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Development and validation of the Spanish version of the Team Climate Inventory: a measurement invariance test

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Título: Desarrollo y validación de una versión española del Team Climate Inventory: un análisis de invariancia factorial.
Resumen: El presente estudio analiza las propiedades psicométricas y la validez de una versión española del Team Climate Inventory (TCI). El TCI es un instrumento para la medición del clima de los equipos de trabajo, que se desarrolla a partir de una teoría de cuatro factores aplicada a la innovación de equipo (West, 1990). El estudio muestra una fiabilidad satisfactoria del instrumento, estimada con índices Alpha de Cronbach y Omega. El análisis factorial exploratorio retuvo cuatro factores más un quinto, tal como se encontró en otras validaciones del TCI. El análisis factorial confirmatorio permitió averiguar que el mejor ajuste a los datos se obtuvo con el modelo de cinco factores. En el estudio, además, se compararon dos muestras (una de equipos de trabajo sanitarios españoles y otra de equipos de trabajo latinoamericanos pertenecientes a una empresa de desarrollo informático) con un total de 1099 participantes, cuya comparación muestra evidencias de invarianza factorial. Finalmente, se aportan evidencias de validez basadas en la predicción del rendimiento de equipo y de la satisfacción de los miembros.
Palabras clave: Clima de equipo; rendimiento de equipo; invarianza factorial.

Abstract: The present study analyzed the psychometric properties and the validity of the Spanish version of the Team Climate Inventory (TCI). The TCI is a measure of climate for innovation within groups at work and is based on the four-factor theory of climate for innovation (West, 1990). Cronbach's alpha and omega indexes revealed satisfactory reliabilities and exploratory factor analysis extracted the four original factors with the fifth factor as reported in other studies. Confirmatory factorial analysis confirmed that the five-factor solution presented the best fit to our data. Two samples (Spanish health care teams and Latin American software development teams) for a total of 1099 participants were compared, showing metric measurement invariance. Evidences for validity based on team performance and team satisfaction prediction are offered.
Key words: Team climate; team performance; measurement invariance test.

Introduction

Teamwork is an essential component contributing to organizational success (Cannon-Bowers & Bowers, 2010) and multidisciplinary teams are present in most areas of industry (Salas, Rosen, Burke, & Goodwin, 2009; Wutchy, Jones, & Uzzi, 2007). Organizations therefore often depend on teams for developing innovative products, making important decisions and improving efficiency (Jackson, Joshi, & Erhardt, 2003). As the presence of teams has become a fact of organizational life, understanding team functioning and performance has become one of the major challenges for organizational theory and practice (Guzzo & Dickson, 1996). Research on team effectiveness in the last decade pointed out that effective team working requires a team atmosphere or *climate* that facilitates team outcomes, like performance and satisfaction (Mathieu, Maynard, Rapp, & Gilson, 2008).
Climate refers to "the set of norms, attitudes, and expectations that individuals perceive to operate in a specific social context" (Pirola-Merlo, Hartel, Mann, & Hirst, 2002, p. 564). Originally conceptualized as an organizational-level construct (e.g., Dickson, Resick, & Hanges, 2006; Melià & Sesé, 2008), climate has been described as more salient at the team-level of analysis (e.g., Tesluk, Vance, & Mathieu, 1999). In fact, people in proximal work team are exposed to common events and processes: they interchange sharing interpretations, which over time may converge on form consensual views of the team climate (Mathisen, Torsheim, & Einarsen, 2006). In the same direction, Anderson and West (1998) argue that the appropriate level of analysis of an innovative climate is the proximal work group, which they defined as "either the permanent or semi permanent team to which individuals are assigned, whom they interact with regularly in order to perform work-related tasks" (Anderson & West, 1998, p. 236). While, most instruments reviewed are designed to provide information about climate at the organizational level (Mathisen, Einarsen, Jørstad, & Brønnick, 2004), the Team Climate Inventory (TCI), developed by Anderson and West (1998), to the best of our knowledge is the most used instrument reviewed that explicitly measures climate at the team or group level.

The Team Climate Inventory (TCI)

The Team Climate Inventory is a measurement instrument of proximal work group climate designed to elicit team members' perceptions of climatic dimensions hypothesized to relate to one aspect of group output – work group innovation (Anderson & West, 1998), based on West's (1990) model. The TCI is composed by 38 items (divided in 4 subscales), which measure four dimensions of climate:

1. *Vision*. Based on the original definition "vision is an idea of a valued outcome which represents a higher order goal

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and a motivating force at work" (West, 1990. p. 310). This subscale consists on 11 items, which pretend to give account of 4 components: clarity, vision nature, attainability and sharedness. Example of an item taken from the first component: "How clear are you about what your team objectives are?"

2. *Participative safety*. Based on the original definition "participation and safety are characterized as a single psychological construct in which the contingencies are such that involvement in decision-making is motivated and reinforced while occurring in an environment which is perceived as interpersonally non-threatening" (West, 1990. p. 311). This scale is composed by 12 items, which pretend to give account of four components: information sharing, safety, influence and interaction frequencies. Example of an item (information sharing): "We share information generally in the team rather than keeping it to ourselves".
3. *Task orientation*. Based on the original definition "a shared concern with excellence of quality of task performance in relation to shared vision or outcomes, characterized by evaluations, modifications, control systems and critical appraisals" (West, 1990, p. 313). This subscale consists on 7 items, which pretend to give account of 3 components: excellence, appraisal and ideation. Example of an item (excellence): "Do you and your colleagues provide useful ideas and practical help to enable you to do the job to the best of your ability?"
4. *Support for innovation*. Based on the original definition "the expectation, approval and practical support of attempts to introduce a new and improved ways of doing things in the work environment" (West, 1990, p. 318). This subscale consists on 8 items that pretend to give account of 2 components: articulated support and enhanced support. Example of an item (articulated support): "Assistance in developing new ideas is readily available".

