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[a]Department of Otorhinolaryngology, TU Dresden, University of Wroclaw and Smell and Taste Clinic; [b]University of Tartu; [c]Gulu University; [d]Stockholm University; [e]University of the Punjab; [f]Westminster College; [g]University of Nigeria; [h]Istanbul University; [i]THETA-Uganda; [j]Franklin and Marshall College; [k]Norwegian University of Technology and Science (NTNU); [l]University Algiers 2; [m]Australian National University; [n]University of Texas at Austin; [o]Institute of Ethnology and Anthropology, Russian Academy of Sciences; [p]Department of Psychology, Ankara University; [q]SWPS University of Social Sciences and Humanities; [r]Université Catholique De Louvain; [s]University of Wrocław; [t]University of California Santa Barbara; [u]Technische Universität Dresden Psychotherapy and Psychosomatic Medicine; [v]Pontificia Universidad Católica del Perú; [w]Sivas Cumhuriyet University; [x]Universidad de la República (Uruguay); [y]Instituto Universitário de Lisboa (ISCTE-IUL), CIS-IUL; [z]Escuela Nacional de Estudios Superiores, Unidad Morelia, UNAM; [aa]University Setif2; [bb]University of Social Sciences and Humanities, Vietnam National University; [cc]Constantine the Philosopher University in Nitra; [dd]University of Maribor; [ee]University of Zagreb; [ff]Chinese University of Hong Kong; [gg]University of Malaya; [hh]Huaqiao University; [ii]Palacký University; [jj]University of Primorska; [kk]University of Amsterdam; [ll]University of Niš; [mm]Opole University; [nn]University of Pécs; [oo]Università Cattolica del Sacro Cuore; [pp]Middle East University; [qq]Vrije Universiteit Amsterdam; [rr]School of Psychology, University of Monterrey; [ss]University of Delhi; [tt]University of Havana; [uu]Pontifical Catholic University of Rio de Janeiro; [vv]K.Bendukidze Free University; [ww]University of Vienna; [xx]Universiti Utara Malaysia; [yy]Vilnius University; [zz]University of British Columbia; [aaa]Rio de Janeiro State University; [bbb]UNATC-CINETIc Bucharest; [ccc]Comenius University and Slovak Academy of Sciences; [ddd]The John Paul II Catholic University of Lublin; [eee]The Delve Pvt Ltd; [fff]University of Gdańsk; [ggg]Center of Social and Psychological Sciences SAS; [hhh]Aga Khan University Hospital; [iii]Vivekananda College, University of Delhi; [jjj]Universidad Catolica de Chile; [kkk]Universidad Latina de Costa Rica; [lll]University of Prof. Dr. Moestopo (Beragama); [mmm]Kyung Hee University; [nnn]Bahria University Karachi Campus; [ooo]University of Ljubljana; [ppp]Cornell University

ABSTRACT

The Triangular Theory of Love (measured with Sternberg's Triangular Love Scale – STLS) is a prominent theoretical concept in empirical research on love. To expand the culturally homogeneous body of previous psychometric research regarding the STLS, we conducted a large-scale cross-cultural study with the use of this scale. In total, we examined more than 11,000 respondents, but as a result of applied exclusion criteria, the final analyses were based on a sample of 7332 participants from 25 countries (from all inhabited continents). We tested configural invariance, metric invariance, and scalar invariance, all of which confirmed the cultural universality of the theoretical construct of love analyzed in our study. We also observed that levels of love components differ depending on relationship duration, following the dynamics suggested in the Triangular Theory of Love. Supplementary files with all our data, including results on love intensity across different countries along with STLS versions adapted in a few dozen languages, will further enable more extensive research on the Triangular Theory of Love.

CONTACT Piotr Sorokowski sorokowskipiotr@yahoo.co.uk Department of Psychology, University of Wrocław
Supplemental data for this article can be accessed on the publisher's website.

Introduction

Love is an inherent part of human experience and one of the most important elements of close relationships. Researchers' interest in love is manifested in a handful of approaches that provide a potential theoretical framework for this unique feeling (e.g., philosophical – e.g., Secomb, 2007; economic – e.g., Becker, 1973; neurobiological – e.g., Diamond & Dickenson, 2012; Fisher et al., 2002, or evolutionary perspectives – e.g., Gray & Garcia, 2013).

Several classic theories of love have been advanced within the social sciences (a comprehensive review of theories can be found in Sternberg & Sternberg, 2019). Among the most popular theoretical approaches, one theory highlights a division into passionate (intense and arousing) and companionate (tender and affective) love (Feybesse & Hatfield, 2019; Hatfield & Walster, 1985), which suggests the parallel importance of love's different aspects. Another typology refers to love styles, as first described by Lee (1973) and as further adapted by C. Hendrick and Hendrick (1986, 2019). This theoretical framework specifies six styles of love: Eros (passionate love), Ludus (game-playing love), Storge (friendship love), Pragma (logical, pragmatic love), Mania (possessive, dependent love) and Agape (all-giving, selfless love). Attachment Theory (Bowlby, 2012), describing infant-parent bonding, also has given rise to a theoretical framework for understanding romantic love (Hazan & Shaver, 1987; Mikulincer & Shaver, 2019). Finally, there is a prominent Triangular Theory of Love (R.J. Sternberg, 2006; Sternberg, 1986, 1988, 2019), which is also the subject of the current study.

According to the Triangular Theory, love is understood in terms of three components that can be seen as vertices of a triangle. These components are intimacy, passion, and decision/commitment. Intimacy refers to closeness, connectedness, communication, caring, and emotional investment and is sometimes described as the "warm" love component (Sternberg, 1986). Actually, intimacy understood in these ways is not exclusively for romantic relationships and it can also appear toward a sibling, parent, or a close friend (Sternberg & Grajek, 1984). The "hot" component – passion – pertains to romance, excitement, physical attraction and even obsession.

