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The social representation of fintech from the perspective of traditional financial sector professionals: evidence from Brazil

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Abstract

This study aims to reveal the social representation of fintech from the perspective of traditional financial sector professionals in Brazil—herein used as a proxy for emerging markets—to interpret and compare it with the scientific literature on the concept of fintech. To achieve this, we applied the social representations theory associated with the word evocation test, similarity analysis, and descending hierarchical classification. After analyzing the results, we perceived a partial misalignment between the existing literature on the concept of fintech and the perspective of traditional financial sector professionals concerning this construct. In contrast to the literature surveyed, the respondents lack perception regarding the potential of fintech to constitute disruptive technology for the traditional financial sector—radically transforming or even eliminating it. In addition, traditional financial sector professionals have little insight into the potential of fintech to financially include the low-income population, owing to their lower costs and greater ease of use. Finally, traditional financial sector professionals failed to appreciate the need to develop a legal and regulatory framework for the performance of fintech in emerging markets. This is a subject that has also been scantily addressed by academia.

Keywords: Fintech, Social representations theory, Word evocation method, Similarity analysis, Descending hierarchical analysis, Emerging markets

Introduction

The financial sector¹ operates in a changing world, which is characterized by greater complexity, interconnectivity, and speed (Gomber et al. 2018; Salampasis and Mention 2018). Amidst a wave of new business models and disruptive technologies, the expression “fintech” arises from the term “FINancial TECHnologies” (Arner et al. 2015; Neenu and Hemalatha 2016; Puschmann 2017; Reed 2016; Wang 2021).

To date, schools of thought emphasize the potential of fintech to improve the financial sector customer experience, whereas others focus on the social role of fintech, perceiving them as enablers of financial inclusion, particularly for low-income classes

¹ In this article, we define the financial sector as the sector of the economy that provides financial services to other sectors of the economy, comprising the central bank, other banks, non-banking financial institutions and regulatory agencies of the financial system (Hackethal et al. 2006, p. 434; Schmidt and Tyrell 2003, p. 3).

(Arslan et al. 2021; Joia and Cordeiro 2021a; Moro-Visconti 2021; Salamasis and Mention 2018).² Moreover, there is a discussion on whether fintech is meant to be associated with a specific group of companies, namely startups (Chuen and Teo 2015), or might be present within the operations of traditional banks and financial institutions (Arner et al. 2015). More radical academics also exist, such as Figurelli (2017), who believed that fintech has the potential to cause a structural collapse in the traditional financial sector—fully transforming the way people deal with their finances and impacting the way competition takes place in this industry.

Thus, we perceive a lack of consensus on the definition of the fintech construct, which can lead academics and practitioners to have distinct perceptions of this new social phenomenon (Choi et al. 2019; Eickhoff et al. 2017; Thakor 2020). According to Dorfleitner et al. (2017), Schueffel (2016), and Thakor (2020), no common definition of fintech has yet been presented. However, the question “what is a fintech” has occupied a prominent place in queries related to fintech on Google, which seems to demonstrate a desperate search for a common understanding of this construct. Indeed, the term fintech has been applied in various business environments, often in a conflicting and ambiguous way, and no effort has been made thus far to seek a consensual definition of this construct (Schueffel 2016; Wang 2022). For example, even in developed countries (e.g., Germany and England), there is ambiguity in how fintech is portrayed by the popular press and addressed in Information Systems Research (Zavolokina et al. 2016a, b). Similarly, Choi et al. (2019) investigated how fintech are socially represented by their major stakeholders (i.e., financial authorities, financial companies, and Information Technology firms) in South Korea.³ They found that each had a divergent awareness and understanding of the fintech phenomenon. Therefore, a common understanding of fintech must be sought to assess the nature of developments in banking and financial services and to create a solid foundation for scientific research on the topic (Milian et al. 2019). Schueffel (2016) argued that this common understanding is necessary for establishing direct and unambiguous communication between academics and practitioners regarding the potential of fintech to transform the current financial sector through competition with traditional banks. Thus, only with this common understanding will financial companies and their professionals be prepared to face a new financial sector accrued from this paradigm shift.

Emerging markets⁴ exist globally where, although financial exclusion is still high by the standards of developed countries, the number of fintech operating in the financial sector has consistently increased—as in Brazil (Frost 2020; Lyon et al. 2021). Gomber et al.

² Although we have cited several authors who point out the superior ability of fintechs to provide financing to the unbanked as something socially desirable, aiming to provide financial inclusion, this issue is contested by some authors in the scientific literature. In fact, Diniz et al. (2012), Gabor and Brooks (2017), and Natile (2020), to name just a few, question the alleged positive impacts brought by fintechs for financial inclusion, presenting the inconveniences for the unbanked arising from the implementation and use of fintechs.

³ The study of Choi et al. (2019) was based on the content of newspapers because of the difficulty of conducting interviews with the different stakeholders.

⁴ According to Cavusgil et al. (2012), emerging markets are countries which are in a transition phase from developing to developed markets due to rapid growth and industrialization. There are several different indices by which a country is measured as emerging. The most established of these indices is that of the International Monetary Fund (IMF). In 2021, the International Monetary Fund considered the following countries as emerging markets: Argentina, Brazil, Chile, China, Colombia, Egypt, Hungary, India, Indonesia, Iran, Malaysia, Mexico, the Philippines, Poland, Russia, Saudi Arabia, South Africa, Thailand, Turkey, and the United Arab Emirates (Dutttagupta and Pazarbasioglu 2021).

(2018) stated that fintech may have a significant impact on the financial inclusion of low-income people and small companies that have little or no access to the traditional banking sector. This conclusion is corroborated by Herrera and Vadillo (2018). Based on a survey conducted for Latin America and the Caribbean, Herrera and Vadillo (2018) concluded that 46% of the fintech in the region is directed toward this type of client. In addition to a well-established traditional banking sector, as of December 2018, there were 423 fintech institutions in Brazil, a 36% increase over that in 2017 (Finnovation 2019). Furthermore, according to Lyons et al. (2021), Brazil (along with India) has led, among all emerging economies, the implementation of fintech in its financial sector, managing to financially include a part of the unbanked⁵ population. This case highlights the importance of studying the fintech phenomenon in emerging markets, as also pointed out by Joia and Cordeiro (2021a). Fintech in emerging markets has created social value⁶ for the unbanked population and small businesses that would otherwise not be inserted in the financial sector (Joia and Cordeiro 2021a; Thomas and Hedrick-Wong 2019). In addition, much of the financial inclusion generated by fintech in Brazil and other emerging markets has been driven by the high penetration and use of cell phones in these countries (Arner et al. 2020; Senyo and Osabutey 2020; Thomas and Hedrick-Wong 2019).

Brazil can be seen as a proxy for emerging markets that have high financial exclusion coexisting with a large number of fintech operating in the financial sector in frank and open competition with large traditional banks (Bunea et al. 2016; Godinho 2021; Lyons et al. 2021; Tambunlertchai et al. 2021). These facts support our choice of using the Brazilian context and back our option of investigating the perception of professionals in the traditional financial sector on the fintech concept. The reason is that other emerging economies might take advantage of the results herein presented. To achieve this, we applied the social representations theory to identify and compare this perception with the existing literature on the concept of fintech to identify cognitive similarities and gaps.

