with parents

may arise, supportive parents are an important source of emotional support (Steinberg & Morris, 2001). A parent's perception of school and the extent to which they value and support the educational experience of their children is vital. Having peers who provide social and academic support creates a mutual sense of belonging (Allen et al., 2018). It is also known that the social and emotional competencies of students, such as self-efficacy, self-esteem, coping skills, adaptability, having prosocial goals, as well as academic motivation (or achievement motivation) and the ability to make and keep friends, impacted how students felt about school (Allen, McInerney et al., 2021; Allen et al., 2017; Durlak et al., 2011; Zins et al., 2004; Zins & Elias, 2007). An emphasis on social and emotional learning and achievement motivation through the curriculum is key to boosting student relationships and overcoming negative attributions (e.g., test anxiety and perceptions of teacher unfairness). A comprehensive socio-ecological framework for understanding the complex dynamics of school belonging offers an opportunity to examine the many hypothesised contributors to school belonging through the educational data collected by PISA (i.e., achievement motivation, test anxiety, collaborative disposition, teacher unfairness, parental emotional support).

Engagement Research

School engagement is another concept that is closely linked to the school environment and, although it is quite distinct from school belonging, it is especially relevant within the belonging literature (Allen & Boyle, in press; Furlong et al., 2014). As a multidimensional construct, different types of engagement have been recognised. Two that are particularly relevant here are behavioural engagement, which involves students' participation in school-related activities, and emotional engagement, which is more concerned with the emotional connection between students and their schools or teachers (Bakadorova & Raufelder, 2017; Estévez et al., 2021; Fredricks et al., 2004; Skinner et al., 2009). Many researchers have pointed out that the emotional engagement construct is similar to that of school belonging (Finn, 1989; Skinner & Belmont, 1993).

Noting this similarity can be useful as students from countries with different cultures have been shown to have varying degrees of school engagement (Shcheglova, 2018), with PISA data even showing that engagement levels are also measured in terms of a student's sense of belonging (Willms, 2000). Furthermore, many of the social factors considered within the socio-ecological model may also be considered from the perspective of engagement (Bakadorova & Raufelder, 2017). As a result of this bidirectional relationship, identifying the factors which influence school belonging will not only allow us to understand variations in

school belonging, but will also enable us to draw connections with other concepts (e.g., engagement) and their associated outcomes (e.g., academic achievement).

Current Research

The current study is an attempt to begin examining the different layers of this socio-ecological model of school belonging with youth cross-culturally (Allen et. al., 2016; Bronfenbrenner, 1979). More specifically, the researchers examine constructs that represent the innermost layers of the model: student (individual) level, microsystem, and mesosystem. This was accomplished by utilising a large international student-level data set from PISA.

PISA collects data on behalf of the Organisation for Economic Co-operation and Development (OECD) on a global scale from both member and non-member countries. The OECD is an international organisation that collaborates with governments from 38 countries in the creation of national policies that aim to promote economic growth and development. Being a member of the OECD is an indicator of the country's state of economic development and of sharing a set of neo-liberal values (Bouhali, 2015), as these are requirements to become a member of the organisation (Organisation for Economic Co-operation and Development OECD, 2021).

Data are collected every 3 years from 15-year-old participants in grade 7 or higher. This data represents 29 million students and aims to evaluate educational systems around the world, especially with respect to mathematics, science, and reading. PISA also conducts assessments of cross-curricular competencies, including students' sense of school belonging.

In findings published in 2018, PISA reported that, across OECD nations, students' sense of belonging has declined since 2003, with the most noticeable deterioration occurring between 2012 and 2015 (Organisation for Economic Co-operation and Development OECD (2017a); Organisation for Economic Co-operation and Development OECD, 2019).

While many correlations between theorised factors and school belonging have been studied in various research projects, there has been limited investigation and holistic analysis regarding how many of these factors comprehensively impact school belonging. The predictive capability of broader socio-ecological factors remains largely untested (e.g., Allen et al., 2016). The aim of this paper is to address this gap in the research and assess whether the variables presented in the PISA data—achievement motivation, test anxiety, collaborative disposition, teacher unfairness, parental emotional support, disciplinary climate, economic, social, and cultural status and the country's affiliation to the OECD—have significant relationships with and/or predictive utility for school belonging when modelled within a socio-ecological framework. The researchers organised these possible predictors of school belonging into the three aforementioned layers as follows: student-level constructs (achievement motivation, test anxiety, collaborative disposition), microsystem level constructs (teacher unfairness, parental emotional support), mesosystem (discipline climate), and macrosystem (economic, social and cultural status and OECD country) based on the conceptualisation of the socio-ecological model found in Allen et al. (2016). By grouping variables into blocks representing the socio-ecological layers and examining the changes in the student, school and country residual variance, this study will provide empirical evidence for the hypothesized layers. A previous meta-analysis (Allen et al., 2018) and prior findings based on the school engagement literature, in which there are multitudes of significant factors, lead to the expectation that each block (re: layer) will be statistically significant. It is also expected that almost all variables will have a positive relationship with school belonging, as identified in previous literature (e.g., Slaten et al., 2016; 2018; O'Brien & Bowles, 2013). The exceptions are teacher unfairness and test anxiety, given the negative connotations of these two constructs.