This Triangular Theory of Love is also relevant to analyzing sexual interactions in different contexts and types of relationships. For example, sexual desire can intensify in response to fertility markers (Buss, 2006; Gonzaga et al., 2006), potentially affecting mating patterns depending on reproductive potential. Also, in loving couples, sexual attraction, and possibly higher frequency of sexual intercourse, may be a very important part of a relationship because it fosters reproduction (Hopcroft, 2006; Sorokowski, Sorokowska, et al., 2017). Finally, commitment/decision – the "cold" component of love – refers to the cognitive decisions regarding relationship maintenance. The short-term aspect of commitment is the decision that one loves a certain other, while the long-term aspect pertains to maintaining a particular relationship over time (Sternberg, 1986).

According to Sternberg's assumptions and further empirical research on his theory, the intensity of the three love components varies as a function of relationship duration. Sternberg (1986) suggested that passion is likely to peak quickly but also to decrease rapidly with time, while commitment generally increases for long-term relationships. Intimacy, in contrast, increases slowly, but then manifest (fully conscious) intimacy often decreases with time (Sternberg, 1986).

Based on the theory of Sternberg (1986), Wojciszke (2002) proposed that a relationship can be divided into 6 phases. He measured the intensity of each love component within each phase; his results were consistent with the theoretical assumptions of Sternberg (1986). At the same time, however, the dynamics of each love component depend on various factors and can vary greatly across couples (Sprecher & Regan, 1998). Acker and Davis (1992) reported that passion decreases over time, but only in females. They observed no time-related fluctuations in the level of intimacy; the level of commitment was indeed higher in more "serious" relationships (Acker & Davis, 1992). Another, more complex approach suggests that passion changes as a function of changes in intimacy. That is, passion is low when intimacy is stable, but an increase in intimacy will also give rise to stronger passion (Baumeister & Bratslavsky, 1999).

Levels of all three love components have also been reported to vary across the lifespan. Adolescents reported lower levels of all three components as compared with young adults, while older adults scored lower on passion and intimacy measures and similarly on the commitment scale as compared with young and middle-aged adults (Sumter et al., 2013). Considering that age should be positively related to relationship duration in those people who maintain the relationships from early adulthood, the study by Sumter et al. (2013) only partially confirms Sternberg's predictions (Sternberg, 1986).

The proposed three components of love can be measured with Sternberg's Triangular Love Scale (STLS) (Sternberg, 1986, 1997). Together with the growing body of literature on the Triangular Theory of Love, various studies have investigated the psychometric properties of the STLS (e.g., Lemieux & Hale, 2000; Overbeek et al., 2007). They revealed its high correlations with other measures of love (Acker & Davis, 1992; Chojnacki, 1990; C. Hendrick & Hendrick, 1986; Levy & Davis, 1988; Whitley, 1993), which suggested that the questionnaire was a valid measure of the love construct. Sternberg (1997) showed that both versions (the 36-item and the 45-item versions) of the scale had satisfactory subscale reliabilities and overall scale reliability. Factor analysis reported in this study revealed three factors ("straightforwardly interpretable as commitment, intimacy, and passion") accounted for approximately 60% of the variance in the data. Although some of the items in the 36-item version of the scale correlated higher with subscales other than their designated subscale, this problem was less pronounced in the 45-item version of the scale. However, a few other studies on Triangular Theory of Love as measured by the STLS indicated a high item-overlap of this scale (Acker & Davis, 1992; Chojnacki, 1990; C. Hendrick & Hendrick, 1989). C. Hendrick and Hendrick (1989) did not observe the three assumed clusters among undergraduate students – many STLS items loaded on more than one factor. The internal consistency for the total 45-item scale was .97 (C. Hendrick & Hendrick, 1986), suggesting that the measured construct had

one rather than three factors. Another psychometric study evaluating a 36–item version of the STLS on a non-student sample also revealed that some items overlapped or loaded weakly on multiple implemented factors (Acker & Davis, 1992). Confirmatory and exploratory factor analyses of the 45-item STLS reported by Whitley (1993) showed that although that the three-factor model provided the best fit to the data, even this solution, however, revealed certain problems, with many items loading on more than one scale. In summary, some research regarding the STLS suggests that the questionnaire provides a good measure of a higher order construct of love. However, the proposed factorial structure remains in question, as previous outcomes have not been consistent.

Many psychological studies trying to depict human universals are based on a single culture, or – even if they are cross-cultural – the sample comprises a specific social group, the so-called "WEIRD" people (Western, Educated, Industrialized, Rich and Democratic, see: Henrich et al., 2010). Cross-cultural perspectives on different constructs allows scientists to form general conclusions about universal aspects of human nature, to broaden perspectives, to increase the range of potentially meaningful variables in their models and, consequently, to better describe and understand the mechanisms and processes underlying important psychological phenomena (see Brislin, 1983). From this perspective, cross-cultural research on love seems more than necessary. Although the STLS sometimes has been used in different cultures (Cassepp-Borges & Martins Teodoro, 2009; Ng & Cheng, 2010), with rare exeptions, available research involving non-Western samples has not focused on the psychometric properties of the STLS, including tests of its cultural invariance. Considering that some previous studies on the STLS (even those involving exclusively American respondents) reveal certain psychometric problems, examining the properties of this scale in other cultures seems warranted to further test the universality of the Triangular Theory of Love and to assess the properties of the scale as proposed as a measure of love in this theory. It will allow for the usage of the STLS in further, cross-cultural studies that are necessary to form conclusions about love that would be broader, richer and not bound to one, specific culture.