Information technology has given rise to new constructs that need to be properly defined such that academics and practitioners perceive them in the same way (Joia and Marchisotti 2020). For example, cloud computing, blockchain, the Internet of things, smart city, information technology governance, and fintech, to name just a few, are new constructs associated with recent technological innovations. Thus, academia has continually faced the challenge of consistently defining new constructs associated with technological innovations, such as fintech, such that they are similarly perceived by practitioners. Therefore, we intend to answer the following research question: what is the social representation of fintech from the perspective of traditional financial sector professionals in Brazil? In other words, how these professionals perceive and understand fintech.

Our motivation to analyze the perception of traditional financial sector professionals in Brazil about fintech stems from the very need to investigate whether the abovementioned professionals are aware of the real business discontinuities that may arise from

⁵ By "unbanked," we mean individuals who do not have access to some form of traditional bank account.

⁶ According to Mercer (2019), social value is the reflection of how we (individuals, organizations, governments) relate to society. Thus, social values include justice, freedom, respect, community, and responsibility.

the new paradigm associated with the operation of fintech (Lee and Shin 2018). The findings will enable us to propose strategies that can be implemented by the traditional financial sector to compete with these new ventures. In other words, our motivation for developing this study is mainly based on the very need to make traditional financial sector professionals aware of the importance of correctly understanding the fintech concept, including its potential to redesign the current financial sector (Dapp et al. 2014; Ozaee and Sohrabi 2017). Without knowing precisely what a fintech is and how it can operate, it is hard to believe that the traditional financial sector is prepared to face the challenge of competing against it (Alt et al. 2018; Mirchandani et al. 2020). For this reason, we adopted the social representations theory associated with the central nucleus theory, operationalized through the Words Evocation Technique. The reason is that this approach, as detailed below, aims to investigate how people perceive and give meaning to a specific concept—in this case, fintech.

This paper is structured, in addition to this section, in five more sections. In the second section, the literature review used in the research is presented, including fintech, social representations theory, and the central nucleus approach. In the next section, the methodological procedures upon which the study was based are presented. Data analysis is then carried out, followed by a section where the results are discussed and compared with the scientific literature on the definition of fintech. Finally, conclusions and implications derived from this research are presented.

Literature review

Fintech

Some articles have already aimed to more clearly understand the complex and sometimes confusing concept of fintech (Milian et al. 2019; Schueffel 2016; Suryono et al. 2020; Zavolokina et al. 2016a, b). However, to date, fintech remains a polysemic construct, still awaiting a generic and unambiguous definition (Choi et al. 2019; Gomber et al. 2017; Mention 2021; Thakor 2020). Therefore, we conducted a literature review to investigate the state-of-the-art associated with the definition of this construct.

The search process was carried out in June 2019 and refined in August 2022. We identified 92 articles on fintech, of which 19 specifically addressed the concept associated with this paradigm, the same used in this research. We then analyzed these articles to investigate possible overlaps in the concepts of fintech. The results of this process are presented below.

Chuen and Teo (2015) stressed that the business models of fintech are based on the LASIC principle, namely: low margin, asset light, scalability, innovative, and compliance easy. This principle aims to enable the deployment of sustainable enterprises, as presented below:

- Low margin: the unit markup rate of fintech (per client) must be low to gain in scale.
- Asset light: the technological infrastructure of fintech must operate innovatively to be able to adapt to possible future changes.
- Scalability: fintech must be prepared to grow without increasing costs or compromising efficiency.
- Innovative: fintech must be innovative in their products and operational processes.

- Compliance easy: as fintech operates in a (so far) less regulated setting, lower investments are necessary for compliance processes, which fosters investments in innovation.

According to Dapp et al. (2014), Knewton and Rosenbaum (2020), Liu et al. (2020), and Takeda and Ito (2021), fintech is an expression to describe the digitalization of the financial sector, namely, the increasing use of mobile artifacts, analysis of large amounts of data (big data), storage of data in clouds (cloud computing), personalization of online services, and convergence of information technology—aspects that support the business models of fintech.

From another perspective, Buckley and Webster (2016) and Chemmanur et al. (2020) suggested that fintech has emerged to improve the experience of users in the handling of financial services. The authors supported that fintech delivers the same financial products and services offered by traditional financial organizations by linking technological platforms to innovative business models.

In addition, Arslan et al. (2021), Chishti and Barberis (2016), Joia and Cordeiro (2021a), Lagna and Ravishankar (2022), Moro-Visconti (2021), and Salampasis and Mention (2018) discussed the impact of fintech in the financial inclusion of the population. According to these authors, fintech is able to reach the base of the economic pyramid, thereby having a significant socioeconomic impact in emerging markets. Moreover, they noted that a key point for this is to use the Internet and other technologies to educate the unbanked population and make them aware of the importance of being financially included, as this might foster their social inclusion.

Moreover, emerging market economies have been increasing their investments in fintech innovation, primarily through infrastructure development and regulatory relief (Alliance for Financial Inclusion 2020; Innes and Andrieu 2022; Rodstrom 2020). Thus, as new market players, fintech is reshaping the financial sector in ways that are benefiting consumers directly and indirectly (Lyons et al. 2021; Thakor 2020). They complement the services of traditional providers, offering faster services, with greater transparency and improved consumer experiences, in addition to using cutting-edge technology to build creative and cost effective products (Innes and Andrieu 2022; Joia and Cordeiro 2021a; Lyons et al., 2021). In this way, the financially excluded or only partially served population can take advantage of the conditions of lower cost and greater flexibility provided by the technological advances made possible by fintech (Joia and Cordeiro 2021a).

Thus, based on a new value proposition, unsurprisingly, fintech is applying pressure on traditional banks like never before (Figurelli 2017; Innes and Andrieu 2022; Salampasis and Mention 2018; Wang et al. 2021). Indeed, traditional banks are being obliged to respond to this challenge by purchasing fintech firms, partnering with fintech companies (e.g., alliances and outsourcing) and/or investing extensively in fintech technologies internally (Clavijo et al. 2019; Innes and Andrieu 2022; Hornuf et al. 2021; Sahay et al. 2020). According to Gomber et al. (2018), who broadly studied the revolutionary process that the financial sector has experienced, fintech has pursued efficient business models that increase user satisfaction. Moreover, they posited that investments in fintech have increased in an exponential manner, which has led traditional financial institutions to develop and implement disruption-based strategies.

As can be seen from the former references, several academics focused on distinct attributes of fintech when defining them. Therefore, we applied componential analysis (Onwuegbuzie et al. 2012) in the literature survey developed to identify the more relevant attributes (components of the meaning) associated with fintech. By doing that, the fintech construct was consolidated through four attributes or dimensions, namely, new business model, user experience, financial inclusions, and disruptive technology. In Table 1, the keywords accrued from the most cited articles in the literature surveyed are presented and associated with these four dimensions.

From Table 1, we realized that the definition of fintech encompasses sundry dimensions raised by several academics. Thus, this work aims to compare these dimensions with the perception of professionals in the traditional financial sector about fintech, to search for possible dissonances between theory and practice regarding the meaning of fintech. To this end, we used the social representations theory discussed below.

Social representations theory

The social representations theory was created in France, in the 1950s, by Serge Moscovici. To date, this theory is one of the dominant approaches in Social Psychology to understand how common sense is developed among distinct human groups (Joia 2017; Vergara and Ferreira 2007).

Vergara and Ferreira (2005) argued that the then-extant psychoanalytical theories established a contrast between individual and collective phenomena. However, the social representations theory offers a new way to understand the whole, seeking to relate individuals with society for the construction of meanings.

