MENSURANDO INTERAÇÕES SOCIAIS EM EQUIPES VIRTUAIS: UMA REVISÃO INTEGRATIVA DA LITERATURA.

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Resumo

Entender a dinâmica dos relacionamentos entre os membros de equipes remotas desperta o interesse de pesquisadores a tempos, o impacto da COVID-19 acrescentou relevância e aplicação premente nas organizações. Esta pesquisa objetiva identificar escalas para mensurar as interações interpessoais em equipes virtuais. Mediante uma revisão integrativa da literatura, numa amostra de 232 artigos coletados nas bases ISI Web of Science e Scopus, publicados até junho de 2023. As expressões semânticas, “virtual teams” ou “distributed teams” são adotadas pela literatura para definir as equipes multi alocadas, sendo a busca pela mensuração das características das equipes virtuais anteriores a COVID-19, porém acelera em seu período. Escalas de confiança estão em 60,8% dos artigos selecionados, com quatro escalas identificadas, escalas para mensuração da identidade de grupo não foram encontradas. Percebe-se serem as mensurações de times dispersos baseados em teorias e conceitos desenvolvidos primariamente para times presenciais, embora agendas de pesquisas propostas não estejam desenvolvidas. Para a teoria, consolidamos escalas, conceitos e particularidades de quinze escalas. Esta pesquisa oferece aos praticantes uma compilação de escalas e modelos para medir fatores de suas equipes virtuais, apresentado suas características e aplicações.

Palavras-chave:interações sociais. escalas. equipes virtual.

Abstract

Understanding the dynamics of relationships between members of remote teams has aroused the interest of researchers for some time, but the impact of COVID-19 has added relevance and pressing application in organizations. This research aims to identify scales to measure interpersonal interactions in virtual teams. Through an integrative review of the literature, a sample of 232 articles collected in the ISI Web of Science and Scopus databases will be published until June 2023. The semantic expressions “virtual teams” or “distributed teams” are adopted by the literature to define multidisciplinary teams. Allocated, with the search for measuring the characteristics of virtual teams before COVID-19 but accelerating in its period. Confidence scales are found in 60.8% of the selected articles, with four scales identified, scales for measuring group identity were not found. The measurements of dispersed teams are based on theories and concepts developed primarily for face-to-face teams, although proposed research agendas have not been developed. For theory, we consolidated the scales, concepts and particularities of fifteen scales. This research offers practitioners a compilation of scales and models to measure factors in their virtual teams, presenting their characteristics and applications.

Keywords: social interactions. scales. virtual teams.

1. Introduction

Working in groups is efficient, two million years ago, humanity developed associative strategies for hunting and gathering food (Dunbar, 2012), making social cooperation a decisive factor in human evolution (Hrdy, 2009). The progress of humanity is linked to the construction of complex social systems and cooperation between teams with a common objective (Boehm, 1999), which are associated with the maturation of language (Dunbar, 1993) and the ability to share intentions (Tomasello et al., 2005).

The development of teamwork is a basic concern for organizations (Aritzeta et al., 2007), it is not enough to hire intelligent and productive people (Edmondson, 2019), members must perceive a work environment conducive to sharing knowledge, concerns, questions and errors, as well as incomplete ideas. Effective teams bring together characteristics of complementary skills, synergy and shared responsibilities (Katzenbach and Smith, 2015). Technology has changed how we socialize and work, the offer of digital means of communication encourages organizations to implement virtual teams, geographically dispersed, allowing members to communicate in different time zones, always with a common objective (Abarca et al., 2020).

Team building is a science, not an art, although Pentland (2012) reveals the difficulty in understanding the dynamics of these groups, which are observable, quantifiable and measurable. Investigating the trajectory from in-person to virtual teams, Vuchkovski et al. (2023) suggest further considerations considering antecedents and their results in the digital transition, allowing for a broader generalization and confirming Verhoef et al. (2021) when they highlight the need to find which organizational structures are suitable to improve the digital agility of virtual teams. Looking at psychological safety in social interactions in teams, Cikara and Van Bavel (2014) perceive that the context and dynamic nature of social identity delineate intergroup relations, warning of a pressing search for improving the understanding of these factors, Jay J. Van Bavel will reaffirm this importance when he presents the relevance of building intra-group identity in facing the COVID-19 pandemic (Bavel et al., 2020).

Social identity can be more difficult to develop in a virtual team, as the construction of team identification is improved over time with interactions between team members, which are more sparse in virtual teams (Stoica et al., 2023). Its development starts with the interaction between the team's capabilities and the members' social identities (Mattarelli et al., 2017), this interpersonal improvement increases trust and positively impacts performance (Davidaviciene, 2020; Taras, 2019). Davidaviciene(2020) reiterates that it is necessary to develop a structure to encourage group identity, as it is a critical factor for trust in virtual teams.

The originality of this research lies in the compilation of scales available to measure the characteristics of virtual teams, in particular distinguishing scales for group identity, knowing that the search for a better understanding of intragroup dynamics has been of academic interest for decades (Walther, 1997) and pressing in virtual teams (Weigel et al., 2020). In 2023, the challenges triggered by the pandemic confinement are clear (Vuchkovski et al., 2023a), including the necessary digital transformation of face-to-face teams into virtual teams, involving the survival of organizations.