Method

Participants

This study uses data from the PISA 2015 survey (Database—PISA 2015). The PISA 2015 assessed 15-year-old students during a 42-day period between 1 March 2015 and 31 August 2015 using a stratified sample for data collection. Stratification was used to ensure adequate representation of specific groups of the target population in the sample. Strata were defined uniquely for each country, and generally consisted of school type (urban versus rural), state and region areas, school size and funding levels, and school gender.

This study examines data from 309,785 students attending 12,668 schools in 52 countries around the world. These are a subsample of the original PISA 2015 data, which contains information for 512,334 students across 72 countries in the measures described below. Not all countries distributed the same questionnaires to students and parents, hence it is not possible to assess the importance of all the variables in every country that participated in PISA 2015. The authors accessed de-identified and anonymised student data that is publicly available through the PISA data website (https://www.oecd.org/pisa/data/). Ethics approval was provided by Monash University Human Research Ethics Committee (Approval Certificate 23045).

The number of students per school and schools per country in the sample vary widely. In the sample used in this study, the mean number of students per schools is 24.45 ($SD = 16.75$), with records ranging from 1 to 526 students per school. The

average number of schools per country is 243.62 ($SD = 137.99$), but ranges between 43 and 798. Of the 52 countries in the sample, 32 are OECD countries or economies, while the remaining 20 are not. Table 4 shows the list and sample size for each of the countries included in the sample.

Measures

Questionnaire indices are presented below and are derived from *The Student Questionnaire* (Organisation for Economic Co-operation and Development OECD, 2017a), which included, in total, 54 derived constructs. Only eight of the derived variables were used in the present study considering the school belonging literature and relevance to school belonging in the data set. The PISA uses an Item Response Theory (IRT) in the scaling of the data. Given the IRT equating, the parameters of items are typically estimated separately for both test forms and subsequently put on the same scale by means of a linear transformation. The outcomes have provided evidence supporting the validity and reliability of the measure (see, PISA, 2015 Technical Report for more information).

The data utilised for this analysis were exclusively from the student questionnaire. Questions include student perceptions about parent and teacher engagement. Answers to these questions do not represent the perspectives of the parents and/or teachers in question.

Dependent variable

Sense of school belonging The Sense of Belonging Scale (OECD, 2017b) focuses on social connectedness and included six items. (e.g., make friends easily, I feel like an outsider, I feel like I belong at school). Responses were given on a four-point Likert scale with the following options: "strongly agree", "agree", "disagree", and "strongly disagree". Higher scores corresponded to higher levels of school belonging. The internal consistency of the scale was strong (Cronbach's alpha = 0.83).

Student-level variables

Achievement motivation Students' academic achievement motivation was measured using five items (e.g., I want top grades in most or all of my courses, I want to be one of the best students in my class, I see myself as an ambitious person; OECD, 2017b). Item answers followed a four-point Likert scale ranging from "strongly agree" to "strongly disagree". Higher scores corresponded to higher levels of motivation to achieve. In the present study, the internal reliability of the scale was strong (Cronbach's alpha = 0.81).

Test anxiety The test anxiety scale (OECD, 2017b) measures the anxiety that students experience during any exam (e.g., I often worry that it will be difficult for me taking a test)

using five items. Items are assessed on a four-point Likert scale which ranges from "strongly agree" to "strongly disagree". Higher scores corresponded to higher levels of test anxiety. In the present study, the internal reliability of the scale was strong (Cronbach's alpha = 0.82).

Collaboration and teamwork dispositions Collaboration and teamwork dispositions (OECD, 2017b) were assessed using eight items and the students were given the opportunity to rate their view on different aspects of cooperation (e.g., I prefer working as part of a team to working alone). Responses were given on a four-point Likert scale ranging from "strongly disagree "to "strongly agree". Higher scores corresponded to higher levels of collaboration and teamwork dispositions. In the present study, the internal reliability of the scale was satisfactory (Cronbach's alpha = 0.79). These items represent two distinct scales, one that measures a student's enjoyment of co-operation and another that measures the value of co-operation for the student.

Microsystem level variables

Teacher unfairness The Teacher Fairness Scale (OECD, 2017b) asked students about how often in the past 12 months they had experienced unfair treatment by teachers. The Teacher Fairness Scale included six items (e.g., teachers called on me less often than they called on other students, teachers graded me harder than they graded other students). Items in the scale were assessed on a four-point scale that discriminated possible answers across four categories, "never or almost never ", "a few times a year ", "a few times a month ", "once a week or more". In the present study, the internal reliability of the scale was adequate (Cronbach's alpha = 0.77).

Parental emotional support Students were asked to rate their perception of the emotional support they received from their parents using four questions (OECD, 2017b). The assessment included items asking whether parents are interested in school activities, support the students' educational efforts and achievements, support students when they are facing difficulties at school and encourage them to be confident (e.g., I encourage my child to be confident). Items were assessed on a four-point Likert scale ranging from "strongly agree" to "strongly disagree". Higher scores corresponded to higher levels of perceived parental emotional support. In the present study, the internal reliability of the scale was strong (Cronbach's alpha = 0.85).