Vergara and Ferreira (2005) claimed that social representations are symbolic constructions of society through which individuals seek to give meaning to the world around them. As such, Farr (2002) supported that social representations consider each individual's perception of a specific social phenomenon, making it possible to understand how social identity is developed.

Thus, social representations portray common sense and strive to make sense of day-to-day life (Moscovici 2015). They are formed through collaborations established in the social setting among people, revealing their perspectives on explicit phenomena associated with the group to which they belong. Accordingly, representations are important for the real world, as they are developed through the communication and behavior of individuals (Arruda 2002; Farr and Moscovici 1984). Consequently, social representation is a complex process in which people make sense through a dynamic process of creating meaning in the context of their interactions with others in the group (Sandberg and Tsoukas 2015). In this cycle, the meaning of an object is constructed and ascribed to it by this social group (Moscovici and Marková 1998).

The perception of reality revealed by social representation largely depends on how people identify with the objects represented by society. Although these representations do not completely dictate the choices people make, they do limit and structure the truth available to them (Cramer et al. 2001).

Furthermore, social representations were created for studies on human beings and their relations with society. However, Jodelet (2001) argued that this theory can also be applied to study a person's relationship with a specific artifact, object, or concept (Jang

Table 1 Fintech dimensions from the scientific literature

Authors	Keywords	Dimensions
Brummer and Gorfine (2014)	Technology and innovation	New Business Model
	Low-cost model	
	User-friendly	User Experience
Dapp et al. (2014)	Disruptive technology	Disruptive Technology
	Client demands	User Experience
	Simplified services	
Chuen and Teo (2015)	Information technology	New Business Model
	Market vulnerability	Disruptive Technology
Arner et al. (2015)	LASIC principle	New Business Model
	Finance and technology	New Business Model
Neenu and Hemalatha (2016)	Financial solutions	User Experience
	Emerging countries	Financial Inclusion
	Financial innovation	New Business Model
Buckley and Webster (2016)	Better services (efficiency and agility)	User Experience
	Market trends	Disruptive Technology
	Improve user experience	User Experience
	User-friendly channel	
Infowester (2016)	Satisfy the needs	
	Innovative business model	New Business Model
	Market rupture	Disruptive Technology
	Low cost	New Business Model
Reed (2016)	Solve problems	User Experience
	Meet the needs	
	Simplicity	User Experience
Chishti and Barberis (2016)	Uncomplicated solutions	
	Market trend	Disruptive Technology
	Social Inclusion	Financial Inclusion
Gomber et al. (2018)	Socio-economic impact	
	Emerging markets	
	Technology	New Business Model
	Efficient business model	New Business Model
	User satisfaction	User Experience
Figurelli (2017)	Financial inclusion	Financial Inclusion
	Revolutionary process	Disruptive Technology
	Structural change	Disruptive Technology
Salampasis and Mention (2018)	Market trend	
	Blockchain and A.I	New Business Model
	Simplicity	User Experience
	Understand the client	
	Financial innovation	New Business Model
He and Tian (2018)	Social inclusion	Financial Inclusion
	Sustainable development	
	Human development	
	Economic empowerment	
	New value proposition	Disruptive Technology
He and Tian (2018)	Pressure on traditional banks	
	Market imperfections	Disruptive Technology
	Potential to change	

et al. 2021; Joia and Marchisotti 2020; Joia and Vieira 2021b)—in this case, fintech. Studies have investigated the social representation of fintech in some countries, such as South Korea (Choi et al. 2019)—according to the perception of the beholders—and Germany and England (Zavolokina et al. 2016a, b)—according to the media. However, the social representation of fintech in Brazil—an emerging economy that has led the diffusion of fintech among other emerging economies (Lyons et al. 2021)—has not yet been investigated from any perspective.

Martins-Silva et al. (2016) affirmed that although there is a unique general theory of social representation, it comprises three complementary approaches. The first approach is structural, which aims to identify the structure of the social representation, mainly its central nucleus, having Jean Claude Abric as its main exponent. The second approach is sociological, which aims to comprehend how social representation arises and circulates within a group, having Willem Doise as its main supporter. Finally, the third approach is “culturalist” or processual, which focuses on the historical and cultural issues associated with social representation, having Denise Jodelet as its main promoter.

The objective of this work is to investigate, through the application of the social representations theory, what is the social representation of fintech for traditional financial sector professionals, namely how they perceive and give meaning to fintech. Hence, to develop a comparison of this representation with the current literature on the definition of this construct, we applied the structural approach of the social representations theory via the central nucleus theory (Joia and Marchisotti 2020), which is explained below.

Central nucleus theory

In 1976, Jean Claude Abric supplemented the social representations theory with the central nucleus theory, arguing that it could help develop better social representation more quickly (Mazzotti 2002). According to Bortolai et al. (2016), the central nucleus theory is a way to organize the internal structure of social representations, aiming to determine which elements are related to common sense. Sá (2002) noted that the internal elements of a social representation could be ranked by applying the central nucleus theory as they do not necessarily have the same importance (Abric 1996).

For Mazzotti (1997), the central nucleus is the solid and rigid base that supports the social representation—non-tradable stability that will ensure the existence and sustainability of the social representation. Machado and de Almeida (2010) related the central kernel to the collective memory, namely, to that which gives meaning, consistency, and tenure to the social representation. Sá (2002) argued that the central nucleus consolidates the consensus on the meaning found. This nucleus is almost immutable, and there is no doubt about its significance. In this manner, Vergara and Ferreira (2007) argued that any change in the central nucleus would generate a new identity for the social representation, as a new meaning would be ascribed to it.

From another aspect, social representation also has non-consensual elements, supporting divergences and doubts about the meanings found (Vergara and Ferreira 2005). Mazzotti (1997) explained that a social representation is not necessarily consensual as there are divergences and negotiations around it to maintain the central kernel. Thus, the existence of a peripheral system must be considered, which, according to Abric (as quoted by Sá 2002), comprises the elements of lesser importance for

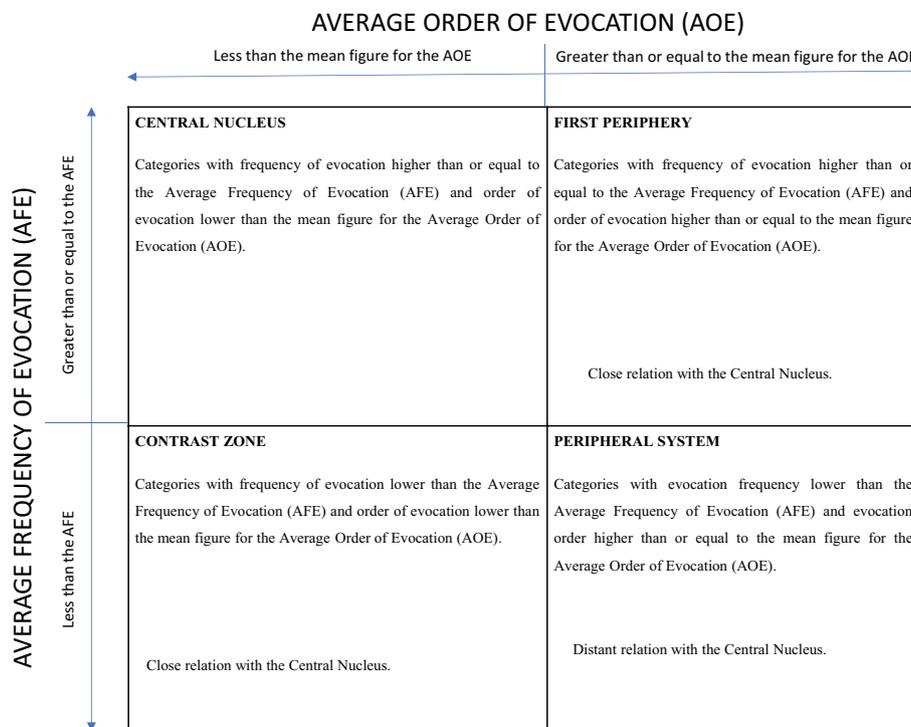


Fig. 1 Vergès' four-quadrant framework. Source: Adapted from Joia and Correia (2018a, p. 85)

social representation. In contrast to the central kernel, the peripheral system enables the integration of individual experiences and histories, thereby supporting the heterogeneity of the group, and evolving and being sensitive to the current context (Sá 1996). According to Vergara and Ferreira (2005), the peripheral system is a part of the social representation that individuals would eventually be ready to revise by renegotiating their concepts, perceptions, and values.