The TCI is an instrument widely used for research as well as for practice, as a team development tool that could facilitate interventions to promote innovation in work groups. For those reasons, since its original formulation, a big amount of research has being done to test its psychometric characteristics. The TCI, in fact, showed adequate psychometric properties in the original English version (Anderson & West, 1994). TCI also demonstrated sufficient robust psychometric properties with acceptable levels of reliability and validity in different occupational samples and countries, such as the United Kingdom (Anderson & West, 1998), Sweden (Agreell & Gustafson, 1994; Dackert, Brenner, & Johansson, 2002), Finland (Kivimäki et al., 1997), Portugal (Curral, Forrester, Dawson, & West, 2001), Italy (Giorgi, Baiardi, Ragazzoni, & Zotti, 1999; Ragazzoni, Baiardi, Zotti, Anderson, & West, 2002), Germany (Brodbeck & Maier, 2001), Canada (Loo & Loewen, 2002), Norway (Mathisen et al., 2004;Mathisen et at., 2006) and more recently in Taiwan (Tseng, Liu, & West, 2009). The instrument showed also good properties in a short version of 14 items (Kivimäki & Elovaino, 1999; Loo & Loewen, 2002; Dackert et al., 2002).

Beside the big amount of research done, the TCI literature still presents some lacks.

First, despite the large production of psychometric studies of TCI in different cultures and countries, so far in Spanish-speaking contexts we only found a validation of the reduced version of the TCI (Boada-Grau, de Diego-Vallejo, Llanos-Serra, & Vigil-Colet, 2011), which analysed only a Spanish sample (not extending the analysis to others Spanish-speaking countries).

Second, although the TCI theoretical model consists of a four-factor solution, studies of factor structures and construct validity across cultures have yielded mixed results. Confirmatory factor analyses on the English, Finnish, and Norwegian versions indicated that the five-factor model exhibited marginally the best fit (Anderson & West, 1998; Kivimaki et al., 1997; Mathisen et al., 2004). Anderson and West (1998) proposed that differences in the five-factor structure might result from the confounding effects of job complexity. Thus, studies not only support the theoretical four-factor model of the TCI but also suggest that a fifth factor may be required to accommodate different cultures or job complexity. The fifth factor coincided with the four items measuring the component *interaction frequency,* defined as "the frequency of interaction, both formally and informally, between team members" (Anderson & West, 1998, p. 244), theoretically included in the participative safety factor (West, 1990).

Third, as far as we know, no study directly assessed the measurement invariance of the TCI. This is considered a key issue for the psychometric development of tests (Brown, 2006), because it allows studying to what extent respondents from different cultures interpret a given measure in a conceptually similar manner (Vandenberg & Lance, 2000).

Finally, numerous studies have demonstrated that work environment and social climates can foster or impede performance (Amabile, Conti, Coon, Lazenby, & Herron, 1996; Mathisen et al., 2004; Oldham & Cummings, 1996; Patterson, Warr, & West, 2004; Benítez, Medina, & Munduate, 2012). But whereas most research has examined the relationship between a general team climate and performance (e.g., Pirola-Merlo et al., 2002), less attention has been given to specific dimensions of team climate and its relation with team level variables, for example team performance as well as team satisfaction (Mathisen et al. 2006).

The present study

In this study, our first objective was to test the psychometric proprieties of the TCI in a Spanish version. We tested whether the 4 or the 5-dimension model better fits to our data. Our second objective was to assess the measurement invariance between two different samples. Our third objective was to offer evidences for validity based on the prediction of external variables, specifically team performance and team satisfaction. Theoretical and practical implications are discussed.

Method

Samples

Sample 1: Health-care teams.- The first sample was composed by 651 respondents, working in 89 teams coming from 25 public hospitals from different Spanish Autonomous Communities (Andalucía, Cataluña, Galicia, Madrid, Castilla la Mancha). Teams operated in different hospital's areas (cardiology, digestive, oncology, orthopedic surgery, psychiatry, respiratory, surgery, and urgencies). Team size averaged 6.94 members (*SD* = 3.08). Team members' age averaged 40.85 years (*SD* = 8.04), 71.4% were women, team members' tenure in the organization averaged 13.2 years (*SD* = 6.21) and tenure working in the teams averaged 9.3 years (*SD* = 6.55).

Sample 2. Software development teams.- The second sample was composed by 484 professionals working in 130 software development teams from a multinational software development firm, in charge of developing software solutions for end-user clients operating, inter alia, in the electronics, energy and food sectors, as well as in government agencies. All teams included in the sample worked in Latin America, coming from 3 Mexican States (Nuevo Leon, Aguascalientes, Baja California) and the Federal District of Mexico. Team size averaged 6.94 members (*SD* = 3.08). Team members' age averaged 30.02 years (*SD* = 9.51), 29.2% were women, team members' tenure in the organization averaged 9.57 years (*SD* = 6.13) and tenure working in the teams averaged 6.3 years (*SD* = 4.51).