The Present Study

To address the issue of the rather inconsistent and culturally homogeneous body of previous psychometric research regarding the STLS, we conducted a large-scale cross-cultural study with the use of this scale. In total, we examined more than 11,000 respondents, who underwent exactly the same research procedure, completing the 45-item version of STLS in order to assess its validity and reliability. Our cross-cultural sample included also non-Western countries (see Methods section). Moreover, our participant pool covered both students and community members. The presented project had several research aims:

A) testing the universality of the Triangular Theory of Love;

B) testing the differences in love components at various stages of a relationship, following the ideas suggested by Sternberg (1986) (further evidence of the accuracy of the proposed construct);

C) testing the cross-country equivalence (measurement invariance) of the STLS in order to allow for proper cross-cultural use of this questionnaire; to complete this research aim, we decided to limit our sample to countries with a sample size of more than 150 participants per country who declared being in a relationship at the time of scale completion;

D) preparing and publishing versions of the STLS that will be usable in various types of studies involving the love variable in a number of non-English speaking countries.

Method

Participants

The current research comprised 11,422 participants from 45 countries who completed the STLS. The participants were recruited to take part in a global study that comprised also a few other questionnaires, unrelated to these study aims. The inclusion criteria were age above 18 years and sufficient literacy to complete the questionnaire; we did not specify the desired education or work profile. To ensure high diversity of the participants, the researchers working in given study sites were instructed to recruit a sample wherein students would constitute a maximum of 50% of the participating group.

We were interested in current romantic relationships. Therefore, for the purpose of further investigation, we proceeded with a two-step selection process.

First, we excluded all participants who declared being single (n = 1724, 15%), divorced (n = 148, 1.3%) or widowed (n = 20, 0.1%) at the time of the study. Thus, all participants in the final sample were in a relationship. The participants who declared being in a relationship at the time of the study were additionally questioned about the type and duration of their relationship, and the final sample comprised n = 3629 (49.5%) dating, n = 887 (12.1%) engaged, and n = 2816 (38.4%) married participants; the mean relationship duration was almost 8 years (M = 91.30 months, SD = 111.46). The participants were not required to provide any other details regarding their family status (e.g., living arrangement).

Second, we excluded all countries with a total sample size lower than 150 participants. As illustrated in Table S1 (see supplementary files), this resulted in a total sample of 7332 participants from 25 countries included in the final analysis: Algeria (DZ), Australia (AU), Belgium (BE), Brazil (BR), Cuba (CU), Estonia (EE), Croatia (HR), Hungary (HU), India (IN), Italy (IT), Lithuania (LT), the Netherlands (NL), Pakistan (PK), Poland (PL), Portugal (PT), Romania (RO), Russia (RU), Serbia (XS), Slovakia (SK), Slovenia (SI), Spain (ES), Turkey (TR), Uganda (UG), Uruguay (UY), Vietnam (VN)). In the final sample, our participants' ages ranged from 18 to 76 (M = 30.67, SD = 11.10). There were 3288 (44.9%) men and 4028 (55.1%) women; 16 people did not indicate their sex. The whole sample was almost evenly distributed across a student sample (44%) and a community sample (56%).

The database with raw data (Supplementary File 1) includes 11,422 participants from 45 countries. Although the final analyses were conducted for 25 countries (as mentioned above), Supplementary File 1 contains data on all participants, including those who declared that they were single, divorced, or

widowed, and on all countries, including those with sample sizes <150 (i.e., Austria (AT), Bulgaria (BG), Chile (CN), China (CL), Colombia (CO), Costa Rica (CR), El Salvador (SV), Georgia (GE), Germany (DE), Greece (GR), Indonesia (ID), Iran (IR), Jordan (JO), Malaysia (MY), Mexico (MX), Nigeria (NG), Norway (NO), Peru (PE), South Korea (KR), Sweden (SW), United States (US)).

All the data presented in Supplementary File 1 can be used for the purpose of other research, without additional requests, but citing this article.

Instrument

All participants filled out the 45-item version of STLS, with 15 items measuring intimacy (sample item: "I receive considerable emotional support from ___."), 15 – passion (sample item: "There is nothing more important to me than my relationship with ___") and 15 – commitment (sample item: "I view my relationship with ___ as permanent."). The subjects were asked to rate their agreement with each statement on a 9-point Likert scale ranging between 1 (not at all) and 9 (extremely). Internal consistency of the scales was very high: intimacy, Cronbach's α = .93, passion α = .92, and commitment α = .92.

The participants completed the scale in their native languages. At each study site where English was not a primary language, local authors were asked to conduct a translation/back-translation procedure (Sechrest et al., 1972). This process typically involves the primary collaborator translating the measures into the native language and then the second collaborator translating the measures back into English. Differences between the original English scale and back-translation were to be discussed and mutual agreements were to be made on the most appropriate translation. If there were two or more groups collecting data in one country, the experimenters were informed that they should arrange translation and back translation collaboratively between groups. Questionnaires translated into all languages are attached as supplementary materials (Supplementary File 2) and might be used for further studies, without additional requests, after citing this article.

Procedure

The global study protocol was approved by the Ethics Committee of Institute of Psychology (University of Wroclaw), and local collaborators obtained additional permits when this was legally required. All participants provided written informed consent prior to their inclusion in the study.

All authors received the study questionnaire before the study began from the corresponding author of the study and were asked to provide feedback about the cultural appropriateness of the applied questions (e.g., potential cultural taboos related to some items/response options). The measures included in the final version of the questionnaire as well as format and response options for all questions were the same in all participating countries.