Mesosystem level variable

Disciplinary climate in science classes The items for disciplinary climate (OECD, 2017b) included statements related to the disciplinary climate in science class, asking students to

respond on a four-point Likert scale with the categories "every lesson", "most lessons", "some lessons" and "never or hardly ever". Sample items included: "Students don't listen to what the teacher says, there is noise and disorder", "the teacher has to wait a long time for the students to quiet down", "students cannot work well", and "students don't start working for a long time after the lesson begins". In the present study, the internal reliability score was strong (Cronbach's alpha = 0.80).

Macrosystem level variables

Economic, social and cultural status This student-level indicator of socio-economic status combines information on the highest parental occupation status, the highest number of years of schooling for both parents, and home possessions, including country-specific assets that indicate wealth (e.g., an espresso machine in Australia or a guest room in the United States), educational resources, and cultural assets such as books and paintings (OECD, 2017b). This builds on Bourdieu's (1986) social reproduction theory and the role that social, human, economic and cultural capital play in social stratification. This is a widely used socio-economic status indicator and is considered to better represent this construct than do single items (e.g., just using occupation) (APA Task Force on Socioeconomic Status, 2007; Avvisati, 2020).

For the economic, social and cultural status scale for PISA 2015, a higher level indicates a higher socio-economic status.

OECD country This variable takes the value of one for the countries that belong to the OECD. This is used as a proxy to measure the set of policies, legislation and governmental views that are shared by the countries that belong to the OECD, as opposed to those that do not.

Data analysis

The data analysis consists of three steps:

1. The estimation of a three-level hierarchical variance component model of sense of school belonging. This step tests whether the data provide support for the existence of a multiple-level structure of belongingness. The data do not allow for tests of the partition of belongingness into all the layers of the socio-ecological framework presented by Allen et al. (2018). Nonetheless, it is possible to test whether the variance of belongingness can be partitioned into three levels: student (which includes the student and microsystem), schools (mesosystem and exosystem) and country (macrosystem).
2. The estimation of three-level hierarchical models

including potential predictors of belongingness at each of the levels. This allows for the testing of the explanatory power of the potential predictors of belonging at each of the three levels (student, school and country). If, when introducing the set of variables at each level, the residual variance of belonging at each level is lower than the variance component for that level (as estimated by the variance component model), this can be interpreted as evidence of the ability of such variables to explain the variance in belonging. The potential predictors were included in three blocks: Block 1 includes the individual layer predictors (achieving motivation, test anxiety, collaboration and teamwork dispositions); Block 2 includes the microsystem level variables (teacher unfairness and parental emotional support); Block 3 includes the mesosystem level variable (disciplinary climate in science classes) and Block 4 includes the macrosystem level variables (ESCS and OECD).

3. The inclusion of random slopes at the school and country levels. This step tests the variability in the explanatory power of the predictors of school belonging by school and country. That is, whether a variable's power to explain belongingness is the same for all schools and countries. In this case, the ability to estimate a model (i.e., convergence) and the magnitude of such variability are interpreted as the existence of variability of the explanatory power of these variables.

The data analysis was conducted on R version 3.6.2 (2019-12-12) (R Core Team, 2019) and the lme4 package (Bates et al., 2015) for the estimation of hierarchical models. All the variables were standardised to have a grand mean of zero and a standard deviation of one. The estimated coefficients can thus be interpreted as effect sizes. Following the PISA convention for the estimation of multilevel models (OECD, 2009), normalised weights per country were applied to the sample to account for the stratified sample design. In no case was the Pearson correlation between variables higher than 0.4 (Table 1), which reduces the risk of potential multicollinearity problems.

Results

Is There Support for a Layered Structure of Sense of School Belonging?

The estimation of the variance component model shown in the second column of Table 2 provides support for a multi-level structure of belonginess. Specifically, it shows that 92.86% of the variation in school belonging is associated with variation among students (within schools and

Table 1 Pearson correlation between all variables in the model

		1	2	3	4	5	6	7	8	9	10
1	Sense of school belonging	1.00									
2	Achieving motivation	0.08	1.00								
3	Test anxiety	−0.14	0.17	1.00							
4	Enjoy cooperation	0.18	0.25	0.08	1.00						
5	Value cooperation	0.17	0.14	0.11	0.45	1.00					
6	ESCS	0.12	0.09	−0.11	0.08	−0.06	1.00				
7	Teacher unfairness	−0.12	−0.01	0.09	−0.09	0.00	0.03	1.00			
8	Parental emotional support	0.21	0.24	0.01	0.26	0.17	0.16	−0.13	1.00		
9	Disciplinary climate in science classes	0.12	0.03	−0.04	0.11	0.08	0.03	−0.22	0.11	1.00	
10	OECD	0.10	−0.14	−0.14	−0.04	−0.12	0.18	−0.01	0.05	−0.03	1.00
11	Female	−0.02	0.02	0.19	0.08	−0.05	−0.02	−0.13	0.03	0.04	−0.02

All coefficients were found to be statistically significant at $p < 0.05$. Standard errors and p-values were calculated using sample-weighted bootstrapping with 2000 iterations

countries); 2.48% of the variation in school sense of belonging is linked to differences between schools (within countries) and 4.66% of the variation in school sense of belonging is associated with variation between countries.

It becomes apparent from this result that the student-level variance (which includes the student and microsystem layers of the socio-ecological model) dominates the variation. That is, if the model supports the existence of multiple layers, it also shows that the most important of these are the student and microsystem layers.

What is the Explanatory Power of the Potential Predictors of Belongingness?

