DECIPHERING INTERACTION WITH COMPANIES AND MARKET ORIENTATION AMONG RESEARCHERS IN BRAZIL

DECIFRANDO A INTERAÇÃO COM EMPRESAS E A ORIENTAÇÃO PARA O MERCADO ENTRE PESQUISADORES NO BRASIL

DESCIFRANDO LA INTERACCIÓN CON EMPRESAS Y LA ORIENTACIÓN AL MERCADO ENTRE INVESTIGADORES EN BRASIL

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ABSTRACT

Objective: To explore market orientation and interaction with companies among academic researchers in Brazil, examining how these aspects vary according to areas of education and gender.

Design/methodology/approach: Use of a quantitative methodology, based on data collected through questionnaires directed at a representative sample of Brazilian researchers.

Results: The study identifies a significant positive correlation between market orientation and interaction with companies. Engineering and Agricultural Sciences show higher levels of these characteristics, while Health Sciences and Humanities display lower levels.

Limitations/research implications: The results are specific to the Brazilian context, limiting generalization to other contexts without further studies. Low response rate from researchers and possible lack of representation in some specific areas of education.

Practical implications: The study suggests the creation of programs that encourage researchers to engage with the business sector. The development of institutional policies that facilitate and value partnerships between universities and companies, such as incentives for collaborative projects and simplification of processes, is recommended.

Social implications: Promoting greater collaboration between universities and companies can result in innovations that benefit the whole of society.

Theoretical implications: This study contributes to the theory by demonstrating how market orientation and interaction with the business sector can vary among different areas of education and genders. It challenges previous perspectives by highlighting the need for approaches that consider the specificities of each area and gender differences.

Originality/value: This study broadens the understanding of interactions between the academic and private sectors in Brazil, offering new evidence on how the area of education and gender influence these dynamics. The study introduces insights for the development of more effective strategies for collaboration and market orientation, contributing to the formulation of public policies that promote greater inclusion and equity in university-company interaction.

Keywords: Market orientation. Interaction with companies. Gender. University-Industry.

RESUMO

Objetivo: Explorar a orientação para o mercado e a interação com empresas entre pesquisadores acadêmicos no Brasil, examinando como esses aspectos variam em função de áreas de formação e gênero.

Desenho/metodologia/abordagem: Utilização de uma metodologia quantitativa, baseada em dados coletados através de questionários dirigidos a uma amostra representativa de pesquisadores brasileiros.

Resultados: O estudo identifica uma correlação positiva e significativa entre orientação para o mercado e a interação com empresas. As áreas de Engenharias e Ciências Agrárias demonstram níveis mais altos dessas características, enquanto as Ciências da Saúde e Humanas exibem níveis mais baixos.

Limitações/implicações da pesquisa: Os resultados são específicos para o contexto brasileiro, limitando a generalização para outros contextos sem estudos adicionais. Baixa taxa de resposta dos pesquisadores e a possível falta de representatividade em algumas áreas de formação específicas.

Implicações práticas: O estudo sugere a criação de programas que incentivem os pesquisadores a engajarem-se com o setor empresarial. Recomenda-se o desenvolvimento de políticas institucionais que facilitem e valorizem parcerias entre universidades e empresas, como incentivos para projetos de colaboração e a simplificação de processos.

Implicações sociais: Promover uma maior colaboração entre universidades e empresas pode resultar em inovações que beneficiem a sociedade como um todo.

Implicações teóricas: Este estudo contribui para a teoria ao demonstrar como a orientação para o mercado e a interação com o setor empresarial podem variar entre diferentes áreas de formação e gêneros. Ele desafia perspectivas anteriores, destacando a necessidade de abordagens que considerem as especificidades de cada área e as diferenças de gênero.

Originalidade/valor: Amplia a compreensão sobre as interações entre o setor acadêmico e o setor privado no Brasil, oferecendo novas evidências sobre como a área de formação e o gênero influenciam essas dinâmicas. O estudo introduz insights para o desenvolvimento de estratégias mais eficazes de colaboração e orientação para o mercado, contribuindo para a formulação de políticas públicas que promovam uma maior inclusão e equidade na interação universidade-empresa.