There is a need for dynamic approaches to understanding remote teams, research is in a divergent and exploratory phase (Shuffler et al., 2020), new theories require new measurement methods that allow different conceptualizations of team dynamics(Rosen et al., 2015). Abarca et al. (2020), after a systematic review of the literature on virtual teams, indicate that emotions should be further researched. Thus, the general and specific research questions of this article are:

RQ1: What scales are adopted to measure social interactions in virtual teams?
RQ1a: What scales are dedicated to measuring group identity in virtual teams?

This research adopts the methodology of an integrative literature review, presenting a conceptual structure around the topics covered (Torraco, 2016), allowing a synthesis of academic knowledge resulting from an objective approach, and ensuring transparency and replicability (Tranfield et al., 2003). The search was carried out in the Scopus and Web of Science databases in June 2023, with a total of 445 publications available. After applying inclusion or exclusion criteria, 232 publications addressing the topic of this study were selected.

In response to the research question, we listed and characterized fifteen scales adopted to measure characteristics of virtual teams, presenting five themes responsible for 91.5% of citations: trust (60.8%), presence (14.7%), cohesion (7.0%), behavior (4.9%), and intercultural (4.1%). We highlight that the search for stopovers predated COVID-19, but during this period, an acceleration was noticed. We listed scales constructed after 2020, highlighting the themes of leadership (2.1%), mental models (1.0%), effectiveness (1.0%), and engagement (0.8%). We show that scales were created to measure virtual teams, built on concepts and theories primarily developed for in-person teams, such as Chaudhary et al. (2022) scale for engagement.

2. Theoretical framework

2.1 Social Interactions

For Piaget (1973), the meaning of social interaction is closely linked to the concepts of reciprocity, where at least two actors are involved, and contact, an encounter that leads to changes in these actors. Knowledge is constructed through social interactions, with social life being fundamental to its formation, development and growth (Piaget, 1973). Homans (1958) shows that social behaviors are an exchange of goods, whether material or immaterial. Deriving from this idea, Thibaut and Kelly (1959) conceptualize social interactions based on rewards, costs and mutual dependence between individuals.

Hinde (1976) defends the need for a typology of social interactions to measure the limits of generalizations about their functioning. What do we mean by relationship? What is your dynamic? Butler (1951, p. 280) was already trying to conceptualize: “the individual man is an individualized form of society, an individual counterpart to it. To think of the individual as completely isolated from social relations is to make him an abstraction.” Addressing virtual relationships, Liu and Burn (2009) show that the construction of relationships is a vital mediator in the virtual social relationship model.

Social presence, postulated by Short, Williams and Christie (1976, p. 65) represents the “degree of relevance of the other person in the interaction and the consequent relevance of interpersonal relationships. . . “, implies the degree to which a person is perceived as a “real person” in mediated communication, social presence is a factor of both the environment and the communicators. It has a mediating role or direct effect on learning behavior, so instructors and leaders should encourage it (Lim, 2023). Activity awareness practices can increase feelings of social presence and the desire to work harder for the team (Haines, 2021), motivating distributed members to make greater effort at work and increasing loyalty to the team.

There is a permanent motivation in individuals to feel good about themselves, maintaining self-esteem achieved through personal achievement or identification with a social group (Worley, 2021), seeking a positive distinction in the group.Tajfel (1981) conceptualizes such a positive distinction as social identity, composed of three distinct and sequential processes:

1. Social categorization: There is a natural tendency for people to group things together. Social categorization is likely to produce numerous overlapping categories, the number of which is limited only by what is useful to the individual. A group is a social category. Categorization systematizes the social world and provides a system of guidance for the author about each person's place in society.

2. Social identification: After categorization, members then identify themselves as belonging to one or more groups. Self-assessment is carried out through social identity. As members of a group, individuals adopt salient aspects of that group's behavior, including an understanding of normative behavior.

3. Social Comparison: Individuals now turn to intergroup social comparison, that is, comparing their ingroup (the social group with which a person psychologically identifies as a member) with relevant outgroups (the social group with which an individual does not identify), seeking positive aspects of the ingroup or seeking negative aspects of an outgroup seeking to improve self-image. An individual strives to achieve and maintain a positive social identity, and a positive social identity is largely based on favorable comparisons between groups.

2.2 Team identity

Team identity represents the sense of unity among team members (Ashforth and Mael, 1989) and is composed of three factors: cognitive of belonging, affective of emotional attraction, and behavioral of joint effort, towards a common goal for the group (Ashforth 2001). It meets individuals' needs for belonging, such as predictability, inclusion, order, and structure (Fiol 2002). Tajfel and Turner (2001) show us that human identity is composed not only of character traits and individually unique physical factors, but also of the notion of belonging to certain social groups as individuals seek certainty and validation in their perceptions, seeking to reduce the uncertainty.

Liu et al. (2021) argue that virtual team identity is strongly associated with team efficiency. They suggest that identity construction is facilitated through activities that promote social interaction between team participants, such as regular videoconference meetings and the creation of a shared virtual work environment. It is urgent for companies to differentiate the dynamics of in-person and virtual teams (Holding Eagle, 2020), with the risk of low efficiency, reduced performance and decreased member satisfaction. Schröder et al. (2021) complement it with the different cultures of the participants, a question to be answered, a need to be filled.