The next step of analysis estimated four hierarchical models, each adding a block of predictors at each level of the socio-ecological model of belongingness. The results of these estimations are presented in Table 2. As shown, all the included variables are individually significantly associated with sense of school belonging. That is, all the variables included in the models are predictors of school belongingness, even after accounting for differences in other variables.

Table 3 shows the percentage reduction in the variance of sense of school belonging at each level (students, schools and countries) after including each consecutive block of variables. As shown in the table, after including the student-level predictors of belongingness (achieving motivation, test anxiety and collaboration and teamwork disposition), the student-level variance of sense of school belonging decreased 7.35%, while its school-level variance decreased 21.57% and its country-level variance increased 2.89%. This is an indicator that the student-level predictors in the model are more strongly correlated with other school-level variables that predict school belonging than with student-level processes. At the same time, these variables incorporate additional information about between-country differences in school belonging that were not captured in the variance component model alone.

By contrast, the microsystem-level variables (teacher unfairness and parental emotional support) only explain an additional 2.02% of the student-level variance of sense of school belonging, but an additional 13.59% and 17.71% of the school- and country-level variance in this variable, respectively. This indicates that the microsystem-level predictors are not only linked to school-level processes, but also to country-level differences that affect belongingness. The mesosystem level predictor (disciplinary climate in science classes) explains an additional 4.31% of the school-level variance of school belonging, which provides support for its classification at this level.

Finally, the macrosystem level predictors (ESCS and OECD) explain an additional 9.57% and 37.46% of the school and country-level variance in belonging, respectively, but only 0.06% of the student-level variance. In this case, since OECD only distinguishes at the country level, the additional reduction of 9.57% in the school-level variance can be attributed to the ESCS, showing that students' economic, social and cultural status predicts school belonging not as a student-level variable but at an outer layer, as stated in the socio-ecological model of belonging.

These findings indicate that the data supports the socio-ecological model insofar as there are different layers for belongingness. These findings also indicate that the layers do not sit in isolation. Rather, there are potential interactions between these layers.

Is There Evidence of Variation in the Explanatory Power of the Predictors for Different Countries and Schools?

There is a large degree of variability in the average sense of school belonging among schools and countries (as shown in Figs. 1 and 2). However, this variability represents only a small proportion of the total variability in this variable. When attempting to estimate random slope

Table 2 Model estimation results

	VCM	Student level	Microsystem level	Mesosystem level	Macrosystem level
Fixed-part estimates					
Intercept	0.004	0.008	0.008	0.008	0.000
	(0.135)	(0.264)	(0.303)	(0.302)	(−0.008)
Achieving motivation		0.104***	0.078***	0.078***	0.074***
		(54.513)	(40.376)	(40.531)	(38.415)
Test anxiety		−0.163***	−0.151***	−0.148***	−0.145***
		(−91.836)	(−85.333)	(−83.813)	(−82.139)
Enjoy cooperation		0.098***	0.071***	0.068***	0.065***
		(50.373)	(36.443)	(34.647)	(33.236)
Value cooperation		0.142***	0.134***	0.131***	0.135***
		(73.513)	(70.065)	(68.771)	(70.312)
Teacher unfairness			−0.071***	−0.059***	−0.061***
			(−40.894)	(−33.230)	(−34.325)
Parental emotional support			0.122***	0.117***	0.112***
			(66.850)	(64.208)	(61.165)
Disciplinary climate in science classes				0.064***	0.063***
				(35.703)	(35.336)
ESCS					0.047***
					(23.141)
OECD					0.107***
					(4.769)
Random-part estimates					
Country	0.047	0.048	0.040	0.040	0.025
School	0.025	0.019	0.017	0.016	0.015
Student	0.930	0.862	0.844	0.841	0.841
Deviance	918,822	894,474	887,656	886,385	885,836

z-values in parenthesis

Dependent variable: Sense of school belonging

All models were estimated using maximum likelihood with a sample of 52 countries, 12,668 schools and 309,785 students

ESCS Economic, social and cultural status

***p-value < 0.01

Table 3 Percentage (%) reduction in the variance of sense of school belonging at each level after variable inclusion

Level	Student level	Microsystem level	Mesosystem level	Macrosystem level
Country	−2.89	17.71	−0.91	37.46
School	21.57	13.59	4.31	9.57
Student	7.35	2.02	0.36	0.06

A negative change denotes an increase in the variance at that level

models for each individual variable, the models did not converge. This can be interpreted as evidence of the lack of variability in the predictive ability of the set of variables by schools and countries (Raudenbush & Bryk, 2002). In other words, the variability in the average sense of school belonging among students around the world does not seem to be explained by variation in the ability of student, micro-, meso- and macro-level variables to predict belongingness. In turn, variables at these levels seem to predict sense of school belonging equally across schools and countries in the sample.