Palavras-chave: Orientação para o mercado. Interação com empresas. Gênero. Universidade-Indústria.

RESUMEN

Objetivo: Explorar la orientación al mercado y la interacción con empresas entre investigadores académicos en Brasil, examinando cómo estos aspectos varían en función de áreas de formación y género.

Diseño/metodología/enfoque: Utilización de una metodología cuantitativa, basada en datos recogidos a través de cuestionarios dirigidos a una muestra representativa de investigadores brasileños.

Resultados: El estudio identifica una correlación positiva y significativa entre la orientación al mercado y la interacción con empresas. Las áreas de Ingeniería y Ciencias Agrarias muestran niveles más altos de estas características, mientras que las Ciencias de la Salud y Humanidades exhiben niveles más bajos.

Limitaciones/implicaciones de la investigación: Los resultados son específicos para el contexto brasileño, limitando la generalización

a otros contextos sin estudios adicionales. Baja tasa de respuesta de los investigadores y posible falta de representación en algunas áreas específicas de formación.

Implicaciones prácticas: El estudio sugiere la creación de programas que incentiven a los investigadores a involucrarse con el sector empresarial. Se recomienda el desarrollo de políticas institucionales que faciliten y valoren las asociaciones entre universidades y empresas, como incentivos para proyectos colaborativos y la simplificación de procesos.

Implicaciones sociales: Promover una mayor colaboración entre universidades y empresas puede resultar en innovaciones que beneficien a toda la sociedad.

Implicaciones teóricas: Este estudio contribuye a la teoría al demostrar cómo la orientación al mercado y la interacción con el sector empresarial pueden variar entre diferentes áreas de formación y géneros. Desafía perspectivas anteriores, destacando la necesidad de enfoques que consideren las especificidades de cada área y las diferencias de género.

Originalidad/valor: Este estudio amplía la comprensión sobre las interacciones entre el sector académico y el sector privado en Brasil, ofreciendo nuevas evidencias sobre cómo el área de formación y el género influyen en estas dinámicas. El estudio introduce ideas para el desarrollo de estrategias más efectivas de colaboración y orientación al mercado, contribuyendo a la formulación de políticas públicas que promuevan una mayor inclusión y equidad en la interacción universidad-empresa.

Palabras clave: Orientación al mercado. Interacción con empresas. Género. Universidad-Industria.

INTRODUCTION

The partnership established between academic institutions and business organizations is of vital importance for driving innovation, technological progress, and economic sustainability on both national and global scales (Etzkowitz & Leydesdorff, 2000; Mowery et al., 2004; Nsanzumuhire & Groot, 2020). These partnerships are at the forefront of knowledge creation and transfer, with significant implications for the competitiveness and growth of economies (Perkmann & Walsh, 2007). However, the complexity of this interaction and the implications in terms of managing conflicting interests and limited resources require an in-depth investigation to explore their potential and overcome the challenges that arise from these partnerships (Ankrah & Al-Tabbaa, 2015; Bruneel et al., 2010; Hillerbrand & Werker, 2019).

The existing literature acknowledges the importance of the "triple helix" approach, which involves the interaction between universities, industries, and governments for the generation of knowledge and innovation (Leydesdorff, 2020; Ranga & Etzkowitz, 2013). Moreover, other studies have investigated the concern of academics regarding the loss of control and freedom in their research when collaborating with the private sector (Bercovitz & Feldman, 2006; Corsino & Torrisi, 2023; Perkmann et al., 2013), as well as the influence of market orientation in establishing partnerships between researchers and companies (D'Este & Perkmann, 2011; Ghauri & Rosendo-Rios, 2016; Thiaw, 2021). In this context, market orientation, which emphasizes understanding and responding to market needs, is crucial for facilitating productive partnerships between universities and industries, driving innovation (Sharma, 2022).