When participants in virtual teams share a common identity, they are motivated to cooperate and communicate effectively (Van Bavel et al., 2018). Hertel et al. (2018) state that social identity is an influencing factor in teams, acting on team efficiency and cohesion. Both prescribe continuity in research seeking a better understanding of the impact of building a sense of interpersonal identity in virtual teams.

Calçada Jr. et al. (2023), seeking the state of the art in research on interpersonal relationships in virtual teams, reveal five themes and three recurring research agenda proposals. Table 1 summarizes the findings, revealing that the search for social identity is both a relevant topic in the research already carried out and a significant proposal for future studies.

Table 1: Themes and research agendas.

Themes	Concepts	Most cited authors
Relevant themes in literature	Knowledge sharing	Nonaka andTakeuchi (1995) Goffin and Koner (2011) Turner & Muller (2015)
	Social identity	Tajfel (1972) Erikson (1968)
	Team cognition	Hollan et al. (200) Nemeth et al. (2006)
	Psychological safety	Edmondson (1999)
	Absorptive capacity	Duffield and Whitty (2016) Ali et al. (2013)
Proposed themes for research agendas	Social identity	
	Share capital	
	Media	

Source: Calçada Jr. et al. (2023), summarized by authors.

2.3 Virtual teams

Virtual teams or distributed teams require technological mediation for communication between members (Beranek 2000), Saunders (2000) suggests that the increase in their adoption is driven by globalization, outsourcing and alternative work arrangements, such as sharing and teleworking. They allow flexibility and collaboration between members beyond geographic and temporal limits, they can shorten trips and expand the meeting of talents, making it possible to build diverse teams (Chiu & Staples, 2011). Bell and Kozlowski (2002) show that virtual teams are an improvement over face-to-face work, with virtuality being a potential characteristic of all teams (Griffith, Sawyer and Neale, 2003).

Members of teams, virtual or not, seek differentiation from others through self-attributed positive characteristics (Haslam 2004), in the workplace, such characteristics can be team cohesion or quality of work (Mirbabaie et al., 2021). Although Vahtera et al. (2017) demonstrate that collaboration mediated by technology can lead to low social identity in virtual teams. Santucci (2021) confirms, individualization is filtered by the media, thus influencing the promotion of social identity, demonstrating that they are the means of communication with a greater degree of naturalness, less demanding in cognitive effort, as face-to-face meetings transmit a greater range of indicative of individualization, which facilitate the construction of personal identity.

2.4 Scales and methods for measuring social interactions in social sciences.

Observing and subsequently formulating is one of the most difficult and crucial actions in scientific endeavors, it is the process of interpreting theory and operationalizing concepts (Greer, 1969). Zeller and Nock (1982) show that this is the moment where creations in the world of possibilities need to be adjusted to the world of probabilities. Synthesizing the notion of interdependence of logical reasoning and sensory perception, Immanuel Kant teaches that concepts without perceptions are empty, perceptions without concepts are blind (Kant, I., 1998).

Not all quantification derives from a measurement (Uher, 2020), quantifying means assigning numerical values, whereas measurement is a multistep process where operational structures make such assignments reliably (Mari et al., 2017). Uher (2020) warns that physical technologies are not appropriate for intangible objects researched in psychology and social sciences, in these situations, the data is generated directly by people, psychometric theories and classification scales, among others. Kalkbrenner (2021) adds, evaluation indoctrination is a pertinent question in social science research, as researchers are led to measure latent variables such as personalities, morals, among others of an abstract nature.

3. Methodology

Literature reviews can be seminal touchstones in the evolution of research on a topic, integrative reviews specifically stimulate new relationships and perspectives not yet explored (Torraco, 2016). An integrative review necessarily results in the advancement of knowledge in the area of research addressed (Snyder, 2019), although managed in various ways, replicability and transparency are expected from the researcher in conducting the studies. A critical analysis of the literature is essential (Torraco, 2005), carefully searching for central ideas, concepts and relationships between themes. This synthesis, a creative activity, must show a new conceptual structure, a new model always associated with the understanding of the themes perceived by the authors.

The structure of an integrative review can be organized by investigating concepts about the topics researched, seeking clarity and coherence in the literature about the topics reviewed and how the topics come together (Torraco, 2016). For Doty and Glick (1994), this methodology can develop a conceptual classification of constructs, supporting new theories. However, without clear and declared methods, a systematic bias can be induced in the research, Whittemore and Knafl (2005) offer a strategy aimed at mitigating such risks, table 2 summarizes the stages of an integrative literature review applied to this research.

Table 2: Stages of an Integrative Literature Review, applied for this research.

Integrative review stage	Illustration of decisions and issues
Problem identification	Academic studies suggest the importance of better understanding the dynamics of virtual teams. Although it is difficult to measure group dynamics, whether by differentiating between face-to-face and virtual teams, or by validating specific scales for each situation. A compilation of existing scales accepted in academia for measurement in virtual teams will be fundamental for any studies that aim to expand the understanding of this relationship.
Literary research	The research focuses on the ISI Web of Science and Scopus databases, with the central criteria adopted being that the articles are accepted, in addition to being related to the research themes, presenting the scales clearly, with all their items declared. Search carried out in June 2023.
Data evaluation	The characterization of the sample makes it clear that the semantic expressions "virtual teams" and "distributed teams" are the most used by researchers to refer to virtual teams. Among the 15 themes in the scales found, 91.5% are restricted to five focuses: trust (60.8%); presence (14.7%); cohesion (7.0%); behavior (4.9%) and intercultural (4.1%). The categorization also highlights recent topics, published during the COVID-19 pandemic.
Data analysis	The research indicates that there was an interest in measuring the dynamics of virtual teams prior to the pandemic, with the first article published in 2004. An acceleration in publications was noted after the start of the pandemic, in March 2020 (table 5). A synthesis of the scales, their intentions and validations and main characteristics is presented.
Presentation	The results are presented in the form of explanatory text, tables and figures, in an attempt to elucidate which measurement scales are appropriate to measure the dynamics of social relationships in virtual teams.