Data collection was conducted simultaneously across all study locations. To ensure similar recruitment methods and study procedure across all study sites, the researchers received a version of the questionnaire that also included instructions to the researcher (explaining, e.g., the sequence of scale presentation, coding procedure) and detailed data-collection protocols. The authors were instructed that the study participants should be recruited among community members and students (with the student sample not exceeding 50% of the total sample) by means of posters, leaflets, press releases, university websites, and social media. The testing sessions were to be conducted face-to-face or – when it was possible to ensure necessary privacy for all participants – in group meetings. The data could not be collected over the Internet, but the use of computer software during the testing sessions was allowed. Participants were given a set of questionnaires, including the love scale, and several unrelated questionnaires in the context of a broader cross-cultural research project (see e.g., Conroy-Beam et al., 2019; Walter et al., 2020)

The data from each study site were coded based on an exemplary questionnaire provided by the corresponding author, with input in individual Excel databases, standardized in advance, and afterward merged.

Results

All descriptive statistics are presented in Table 1. The first research problem of our investigation was the discovery of the psychometric parameters of the STLS. More specifically, the aim of our first analysis was to examine if the assumed, three-factor structure of this instrument replicated in our dataset. The second of our analyses focused on the measurement invariance of the STLS, including the test of configural invariance (i.e., whether the same, three-factor structure of STLS exists across countries); metric invariance, which requires that all factorial loadings are the same in all countries; and scalar invariance, which shows that differences in the means of STLS scales may be attributed to the underlying, latent constructs – intimacy, passion, and commitment. In other words, configural invariance requires that the fit of the three-factor model in multi-group confirmatory factor analysis is above the recommended criteria (Hu & Bentler, 1999): a Comparative Fit Index (*CFI*) and Tucker Lewis Index (*TLI*) above .90 were interpreted as showing adequate fit (and values above .95 as showing good fit), a root mean square error of approximation (*RMSEA*) below .08, and a standardized root mean square residual (*SRMR*) below .06, indicating no misfit. Metric invariance provides an additional constraint into the model, as it requires factor loadings to be equal, while scalar invariance additionally forces measurement intercepts to be equal (see: Chen, 2007; Cheung & Rensvold, 2002).

The overall fit of the model estimated in the laavan package for R (Rosseel, 2012) with Weighed Least Square with adjusted Means (WLSM) estimator on the total sample was good, with *CFI* = .950, *TLI* = .948, *RMSEA* = .068 (90% CI: .066-.069) and *SRMR* = .048. As illustrated in Figure 1, although the latent correlations between variables were high: r = .75 between intimacy and passion, r = .81 between intimacy and commitment and r = .80 between passion and commitment, they fell below r = .85, that is, the recommended cutoff for low discriminant validity (Kline, 2011). All factor loadings were robust (Table 2), ranging from λ = .62 to λ = .81 in the case of intimacy (median λ = .73),

Table 1. Descriptive statistics.

	Sample Size	Men	Women	Age (M, SD)	Dating	Engaged	Married	Intimacy (M, SD)	Passion (M, SD)	Commitment (M, SD)
AU Australia	256	44.9%	55.1%	31,93 (10,71)	49.2%	10.5%	40.2%	8,07 (0,85)	7,1 (1,49)	8,01 (1,08)
BE Belgium	255	44.3%	55.7%	30,63 (9,82)	66.7%	6.3%	27.1%	7,88 (0,86)	6,95 (1,3)	7,85 (1,05)
BR Brazil	179	48.0%	52.0%	31,01 (13,04)	57.5%	3.4%	39.1%	7,84 (0,91)	7,22 (1,22)	7,92 (1,06)
CU Cuba	177	47.4%	52.6%	33,1 (13,69)	13.0%	46.9%	40.1%	8,11 (1,16)	7,03 (1,66)	7,72 (1,59)
DZ Algeria	324	44.4%	55.6%	29,86 (7,91)	43.2%	14.5%	42.3%	7,44 (1,26)	7,1 (1,59)	7,8 (1,38)
EE Estonia	153	45.8%	54.2%	28,86 (9,93)	12.4%	63.4%	24.2%	7,7 (0,97)	7,15 (1,33)	7,78 (1,28)
ES Spain	260	38.6%	61.4%	33,68 (13,48)	61.5%	1.9%	36.5%	7,93 (0,96)	7,17 (1,29)	7,93 (1,14)
HR Croatia	228	40.8%	59.2%	33,17 (13,11)	52.6%	1.8%	45.6%	7,96 (0,99)	7,01 (1,44)	7,89 (1,23)
HU Hungary	831	49.9%	50.1%	29,65 (10,89)	62.7%	8.1%	29.2%	8,14 (0,89)	7,53 (1,32)	8,17 (1,22)
IN India	233	48.5%	51.5%	29,97 (10,69)	46.4%	3.9%	49.8%	7,94 (0,93)	7,39 (1,26)	8 (1,14)
IT Italy	285	34.0%	66.0%	33,29 (12,83)	12.6%	47.0%	40.4%	8,06 (0,92)	7,34 (1,26)	8,1 (1,11)
LT Lithuania	183	50.3%	49.7%	29,7 (10,82)	58.5%	3.8%	37.7%	7,84 (1,06)	6,88 (1,63)	7,84 (1,28)
NL Netherlands	153	43.4%	56.6%	34,24 (14,96)	60.1%	3.3%	36.6%	7,73 (0,91)	6,81 (1,27)	7,65 (1,05)
PK Pakistan	472	47.5%	52.5%	28,1 (8,9)	44.7%	20.6%	34.7%	6,57 (1,37)	6,2 (1,4)	6,73 (1,57)
PL Poland	386	54.8%	45.2%	28,55 (9,19)	47.7%	16.8%	35.5%	7,87 (1,15)	7,28 (1,39)	7,87 (1,39)
PT Portugal	156	37.7%	62.3%	29,1 (9,17)	64.7%	3.2%	32.1%	8,16 (0,79)	7,63 (1,22)	8,03 (1,06)
RO Romania	151	50.3%	49.7%	30,17 (11,19)	1.3%	60.9%	37.7%	8,07 (1,08)	7,29 (1,56)	7,84 (1,62)
RU Russia	161	44.1%	55.9%	30,37 (10,61)	37.9%	5.6%	56.5%	7,81 (1,2)	6,84 (1,61)	7,86 (1,36)
SI Slovenia	466	49.6%	50.4%	32,59 (11,72)	59.9%	2.8%	37.3%	8,1 (0,93)	7,14 (1,35)	8,13 (1,04)
SK Slovakia	289	24.9%	75.1%	30,28 (13,24)	62.6%	4.8%	32.5%	7,94 (0,95)	6,88 (1,5)	8,04 (1,1)
TR Turkey	648	43.6%	56.4%	31,67 (12,02)	52.9%	3.9%	43.2%	7,56 (1,46)	6,58 (1,75)	7,19 (1,87)
UG Uganda	171	59.6%	40.4%	29,12 (7,91)	37.4%	21.6%	40.9%	6,77 (1,36)	6,43 (1,59)	6,83 (1,74)
UY Uruguay	214	38.8%	61.2%	29,85 (10,39)	76.2%	3.7%	20.1%	8,07 (0,96)	6,68 (1,5)	7,78 (1,27)
VN Vietnam	334	38.6%	61.4%	30,31 (5,82)	26.6%	2.1%	71.3%	7,28 (1,36)	6,72 (1,55)	7,52 (1,5)
XS Serbia	367	45.2%	54.8%	30,19 (11,37)	61.6%	2.2%	36.2%	8,02 (1,02)	6,96 (1,52)	7,7 (1,3)
Total	7332	44.9%	55.1%	30,67 (11,11)	49.5%	12.1%	38.4%	7,78 (1,17)	7,01 (1,5)	7,75 (1,4)