Despite these contributions, there are still gaps in the literature regarding a detailed analysis of the levels of market orientation and interaction with companies in the specific context of emerging countries (Bruneel et al., 2010; Shi & Wang, 2023). The influence of individual and institutional factors on collaboration between academic researchers and companies in different cultural and socioeconomic contexts also requires further investigation (Boardman, 2009; da Silva et al., 2022; D'Este & Perkmann, 2011; Suzigan & Albuquerque, 2011).

Considering this gap, this study is guided by the following research question: "What is the level of market orientation and interaction with companies among academic researchers in Brazil, and how do these aspects vary according to areas of expertise and gender?" To address this

question, the article analyzes the levels of market orientation and the interaction between academic researchers and companies in Brazil, differentiating these relationships by areas of expertise and gender. Employing a quantitative approach, the study is based on data collected through questionnaires administered to a representative sample of Brazilian researchers.

This study aims to enrich the theoretical understanding of the interactions between academia and the industrial sector, particularly with regard to market orientation across various fields of expertise and among different genders in the context of an emerging country like Brazil. Theoretically, it seeks to enrich the literature on university-industry collaboration by introducing gender and areas of expertise as variables that may modulate the intensity and effectiveness of these partnerships. Practically, this work provides support for the development of public policies and organizational strategies that promote more efficient and equitable collaboration between universities and companies. By identifying the factors that enhance or limit these interactions, the study suggests ways for academic managers and business leaders to better structure their partnership initiatives, ensuring mutual benefits and contributing to technological and economically sustainable development.

The structure of this study is organized into six sections. In addition to this introductory section, the next section addresses the theoretical foundation, discussing the relevant theoretical models and empirical studies that support our research. Next, the methodology details the sample, data collection procedures, and measurement instruments used. The results section presents the research findings, while the discussion connects these findings with the theories discussed earlier. Finally, the conclusions summarize the main results, highlight the study's limitations, and present the theoretical and practical implications and directions for future research.

THEORETICAL BACKGROUND

University-industry collaboration

The synergistic connection between universities and companies is a cornerstone for sti-mulating innovation and ensuring robust and sustainable economic growth (Etzkowitz & Leydesdorff, 2000; Plewa et al., 2013). This connection facilitates the exchange of knowledge, resources, and experiences between the two sectors, which, in turn, enables the development of new technologies, products, and services that meet market demands and contribute to improving people's quality of life (Ankrah & Al-Tabbaa, 2015; Nsanzumuhire & Groot, 2020; Perkmann et al., 2013). Moreover, the partnership between academic and corporate institutions fosters the training of skilled professionals with relevant abilities to operate in an ever-evolving environment and promote social progress (Guerrero et al., 2016; Santoro & Chakrabarti, 2002).

University-Industry collaboration also allows for the efficient translation of scientific and technological knowledge into practical innovations, resulting in mutual benefits for all parties involved and encouraging applied research, technology transfer, and the creation of new business opportunities (Ranga & Etzkowitz, 2013). The effectiveness of this alliance, which underscores the synergy between universities and companies, lies in the combination of the resources and competencies of both actors. This interaction allows for the identification and resolution of complex problems, generating innovative solutions that address the needs of society and the market (Boardman, 2009; T. Lee & Tsai, 2005). Such collaboration promotes the creation of public policies that encourage innovation, competitiveness, and sustainable development, benefiting society as a whole (Cooke, 2001; Fritsch & Wyrwich, 2017).

However, despite its benefits, University-Industry collaborations also present significant challenges. One of these challenges is the concern of academics regarding the loss of control and freedom in their research when collaborating with the private sector (Corsino & Torrisi, 2023; Mendoza & Öcal, 2022; Perkmann et al., 2013). Researchers may face pressures to direct their investigations according to the commercial demands and deadlines of companies, which may jeopardize academic integrity and scientific objectivity (Geuna & Muscio, 2009; Rossoni et al., 2023; Slaughter & Leslie, 1997). Additionally, concerns may arise regarding intellectual property and the public disclosure of research results

(Awasthy et al., 2020; Cohen et al., 2002; Hertzfeld et al., 2006).