Source: authors, adapted from Whittemore and Knafl (2005).

Searches carried out in the ISI Web of Knowledge and Scopus databases among articles with full access permitted free of charge in June 2023. To include the largest possible number of articles in the databases, minimizing the risk of unintentional exclusion, we selected the "topic" option in the search key. Seeking to include all publications related to the topic and proposing semantic terms similar to the expression "virtual teams", we defined a comprehensive search algorithm (string) based on the wording of the objective, as shown in table 3, where each search term was applied individually, with the purpose of identifying in the literature which semantic expression is most commonly used to express virtual teams.

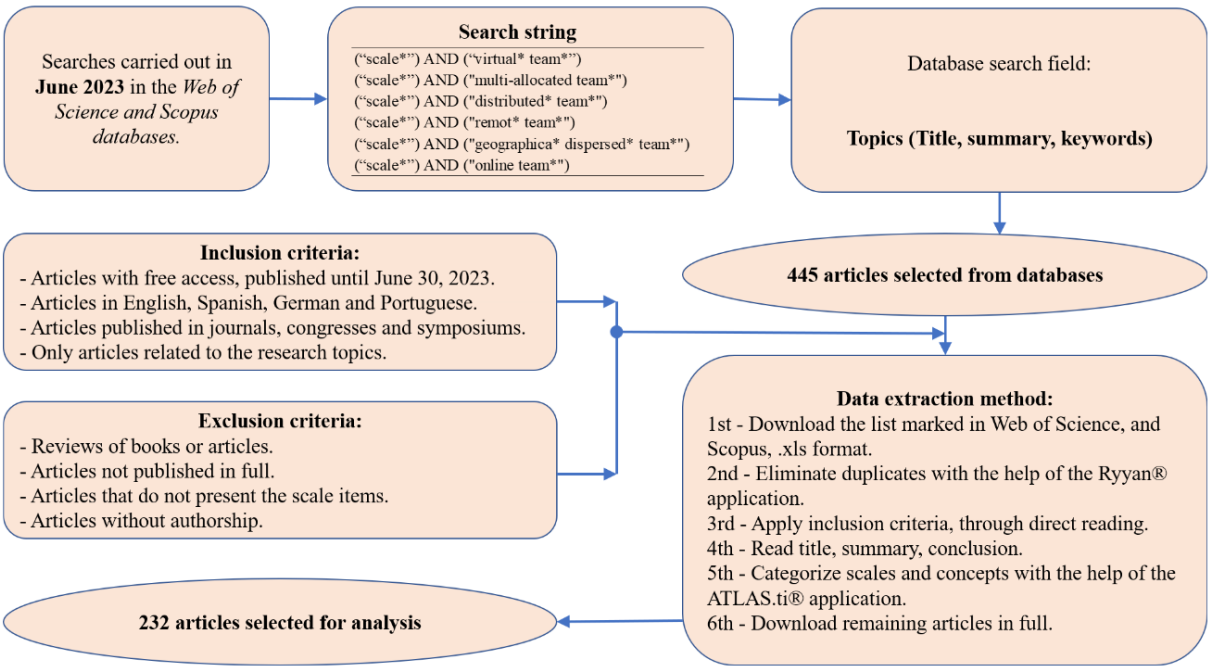
Table 3: search terms (string)

("scale*") AND ("virtual* team*")
("scale*") AND ("distributed* team*")
("scale*") AND ("global team*")
("scale*") AND ("online team*")
("scale*") AND ("remot* team*")
("scale*") AND ("geographica* dispersed* team*")

Source: authors.

Figure 2 presents the protocol developed for this research, based on Pollock and Berge (2018).

Figure 2: Analysis protocol.



Source: authors, adapted from Pollock and Berge (2018).

4. Analysis of results

The analysis of the results is organized into sections as follows: characterization of the sample of selected articles (topic 4.1); presentation of fifteen scales and authors and articles that will develop them (table 5), concepts covered in the social identity communication scale (topic 4.2).

4.1 Characterization of the sample of selected articles

The investigation into the databases shows that the expressions “virtual teams” and “distributed teams” are used in 81% of the selected studies when the authors want to refer to virtual teams (table 4).