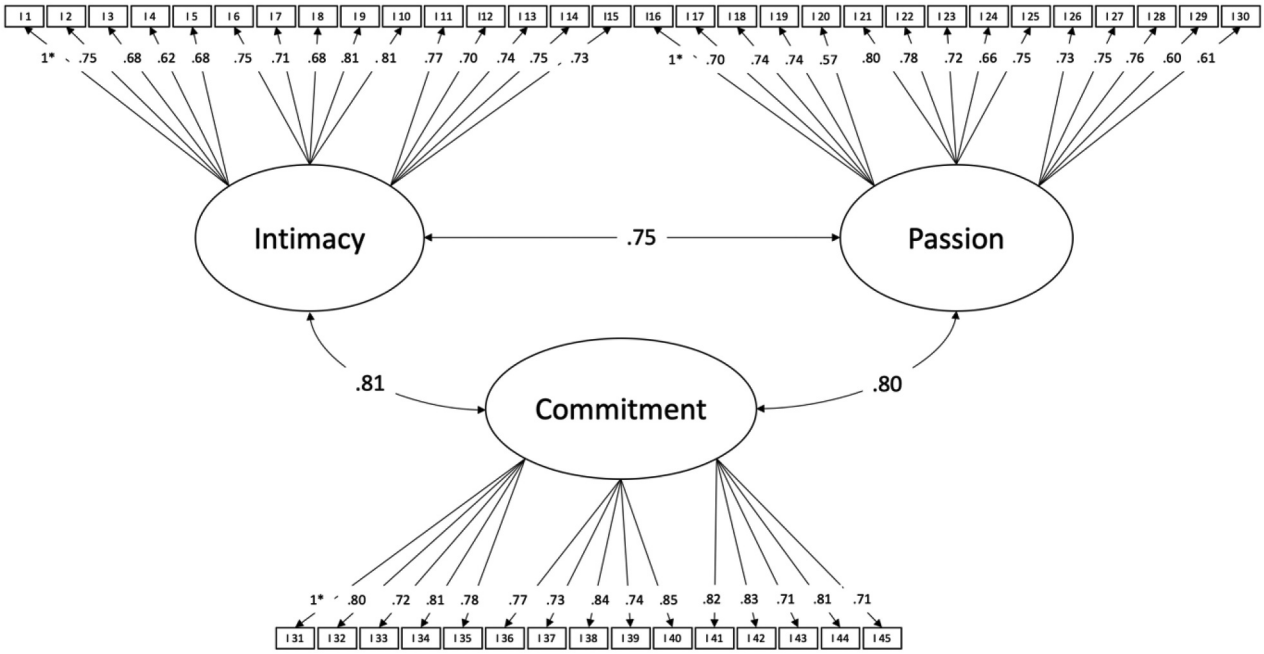

Figure 1. The overall three-factor model of love as measured by STLS.

from λ = .57 to λ = .78 in the case of passion (median λ = .74), and from λ = .71 to λ = .85 in the case of commitment (median λ = .79). High factor loadings resulted in very high composite reliability of latent factors (Hancock & Mueller, 2001): H = .94 in the case of intimacy, H = .94 in the case of passion, and H = .96 in the case of commitment.

To examine measurement invariance across countries, we proceeded with a series of three multi-group CFA models, adding constraints at each step. The first model tested configural invariance (the same three-factor structure in all countries). The second model examined metric invariance (equality of forced factor loadings across countries), while the third tested scalar invariance (equality of measurement intercepts). We relied on usually applied cutoff criteria recommended for testing measurement invariance (Chen, 2007; Cheung & Rensvold, 2002): a change of CFI (Δ*CFI*) of less than .01 (Δ*CFI* < .01) and a change of *RMSEA* of less than .015 (Δ*RMSEA* < .015), which indicate that compared models do not differ in terms of model fit.