Another challenge in University-Industry collaboration is managing conflicting interests and limited resources (Ankrah & Al-Tabbaa, 2015; D'Este & Perkmann, 2011). Universities and companies may have different objectives, such as the pursuit of fundamental knowledge in the case of academic institutions and financial return in the case of companies (Hillerbrand & Werker, 2019; Partha & David, 1994; Thursby et al., 2007). This divergence of objectives can generate tensions and difficulties in decision-making during the collaboration (Bruneel et al., 2010; Galán-Muros & Plewa, 2016; Hillerbrand & Werker, 2019).

Market orientation and interaction with companies

The concept of market orientation refers to the ability and willingness of organizations to identify, understand, and meet the needs and expectations of their customers, as well as adapt to changes in the business environment (Kohli & Jaworski, 1990; Narver & Slater, 1990; Schlosser & McNaughton, 2009). In the context of collaboration between researchers and companies, market orientation implies an approach where academic institutions actively seek to connect with the private sector to apply and commercialize their research (Etzkowitz & Leydesdorff, 2000; Perkmann et al., 2013; Thiaw, 2021). This collaboration can benefit both parties, promoting innovation and contributing to sustainable economic development (Mowery et al., 2004).

The existing literature on levels of market orientation and interaction with companies emphasizes the importance of relationships between universities and companies to drive innovation and economic growth (Bozeman et al., 2013; Rothaermel et al., 2007; Thiaw, 2021). Studies have shown that greater market orientation and deeper interaction with companies are associated with better outcomes in terms of innovation and technology transfer (Bercovitz & Feldman, 2006; D'Este & Perkmann, 2011; Frank et al., 2016). However, most of these studies have focused on developed countries, leaving gaps in understanding the phenomenon in the context of emerging countries, such as Brazil (Albuquerque et al.,

2015; Sutz, 2000).

Emerging countries like Brazil face specific challenges regarding market orientation and interaction with companies. Among these challenges are the lack of financial resources, bureaucracy, and the need to enhance institutional capacity to support University-Industry collaboration (Cassiolato & Lastres, 2000; Rapini et al., 2009, 2017). Furthermore, the educational system and research infrastructure in these countries may not be adequately aligned with the demands of the private sector, making effective collaboration difficult (Suzigan & Albuquerque, 2011).

Individual and institutional factors influencing collaboration

Collaboration between academic researchers and companies is influenced by a range of individual and institutional factors. At the individual level, characteristics such as motivation, previous experience, and communication skills of researchers can affect their willingness and ability to engage in collaborations with the private sector (D'Este & Perkmann, 2011; Perkmann et al., 2013). Moreover, the literature suggests that interaction between academics and companies tends to be more successful when researchers possess an entrepreneurial mindset and are open to the commercialization of their research (Etzkowitz & Leydesdorff, 2000; Rothaermel et al., 2007).

At the institutional level, organizational culture and the resources available in universities can play an important role in promoting or inhibiting collaboration between academics and companies (Bercovitz & Feldman, 2006; Mowery et al., 2004). For example, universities with a strong entrepreneurial culture and administrative support for technology transfer tend to have higher levels of collaboration between their researchers and the private sector (Bozeman et al., 2013; Siegel et al., 2003). Policies and incentives related to intellectual property and research funding can also influence universities' engagement in collaboration with companies (Geuna & Muscio, 2009; O'Shea et al., 2005).

Hypothesis development

Collaboration between researchers and companies has been extensively studied in the literature on innovation and technology transfer (Ankrah & Al-Tabbaa, 2015; Boardman, 2009; Perkmann et al., 2013). The symbiotic relationship between the parties is considered beneficial for both academia and the business sector, enabling the exchange of knowledge, resources, and experiences (Bruneel et al., 2010; Cohen et al., 2002). Thus, researchers who interact with companies tend to develop a stronger market orientation as they become more aware of the needs and demands of the business sector, leading them to adapt their research to meet these demands (Plewa et al., 2013; Plewa & Quester, 2006). On the other hand, researchers' market orientation brings better alignment of objectives with private sector partners, facilitating collaboration in research, development, and innovation projects (Ghauri & Rosendo-Rios, 2016). Hence, our first hypothesis is:

Hypothesis 1 (H1): There is a positive and significant correlation between academic researchers' market orientation and their interaction with companies.