Procedure

In the first sample the TCI was handed out to hospitals' human resources departments, which in turn contacted each team member. In the second sample a member of the management team contacted participants personally for participating and questionnaires were posted on the firm's intranet, ensuring the anonymity. For both samples, the team performance questionnaire was filled out by at least three independent expert persons in a formal position as supervisors, leaders, or managers in the organization. These persons were in a superior position, external but knowledgeable about the team. At the end of the data collection, we returned the results to the participant organizations.

Measures

Team Climate Inventory (TCI).- Two expert psychologists translated the 38 items from the English version of the TCI into Spanish, and a native English speaker then back translated it. The back-translated version was then compared with the original one by a group of 3 experts, external to this investigation (3 associates professors of organizational behavior) for differences in meaning. No major differences were observed. It was therefore concluded that the Spanish items presented the same meanings as the original English items. Items were presented with a 5-point Likert-type scale (1 = *completely disagree*, 5 = *completely agree*).

Team Performance.- Team performance was assessed through Ancona and Caldwell's (1992) scale. This scale is composed by 5 items asking for team's efficiency, quality of technical innovations, adherence to schedules, and ability to resolve conflicts. Team managers used a 5-point Likert-type scale to score each dimension (1 = *completely disagree*, 5 = *completely agree*). The resulting inter-judge coefficient was .83. Then, we averaged the three performance ratings from each team to compose overall team performance scores. According to the authors, this team performance measure is multidimensional and subjective, as team performance cannot be seen as a simple, one-dimensional construct (Ancona & Caldwell, 1992; Hackman & Walton, 1986).

Team satisfaction.- Team satisfaction was assessed using Gladstein's (1984) scale of three items (Cronbach's alpha = .82; omega = .89), which measured the degree to which subjects display satisfaction with their colleagues, the manner of team working and with the team as a whole. Responses were scored using a five-point Likert scale (1= disagree completely, 5 = completely agree).

Data Analyses

Psychometric analyses of the TCI Spanish version included: (a) tests of internal consistency, (b) correlations between factors, (c) exploratory factorial analysis to test the theoretical structure of the TCI and a reliability estimation based on omega index for rotated factors, (d) confirmatory factor analysis (*CFA*) to test the robustness of the four versus five-factor solution, (e) factorial invariance analysis to test the measurement invariance, (f) regression analysis for testing evidences for external validity and finally.

Internal consistency reliability for each scale score was estimated using Cronbach's alpha coefficient, complemented with omega coefficient calculated on the extracted factors, given that the first estimation index may underestimate or overestimate the real reliability (McDonald, 1999). We calculated inter-correlation between the 4 and 5 theoretical scales of the TCI. We also correlated the 4 and 5 TCI theoretical scales (aggregated at team level) with the team performance and team satisfaction scales, employing the SPSS 19 software.

Then, we proceed with the exploratory factor analysis (*EFA*) to explore the underlying factors structure. Before, we computed missing data following recent recommendations in the literature suggest the employment of Maximum

Likelihood based estimation (Enders, 2010) because of less bias. The *EFA* was conducted with the software *Factor* (Lorenzo-Seva & Ferrando, 2006). Then we performed a *CFA* to examine the robustness of different proposed factor solution (Martínez García & Martínez Caro, 2009). To run the analysis, we employed *Mplus Software* version 5 (Muthen & Muthen, 2007). We tested the goodness-of-fit statistics of the nested model comparing the four and five factor solution, as recommended by Anderson and West (1994). For the four-factor model, the first factor contained the participative safety items, the second the task orientation items, the third the vision items, and the fourth support for innovation items. For the five-factor model, a fifth factor, interaction frequency, consisted of four items extracted from the participative safety factor. Model adequacy was assessed through comparison of goodness-of-fit indices. Criteria to evaluate the fit of the models included (a) the ratio of maximum-likelihood chi-square to the degrees of freedom ($\chi 2/df$); (b) the comparative fit index (*CFI*); (c) the Tucker–Lewis Index (*TLI*); (d) the root mean square error of approximation (*RMSEA*) and the standardized *SRMR*. The following criteria were used to evaluate the goodness of fit: *TLI* and *CFI* should be close to or greater than 0.90 (Hu & Bentler, 1998), and an *RMSEA* value of 0.08 or lower (Browne & Cudeck, 1992). Regarding the $\chi 2$/df, various rules of thumb ranging from 0 to 3 have been recommended as cutoff for goodness of fit.

Once established the best factorial solution, we assessed the measurement invariance trough a multiple group *CFA*, following Brown's (2006) recommendations. Our analysis involved two groups (i.e. sample 1 and sample 2), so two *separate* input matrices were analyzed with Mplus software. This allowed us to examine all the aspects of measurement invariance and population heterogeneity (i.e., factor loadings, intercepts, residual variances, factor variances, factor covariances, latent means) in different steps (Vandenberg & Lance, 2000). The first step consists in the exam of the *configural invariance* trough the exam of equal factor structures (equal form means that the number of factors and pattern of indicator–factor loadings is identical across groups). The second step is based on the assessment of the *metric invariance* or *weak factorial invariance* referred to the equality off actor loadings between groups. The third step is to study the *scalar invariance* or *strong factorial invariance* by valuing the equality of indicator intercepts. Finally the fourth step is to test the *strict factorial invariance* (Meredith, 1993), based on the equality of the indicator residuals.