As shown in Table 3, the fit of all models was acceptable according to these criteria. Importantly, the decrease in fit of a more constrained model in comparison to a more liberal

Table 2. Details of confirmatory analysis results.

	Unstandardized Estimate	SE	Standardized Estimate	P
Intimacy				
Intimacy1	1.000	0.922		
Intimacy2	1.262	0.037	0.750	<.001
Intimacy3	1.152	0.039	0.682	<.001
Intimacy4	0.855	0.029	0.615	<.001
Intimacy5	1.103	0.037	0.675	<.001
Intimacy6	1.329	0.044	0.751	<.001
Intimacy7	1.074	0.035	0.706	<.001
Intimacy8	1.150	0.041	0.682	<.001
Intimacy9	1.122	0.038	0.806	<.001
Intimacy10	1.260	0.042	0.809	<.001
Intimacy11	1.298	0.044	0.772	<.001
Intimacy12	1.179	0.041	0.702	<.001
Intimacy13	1.405	0.051	0.735	<.001
Intimacy14	1.256	0.044	0.746	<.001
Intimacy15	1.328	0.046	0.725	<.001
Passion				
Passion1	1.000	1.231		
Passion2	1.000	0.020	0.702	<.001
Passion3	1.181	0.026	0.737	<.001
Passion4	0.970	0.020	0.740	<.001
Passion5	1.059	0.027	0.574	<.001
Passion6	1.403	0.033	0.800	<.001
Passion7	1.200	0.028	0.776	<.001
Passion8	1.264	0.032	0.719	<.001
Passion9	1.000	0.026	0.658	<.001
Passion10	1.259	0.029	0.751	<.001
Passion11	1.244	0.029	0.734	<.001
Passion12	1.356	0.034	0.746	<.001
Passion13	1.192	0.028	0.762	<.001
Passion14	1.138	0.027	0.603	<.001
Passion15	1.114	0.026	0.608	<.001
Commitment				
Commitment1	1.000	1.035		
Commitment2	1.226	0.028	0.801	<.001
Commitment3	1.271	0.034	0.720	<.001
Commitment4	1.395	0.037	0.809	<.001
Commitment5	1.428	0.037	0.783	<.001
Commitment6	1.490	0.041	0.766	<.001
Commitment7	1.213	0.033	0.729	<.001
Commitment8	1.338	0.034	0.837	<.001
Commitment9	1.531	0.042	0.736	<.001
Commitment10	1.395	0.032	0.848	<.001
Commitment11	1.454	0.038	0.817	<.001
Commitment12	1.312	0.034	0.828	<.001
Commitment13	1.045	0.030	0.710	<.001
Commitment14	1.159	0.029	0.813	<.001
Commitment15	1.121	0.030	0.711	<.001

Table 3. A summary of measurement invariance tests.

Invariance	χ^2(*df*)	*CFI*	*RMSEA*	$\Delta\chi^2$ (Δdf)	ΔCFI	$\Delta RMSEA$
Configural	15,813 (23,550)	.939	.077			
Metric	31,776 (24,558)	.941	.073	2258 (1008)	.003	.003
Scalar	37,141 (25,566)	.925	.081	11,185.3 (1008)	.016	.008

configural and metric invariance model did not exceed the usually recommended criteria – the difference between the configural and the scalar model was estimated at ΔCFI = .014 and $\Delta RMSEA$ = .004, while the difference between the configural and the metric model was ΔCFI = .003 and $\Delta RMSEA$ = .003, and between the metric and the scalar model, ΔCFI = .016 and $\Delta RMSEA$ = .008. Therefore, we conclude that the STLS in our study was invariant across countries.

We additionally tested measurement invariance across men and women. It became apparent that, also in this case, configural (*CFI* = .949, *RMSEA* = .069), metric (*CFI* = .967, *RMSEA* = .055) and scalar (*CFI* = .965, *RMSEA* = .056) invariance were satisfactory.

In an attempt to examine if the levels of scores on love factors differed depending on relationship duration, we conducted a multivariate analysis of variance (MANOVA), with scores on love factors as dependent variables and relationship length categorized into 7 categories (up to 1 year, 1–3 years, 3–6 years, 6–10 years, 10–15 years, 15–20 years, and 21 or more years). This analysis was conducted for participants from all countries, including those with fewer than 150 participants per country. Given that there were some missing data in the question about the relationship's length, the sample size varied, as illustrated by degrees of freedom. There were statistically significant differences across categories in the case of intimacy, $F(6, 6153) = 5.42$, $p < .001$, $\eta_p^2 = .005$, passion, $F(6, 6153) = 11.96$, $p < .001$, $\eta_p^2 = .012$ and commitment, $F(6, 6153) = 19.54$, $p < .001$, $\eta_p^2 = .019$.

As illustrated in Figure 2, levels of intimacy differed, depending on relationship duration. It was lowest in relationships lasting up to 1 year, slightly higher for relationships lasting 1–3 years, followed by those lasting 3–6 years, and then again lower in couples who were together for 6–10 years, 10–15 years, 15–20 years, and 21 or more years. A pairwise comparison with Sidak corrections showed significant differences in the declared intensity of intimacy between participants who stayed in the relationship up to 1 year and these with 3–6-years-long experience ($p < .001$), as well as between these who stayed in the relationship for 3–6 years and participants with a 6–10-years-long experience ($p = .01$) and over 20 years-long experience ($p = .005$).