Differences between fields of expertise have been studied regarding university-industry collaboration and market orientation (D'Este & Perkmann, 2011; Y. S. Lee, 2000). Certain fields, such as engineering and applied sciences, are more inclined toward collaboration and market orientation due to the practical nature of their work and the need to solve concrete problems faced by business sectors (D'Este & Perkmann, 2011; Philbin, 2008). Conversely, fields such as social sciences and humanities may exhibit lower interaction with companies and less market orientation due to their theoretical nature and focus on social and cultural issues (Gulbrandsen & Smeby, 2005; Olmos-Peñuela et al., 2014). Based on these considerations, we describe the second and third hypotheses:

Hypothesis 2 (H2): Academic researchers' interaction with companies varies significantly across different fields of expertise.

Hypothesis 3 (H3): Academic researchers' market orientation varies significantly across different fields of expertise.

Gender differences in science and university-industry collaboration have been a subject of study in the literature (Etzkowitz & Gupta, 2006; Whittington & Smith-Doerr, 2005; Xie & Shauman, 1998). Studies show that women face additional challenges in their scientific careers, including discrimination and gender stereotypes, which may affect their participation and collaboration in research and development activities (Etzkowitz & Gupta, 2006; FOX, 2001). Moreover, gender differences may influence how researchers approach and perceive the applicability of their knowledge in the market, with possible implications for market orientation (Whittington & Smith-Doerr, 2005). Male researchers are sometimes reported to have greater ease or willingness to establish industrial connections, which can be attributed to a combination of sociocultural and institutional factors that favor male proactivity in aligning research with market demands. These observations form the basis for the following hypotheses:

Hypothesis 4 (H4): Interaction with companies will be significantly higher among male researchers than among female researchers.

Hypothesis 5 (H5): Academic researchers' market orientation will be significantly more pronounced among male researchers than among female researchers.

Intersectionality, a concept that highlights how different social categories, such as gender and field of expertise, interact and influence individual experiences, emerges as a crucial aspect in analyzing the dynamics of university-industry collaboration. This approach recognizes that interactions and market orientations are not affected by single categories in isolation but rather by the overlap of these variables, which can create unique scenarios for each group of researchers (Crenshaw, 2013; McCall, 2005). Given the com-

plexity of these interactions and the potential to reveal significant insights into how different interconnected factors influence collaboration with companies, we propose the following hypothesis:

Hypothesis 6 (H6): Interaction with companies and market orientation among academic researchers vary significantly based on the intersectionality between gender and field of expertise, suggesting that the dynamics of collaboration and alignment with market demands are influenced by a complex interplay of these sociodemographic and contextual variables.

To visualize how these hypotheses interrelate, we present the conceptual model in Figure 1. This model illustrates the relationships among market orientation, interaction with companies, fields of expertise, gender, and the intersectionality between gender and fields of expertise. Figure 1 below highlights how each of the proposed hypotheses connects to the main variables, providing a framework for the analysis of mean differences.

Figure 1

Conceptual model.
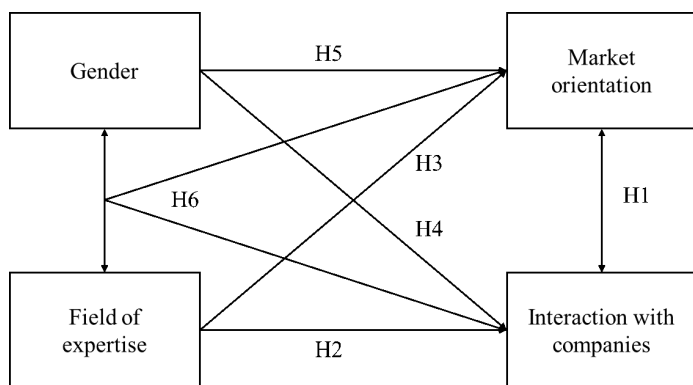
METHODOLOGY

Study design and sample

The sample selection was based on data from the Web of Science, identifying scientific articles published by Brazilian researchers in 2022. To ensure the representativeness of the sample, all fields of expertise and academic institutions in Brazil were considered. The inclusion criteria were researchers who had published at least one article in 2022 and were affiliated with a Brazi-

lian institution. Researchers whose contacts were unavailable or who did not meet the control and attention criteria established in the questionnaire were excluded. A total of 73,945 documents (49,529 contacts) were found in a search conducted on 02/10/2023, and 7,212 researcher contacts were randomly selected to receive the questionnaire via email, covering various fields of expertise and genders.