Vergès (1994) organized social representation through a square made out of four quadrants that depict the central nucleus and the peripheral system simultaneously (Fig. 1). As indicated by Vergès (1994), these quadrants are utilized for the examination of the words evoked, combining their frequency of evocation with the order of evocation of the expressions related to the construct to be represented socially. The reason is that the social representations theory considers the first expressions evoked by the respondents as being more firmly connected with what it is socially intended to represent than the final ones (Vergès 1994; Sá 2002). The central nucleus is situated in the upper left quadrant, whereas the peripheral system is situated in the lower right quadrant (Fig. 1). In addition, the upper right and lower left quadrants, respectively called the first periphery and contrast zone, are less important as they have an arguable and tenuous connection with the central nucleus (Vergara 2005).

Thus, using the central nucleus theory, we intend to achieve the objectives of this work, that is, to find the social representation of fintech according to professionals from the traditional financial sector in Brazil. Then, we will compare it with the academic literature on the subject.

Methodological procedures

In this section, we outline the methodological procedures adopted to generate and interpret the central nucleus of the social representation of fintech, allowing us to compare it with the fintech concepts proposed in the existing academic literature.

Social representations are linked to the social group and the context in which people are inserted (Franco 2004; Weerasinghe et al. 2018). Thus, we decided not to include professionals who work in fintech in the sample to avoid any bias. In this manner, all respondents who comprise the sample used in this article work in the traditional Brazilian financial sector, namely, the sector that is by far the most threatened by the emergence and growth of fintech (Chen 2020; Romãnova and Kudinska 2016).

The data collection was made using an electronic questionnaire divided into two parts: the first (principal) was developed to conduct the word evocation test, and the second (ancillary) was developed to collect demographic data and depositions from the interviewees.

The word evocation test is an associative approach developed to capture the first word that comes to the mind of a respondent when an inductor term is presented to him/her (Abric 1996; Vergara 2005). In this study, we obtain the first five words or expressions evoked after the term “fintech” is cited (Joia and Marchisotti 2018b). For Sá (2002), the hierarchy of the order in which respondents evoked the words is directly related to the importance of the words to them.

Open- and closed-ended questions comprised in the ancillary questionnaire seek to obtain in-depth knowledge of the sample and support deeper analysis of the categories that constitute the social representation.

We adopted the snowball technique to reach the necessary sample size (Gooman 1961). We also used e-mails and social media tools, namely, LinkedIn and Facebook, to collect data throughout the month of June 2019. The total sample consisted of 152 respondents—all of them being professionals in the traditional financial sector in Brazil—which generated 760 words evoked. This number is an adequate quantity for studies using the social representations theory (Wachelke et al. 2016).

Table 2 presents the characteristics of the sample selected.

Data analysis

The data analysis followed the guidelines proposed by Joia and Correia (2018a) and Nascimento-Schulze and Camargo (2000), that is, divided into two stages. In the first stage, we conducted the treatment of the words related to fintech evoked by the respondents to assess their relevance and congruence. Then, we analyzed the content of the open discourses related to the meaning of fintech, aiming to enrich and complement the initial analysis.

The first step was to group the words evoked into semantic categories to process the words evoked and identify the four Vergès quadrants of the social representation of fintech, as suggested by Esfahani et al. (2019), Nickerson et al. (2013), and Oberländer et al. (2019). This manner avoids placing evoked words with the same meaning in different categories (Joia 2017; Vergara 2005).

Table 2 Description of the sample

Item	Characteristics of the sample
1	The size of the sample—152 respondents—can be considered adequate for the research (Wachelke et al. 2016; Joia and Marchisotti 2018b)
2	Male respondents represent 70% of the sample—which is compatible with gender division in the financial sector in Brazil (Collini et al. 2015)
3	The average age of the sample is 34 years and the average time in the financial sector is 10 years, which ensures the necessary professional experience of the respondents
4	High number of certified graduate professionals (75%)
5	70% of the respondents occupy managerial positions, which attributes seniority to the sample
6	All of the respondents, while working at traditional financial institutions, have broad knowledge about fintechs, which ensures the proximity of the sample with the object under study
7	More than half of the respondents work in large companies with more than 500 employees
8	All of the respondents work in private companies

We then applied the four-quadrant technique proposed by Pierre Vergès. This technique aims to cross-check the average frequency of the words evoked (of a quantitative type) with the average order of evocation (of a qualitative type) (Abric 2003). Thus, two thresholds must be calculated: the average frequency of evocation of the categories created from the words evoked (AFE) and the mean figure of the average order of evocation of the words belonging to each category found (AOE) (Vergara and Ferreira 2005), as depicted in Fig. 1 through Vergès' four-quadrant framework.

According to Vergès (2003), the cross-checking of the word frequency with their order of evocation makes it possible to analyze the social representation of a given social object (in this case, fintech), as shown below:

- The upper left quadrant comprises the most important elements—having been cited with frequencies greater than or equal to the AFE and order of evocation lower than the mean figure for the AOE. This is the central nucleus, having the function of generating meaning for the social representation of fintech.
- The lower right quadrant comprises the least important elements—having been cited with frequencies lower than the AFE and order of evocation higher than or equal to the mean figure for the AOE. This is the peripheral system, comprising the elements of little significance for the social representation, thereby being distant from the central nucleus.
- The upper right quadrant comprises the elements that are often cited but with little significance, namely, having frequencies higher than or equal to the AFE but with an order of evocation greater than or equal to the mean figure for the AOE. This is the first periphery—close to the central nucleus.
- The lower left quadrant comprises elements that are not often cited but with a greater level of relevance. They have frequencies lower than the AFE and order of evocation lower than the mean figure for the AOE. It is the contrast zone—close to the central nucleus.

We applied EVOC software to classify the expressions evoked, allocating them to the respective categories of analysis.

Moreover, to mitigate possible flaws arising from the application of the abovementioned technique, Pereira (1997) recommended that an analysis of similarity should be conducted (Flament 1985). This method allows for ascertaining the degree of connectivity among the categories evoked, namely, the co-occurrence between the words that were evoked by each respondent of the sample. Using this method, it is possible to understand the connection between the elements that make up the social representation, confirming or modifying the central nucleus of the Vergès quadrants (Gras and Almoloud 2002). To achieve this, we used IRAMUTEQ software.