Levels of passion also differed across relationships with different durations, with the highest levels reported in couples of the shortest relationship duration, and the lowest levels of passion observed in couples of the longest duration (see Figure 2). Pairwise comparisons showed statistically significant differences between participants in the shortest relationships (up-to-1-year) and those in relationships of 1–3 years ($p = .004$), 3–6 years ($p = .006$), as well as those in relationships of 20 years or longer ($p = .008$). People staying in the relationship for 1–3 years declared significantly higher passion than those with 6–10 years ($p = .02$), 15–20 year-long relationships ($p = .008$), or 21 years or more of experience ($p < .001$). Participants whose relationships lasted 3–6 years were more passionate than those with the shortest experience (up-to-1-year, $p = .006$), as well as those who were in their relationship for 6–10 years ($p = .02$), 15–20 years ($p = .008$) or 21 or more years ($p < .001$). Finally, people with 10–15 years in their relationship declared higher passion than those with 20-year or longer relationships ($p = .009$).

In the case of commitment, people with the shortest experience in their relationship (up-to-1-year) were characterized by significantly lower commitment than those in all remaining categories (all ps $< .001$). Participants with slightly longer relationships (1–3 years) were less committed than those staying in the relationship for 3–6 years ($p = .01$), or over 20 years ($p = .008$) (see Figure 2 for details).

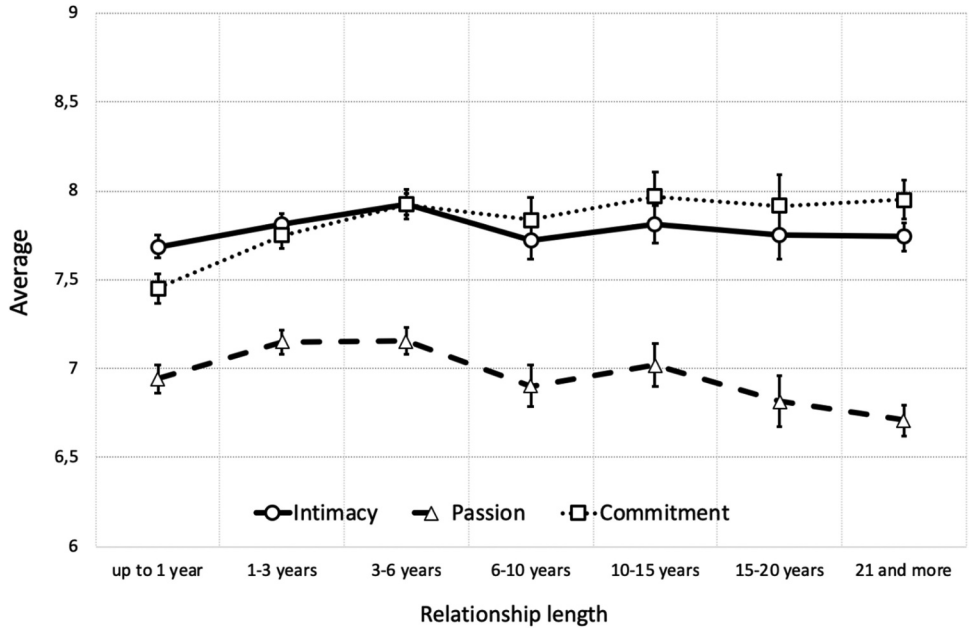

Figure 2. Differences in the intensity of love aspects depending on the relationship's length. Note. Potential scores on y-axis range from 1 to 9.

Discussion

Our large, cross-cultural study results show that, as assumed, the Triangular Theory of Love has a three-factor structure in a global sample. We tested configural invariance, metric invariance, and scalar invariance of the STLS scale measuring love, and our data confirmed the cultural universality of the theoretical construct of love presented by Sternberg (1986, 1988, 1997). Our outcomes support the further use of versions of STLS scales employed in the current research (see Supplementary File 1) and open new possibilities for studies, including cross-cultural, that would require testing participants' love levels.

Differences in the love components we observed between couples varying in relationship length are yet another empirical demonstration consistent with the Triangular Love Theory, as suggested by Sternberg (1986) and other authors (e.g., Wojciszke, 2002). Passion was the highest in couples of short relationship duration, while commitment exhibited a positive association with relationship length. However, it should be highlighted that, although the differences in the levels of love components were statistically significant, their absolute sizes were rather low. Additionally, our comparisons were cross-sectional, not longitudinal.

Although the trends we observed are consistent with temporal dynamics predicted by Triangular Love Theory, we only analyzed differences attributed entirely to relationship duration. These outcomes might be associated also with other factors predicted by relationship length, or certain biases resulting from short- and long-term couples' sample characteristics. For example, short-term, less intimate and less committed relationships of some respondents could have dissolved too quickly to be included in the analyses, or some individuals in a long-term partnership characterized by low levels of all love components could have refused to participate in a study on their relationship. Therefore, our data are a valuable starting point for the analyses of dynamics of love and provide some suggestive information, but their implications should not be overstated.

The Triangular Theory of Love is a prominent theoretical love concept used in empirical research (e.g., Billedo et al., 2015; Sabiniewicz et al., 2017; Weisman et al., 2015). Unfortunately, similar to other studies from the area of social sciences (see Henrich et al., 2010), previous research comprised almost exclusively Western samples. One of the most important aims of the current research was to enrich the existing research by conducting a large-scale cross-cultural study. We also hope that the collected data and possibilities provided by the STLS versions adapted in a few dozen countries will further promote future research on the Triangular Theory of Love, as all our data are free for use by any interested person. Based on the current dataset, scientists can conduct numerous analyses and publish articles concerning various love-related research questions: They can examine cross-cultural differences in sexual or marital satisfaction, identifying other country-level predictors of love. Although differences in love levels have been investigated in some cross-cultural studies (e.g., Dion & Dion, 1996; Karandashev, 2017; De Munck & Korotayev, 1999), due to the vast amount of data from this study, our results and dataset may also serve as a reference point in further studies regarding love.