Discussion

The current study sought to explore whether data derived from PISA could be applied to a socio-ecological theoretical model for examining school belonging (Allen et al., 2018). We expected student factors (achieving motivation, test anxiety, collaborative/teamwork disposition) microsystem factors (teacher unfairness, parental emotional support), mesosystem factors (disciplinary climate in science class) and macrosystem factors (economic, social and cultural status and OECD country) to be significantly
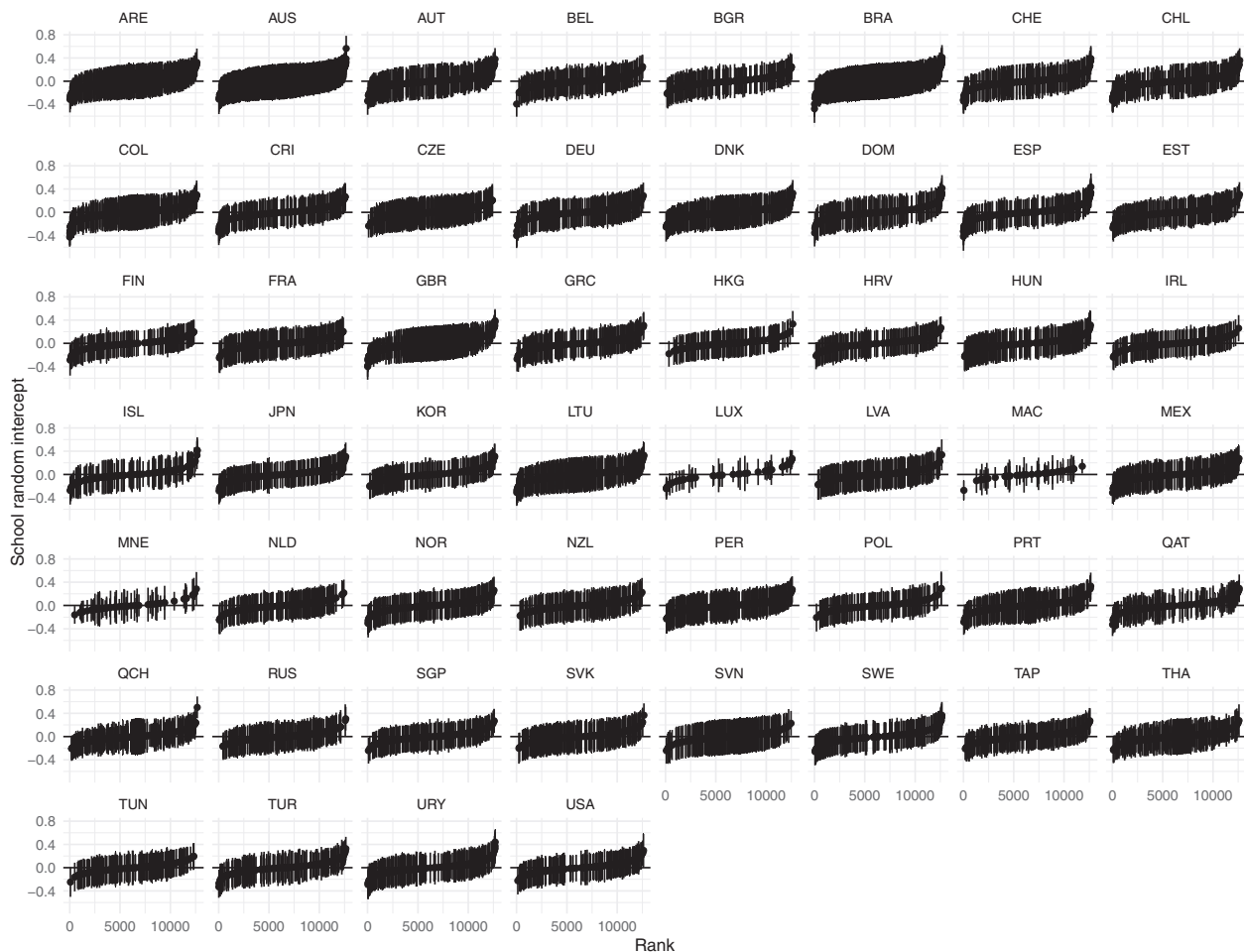
Fig. 1 Caterpillar plot for the school random intercepts of school belonging by country as derived from the variance component model. This figure illustrates the variability in the average sense of school belonging by school in all the countries

related to school belonging. This hypothesis was supported. It was also expected that all variables (except teacher unfairness and test anxiety) would have a positive relationship with school belonging. This hypothesis was supported, and findings were largely consistent with previous studies (Allen et al., 2018; Strayhorn, 2012).

It is important to note here that the factors with the strongest relationship and greatest contribution to explained variance were student-level factors that are based on perceptions of internal and environmental conditions. This suggests that it may be possible to design interventions to help students adjust their perceptions of themselves and their environments, something that is within their control. Findings support previous research demonstrating that each of the variables has merit for fostering a sense of belonging and provides initial evidence for the socio-ecological model of belonging at the student, microsystem, and mesosystem levels (Allen et al., 2018). While many of these correlations have already been empirically supported, very few of these factors have ever been analysed in a single study with such a large sample size. The results of

this study, particularly the ability to note which factors have the strongest effects and which layers of the socio-ecological framework explain the most variation, provide insights that will allow future, more focused analysis directed at understanding how to influence and improve school belonging in adolescents worldwide.

Student-Level Factors

Based on the socio-ecological model of school belonging in Allen et al. (2016; 2018), the current study reinforced the idea that student or individual intrapersonal factors can have a significant impact on a student's perception of belonging in an educational setting. More specifically, the strongest individual factors in the current study were collaboration/teamwork dispositions (enjoy cooperation and value cooperation) and text anxiety.