Data collection

Data collection was carried out from 03/11/2023 to 04/30/2023, through an online questionnaire sent to each of the 7,212 identified researchers, with 513 (7.11%) emails returned as invalid and subsequently excluded from the study. Among the researchers approached, we received 1,304 responses, corresponding to a response rate of 19.46% (1,304 out of a total of 6,699 contacts). After processing and verifying the data, which involved eliminating incomplete responses and those that did not meet the inclusion and exclusion criteria, we confirmed the validity of 635 complete responses, corresponding to 9.48% of the initial contact total. These validated responses formed the basis for our analysis. Given the typically low response rate in online surveys, as pointed out by Hung and Law (2011), we implemented analytical measures to ensure the representativeness of our data. We conducted data weighting to adjust for possible under-representation of groups in the sample and applied sensitivity analysis to test the robustness of our results considering the non-responded data. These strategies were essential to minimize the impact of the limited response rate on our results and conclusions.

The questionnaire comprised questions related to researchers' interaction with companies and their market orientation, as well as demographic information such as field of expertise, institution, region, and experience. The respondents were distributed as shown in Table 1, further below.

Instruments and measures

To measure the constructs of the research, 7-point Likert scales were used. Interaction with companies was assessed by considering the frequency with which researchers engaged in partnership, collaboration, and knowledge transfer activities. This aspect was measured through five indicators, reflecting the complexity of this interaction in the academic environment (Boardman, 2009), as shown in Table 2. Originally, the instrument contained eight indicators, but the final version used in this research consisted of five indicators, selected for their relevance and ability to capture the specific nuances of interaction with companies among Brazilian academic researchers. This process included a translation stage from English to Portuguese to preserve the original meaning while ensuring comprehensibility and applicability to the context of our research (Boardman, 2009). Market orientation was measured using the I-Markor scale (Schlosser & McNaughton, 2009), which was adapted to the context of academic researchers. The I-Markor scale, composed of three dimensions that examine market information seeking, information sharing within the organization, and responsiveness to customer needs, underwent a meticulous adaptation process. This included language adjustments to reflect the academic context and pre-testing with a sample of 218 Brazilian researchers between March 1st and 5th, 2023. This procedure ensured that the 20 adapted indicators effectively captured the three dimensions of market orientation among the target audience, aligning with the goal of exploring this construct within the academic context with precision and relevance (Table 2).Análise de

Table 1
Distribution of respondents by demographic data

Institutions	N (Institution)	Field	N (Field)	Gender	N (Gender)	Region of the Country	N (Region)	Experience	N(Exp)
1- Pub. Univ.	437	1- Agricultural sciences	114	1 – F	256	1- North	40	Up to 10 years	273
2- Priv. Univ.	66	2- Biological sciences	97	2 – M	379	2- Northeast	110	10 to 20 years	189
3- Res. Inst.	78	3- Health sciences	112			3- Midwest	57	20 to 30 years	104
4- Government	29	4- Exact and earth sciences	112			4- Southeast	280	Above 30 years	69
5- NGOs	8	5- Engineering	110			5- South	148		
6- Others	17	6- Humanities	44						
		7- Social sciences	46						
Total	635		635		635		635		635