Then, we proceeded with the analysis of the evidences for external validity: employing the SPSS 19 software first we correlated the complete TCI and each team climate subscale with the external evaluators' ratings of team performance and with the internal perception of team satisfaction. We regressed, in a multiple lineal regression model, all the dimensions of the team climate inventory on team performance and on team satisfaction, for both sample separately; we also regressed the complete team climate inventory on team performance and team satisfaction, for both sample separately.

Results

Scale analysis and internal consistency

As shown in Table 1, means of the four and five TCI subscales calculated over the 1099 respondents were: vision (M = 3.45, SD = 0.75), participative safety 4-factor solution (M = 3.45, SD = 0.83), participative safety 5-factor solution (M = 3.53, SD = 0.82), task orientation (M = 3.17, SD = 0.89), support for innovation (M = 3.19, SD = 0.87), interaction frequency (M = 3.70, SD = 0.87). The mean of the full questionnaire was (M = 3.34, SD = 0.74). As shown in Table 1, the internal consistencies estimated by alpha coefficient were adequate and similar to those found in other published studies (ranged in .85 - .92), whereas omega indexes over extracted factors ranged between .87 – .96.

Table 1. Descriptive statistics, alphas, team level aggregation indexes and correlation between scales.

Scales	*M*	*SD*	Ω	α	ICC(2)	ICC(1)	1	2	3	4	5	6	7	8
1 Vision (11 items)	3.45	.75	.96	.90	.78	.57								
2 Participative safety (12 items)	3.45	.83	.94	.90	.81	.58	.601**							
3 Participative safety (8 items) (a)	3.53	.82	.91	.90	.79	.58	.606**	(c)						
4 Task orientation (7 items)	3.17	.89	.94	.90	.76	.54	.622**	.608**	.693**					
5 Support for innovation (8 items)	3.19	.87	.92	.92	.83	.58	.608**	.711**	.729**	.678**				
6 Interaction frequency (4 items) (a)	3.70	.87	.85	.85	.72	.45	.513**	(c)	.791**	.699**	.678**			
7 Team Climate Inventory (38 items)	3.34	.74	.98	.97	.78	.61	(c)	(c)	(c)	(c)	(c)	(c)		
8 Team performance (b)	3.95	.50	.85	.85	.90		.196*	.297**	313**	.181*	.266*	.145	.280*	
9 Team satisfaction (b)	4.31	.84	.83	.83	.81	.58	.419*	.400*	594**	.442*	.380*	605**	.441*	.167*

N = 1135; ** $p < .01$; * $p < .05$

(a) = Calculated for the 5-factor solution; (b) = Correlations were calculated over team level aggregated dimensions; (c) = Not included, because the dimension is included in (or inclusive of) the other dimension.

Inter-scale correlation analyses among the TCI scales, as listed in Table 1, showed that all scales were significantly and positively correlated ($p < .01$). In the 4-factor solution, the highest degree of inter-correlation was found between participative safety and support for innovation ($r = .711$; $p < .01$); the lowest inter-correlation was between the scales vision and participative safety ($r = .601$; $p < .01$). In the 5-factor solution, the highest degree of inter-correlation existed between participative safety (8 items) and interaction frequency (r = .791; p < .01); the lowest inter-correlation was between the scales vision and interaction frequency (r = .513; p < .01).

Exploratory factorial analysis

The *EFA* was conducted on sample 1. First, to ensure that our data were appropriate to perform factor analysis on the data, Kaiser's measure of sampling adequacy was computed prior to performing the factor analysis (Comrey, 1978). The Kaiser-Meyer-Olkin measure of sampling adequacy was 0.942, and Bartlett's test of sphericity was significant (p <.001), indicating that the sample was suitable for factor analysis. Secondly, to choose the extraction method we tested multivariate normality beginning with the Mardia Test (Mardia, 1975), confirming that our data did not follow the multivariate distribution (p < .001). As literature recommends in these cases (McDonald, 1999) we decided to calculate the *Polychoric* correlation matrix and we choose *Unweighted Least Square* extraction method (Curran, West, & Finch, 1996).

Table 2. Four-Factor Model: Loadings of Factor Analysis for the Team Climate Inventory (TCI) Spanish Version.