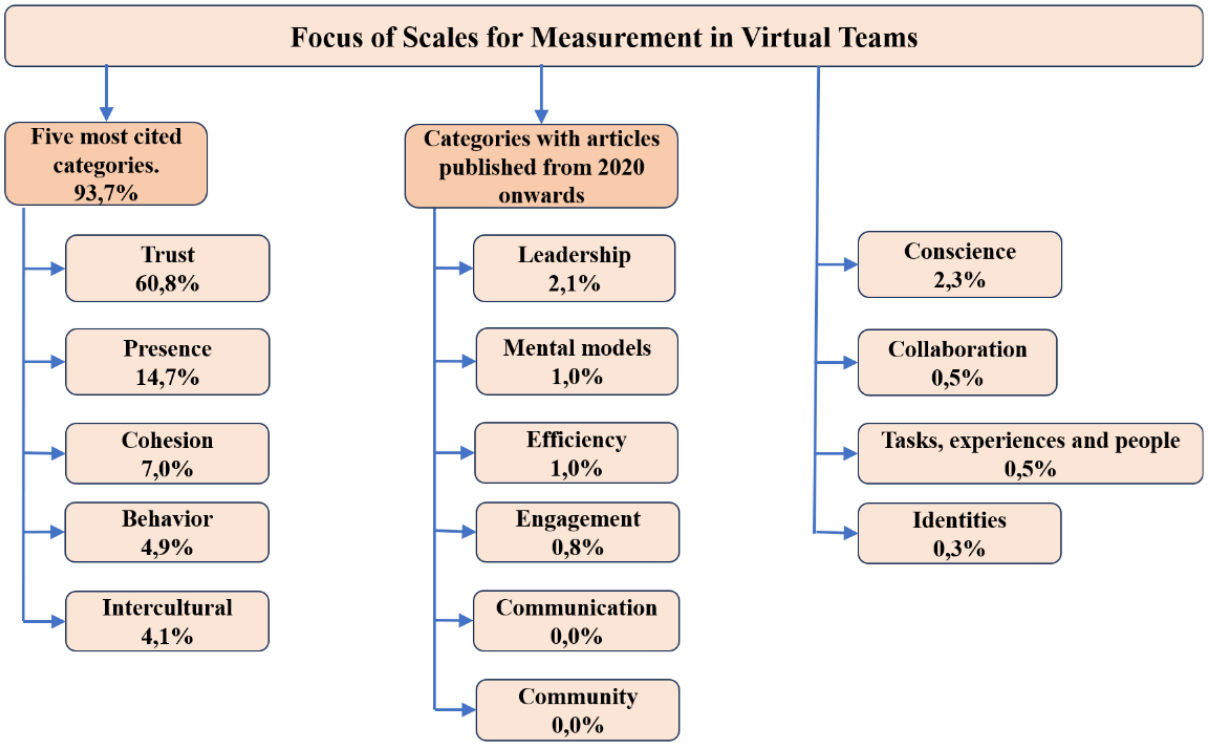
Table 4: Summary of selected articles.

	Scopus	*WoS*	Selected	%
(“scale*”) AND (“virtual* team*”)	133	78	100	43%
(“scale*”) AND ("distributed* team*")	103	58	87	38%
(“scale*”) AND ("global team*")	25	16	13	6%
(“scale*”) AND ("online team*")	19	11	16	7%
(“scale*”) AND ("remot* team*")	12	8	7	3%
(“scale*”) AND ("geographica* dispersed* team*")	12	7	9	4%
		Total:	**232**	**100%**

Source: Authors.

Figure 3 presents a schematic representation of the core of the scales found, with emphasis on the five categories that received 91.5% of total citations. It is significant to note that the focuses of the scales are themes related to the measurement of interpersonal relationships, where the interest of almost all the researchers approached is to understand the dynamics of social interactions between team members. An exception can be argued on the topic of mental models, although attention to the proposed scale makes clear the importance of interpersonal relationships in this approach. Figure 4 also highlights articles published from 2020 onwards, in times of COVID-19, where the topic of leadership stands out with 2.1% of total citations.

Figure 3: Focus of the scales.

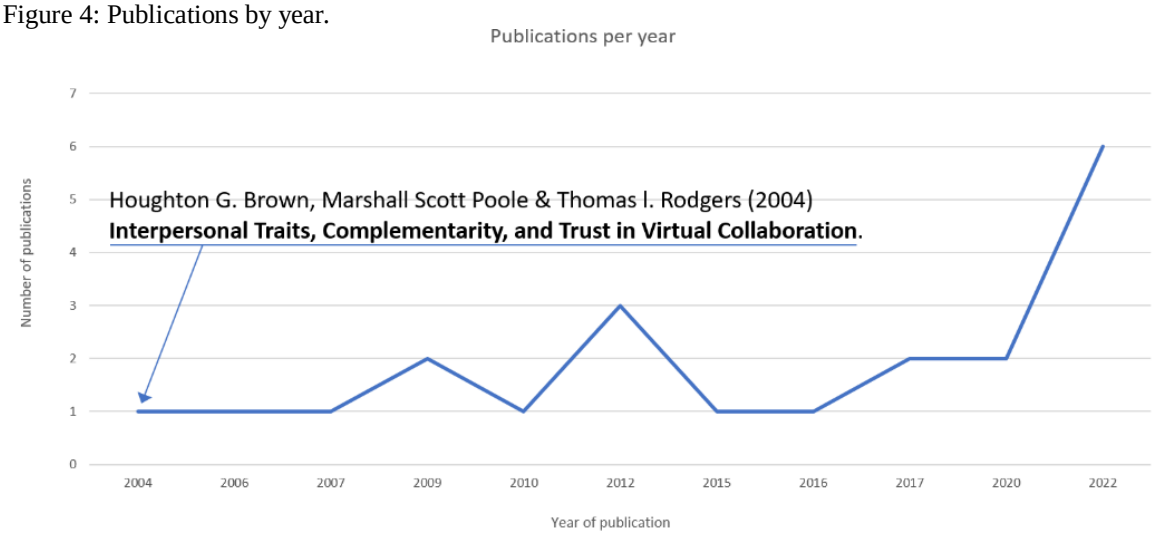


Source: Authors.