Finally, we performed lexical and content analyses as proposed by Marchisotti et al. (2019) and Nascimento-Schulze and Camargo (2000). Lexical analysis (Freitas et al. 2000) ranges from text analysis to lexicon analysis by analyzing the range of all words identified in the answers. The descending hierarchical classification (DHC) method was applied to group the words evoked into categories, seeking to understand the social representation produced. The lexical analysis grouping is represented by a dendrogram, namely, a graphic representation of the correlated categories based on their similarities (Bueno and Couto 2017). From another aspect, content analysis (Frankfort-Nachmias and Nachmias 1996) consists of the exhaustive reading and coding of each one of the answers to interpret them vis-à-vis the categories created, seeking to obtain a complete overview of the social representation (Freitas and Janissek 2000).

Results

After clustering the 760 words evoked, we identified the semantic categories. We then verified which of these categories need to be analyzed using Vergès' technique, namely, the ones significant enough to be considered by Vergès' framework. A minimum value for the frequency of evocation should be defined to establish these categories. In this work, we adopted the metrics suggested by Vergès. With a cut at 57.24%, the percentage of the frequency of evocation approximates more closely to the 50% mark (Sá 2002; Marchisotti et al. 2019), as presented in Table 3.

In this manner, only the categories with a minimum frequency of 19 evocations will form part of the social representation of fintech. Thus, only 11 (12.9%) of the 85 categories identified were considered in this research.

We, therefore, calculated the AFE and AOE of the categories, which is 31 and 2.99, respectively. Having calculated the two aforementioned thresholds, Vergès' quadrants can be developed (Fig. 2).

The technology, innovation, low cost, and finance categories were located at the central nucleus of the social representation of fintech. In other words, these categories are fully rooted in the concept of fintech according to the traditional financial sector professionals in Brazil.

The maximum similarity tree—a graph with vertexes and edges connecting all categories with a single path between any two vertexes on the graph (Degenne and Vergès 1973)—was then developed using IRAMUTEQ software to validate the aforementioned Vergès quadrant, as shown in Fig. 3.

The maximum similarity tree produced seeks to confirm and validate the social representation thus far obtained (Wachelke and Contarello 2011). This graph allows us to

Table 3 Reverse accumulation of the evocation frequencies

Evocation frequency	No. of the category	Evocation frequency accumulation		Reverse accumulation of the evocation frequency	
1	27	27	3.55%	760	100.00%
2	9	45	5.92%	733	96.45%
3	5	60	7.89%	715	94.08%
4	7	88	11.58%	700	92.11%
5	4	108	14.21%	672	88.42%
6	3	126	16.58%	652	85.79%
7	5	161	21.18%	634	83.42%
8	3	185	24.34%	599	78.82%
9	2	203	26.71%	575	75.66%
11	1	214	28.16%	557	73.29%
12	2	238	31.32%	546	71.84%
13	3	277	36.45%	522	68.68%
14	1	291	38.29%	483	63.55%
16	1	307	40.39%	469	61.71%
18	1	325	42.76%	453	59.61%
19	3	382	50.26%	435	57.24%
22	1	404	53.16%	378	49.74%
30	1	434	57.11%	356	46.84%
31	1	465	61.18%	326	42.89%
35	2	535	70.39%	295	38.82%
51	1	586	77.11%	225	29.61%
82	1	668	87.89%	174	22.89%
92	1	760	100.00%	92	12.11%

Bold indicates cut-off frequency of evocation

verify which categories are more important (represented by the size of the diameter of the circles) and how the categories are connected to one another (according to the number associated with the links between the categories).⁷ Thus, from the tree developed, we perceived three major clusters of categories, each related to a key category acknowledged as being the most important among all the categories that pertain to the same cluster. Thus, the technology, innovation, and agility categories are featured as the most representative in the maximum similarity tree of fintech. Unsurprisingly, the technology and innovation categories were specifically cited as these are the most representative categories of the central nucleus. However, in the analysis already conducted, the agility category was placed in the first periphery (Fig. 2). Therefore, based on the importance of this category in the maximum similarity tree—which is important for the validity of the social representation of a concept (Jung et al. 2009)—and as supported by Joia and Marchisotti (2020) among others, we altered the central nucleus previously produced. That is, we incorporated agility into the central nucleus, which is presented in a definitive way in Fig. 4.

⁷ For more information on the maximum similarity tree, see Flament (1986), Jung et al. (2009), Nicolini (1999), Pawlowski et al. (2007), to name just a few.

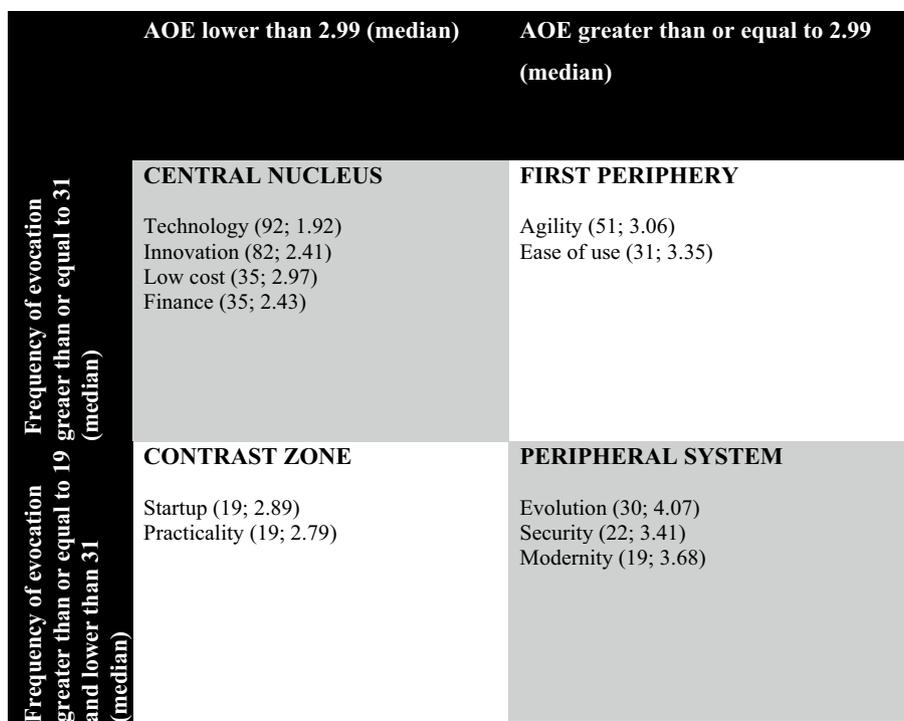


Fig. 2 Vergès' four-quadrant framework for Fintech

To complement the two aforementioned analyses, we conducted lexical and content analyses of the answers to the following question: “What do you mean by fintech?” We collected 111 responses. By using IRAMUTEQ software, we extracted 83 excerpts from the answers received for the DHC, which led to five classes, as shown in Fig. 5.

The dendrogram presented in Fig. 5 begins by class 3, which encompasses the highest concentration of excerpts, namely 30.1% of the total analyzed. This class is aligned with the idea that, by using technology, companies are able to provide innovative services to their clients, which is also supported by Legowo et al. (2020) among others, and reflected by some respondents when defining fintech:

“They are companies that use technology to make the financial life of people easier. They seek to offer innovative financial products and services that can replace those, provided by traditional banks.”

“Innovative companies in the financial sector very much linked to technology and using it to disseminate their products and services in a practical way.”

Thus, this class 3 corroborates the aforementioned innovation category located in the central nucleus of the Vergès quadrant (Fig. 4).