factor	item	factor 1	factor 2	factor 3	factor 4	theoretical TCI scale
1.Participative safety	cl_pa_1	(<0.3)	**0.399**			Task orientation
	cl_pa_2	**0.579**				Participative safety
	cl_pa_3	(<0.3)			**0.407**	Support for innovation
	cl_pa_4	**0.747**				Participative safety
	cl_pa_5	**0.433**			0.350	Participative safety
	cl_pa_6	**0.411**	0.327			Participative safety
	cl_pa_7	(<0.3)			**0.496**	Support for innovation
	cl_pa_8	**0.832**				Participative safety
	cl_int_1	**0.820**				Participative safety
	cl_int_2	**0.799**				Participative safety
	cl_int_3	**0.944**				Participative safety
	cl_int_4	**0.631**				Participative safety
2. Task orientation	cl_tas_1	**0.749**	(<0.3)			Participative safety
	cl_tas_2		**0.694**			Task orientation
	cl_tas_3		**0.701**			Task orientation
	cl_tas_4		**0.781**			Task orientation
	cl_tas_5		**0.753**			Task orientation
	cl_tas_6	0.447	**0.610**		-0.303	Task orientation
	cl_tas_7	**0.488**	(0.355)			Participative safety
3.Vision	cl_vis_1			**0.530**		Vision
	cl_vis_2			**0.765**		Vision
	cl_vis_3			**0.877**		Vision
	cl_vis_4	0.414		**0.541**		Vision
	cl_vis_5		**0.465**	(0.436)		Task orientation
	cl_vis_6			**0.708**		Vision
	cl_vis_7	0.367		**0.807**		Vision
	cl_vis_8			**0.642**		Vision
	cl_vis_9	0.303		**0.558**		Vision
	cl_vis_10			**0.814**		Vision
	cl_vis_11	**0.563**		(0.357)		Participative safety
4. Support for innovation	cl_inn_1	**0.691**			(<0.3)	Participative safety
	cl_inn_2		0.322		**0.349**	Support for innovation
	cl_inn_3				**0.425**	Support for innovation
	cl_inn_4		0.367		**0.429**	Support for innovation
	cl_inn_5				**0.684**	Support for innovation
	cl_inn_6		0.356		**0.514**	Support for innovation
	cl_inn_7	**0.509**			(0.440)	Participative safety
	cl_inn_8		0.321		**0.385**	Support for innovation
Explained variance		0.461	0.543	0.614	0.657	
Reliability: Omega over rotated factors		0.909	0.936	0.962	0.873	

After the extraction, the number of factor was determinate as follow. *Keiser's Criteria* indicates to retain 5 factors, but given that it tends to overestimate the number of factors (Browne, 1968; Cliff, 1988) we performed a *scree plot test* and run a *parallel analysis* (Hayton, Allen, & Scarpello, 2004). Results confirmed that the best solution was the 5 factors one, which represented the four factors of team climate (vision, task orientation, participative safety, and support for innovation) with the fifth theoretical dimension defined as interaction frequency. Given that the fifth factor presented an eigenvalue very close to the random eigenvalue produced with the parallel analysis, we decided to perform the analysis while retaining both four and five factors, respectively, coherent with other TCI original construction model. We applied a *Promin Rotation* to interpret the found solution. Tables 2 and 3, respectively, list the four- and five-factor solutions and factor loadings for the TCI Spanish version.

For the four-factor solution, the normalized factor loading indicated that all but 9 items exhibited the highest loadings on the factor to which they were originally referred. Just 4 of these 9 items had factor loadings with their theoretical scale below 0.3. The present analysis revealed that the order and quantity of variance accounted for each factor was as follows. The first factor (participative safety), accounting for 46.10 of the variance[1], included 9 items from its theoretical scale and 5 external items, 2 from task orientation, 1 from vision and 2 from support for innovation. The second factor (task orientation), accounting for 8.20% of the variance included 5 items from its theoretical scale and 2 external items, coming from participative safety and vision scales. The third factor (vision) accounting for 7.10% of the total variance included 9 items from its theoretical scale. The fourth factor (support for innovation) accounting for 4.30% of the total variance included 6 items from its theoretical scale and 2 external items from the participative safety scale.

Table 3 shows that the results of the five-factor solution exhibited similar fit to the theoretical model than those of the four-factor solution. Seven, instead of nine items, were not loaded most highly on the factor to which they originally referred, five of which had factor loadings with their theoretical scale below 0.3. Factor 1 (participative safety) accounted for 46.10% of variance (based on eigenvalue) and consisted of seven items theoretically designed to refer to that construct, and two items from the interaction frequency scale. Factor 2 (support for innovation) accounted for 8.20% of the variance, and included all the eight items from the theoretical support for innovation scale, and one item originally intended for the participative safety scale. The third factor (interaction frequency), accounting for 7.10% of the variance, included two items from the interaction frequency scale and five external items, three from the task orientation and two from vision. Factor 4 (task orientation) accounted for 4.30% of the variance and included 4 items from its theoretical scale. The fifth factor (vision), representing 3.50% of the variance, included nine items from its theoretical scale.

Confirmatory factorial analysis

Confirmatory factorial analysis was conducted on sample 2. Given the nature of our data (5 categories of answer, no multivariate-normality) we run *CFA* using MLM, an extraction method demonstrated to be robust in similar circumstances (Finney & DiStefano, 2006). We studied both the four and five solution (4 factor model and 5 factor model) where items were allocated to their respective factors based on the theoretical structures. The results shown in Table 4 indicated that the 5 factors correlated model had the best fit to the theoretical model ($\chi 2/df$ = 6.864, *TLI* = 0.91, *CFI* = 0.89, *RMSEA* = 0.062, *SRMR* = 0.054), followed by the four-factor correlated model, ($\chi 2/df$= 7.317, *TLI* = 0.87, *CFI* = 0.84, *RMSEA* = 0.092, *SRMR* = 0.088). We compared both models trough the nested model comparison, we found that the five-factor solution presented a significantly better fit to the data ($\Delta\chi 2$ = 122.56, Δdf = 1, p < .001).