Figure 4 shows the evolution of publications, where the most cited article also begins the historical series of publications on rosters for virtual teams. Equally notable is the academic interest in measuring the dynamics of dispersed teams before the start of the

COVID-19 pandemic in March 2020 (Shorten et al., 2023), although the acceleration after this date can be seen.

Figure 4: Publications by year.



Source: compiled from databases by the authors.

Table 5 lists fifteen scale focuses with articles and authors who developed them, revealing that the search for understanding trust in virtual teams is the most relevant among the topics listed, with four studies, this subject covers the two most cited articles and 60, 8% of total citations, demonstrating the significance of measuring trust in virtual teams.

Table 5: Selected articles with declared scale

	Scale	Selected article, with declared scale	Quotes	
1	**Trust scales**	Lippert, Helge & Dulewicz, Victor. (2017). **A profile of high-performing global virtual teams**. Team Performance Management: An International Journal. 24. 10.1108/TPM-09-2016-0040.	19	4,9%
		Rusman, Ellen & Bruggen, Jan & Sloep, Peter & Koper, Rob. (2010). **Fostering trust in virtual project teams: Towards a design framework grounded in a TrustWorthiness ANtecedents (TWAN) schema**. International Journal of Human-Computer Studies. 68. 834-850. 10.1016/j.ijhcs.2010.07.003.	63	16,2%
		Houghton G. Brown, Marshall Scott Poole & Thomas l. Rodgers (2004) **Interpersonal Traits, Complementarity, and Trust in Virtual Collaboration**, Journal of Management Information Systems, 20:4, 115-138 http://dx.doi.org/10.1080/07421222.2004.11045785	153	39,4%
		Sarah Fischer & Arlene Walker (2022) **A qualitative exploration of trust in the contemporary workplace**, Australian Journal of Psychology, 74:1, 2095226, DOI: 10.1080/00049530.2022.2095226	1	0,3%
2	**Sense of presence scales**	Malbos, Eric & Rapee, Ronald & Kavakli, Manolya. (2012). **Behavioral Presence Test in Threatening Virtual Environments**. Teleoperators and Virtual Environments - Presence. 21. 268-280. 10.1162/PRES_a_00112.	22	5,7%
		Carol A. Thornson, Brian F. Goldiez, Huy Le, **Predicting presence: Constructing the Tendency toward Presence Inventory**, International Journal of Human-Computer Studies, Volume 67, Issue 1, 2009, Pages 62-78, ISSN 1071-5819, https://doi.org/10.1016/j.ijhcs.2008.08.006.	35	9,0%
3	**Perceived Cohesion Scale**	David, Salisbury & Carte, Traci & Chidambaram, Laku. (2006). **Cohesion in Virtual Teams: Validating the Perceived Cohesion Scale in a Distributed Setting**. ACM Sigmis Database. 37. 147-155. 10.1145/1161345.1161362.	27	7,0%
4	**Behavioral scales**	Andersson, D., Rankin, A. & Diptee, D. **Approaches to team performance assessment: a comparison of self-assessment reports and behavioral observer scales**. Cogn Tech Work 19, 517–528 (2017). https://doi.org/10.1007/s10111-017-0428-0	19	4,9%
5	**Intercultural Effectiveness Scale**	Petrovskaya, I., Shaposhnikov, S. **Enhancing intercultural effectiveness in international virtual student teams: an exploratory study**. Educ Res Policy Prac 19, 345–361 (2020). https://doi.org/10.1007/s10671-020-09262-w	7	1,8%
		Wolfgang Messner , (2015),"**Measuring existent intercultural effectiveness in global teams**", International Journal of Managing Projects in Business, Vol. 8 Iss 1 pp. 107 - 132	9	2,3%
6	**Leadership Scale**	Batirlik, Sema & Gencer, Yasin & Akkucuk, Ulas. (2022). **Global Virtual Team Leadership Scale (GVTLS) Development in Multinational Companies**. Sustainability. 14. 1038. 10.3390/su14021038.	8	2,1%

Source: Authors.

Table 5: Selected articles with declared scale (sequence).