Collaboration and teamwork dispositions was the strongest predictor of school belonging examined in the study, thus supporting the need to incorporate social and emotional learning into the curriculum so that all students have an
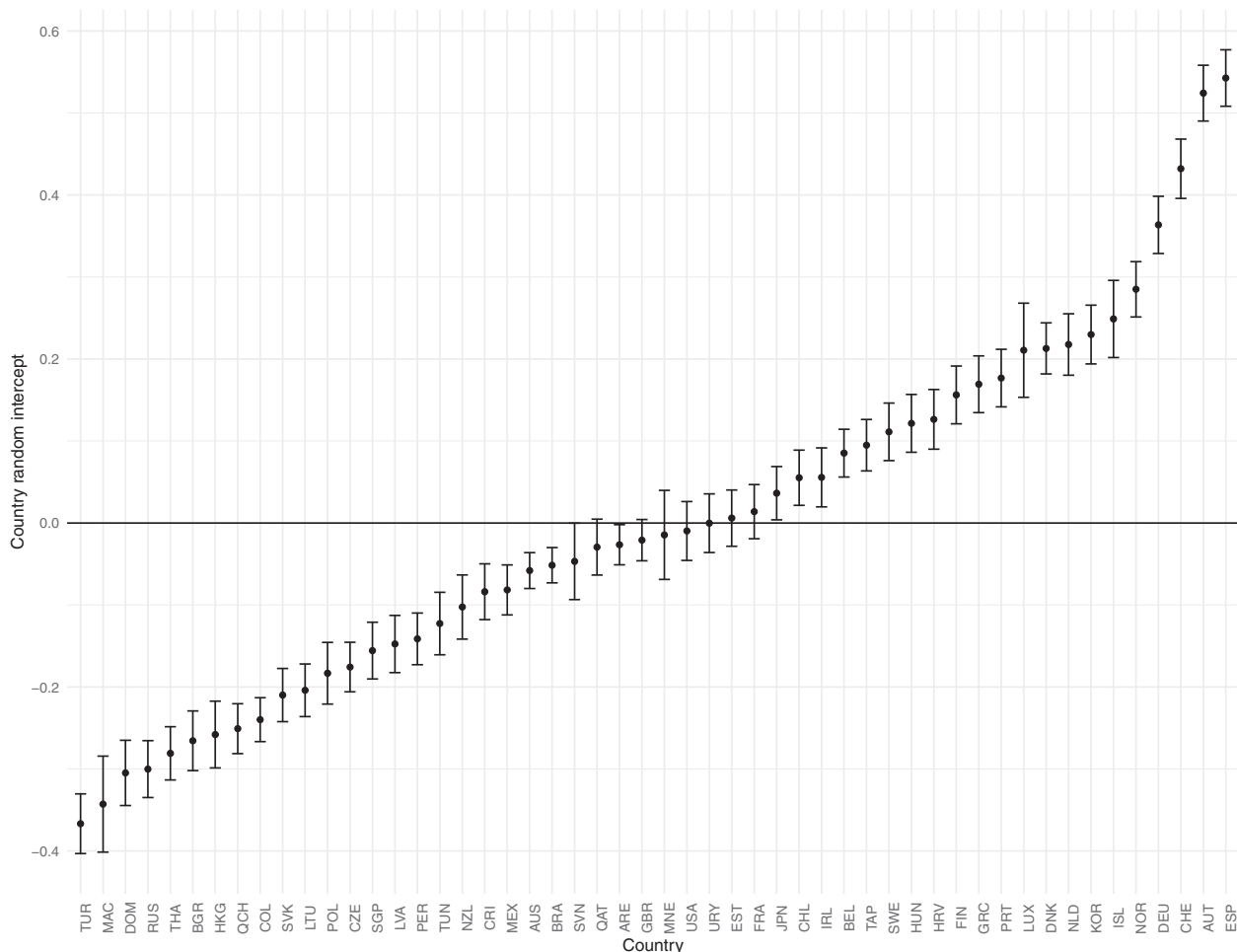
Fig. 2 Caterpillar plot for the country random intercepts of school belonging as derived from the variance component model. This figure illustrates the variability in the average sense of school belonging by country

opportunity to learn social skills, relationship-building and teamwork skills, empathy, and respectful behaviours, which are necessary and foundational for collaboration and teamwork dispositions (Collaborative for Academic, Social, and Emotional Learning CASEL, 2003). Self-discipline, impulse control, emotional regulation and organisational skills can equip students with the ability to work effectively within teams and groups (Collaborative for Academic, Social, and Emotional Learning CASEL, 2003). According to Collaborative for Academic, Social, and Emotional Learning CASEL (2003), these skills can be taught through direct instruction and curriculum at the classroom level, as well as through whole school practices and policies, and through partnerships with parents and caregivers as well as with the broader school community. Work can also occur at the individual level. For some students, additional individualised intervention with a psychologist or mental health professional is necessary to address skills in the case of which a deficit may be recognised. Interventions concerned with collaboration and teamwork dispositions lend themselves to a socio-ecological approach as such skills are necessary at many layers of a school's ecology

(e.g., interactions with the broader community, working with groups, and interpersonal relationships).