In addition, class 5, which comprises 15.7% of the excerpts collected, focuses on the client. This case indicates that fintech should seek new customers and retain current ones by offering low cost and agile services. Thus, this category indicates the potential of fintech in enabling the financial inclusion of the niche of people outside the traditional financial sector, which is also supported by Arslan et al. (2021), Joia and

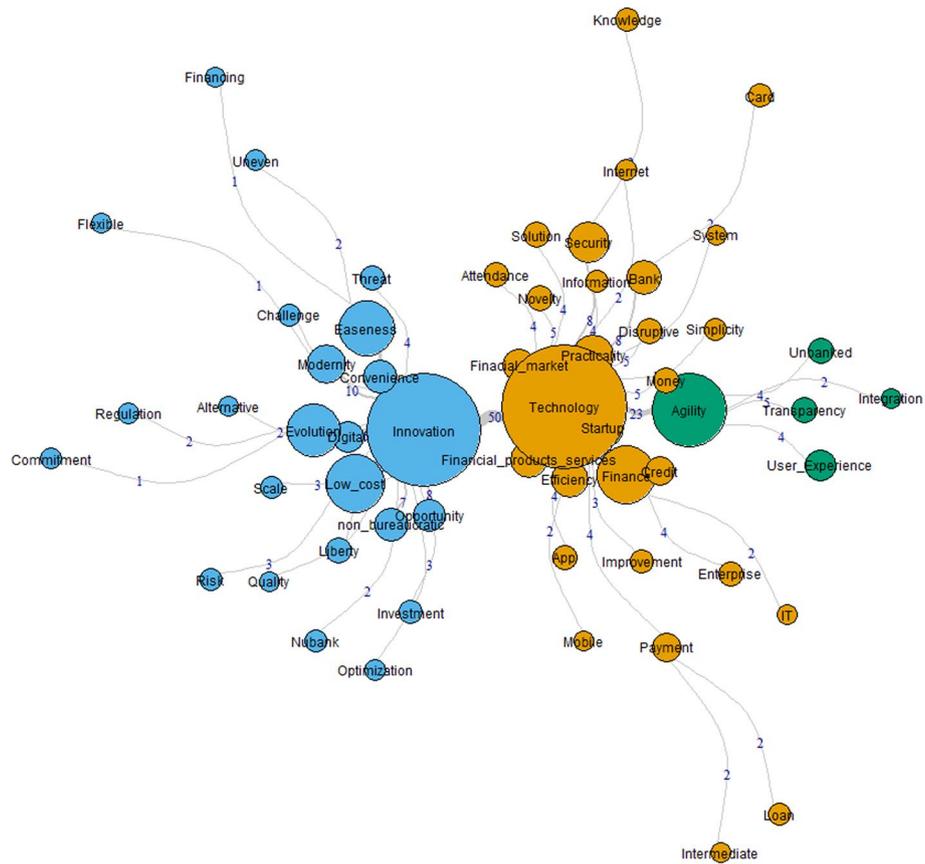


Fig. 3 Maximum similarity tree of the social representation of Fintech

<p>CENTRAL NUCLEUS</p> <p>TECHNOLOGY INNOVATION AGILITY LOW COST FINANCE</p>	<p>FIRST PERIPHERY</p> <p>EASE OF USE</p>
<p>CONTRAST ZONE</p> <p>STARTUP PRACTICALITY</p>	<p>PERIPHERAL SYSTEM</p> <p>EVOLUTION SECURITY MODERNITY</p>

Fig. 4 Final social representation of Fintech

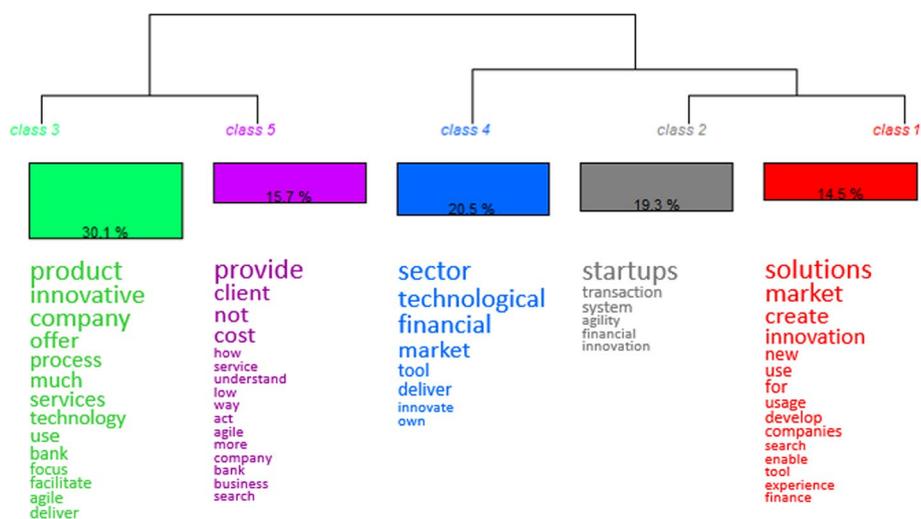


Fig. 5 Dendrogram of Fintech

Cordeiro (2021a), and Moro-Visconti (2021). The following excerpts on the definition of fintech can be highlighted:

“Companies that use technology to provide a service, mainly to the ‘unbanked,’ in a simple and agile way.”

“Companies that deliver value to their clients in an agile and digital way and with low costs. Usually, the fintechs focus on market niches where the existing traditional financial sector is not present due to higher entry barriers imposed by the government.”

Thus, this class 5 corroborates the aforementioned low cost and agility categories, located in the central nucleus of the Vergès quadrant (Fig. 4). However, this category highlights a new dimension of fintech, namely, their potential to enable financial inclusion among the “unbanked.”

When we analyzed the right side of the dendrogram, we perceived that class 4 (representing 20.5% of the collected excerpts) refers to fintech as technology-based companies that operate in the financial sector:

“Financial companies that own and operate robust technological infrastructure.”

“Technology companies that operate in the financial sector.”

This issue corroborates the fact that the technology category was placed in the central nucleus of the Vergès quadrant of the social representation of fintech.

Moreover, class 2, representing 19.3% of the total excerpts, depicts fintech as startups instead of technology-based companies, namely, with a specific business model. Indeed, several articles referred to fintech as fintech startups, such as Homuf et al. (2021) and Moro-Visconti et al. (2020). Furthermore, the remarks reveal that these companies positively contribute to the market and existing financial services:

“Financial startups that are bringing important contributions to the innovation of the global finance market via new business models.”

“Startups that use new business models and technological innovations to deliver financial services, making them more practical and agile.”

This category supports the location of the startup category in the contrast zone as it is a less frequently evoked category. However, this category quickly springs to the mind of the group of respondents and supports the aforementioned lack of consensus on the nature of fintech—(financial) startup vs. technology-based companies.

Last, class 1 encompasses 14.5% of all the excerpts, mainly emphasizing the capacity that fintech has to deliver tailor-made solutions applicable to the financial sector. In addition, this class also stresses that fintech pursues improvements not only for the market but also related to the experience of the users, as also supported by Hwang et al. (2021). We can highlight the following depositions:

“Companies that provide customized solutions for the financial sector.”

“Financial sector initiatives aiming to improve the experience of the user via the heavy use of new technologies.”

Interestingly, this class, associated with customization and user experience dimensions, is not represented in Vergès' quadrant, which deserves further investigation.