	Scale	Selected article, with declared scale	Quotes	
7	**Shared Mental Models Scale**	Müller, Rebecca & Antoni, Conny. (2020). **Scale development and validation of shared mental models of information and communication technology (ICT SMM)**. Team Performance Management: An International Journal. 26. 391-407. 10.1108/TPM-03-2020-0025.	4	1,0%
8	**Team Effectiveness Scale**	Kunte, Monica & Bhattacharya, Sonali & Neelam, Netra. (2020). **Shall we ever meet; does it matter: unfreezing the constructs of virtual team effectiveness**. International Journal of Networking and Virtual Organisations. 23. 128-148. 10.1504/IJNVO.2020.10028863.	4	1,0%
9	**Work Engagement Scale**	Vijesh Chaudhary, Smrutirekha Mohanty, Poonam Malik, A. Apsara Saleth Mary, Jnaneshwar Pai Maroor, M.Z.M. Nomani, **Factors affecting virtual employee engagement in India during Covid-19**, Materials Today: Proceedings, Volume 51, Part 1, 2022, Pages 571-575, ISSN 2214-7853,	3	0,8%
10	**Communication Behaviors Scale**	Hartner-Tiefenthaler, M., Loerinc, I., Hodzic, S., & Kubicek, B. (2022). **Development and validation of a scale to measure team communication behaviors**. Frontiers in Psychology, 13, 961732.	0	0,0%
11	**Psychological Sense of Community Scale**	Arnold, W., Arnold, D., Neher, A., & Miles, M. P. (2020). **Developing a contemporary measure of employee perceptions of their work unit's psychological sense of community**. Journal of Workplace Learning, 32(1), 16-34.	0	0,0%
12	**Awareness scales**	Scielzo, S., Strater, L. D., Tinsley, M. L., Ungvarsky, D. M., & Endsley, M. R. (2009). **Developing a Subjective Shared Situation Awareness Inventory for Teams**. Proceedings of the Human Factors and Ergonomics Society Annual Meeting, 53(4), 289–293. https://doi.org/10.1177/154193120905300427	3	0,8%
		Daassi, Mohamed & Favier, Marc. (2007). "**Developing a Measure of Collective Awareness in Virtual Teams**". IJBIS. 2. 413-425. 10.1504/IJBIS.2007.012543.	6	1,5%
13	**Collaboration Intention Scale**	Alsharo, Mohammad and Gregg, Dawn, "**Intention to Collaborate: Investigating Online Collaboration in Virtual Teams**" (2012). AMCIS 2012 Proceedings. 22. https://aisel.aisnet.org/amcis2012/proceedings/VirtualCommunities/22	2	0,5%
14	**Scale of tasks, experiences and people**	Mohamed Ariff, Mohamed Imran & Milton, S.K. & Bosua, Rachelle & Sharma, Rajeev. (2012). **Transactive memory systems: Exploring task, expertise and people (TEP) unit formation in virtual teams: Conceptualization and scale measurement development**. Proceedings - Pacific Asia	2	0,5%
15	**Identity Communication Scale**	Brown, Susan & Thatcher, Sherry & Wilson, David. (2016). **Measurement and Outcomes of Identity Communication in Virtual Teams**. 888-897. 10.1109/HICSS.2016.114.	1	0,3%

Source: Authors.

Table 6 lists concepts and authors highlighted in the study by Calçada Jr. et al. (2023), with scales found in this research. It is pertinent to note that scales built for virtual teams have their foundations and concepts developed for face-to-face teams.

Table 6: Concepts and scales.

Concepts	Most cited authors	Authors with scales derived from concepts	Quotes	%
Knowledge sharing	Nonaka (1994)	Cummings, J. L., & Teng, B.-S. (2003)	607	**20%**
		Lewis, K. (2004)	497	**16%**
		Donate, M. J., & Sánchez De Pablo, J. D. (2015)	441	**14%**
	Goffin e Koners (2011)	Arnett, D. B., Wittmann, C. M., & Hansen, J. D. (2021)	16	**1%**
	Muller et al. (2015)	Não encontrado		
			Total=	**51%**

Source: Calçada Jr. et al. (2023) and authors.

Table 6: Concepts and scales (sequence)

Concepts	Most cited authors	Authors with scales derived from concepts	Quotes	%
Social identity	Tajfel (1974)	Pamela J. Hinds, Mark Mortensen, (2005)	773	**25%**
		Tsai, H.-T., & Bagozzi, R. P. (2014)	368	**12%**
		De Vries, R. E., Van Den Hooff, B., & De Ridder, J. A. (2006)	358	**12%**
	Erikson (1968)	Li, X., Hess, T. J., & Valacich, J. S. (2008)	354	**12%**
		Cheng, X., Yin, G., Azadegan, A., & Kolfschoten, G. (2016)	53	**2%**
		Rose, J., & Schlichter, B. R. (2013)	34	**1%**
			Total=	**64%**
Team cognition	Hollan et al. (2000)	Not found		
	Nemeth et al (2006)	Lewis, K. (2004)	497	**16%**
			Total=	**16%**
Psychological safety	Edmondson (1999)	Pirson, M., & Malhotra, D. (2011)	207	**7%**
		Zhang, Y., Fang, Y., Wei, K.-K., & Chen, H. (2010)	202	**7%**
		Hoch, J. E. (2013).	197	**6%**
			Total=	**20%**
Absorptive capacity	Duffield e Whitty (2016)	Not found		
	Ali et al. (2018)	Not found		

Source: Calçada Jr. et al. (2023) and authors.

Below, we present the only scale with measurements related to group identity.

4.2 Identity Communication Scale

The researchers, Brown et al. (2016), noting the important empirical basis in identity research in non-mediated teams (face-to-face teams), develop the idea that perceived virtual identity is a factor with a positive impact on the trust and efficiency of virtual teams. They offer a scale to measure the identity communication resources of a medium and users' perceptions of virtual communication, arguing for people's natural need to communicate their identities (Swann, 1983).

They developed the Scale for Identity Communication Capabilities and Perceived Virtual Identity, enabling research into media factors that support identity communication and the perceived virtual antecedents of identity communication. Brown et al. (2016) believe that communication capabilities can support or hinder the efficiency of perceived identity communication in virtual teams, and a better understanding of this relationship can help professionals improve the performance of virtual teams.