Study findings suggest there is also a significant negative relationship between school belonging and test anxiety, another student-level factor. While less research has investigated the effect of test anxiety on school belonging directly (e.g., Araki, 1992; Locker & Cropley, 2004; McDonald, 2001; Onyeizugbo, 2010), pivotal work on anxiety in general suggests that this type of pathology is at odds with a student's sense of belonging (Baumeister & Tice, 1990; Putwain & Daly, 2014). Mental health promotion in schools is important and this paper highlights the need to ensure that all pathology is adequately addressed at the student level and not undermined by the fact that test anxiety could be considered a norm in the presence of testing and exams at school. From a socio-ecological perspective, there have been concerns raised from the literature that an increase in so called "high stakes" standardised testing could be causing the increased prevalence of test anxiety (McDonald, 2001; Locker & Cropley, 2004; Thompson, 2013). Thompson (2013) suggests that the

motivation behind publishing standardised testing data publicly, that is, to make teachers accountable for their quality of teaching, has created student and teacher stress and anxiety, and a decrease in student motivation.

Microsystem Level Factors

Consistent with the theoretical framework of Allen et al. (2018), microsystem level factors also demonstrated a significant relationship with school belonging. Specifically, these factors included parental emotional support and teacher unfairness. In the present study, teacher unfairness was found to have a relationship with school belonging. In the present study, the variable of teacher unfairness was examined using items that reflected a lack of ability to be fair (e.g., teachers called on me less than they called on other students; teachers gave me the impression that they think I am less smart than I really am; teachers said something insulting to me in front of others). This may have been one reason why there was a relatively small effect for school belonging, which contrasts with past research showing that teacher support is a leading factor in fostering school belonging for secondary school students (Allen et al., 2018; Klem & Connell, 2004). A focus on exhibiting negative support rather than positive support generally (i.e., not related to a specific subject like science) is not available in the PISA survey for measures that related to school belonging. Therefore, increasing student perceptions of teacher fairness needs to be tackled at the whole school level with school leaders ensuring that teachers have sufficient resources (personal, practical, and professional) to manage work stress. At a student level, strengthening the student-teacher relationship may also address feelings of teacher unfairness (Čiuladienė & Račelytė, 2016; Koutrouba et al., 2012; Vieno et al., 2005; Resh & Sabbagh, 2014).

Our finding that parental emotional support significantly predicts school belonging concurs with the literature showing that parents have a particularly unique role in creating a sense of belonging for students (e.g., Garcia-Reid, 2007). Parents who can provide educational support, values in education, and a belief that their children are capable and competent learners are working towards creating a good connection to school. Motivation to achieve was also positively associated with students' sense of school belonging in the present analysis. Past research has supported these findings (Anderman, 2003; Ibañez et al., 2004).

Mesosystem Level Factors

The mesosystem level factor of disciplinary climate in science class involved students responding to items related to their perceptions of general disruptiveness in the classroom by students. It is plausible that this factor was responsive to feelings of safety at school, which is identified in the literature as an important factor in a student's sense of belonging to school (Centers for Disease Control and Prevention, 2009; Wingspread Declaration on School Connections, 2004; Ma, 2003; McNeely et al., 2002) and has also been found to be a central theme in measures of school connectedness and belonging (Libbey, 2004). Despite this, the items for the present study have more applicability to applied practice and present new and important contributions to what specifically may foster school belonging, such as effective behaviour management in the classroom.

Socio-economic status was utilised as a block variable to control for the portion of variance it may cause in understanding school belonging. As part of this examination, socio-economic status was found to be weakly but significantly related to school belonging, even after accounting for other variables in the socio-ecological model of belonging, a finding that is supported by past research (Allen et al., 2018; Anderman, 2002; Appleton et al., 2008; Gillen-O'Neel & Fuligni, 2013; Marks et al., 2001). This factor implies a need to address educational inequalities in education based on social and economic status. The variable describes inequalities in access to different forms of capital between students (Organisation for Economic Co-operation and Development OECD, 2017b).

Limitations

Secondary data analysis has obvious limitations in terms of study design. Specifically, the variables and measures used in the primary collection of data can be more clearly guided by pre-determined research questions. For the analysis of secondary data, research questions are often framed well after the data have been obtained. Notwithstanding this, the current data set had significant advantages. The use of the existing PISA data is efficient, and the cross-country data and number of participants allows for greater generalisability of results.

Additionally, the effect sizes of some variables included in the model are small. Like statistical significance, the power of effect size depends upon sample size (Sullivan & Feinn, 2012), which might explain the small proportion of variance in school belonging. Despite this limitation, the study results provide important practical and theoretical implications for future research and applications.

Research in this field is also generally limited to survey data, as is the case with the collected PISA data. The use of survey data brings with it a variety of uncertainties regarding data integrity. Specifically, students may respond with hidden biases (e.g., not wanting to reveal certain beliefs or weaknesses they feel they possess) or may not be comfortable answering certain questions about their relationships (friends, parents, and teachers). It is also worth noting that students may respond with different relative scales in their Likert responses, which

could potentially skew the accuracy of the data. These limitations, however, should not result in significantly different study results, especially with large sample sizes. An additional limitation stems from the fact that it is not possible to examine the variance of school belonging at every layer of the socio-ecological model, given the availability of data. For example, using the PISA 2015 study, it is not possible to assess the importance of genetics.