Measurement invariance

We assessed measurement invariance trough a cross sample comparison. We run a group comparison between the two samples, testing the first level, and we found that in our sample we had no significantly different factor number ($\Delta\chi 2$ = 9.943,Δdf = 4, p = *ns*), affirming that we found configural invariance. Secondly, we found that between our samples we had metric invariance, which means that in our two samples we had no significantly different (unstandardized) factor loadings ($\Delta\chi 2$= 41.433, Δdf = 33, p = *ns*). Then we tested, the between-group equality of indicator intercepts, but we found that the means of the indicators were different between our samples.

Evidence for Validity based on prediction of other variables

We measured team climate and team satisfaction at the individual level, therefore, we aggregated members' answers to the team level (Bliese, 2000). We first tested whether the teams could be differentiated on both variables by calculating ICC(2) index. As shown in table 1, ICC(2) values were acceptable for all the team climate scales (ranging from .72 to .83) and team satisfaction (.81). To further support aggregation, we calculated ICC(1). Results justified aggregation for all the variables (Bliese, 2000): for all the team climate scales, ICC(1) ranged from .45to .58, whereas for team satisfaction the ICC(1)= .58.

As shown in Table 1, all but one (interaction frequency) the TCI scales were positively related with team performance (ranging from .181 to.313; at least p < .05). All the TCI scales were positively related with team satisfaction, ranging from .400 to .605 (at least, p < .05). Correlations between the team climate scales and team satisfaction were strongly positive (ranging from .380 and .605; at least p < .05). The total TCI punctuation was also positively and significantly correlated with team performance (r = .280; p < .05) and team satisfaction (r = .441; p < .05).

Regressions models were run separately for each sample. As we reported in table 5, in health care teams (sample 1), by

[1] Our solution was obtained with a diagonal rotation, so we cannot attribute variances to a single extracted dimensions.

regressing all the 5 team climate dimensions on team performance, only task orientation (β = .331; p < .01) and participative safety (β = .275; p < .05) result significant and positively related. Regressing all the team 5 climate dimensions on team satisfaction, only vision (β = .419; p < .05) task orientation (β = .273; p < .01) result significant and positively related with the predicted variable. In the same sample, the total TCI is positively related with team performance (β = .410; p < .001) and team satisfaction (β = .258; p < .001). In the second sample (software development teams), by regressing all the team 5 climate dimensions on team performance, three dimensions resulted positively related: in order of relevance, participative safety (β = 1.271; p < .001), support for innovation (β = .537; p < .05) and task orientation (β = .386; p < .01). Similarly, regressing all the team 5 climate dimensions on team satisfaction, three dimensions resulted positively related: in order of relevance, participative safety (β = 1.023; p < .001), interaction frequency (β = .522; p < .05) and task orientation (β = .386; p < .01). In the same sample, the total TCI is positively related with team performance (β = .637; p < .001) and team satisfaction (β = .724; p < .001).

Table 3. Five-Factor Model: Loadings of Factor Analysis for the Team Climate Inventory (TCI) Spanish Version.

item	*factor 1*	*factor 2*	*factor 3*	*factor 4*	*factor 5*	*theoretical TCI scale*
cl_pa_1	**0.461**					Participative safety
cl_pa_2	**0.365**					Participative safety
cl_pa_3	(<0.3)	**0.619**				Support for innovation
cl_pa_4	**0.455**					Participative safety
cl_pa_5	**0.619**					Participative safety
cl_pa_6	**0.740**					Participative safety
cl_pa_7	**0.790**					Participative safety
cl_pa_8	**0.673**					Participative safety
cl_inn_1		**0.544**				Support for innovation
cl_inn_2		**0.622**				Support for innovation
cl_inn_3		**0.617**				Support for innovation
cl_inn_4		**0.753**				Support for innovation
cl_inn_5		**0.434**				Support for innovation
cl_inn_6		**0.880**				Support for innovation
cl_inn_7		**0.709**	0.325			Support for innovation
cl_inn_8		**0.679**				Support for innovation
cl_int_1	**0.733**		(<0.3)			Participative safety
cl_int_2	**0.990**		(<0.3)			Participative safety
cl_int_3	0.516		**0.690**			Interaction frequency
cl_int_4	0.425		**0.533**			Interaction frequency
cl_tas_1			**0.508**	0.455		Interaction frequency
cl_tas_2				**0.425**		Task orientation
cl_tas_3				**0.415**		Task orientation
cl_tas_4				**0.525**		Task orientation
cl_tas_5				**0.443**		Task orientation
cl_tas_6			**0.690**	(<0.3)		Interaction frequency
cl_tas_7			**0.683**	(<0.3)		Interaction frequency
cl_vis_1					**0.594**	Vision
cl_vis_2					**0.722**	Vision
cl_vis_3					**0.885**	Vision
cl_vis_4			**0.614**		(0.444)	Interaction frequency
cl_vis_5					**0.484**	Vision
cl_vis_6					**0.629**	Vision
cl_vis_7			0.478		**0.696**	Vision
cl_vis_8					**0.691**	Vision
cl_vis_9			0.311		**0.520**	Vision
cl_vis_10					**0.755**	Vision
cl_vis_11			**0.650**		(0.390)	Interaction frequency
Ex	0.461	0.543	0.614	0.657	0.692	
	0.943	0.945	0.925	0.819	0.926	

Table 4. Confirmatory Factor Analysis of the Team Climate Inventory (TCI) Spanish Version

Model (total sample)	*chi square*	*df*	*chi/df*	*TLI*	*CFI*	*RMSEA*	*SMRS*
4 factors correlated	1973.62	659	7.317	0.87	0.84	0.092	0.088
5 factors correlated	4496.13	655	6.864	0.91	0.89	0.062	0.054
4 factor uncorrelated	7663.50	665	11.524	0.73	0.74	0.128	0.101
5 factors uncorrelated	8536.85	665	12.837	0.70	0.71	0.134	0.054

Table 5. Regression Results: Team Climate dimensions and Team Climate Inventory on Team performance and Team satisfaction.