5. Discussion

Table 5 answers the research question RQ1 (Which scales are adopted to measure social interactions in virtual teams?) showing that the search for measuring the dynamics of virtual teams began before the COVID-19 pandemic, with the assessment of trust between team members being the primary theme and cited in more than 60% of the articles analyzed. Partially confirming the statements of Hertel et al. (2018), where trust is a prominent factor in the success of virtual teams. Although research indicates that it is the most studied topic, Weigert (1985) highlights the lack of instruments to measure institutional trust in virtual teams.

With the growth of dispersed teams from 2020 onwards (figure 5), concerns about measuring teams have increased, and more scales are being presented, although still limited and lacking validation, as stated by the authors Batırlık et al. (2022), with their leadership scale proposal, and Müller & Antoni (2020), with the mental models scale. The research shows that scales for virtual teams are derived from concepts and theories originally developed for face-to-face teams, such as the proposal by Chaudhary et al. (2022) for the UWES scale for engagement, derived from the concepts of Schaufeli et al. (2002) and (Shimazu et al. (2008), to characterize work engagement (table 5).

Knowledge sharing scales, found in three studies totaling 1,545 citations (table 6), present Nonaka (1994) as the builder of concepts and theories. Nonaka (1994) exposes the idea of differentiating between information, a flow of messages, and knowledge, a flow of information created and organized, with two dimensions: explicit, or declared knowledge, and tacit, procedural knowledge. They highlight three factors in the creation of knowledge: intention, autonomy and a level of environmental fluctuation. They present four ways to convert knowledge: 1) tacit to tacit (socialization); 2) explicit to explicit; 3) tacit to explicit; and 4) explicit to tacit. Organizational knowledge creation occurs when the four modes are managed to form a single, continuous cycle.

Measurement scales for social identity, with six studies perceived in the sample in a total of 1,499 total citations (64%) (Table 6), show that the taxonomy of Tajfel (1974) and Erikson (1968) is fundamental for the studies, although this research reveals the lack of specific scales for measuring group identity (Table 5). Tajfel (1974) aims to form a theory relating social psychological aspects of (face-to-face) intergroup behavior, conceptualizing social categorization as "a process of gathering social objects or events into equivalent groups in relation to an individual's actions, intentions and belief system" (Tajfel, 1979, p. 254). Three fundamental concepts of this author are: intergroup phenomena require categorization to occur, social identity is the aspect of the individual's self-image in each social category and the notions of value of this belonging result from processes of social comparison.

Table 5 also defines the research question RQ1a (Which scales are dedicated to measuring group identity in virtual teams?), it is demonstrated that the only scale present in this selection does not answer the research question RQ1a, as the focus is not on measuring group identity. In this study, we showed that the scales developed to measure characteristics of virtual teams are based on concepts and theories built for face-to-face teams, but the selected articles did not see an adaptation of measurements for the study of group identity in virtual teams. Although there are proposals from authors with scales for researching group identity in face-to-face teams, such as Ashforth and Mael (1989), Van Zomeren, Spears and Leach (2008), and Postmes, Haslam and Swaab (2005).

6. Final considerations

This research strongly suggests that the semantic expressions “virtual teams” or “distributed teams” are adopted by the literature to define multi-allocated teams. We answered the research question by presenting fifteen scales aimed at measuring interpersonal characteristics in virtual teams and demonstrated that the construction of scales predated COVID-19, however, the search accelerated during this period. Highlights are trust measurement scales, with four scales presented.

This research corroborates a literature review by Calçada Jr. et al. (2023) in two ways: first, we prove that research on interpersonal relationships in virtual teams is based on concepts and theories developed primarily for face-to-face teams. Next, we show that the research agendas presented in literature reviews have not yet been developed, and of the three themes identified as central, only social identity presents a correlated scale, although in a non-objective way (Identity Communication Scale).

This research adds to theoretical knowledge a compilation of scales aimed at measuring virtual teams, and shows that several of them are supported by concepts and theories primarily developed for face-to-face teams. Several scales were recently constructed, lacking validation and proof. We also highlighted the gap in knowledge when we noticed the lack of scales for the identity of virtual teams, although there are scales developed and validated for the identity of face-to-face teams.

For practice, we demonstrate that the search for understanding the dynamics of social interactions in virtual teams is current and necessary, presenting a useful compilation that consolidates, characterizes and shows the current stage of the scales developed to diagnose virtual teams. It allows the practitioner to choose which characteristic they want to measure and find the way to do so. It also presents the studies already carried out, allowing an analysis of the expected results when applying the scales.

This research proposes that the dynamics of virtual teams lack models and scales for their measurement, showing that it is a significant research agenda to seek validation of the scales already constructed. Otherwise, address concepts and theories already consolidated for measuring face-to-face teams and understanding the differentiation between the dynamics of virtual teams, proposing new scales to understand the specific characteristics of dispersed teams.

Although this study summarizes fifteen scales dedicated to virtual teams, when we relate them to the concepts and research agendas proposed by Calçada Jr. et al. (2023), the gap in models for measuring distributed teams is clear (table 1). Likewise, the authors expose three relevant research agendas highlighted in the developed SLR: social identity, social capital, and media. This research only found a scale minimally related to the topic of social identity, with social capital and media awaiting models and scales for measurement.

A limitation found by the research was that in the selected articles, the authors did not declare the scale items. The sample also found articles that, although they respected the search string, were not related to the research topics.

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