Cultural dimensions might influence romantic relationships (Dion & Dion, 1993). For example, Gao (2001) found that the level of passion was higher in American compared with Chinese couples, while intimacy and commitment did not vary between the samples. On the other hand, another study comparing European and Chinese Canadians found differences between these two samples, with Chinese Canadians scoring lower than European Canadians, a difference mediated by gender-role traditionalism (Marshall, 2008). To further investigate the bases of such differences, new studies based on our data might include various, new potential country-level

predictors, for example, Schwartz's value orientations (Schwartz, 2006), Hofstede's culture dimensions (Hofstede, 2001), or other variables likely related to love, like partnership satisfaction (Sorokowski, Randall, et. al., 2017).

Additionally, there are certain individual-level predictors that could affect love, like family and residential status (e.g., couples living apart without children; married couples living with extended family; married couples with a few young children), or work backgrounds (e.g., rural farmers, undergraduate students, working class participants in large cities) of the participants. These elements could be tested in further research and analyzed together with country-level data, which would allow for the creation of comprehensive, multi-level models.

Nonetheless, it would be interesting to analyze (with a number of different measures) which aspects/factors/components of love are the most universal culturally. There are interesting studies that describe a common, "core" structure of romantic love and explain its variations in the context of cultural differences (Hatfield & Rapson, 1996; De Munck et al., 2011; Nelson & Yon, 2019). Our study, confirming the cross-cultural existence of the three love components, suggests that this universal "core" structure might comprise factors quantified by all these components. However, previous cross-cultural research has been rather limited and studies employed a variety of measures to test love. It is thus hard to draw any definite conclusions on core/universal love factors, the only exception being perhaps the common existence of the "passion", "desire" or "eros" element (Karandashev, 2017).

Nevertheless, the fact that at least some aspects of love appear universal (Jankowiak, 1995; Jankowiak & Fischer, 1992; Karandashev, 2017) indicates that love might have a biological basis and/or additional evolutionary importance (Diamond & Dickenson, 2012; Fisher, 2004; Gray & Garcia, 2013). Love can be based on neural mechanisms (Bartels & Zeki, 2004; Fisher et al., 2002), hormonal factors (Marazziti & Canale, 2004; P. Sorokowski et al., 2019), and/or aspects related to biological fitness (Hopcroft, 2006; Sorokowski, Sorokowska, et al., 2017). Therefore, linking particular love components with cultural and biological factors definitely warrants further investigation.

The results suggest also another further research direction. In our study and in previous work (Acker & Davis, 1992; Chojnacki, 1990; C. Hendrick & Hendrick, 1989), the correlations among subscales have been substantial despite discriminant validity among the three scales of the STLS. One possible reason is simply that intimacy, passion, and commitment tend to occur together in most, although certainly not all, love relationships. Especially in the early stages of a successful relationship, people may idealize their partners (Hall & Taylor, 1976; Murray & Holmes, 1997) and highly agree with (positive) statements in the STLS. Therefore, it may be advisable, in the future, to think about behavioral or even psychophysiological measures that would correspond to the three aspects of love – intimacy, passion, and commitment – and that might be less susceptible to halo effects (Nisbett & Wilson, 1977) than ratings that are expressed on a Likert scale.

It needs to be noted that our study has certain limitations that could be remedied in future research. In addition to the cross-sectional nature of our data, which was discussed above, the most important issue is the number of countries that had to be excluded from our main analysis. This was related to an insufficient number of participants in relationships who completed the questionnaire in some countries. Nevertheless, our database has been published in an open-access format and interested researchers might either use it to test their hypotheses or – possibly – continue the data collection to conduct analyses related to the universality of the Triangular Theory of Love among an even more impressive number of countries.

To sum up, the current research provided evidence to support aspects of construct validity across cultures for the Triangular Love Scale, and consequently provided additional support for the Triangular Theory of Love. We hope other researchers will accept our invitation to further analyze our data and also to conduct their own studies on the structure of love across a large range of cultures.

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ORCID

Carlota Batres http://orcid.org/0000-0002-3833-7667
Marina Butovskaya http://orcid.org/0000-0002-5528-0519
Hakan Çetinkaya http://orcid.org/0000-0001-5585-8678
Dominika Chabin http://orcid.org/0000-0002-6618-8240
Marcin Czub http://orcid.org/0000-0003-0184-8284
Berna Ertugrul http://orcid.org/0000-0002-4966-601X
Ignacio Estevan http://orcid.org/0000-0003-4743-1310
Konstantinos Kafetsios http://orcid.org/0000-0001-5933-4409
Mohammad Madallh Alhabahba http://orcid.org/0000-0002-4269-8457
Mario Sainz Martinez http://orcid.org/0000-0002-2048-5872
Norbert Meskó http://orcid.org/0000-0002-4355-9563
Anna Oleszkiewicz http://orcid.org/0000-0003-2217-1858
Baris Özener http://orcid.org/0000-0003-2986-9052
Ariela Francesca Pagani http://orcid.org/0000-0002-7149-9350
Miriam Parise http://orcid.org/0000-0003-2150-6636
Aneta Przepiórka http://orcid.org/0000-0001-6722-7355
Joanna Różycka-Tran http://orcid.org/0000-0003-1131-3910
Meri Tadinac http://orcid.org/0000-0002-3770-9000
Truong Thi Khanh Ha http://orcid.org/0000-0003-3940-8399
Robert J. Sternberg http://orcid.org/0000-0001-7191-5169

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