Sample and Variables	*B*	*SE*	ß	*t*	*p*	$R^2_{adjusted}$
Sample 1: Regression on Team performance						176***
Vision	.026	.092	.028	.287	*ns*	
Participative safety	.242	.123	.275	1.970	.045	
Task orientation	.351	.144	.331	2.656	.008	
Support for innovation	.130	.126	.143	1.040	*ns*	
Interaction frequency	.094	.177	.081	.308	*ns*	
Team Climate Inventory	.667	.075	.410	7.733	.000	.192***
Sample 1: Regression on Team satisfaction						.201***
Vision	.679	.085	.419	7.971	.045	
Participative safety	.189	.184	.127	1.028	*ns*	
Task orientation	.405	.152	.273	2.656	.008	
Support for innovation	-.113	.192	-.073	-.586	*ns*	
Interaction frequency	.104	.181	.099	.398	*ns*	
Team Climate Inventory	.252	.055	.258	4.567	.000	.530***
Sample 2: Regression on Team performance						525***
Vision	.450	.351	.160	1.281	*ns*	
Participative safety	2.869	.819	1.271	3.504	.001	
Task orientation	.596	.437	.386	2.639	.008	
Support for innovation	1.226	.553	.537	2.215	.031	
Interaction frequency	.948	.685	.423	1.383	*ns*	
Team Climate Inventory	1.697	.215	.637	7.909	.000	.405***
Sample 2: Regression on Team satisfaction						.747***
Vision	.101	.119	.078	.853	*ns*	
Participative safety	1.070	.277	1.023	3.856	.000	
Task orientation	.396	.137	.386	2.889	.006	
Support for innovation	-.039	.187	-.037	-.209	*ns*	.
Interaction frequency	.543	.232	.522	2.343	.023	
Team Climate Inventory	.980	.083	.724	11.843	.000	.521***

*** $p < .001$; ** $p < .01$; * $p < .05$.

Discussion

Our first objective was the development and the study of psychometric properties of the Spanish version of the Team Climate Inventory, extending previous evidence on the reduced version (Boada-Grau et al., 2011). Most of the applied psychometric tests gave good results. Testing the internal consistency, reliability of both the four- and five-factor solutions exceeds the usually accepted level by employing the Cronbach's Alpha (> .80) as well as the Omega Index (>.85). The exploratory factor analyses demonstrated that the five-factor solution represented a significant proportion of the total variance, even if half of the items in the fifth factor interaction frequency cannot be easily separated from the original factor of participative safety. The *CFA* suggested that both the correlated four and five-factor models exhibited good fit with the current data, and the five-factor model displayed the best fit, as the differences between the 4 and 5—factor solution were significant. Fit indexes found are in line with the other versions of the TCI, and reach the recommended levels for a good fit. We obtained good *RMSEA* and *SRMS*, and our *TLI* and *CFI* were close to the recommended limit (.90). Those results extend previous studies on the Spanish version of the TCI. In the reduced version (Boada-Grau et al., 2011), the different dimension of the TCI only demonstrated acceptable reliability (Alpha values ranging from .75 to .82), something clearly related to the number of items included for each dimension, whereas in the present study we found Alpha values ranging from .85 to .92.

Our results are coherent with the findings from the English (Anderson & West, 1998), Norwegian (Mathisen et al., 2004), Italian (Ragazzoni et al., 2002), Finnish (Kivimaki et al., 1997) and Canadian (Loo & Loewen, 2002) samples and indicate that the model should be revised to display a five-factor structure. Moreover, these results might support Anderson and West (1998) proposition that differences in the factor structures may result from the confounding effects of job complexity. All the scales were found to be inter-correlate positively, replicating the pattern of results obtained in the original TCI scales. Similar to the Norwegian version of TCI (Mathisen et al., 2004), the most notable relationship existed between support for innovation and participative safety (r = .729; p < .001). Clearly, the Spanish version of the TCI demonstrates the robustness of the instrument in terms of both reliability and measurement constructs of team climate.