Therefore, we realized that classes 3 and 5—on the left-hand side—share common features, namely, the focus on the client and the type of financial services and products provided to them. From another aspect, classes 1, 2, and 4—on the right-hand side—focus on the financial sector, revealing a discussion about the nature of fintech, namely, (financial) startups vs. technology-based companies that offer solutions for the financial sector.

Discussion

By using the four-quadrant technique, it was possible to define the most representative semantic categories to compose Vergès' quadrant among the 760 words evoked. To achieve this, we used the AFE and AOE. That done, the central nucleus encompassed the following categories: technology, innovation, agility, low cost, and finance. The word fintech merges two English words, namely finance and technology. Valle et al. (2014) pointed out that in the word evocation test, it is common to have the respondents evoking words or expressions similar to the inducing expression. This case explains the finance and technology categories being featured in the central nucleus.

We can now compare the social representation of fintech according to traditional finance market professionals in Brazil with the academic literature on the subject, as presented below.

Fintech: social representation versus academic literature

From Table 4, we perceived that the existing theoretical references on fintech encompass all five categories located in the central nucleus of the social representation of the same. Thus, the academic literature on fintech has fully grasped the perception of the professionals of the traditional financial sector in Brazil with respect to this construct.

However, the reverse is not true. That is, the four key categories that have originally accrued from the theoretical background on fintech are barely perceived, if at all, by the traditional financial sector professionals in Brazil, as presented below.

Table 4 Theoretical references versus social representation of Fintech

Categories associated with the Fintech construct	Academic literature	Perceptions of the traditional financial sector professionals in Brazil
Technology*	Arner et al. (2015), Brummer and Gorfine (2014), Chishti and Barberis (2016), Dapp et al. (2014), Gomber et al. (2018), Knewton and Rosenbaum (2020), Liu et al. (2020)	Mandatory (Central Nucleus)
Innovation*	Buckley and Webster (2016), Chuen and Teo (2015), Gomber et al. (2018), Neenu and Hemalatha (2016), Salampasis and Mention (2018), Suryono et al. (2020) Thakor (2020)	Mandatory (Central Nucleus)
Agility*	Chemmanur et al. (2020), Gomber et al. (2018), Neenu and Hemalatha (2016), Wang et al. (2021)	Mandatory (Central Nucleus)
Low cost*	Brummer and Gorfine (2014), Infowester (2016), Ko et al. (2018), Kou et al. (2021), Wang et al. (2021), Zhang and Yang (2019)	Mandatory (Central Nucleus)
Finance*	Arner et al. (2015), Chemmanur et al. (2020), Liu et al. (2020), Suryono et al. (2020)	Mandatory (Central Nucleus)
New business model**	Arner et al. (2015), Brummer and Gorfine (2014), Buckley and Webster (2016), Chishti and Barberis (2016), Chuen and Teo 2015, Dapp et al. (2014), Gomber et al. (2018), He and Tian (2018), Infowester (2016), Liu et al. (2020), Neenu and Hemalatha (2016), Salampasis and Mention (2018), Wang et al. (2021)	Inconclusive (Contrast Zone) + Perceived in Class 2 of the DHC (Fig. 5)
User experience**	Arner et al. (2015), Brummer and Gorfine (2014), Buckley and Webster (2016), Chemmanur et al. (2020), Chuen and Teo 2015, Dapp et al. (2014), Gomber et al. (2018), Infowester (2016), Kou et al. (2021), Mittal et al. (2017), Neenu and Hemalatha (2016), Reed (2016), Salampasis and Mention (2018), Tan et al. (2018)	Not featured in the Vergès Quadrant (Fig. 4) + Perceived in both Classes 1 and 5 of the DHC (Fig. 5)
Financial inclusion**	Arner et al. (2015), Chishti and Barberis (2016), Gomber et al. (2018), Lagna and Ravishankar (2022), Salampasis and Mention (2018), Takeda and Ito (2021)	Not featured in the Vergès Quadrant (Fig. 4) + Perceived in Class 5 of the DHC (Fig. 5)
Disruptive technology**	Brummer and Gorfine (2014), Buckley and Webster (2016), Dapp et al. (2014), Figurelli (2017), Gomber et al. (2018), He and Tian (2018), Liu et al. (2020), Salampasis and Mention (2018)	Not featured in the Vergès Quadrant (Fig. 4), nor perceived in the DHC (Fig. 5)

*Category originally accrued from the central nucleus of the social representation of fintech

**Category originally accrued from the academic literature on fintech

The “new business model” category, associated here with the startup category, although belonging to Vergès’ quadrant, is located in the contrast zone, leading to a vague interpretation. In other words, this expression is not frequently evoked by most traditional financial sector professionals. However, when it is, it soon springs to the minds of respondents. In the event that these respondents are opinion makers, this category could likely move to the central nucleus of the social representation. This case supports the fact that traditional financial sector professionals are aware that fintech

is coming up with new business models that can challenge the performance of their companies.

The other categories—“user experience,” “financial inclusion,” and “disruptive technology” —were not even featured in Vergès’ quadrants associated with the social representation of fintech. The references to these categories, when they do appear, come from the DHC. In this respect, the “user experience” category is perceived in classes 1 and 5 of the DHC, “financial inclusion” is only perceived in class 5 of the DHC, and finally, “disruptive technology” is a category that, besides not being featured in the Vergès’ quadrants of the social representation of fintech, it is also not perceived by the DHC.

A possible explanation for the abovementioned cognitive dissonances between the social representation of fintech and the scientific literature on this concept might be because all respondents work in the traditional financial sector—being, therefore, under another paradigm.

Research limitations

The aforementioned discussion may have been influenced by some research limitations, as explained below.

The first limitation relates to the data-categorization process adopted. The consolidation of 760 words into 82 semantic categories is not a straightforward process, as it is quite difficult for researchers to do this without a certain degree of subjectivity. Therefore, the clustering of some expressions evoked into certain categories may not have been unbiased.

Another limitation of this research is the minimum frequency of evocation established in this work and the thresholds chosen for the AFE and median value of the AOE. As no consensus exists on how to calculate these values (Sarubbi et al. 2013, Joia and Marchisotto 2020), the choice of another way to define these values might have led to outcomes other than those presented here.

Finally, the sample of this research addressed only professionals from the traditional financial sector in Brazil, leaving aside other stakeholders of the financial sector and society as a whole.

Thus, some conclusions for fintech and the traditional financial sector can now be drawn from the abovementioned discussion, as presented below.

Conclusions

As stated at the very beginning of this article, this work aims to investigate the social representation of fintech from the perspective of traditional financial sector professionals in Brazil. In other words, we aim to investigate how these professionals perceive and understand fintech. Thus, according to the results obtained, the main conclusion of this work is consistent with the aforementioned research question and based on the categories located in the central nucleus of the social representation of fintech. That is, for the traditional financial sector professionals in Brazil: “fintech is a technology-based financial company, operating under the agile paradigm, and offering innovative financial products and services at a low cost.”

In addition, respondents do not perceive fintech as a disruptive technology and a driver of competitive advantage in the financial sector through new business models

(Kou et al. 2021). Hence, some traditional sectors should be highlighted, which have been severely affected recently by the disruptive emergence of new technologies associated with new processes and innovative business models, such as Uber vs. taxis, Netflix vs. video rental companies, and Airbnb vs. hotels, among others. Thus, we can conclude that, as seems to be happening now, in the very recent past, professionals in these established industries did not foresee the disruptive aspects of these new business models either.