While the variables explored in this study (i.e., teacher unfairness, parental emotional support, achieving motivation, test anxiety, collaboration and team work dispositions, disciplinary climate in class, economic, social, and cultural social status, and country) may not be the direct cause of the weakened sense of belonging observed in the PISA data that indicates a decline in reported sense of belonging since 2003, they are broader ecological social variables that warrant consideration and acknowledgement. A greater understanding of why we are observing a trend towards a decline in school belonging also requires urgent attention (OECD, 2019). Given the importance of collaboration and teamwork dispositions in the current study, another priority area for future research will be how schools can improve a student's social and emotional competencies in these areas. The evaluation of interventions and development of strategies in the area of school belonging should be a consideration for future researchers.

Implications

The present study sought to conduct an exploratory analysis of secondary data to examine the validity of the ecosystem model proposed by Allen et al. (2016; 2018). Findings from this study provide further evidence that there is a need to develop interventions designed to facilitate increased school belonging (Allen, Jamshidi et al., 2021). Future interventions may consider drawing on the current findings to emphasise the importance of teamwork and collaboration. This study reveals that simply engaging in teamwork and collaboration is not enough. Instead, interventions in the student layer must help create the desire to participate and, more importantly, focus on developing the skills needed to participate in teamwork effectively. An emphasis on social and emotional skills was also found to be important for successful peer and teacher relationships. In the microsystem layer, it may be crucial to address teacher unfairness at the school level. Reducing teacher stress and encouraging positive support techniques may be helpful, but the data available from the PISA survey was unable to confirm this. It is also important to highlight the significant impact of socio-economic status on school belonging. Tackling issues of social inequality based on economic, social and cultural status may be imperative for school belonging. For students who face educational inequality based on their race, socio-economic status or cultural heritage, targeting a sense of belonging in school may become critical to addressing disparities in school attendance and retention rates among students, irrespective of their background.

To conclude, no single strategy is sufficient on its own to bolster a sense of belonging in students. Further research is needed to better understand what factors nurture a sense of school belonging and what factors present as barriers. While schools should not necessarily promote additional responsibilities for school staff, we suggest that a focus on school belonging is something that can be absorbed into already existing practices and operations at school, given the multiple variables found to influence school belonging. Ultimately, a variety of systemic influences need to be addressed to develop an authentic school climate that effectively creates a sense of school belonging for all involved.

Data availability

The data that support the findings of this study are openly available in the PISA 2015 Database at https://www.oecd.org/pisa/data/2015database/.

Compliance with Ethical Standards

Conflict of Interest The authors declare no competing interests.

Ethical Approval The present study used secondary data from the Program for International Student Assessment. As such data for the present study are not sensitive and the individuals that contributed to the data are anonymous (and cannot be made un-anonymous). Ethics approval was provided by Monash University Human Research Ethics Committee (Approval Certificate 23045).

Informed Consent Informed consent was obtained for all individual participants included in the study.

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Appendix

Table 4

Table 4 Sample size for each country included in the sample

Country		Students	Schools
ARE	United Arab Emirates	11,830	468
AUS	Australia	11,226	750
AUT	Austria	5455	258
BEL	Belgium	7986	266
BGR	Bulgaria	4869	179
BRA	Brazil	14,538	798
CHE	Switzerland	4839	224
CHL	Chile	6139	226
COL	Colombia	10,730	371
CRI	Costa Rica	5463	205
CZE	Czech Republic	6285	333
DEU	Germany	4592	239
DNK	Denmark	6163	326
DOM	Dominican Republic	3721	191
ESP	Spain	5332	197
EST	Estonia	5296	205
FIN	Finland	5583	162
FRA	France	5290	251
GBR	United Kingdom	12,129	547
GRC	Greece	5185	208
HKG	Hong Kong	3768	138
HRV	Croatia	5051	160
HUN	Hungary	4542	241
IRL	Ireland	5098	166
ISL	Iceland	2987	124
JPN	Japan	6312	197
KOR	Korea	5119	168
LTU	Lithuania	5850	311
LUX	Luxembourg	4473	43
LVA	Latvia	4444	249
MAC	Macao	3925	45
MEX	Mexico	6826	273
MNE	Montenegro	4508	63
NLD	Netherlands	4218	180
NOR	Norway	5048	228
NZL	New Zealand	3835	183
PER	Peru	5963	276
POL	Poland	4317	169
PRT	Portugal	5119	243
QAT	Qatar	9623	167
QCH	B-S-J-G (China)	9121	268
RUS	Russian Federation	5306	209
SGP	Singapore	5681	177

Table 4 (continued)

Country		Students	Schools
ARE	United Arab Emirates	11,830	468
SVK	Slovak Republic	5462	279
SVN	Slovenia	2214	285
SWE	Sweden	4915	200
TAP	Chinese Taipei	7049	213
THA	Thailand	7218	268
TUN	Tunisia	4284	165
TUR	Turkey	5200	182
URY	Uruguay	4603	218
USA	United States	5055	176

Excluded countries, regions and economies are: Albania, Canada, Algeria, Georgia, Indonesia, Israel, Italy, Jordan, Kosovo, Lebanon, Moldova, FYROM, Malta, Argentina (Ciudad Autonoma de Buenos Aires), Spain (Regions), Massachusetts (USA), Puerto Rico (USA), North Carolina (USA), Romania, Trinidad and Tobago, and Vietnam

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