Our second objective was to assess the measurement invariance. We compared 2 samples (one composed Spanish health care teams and the other from a Latin American multinational software development enterprise). Following Brown's (2006) recommendations, we found a second level of measurement invariance. Because the constraint of equal factor loadings did not significantly degrade the fit of the solution, we can conclude that the indicators evidence comparable relationships to the latent construct of TCI in health care teams and software development. However, because the intercepts have not been found to be equivalent (third step of measurement invariance), it cannot be concluded that Spanish health care teams and Latin American software development teams would evidence equivalent observed *scores* on an indicator at a given level of the different TCI extracted dimensions (Brown, 2006). As far as we know, this is the first study that compared sample in different countries; in this sense our results extend the TCI literature providing the first evidence of cross-cultural measurement invariance. This is especially important, considering that we studied the Spanish version of the TCI, language that is spoken in 22 countries around the world and that till the moment was only tested in its reduced version in a Spanish sample (Boada-Grau et al., 2011). Till the moment, the only cultural comparisons available were the differences in factors order retrieval among countries, that may reflect not only differences in sample characteristics but also differences in organizational cultures, as suggested by Tseng et al. (2009). Reweaving the literature on climate, in the original English version, the factors were extracted in the following order: vision, participative safety, support for innovation, and task orientation (Anderson & West, 1994). In the Taiwan version (Tseng et al., 2009), the analysis results in vision, support for innovation, participative safety, and task orientation. This last solution is different from the Italian (Ragazzoni et al., 2002) and Swedish (Agrell & Gustafson, 1994) versions. In our sample, only the first and the second dimensions coincided with the English one, whereas the third was task orientation, followed by support for innovation and interaction frequency. The fact that support for innovation explained less variance than task orientation in our sample may be due to the nature of healthcare organizations where the data were collected. In this work context, there may be less space for team to innovate (so possibly, less variability in terms' perceptions on support for innovation), and innovation may not be considered as a key element for team performance (consistent with what we show by predicting the team performance with the different team climate dimensions).

Our third objective was to offer evidences for validity based on predictability of external variables. This represents an advance in the TCI climate literature (specially considering the validation of the Spanish reduced version, that didn't offer those tests), since we use two source of information (team members and external leaders) to assess these aspects of validity. We tested whether the TCI could offer a measurement of different climate dimensions (as well as for the total score) that permit to predict team satisfaction and team performance. In both samples, the total TCI measure allows us to predict both, team performance and team satisfaction. In health care teams, considering the 5 dimensions of the TCI predicting team performance, it is possible to state that the greatest weight in the model corresponds to the task orientation theoretical scale, more than participative safety, whereas the other 3 dimensions were not significant. Regarding the software development teams, the participative safety theoretical scale had the greatest weight in predicting team performance, followed by support for innovation and task orientation, whereas the other 2 were not significant. With respect to the team satisfaction of health care team, the vision dimension had the greatest weight, followed by task orientation. In software development teams, team satisfaction can be predicted employing three TCI theoretical scales: participative safety, interaction frequency and task orientation. These results extend our comprehension of the weight of the different dimension of the team climate construct in predicting team performance and team satisfaction in different context. We found that the reciprocal position of the 5 theoretical scales in predicting both team performance and team satisfaction, in terms of significance and weights, is quite different in the two samples. This is not surprising at all: on one hand health care teams were working in large public hospitals, in which organizational context is manifested in a high hierarchy and strong centralization (West, Guthrie, Dawson, Borrill, & Carter, 2006). On the other hand, teams in a Software development enterprise, might present different configuration of climate, due to the different tasks that the teams are called to accomplish (Levesque, Wilson, & Wholey, 2001).

Our results represent a contribution to the TCI literature in its study on the relations and the predictability of related constructs. Our results confirm Anderson and West (1998) proposition that different cultures or job complexities might need different climate structures. Moreover, our findings also evidenced that it might be necessary to differentiate and separate the different climate dimensions, coherently with other studies, where single dimensions (e.g., support for innovation) have shown to be particularly good predictors of team outcomes (e.g, team innovation, Mathisen et al., 2004). Additionally, we confirm that keeping a number of factors rather than a composite score may increase practical value of this instrument suggesting its use as diagnostic tool for team climate interventions (Loewen and Loo, 2004). According to Tseng et al., (2009) we agree that directing the TCI survey feedback toward specific factors may be more effective than adopting an unspecified composite approach.

Practical implications

Team climate is a key characteristic of successful and innovative teams in different context, as for example in health care settings (Ouwens et al., 2008). To date, in Spain and Latin American's countries the complete version of the TCI has not been available. The translation and psychometric testing of the TCI in its complete version has thus important practical values. The TCI can be used as a diagnostic tool in organizational climate surveys, team building and development. Through the application of the TCI, practitioners can offer evidences to change and develop existing work organizations, using the evaluation as guide for goal-setting, especially for process changing. Moreover, reliable and valid measures of team climate, considering the whole instrument as well as its different dimensions, can be used to evaluate the effects of specific interventions on team climate. Additionally, the translated TCI can be used to answer to recent calls in research on cross-cultural differences in team climate and associated factors in Latin American organizations (Nicholls-Nixon, Davila-Castilla, Sánchez-García, & Rivera-Pesquera, 2011) also by comparisons with Spanish organizations, as shown with our factorial invariance test.

Limitations

Besides its theoretical and practical implications, our study is limited in several ways. First, our samples were not equal in terms of size and this makes some interpretation of the analysis to be more complex. This is because many aspects of the fit indexes calculated in the *CFA* are influenced by (sensitive to) the sample size, especially those based on $\chi 2$ (e.g., overall fit statistics and modification indexes). Although it is permissible to conduct multiple-groups *CFA* with unequal sample sizes (Brown, 2006), it is preferable for the sizes of the groups to be as balanced as possible. So we must be careful with interpreting our results. Future research should consider this issue by addressing a measurement invariance test.

Second, we are unable to distinguish whether the no-invariance sources are due to organizational level constructs or to cultural differences. Future investigations should take into account these issues: this could allow practitioners and investigators to redefine the instrument to enhance a better factorial invariance.

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