Therefore, we present below some contributions to academia, public policy, and practice—particularly regarding traditional banks operating in the financial sector—arising from this work to deal with that situation and better understand the impact of fintech on the traditional financial sector.

Research contributions

The outcomes presented in Table 4 reveal that traditional financial sector professionals in Brazil are not aware of the actual business discontinuities that might accrue from the new paradigm associated with the operation of fintech. Thus, as a practical contribution of this work to tackle this challenge, large traditional financial organizations in Brazil must either implement their own fintech as new strategic business units or acquire existing fintech in the Brazilian market, running them as separate enterprises. This strategy is in line with the findings of Kou et al. (2021). They investigated the impact of fintech on the performance of traditional European banks and argued that they should invest in fintech, focusing on payment and money transfer alternatives, to attract the attention of customers, satisfy their expectations, and reduce costs. Asamoah et al. (2020), Azemi et al. (2019), Koomson and Ibrahim (2018), Kou et al. (2021), and Mensah et al. (2020) corroborated that investments by traditional banks in fintech should mainly focus on payment alternatives to attract the attention of customers and achieve effective collection of receivables, including money transfers. This phenomenon can help traditional banks reduce costs and positively impact their sales volume.

Thus, traditional financial sector professionals in Brazil urgently need to understand the fintech phenomenon more as a revolution than an evolution—the latter being a category located in the peripheral system of social representation (Fig. 4). Through this, the potential benefits generated from this new paradigm can be made available to the entire population, irrespective of socioeconomic conditions. Therefore, traditional financial companies must develop capacity-building initiatives that aim to present to their professionals the potentially serious impact and imminent threat of fintech to their current business models.

Furthermore, financial exclusion remains a reality for the low-income population in Brazil (Helal and da Cunha 2017; Joia and Cordeiro 2021a; Joia and Dos Santos 2019). Another practical contribution of this work is highlighting that the traditional financial sector should not attribute minor relevance to the potential of fintech to enable financial inclusion in emerging markets through reduced transaction costs and ease of access. In fact, this case has already happened, given that this category was not located in the Vergès quadrant. Thus, traditional financial companies could create and implement their own fintech within their organizational structure. They can complement their financial

products and services already on offer or even acquire existing fintech in the financial sector, aiming at the financial inclusion of the low-income population in Brazil.

Moreover, fintech can provide financial services to the younger generation, having the potential to produce socially desirable consequences (Friedline and Rauktis 2014), owing to the accelerated process of *financialization*⁸ that society is going through (Van der Zwan 2014). Erturk et al. (2007) noted that the transition of finance into daily life had been made possible by the democratization of finance via information technology (Davis 2009). Moreover, financial products and services have been made available to large parts of the population (including youngsters), rather than just being a prerogative of the rentier elite. Although Brazil is a country with a large youth population, this issue was not directly captured in the social representation of fintech according to the traditional financial sector. In this sense, user experience is a critical variable for young people to access and use financial products and services (Tan et al. 2018). As such, the traditional financial sector companies need to develop user-friendly interfaces to provide, particularly for younger clients (Tan et al. 2018), a pleasant experience, which might lead these traditional financial organizations to better compete against the fintech.

In addition, the pressing need for governments in emerging markets to develop a legal and regulatory framework for the operation of fintech is a dimension scantily addressed by academia and also absent from the social representation of fintech (Mention 2021). Zavolokina et al. (2016a, b) found that fintech regulation has increasingly attracted the attention of the English and German press and that changes in the existing regulation are the top issues in scientific articles on fintech produced in developed countries in recent years. In addition, the 2008 global financial crisis made it mandatory for nations to develop and institutionalize regulatory frameworks for fintech operations. However, the results of this work show that this topic is not considered relevant for traditional financial sector professionals in an emerging economy, such as Brazil. In this sense and putting it in context for the socioeconomic environment found in emerging markets, Hui et al. (2019) pointed out the need to develop less bureaucratic regulation for a public currently neglected by the traditional financial sector. According to Joia and Cord-eiro (2021a), complex rules for the operation of fintech can result in an incentive for informality, creating barriers to business, innovation, and financial inclusion. However, Brown and Piroška (2022) argued that this debate lacks a critical perspective. For them, regulators must challenge the ability of fintech to enable financial inclusion, including their consequent speech on technological innovation and superiority over the traditional financial sector. In addition, according to Brown and Piroška (2022), the fintech regulatory framework needs to incorporate the contribution of specific groups and non-governmental organizations related to vulnerable populations. The framework should include experts in ethics, political economy, economic sociology, and social studies of science and technology to increase the level of transparency and accountability to facilitate the supervision of these new ventures.

⁸ *Financialization* refers to the web of interrelated processes—economic, political, social, technological, cultural etc.—through which finance has extended its influence beyond the marketplace and into other realms of social life (Van der Zwan 2014).

Furthermore, the partial lack of alignment between theory and practice in relation to the fintech concept (Table 4) clearly shows that most current academic literature addressed the context of developed countries rather than emerging economies, such as Brazil. Therefore, in relation to the academic contribution of this article, substantial knowledge about fintech related to the social, political, economic, and technological environment of emerging economies should be developed to prevent fintech in emerging markets from erroneously imitating their counterparts in developed countries, as also supported by Arslan et al. (2021), Hui et al. (2019), and Joia and Cordeiro (2021a).

Further steps

Based on the research limitations already presented, future steps can be foreseen for this study, as explained below.

First, further research might apply the same methodological approach used in this study to analyze the social representation of fintech according to their own professionals, including potential clients and users of this new paradigm, not only in Brazil but also in other emerging economies. For instance, Choi et al. (2019) studied the social representation of fintech from the perspective of their major stakeholders in South Korea. In this way, the social representations obtained can be compared, aiming to fill possible cognitive gaps observed.

In addition, as social representations are dynamic (Choi et al. 2019), further research on the evolution of the social representation of fintech over time could be carried out.

Moreover, other methodological approaches may be used to deepen the understanding of the fintech concept and its impact on the traditional financial sector, such as inventive problem-solving maps (Kou et al. 2022).

Last, another avenue for future research is to assess the impact of fintech on the financial inclusion of the unbanked, not only in Brazil, but also in other emerging economies, as also suggested by Joia and Cordeiro (2021a). As explained above, the Brazilian experience with fintech implementation can be seen as a proxy for emerging markets that have high financial exclusion coexisting with a large number of fintech operating in the financial sector in frank and open competition with large traditional banks (Bunea et al. 2016; Godinho 2021; Lyons et al. 2021; Tambunlertchai et al. 2021). However, in doing so, the legal frameworks in place in these countries need to be understood so that regulatory frameworks are developed, implemented, and enforced accordingly (Laidroo and Avarmaa 2020).

In essence, we hope to have shown the novelty of this work through a better definition and consolidation of the fintech construct. We aim that future research on the subject, developed in emerging markets, can further deepen the understanding of this new paradigm of the financial sector.

Abbreviations

AFE	Average frequency of evocation of the categories created from the words evoked
AOE	Mean figure of the average order of evocation of the words belonging to each category found
DHC	Descending hierarchical classification

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Author contributions

LAJ's tasks on the article development: Conceptualization, Supervision, Validation, Writing-Reviewing and Editing, Resources. RP's tasks on the article development: Investigation, Software, Data curation, Writing-Original draft preparation. Both authors read and approved the final manuscript.

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Availability of data and materials

The dataset used during the current study is available from the corresponding author on reasonable request.

Declarations**Competing interests**

The authors declare that they have no competing interests.

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