Table 2
Market orientation and interaction with companies indicators

Construct	Dimensions	Indicator
Market orientation	Information seeking (market intelligence)	I ask people who use/have used the products/services I helped develop to evaluate their quality.
		I interact with people outside my institution to discover what products or services they will need in the future.
		I regularly review how changes in my institution may affect my communication with external people.
		During my communication with people outside my institution, I seek to detect fundamental changes in our sector, such as competition, technology, and regulation.
		I try to talk or conduct surveys with people who can influence the purchasing decisions of our target audience.
		I regularly review our product/service development efforts with our target audience to ensure they are aligned with their needs and desires.
		I actively participate in informal discussions about the tactics and strategies of other institutions to stay up-to-date on the market and improve strategic decision-making in my institution.
		I collect industry information through informal means (e.g., lunch with industry friends, conversations with business partners).
	Information sharing within the organization	I participate in interdepartmental meetings to discuss market trends and developments.
		I inform the appropriate departments when I discover that something important has happened in the external environment of my institution (sector, partners).
		I coordinate my activities with colleagues and/or departments in my institution.
		I pass on information that can help decision-makers in my institution review the changes that are occurring in our environment/sector.
		I communicate market developments to other departments beyond R&D and Technology Transfer (TT).
		I communicate with our R&D and TT departments about market developments.
		I distribute documents such as emails, reports, and newsletters containing information from our target audience to the appropriate departments to enhance interdepartmental communication and collaboration.
	Responsiveness to customer/ consumer needs	When someone presents a problem with our product or service, I seek to find a solution or direct them to the person responsible for handling the problem.
		I strive to help people who relate to my institution achieve their goals.
		I try to respond promptly when someone presents a problem with our products/services.
		As soon as I discover that someone is dissatisfied with the quality of our product or service, I take steps to resolve the situation.
		Together with members of our relationship team, I develop solutions to meet the needs of the people.
Interaction with companies		People from companies requested information about my research, and I provided it.
		I contacted people from companies asking about their research or research interests.
		I worked with people from companies on research that resulted in patents or copyrights.
		I worked with people from companies to transfer or commercialize technology or applied research.
		I co-authored a paper with people from companies, which was published in an academic journal or refereed conference proceedings.

Reliability and validity analysis

To ensure the reliability and validity of the measurement instruments in this study, we conducted meticulous analyses. This included verifying the internal consistency of the scales and the adequacy of the measures concerning the underlying theoretical constructs. We used Cronbach's alpha, an indicator of internal consistency, and Confirmatory Factor Analysis (CFA), a technique to validate the structure of the constructs. The results revealed a Cronbach's alpha of 0.833 for the five interaction with companies indicators and 0.964 for the 20 market orientation indicators, demonstrating high reliability in both constructs (Hair et al., 2019).

In the CFA, fit indices such as the Comparative Fit Index (CFI), Tucker-Lewis Index (TLI), Root Mean Square Error of Approximation (RMSEA), and Standardized Root Mean Square Residual (SRMR) assessed how well the models fit the observed data. For interaction with companies, the results were CFI of 0.990, TLI of 0.974, SRMR of 0.0164, and RMSEA of 0.0693. For market orientation, we obtained a CFI of 0.946, TLI of 0.939, SRMR of 0.0407, and RMSEA of 0.0702, indicating a satisfactory fit of the models to the data and validating the measures used to assess the three dimensions of academic researchers' market orientation (Hair et al., 2019).

After confirming the validity and reliability of our constructs, we opted for a pragmatic approach in the subsequent analysis, using the average of the indicators for each dimension. This applied to both interaction with companies and market orientation. Specifically, for market orientation, we used the overall average derived from the three dimensions. This simplified approach allowed us to efficiently compare the groups of interest while maintaining the clarity and integrity of the constructs. We chose this methodology because it facilitates data analysis and interpretation, allowing for direct and meaningful comparisons between different groups without compromising the depth of the constructs' analysis.

Data analysis procedure

To explore the relationships and variations proposed in hypotheses H1 to H6, the collected data were subjected to a series of statistical analyses using the Jamovi software, version 2.3 (The Jamovi Project, 2023), and SPSS, version 21.

To test Hypothesis 1, which postulates a positive and significant correlation between academic researchers' market orientation and their interaction with companies, we used Spearman's correlation because of its suitability for ordinal variables and resistance to outliers (Hair et al., 2019).

To test Hypotheses 2, 3, 4, and 5, related to variations in the interaction with companies and market orientation across different fields of expertise and gender, we applied one-way ANOVA, followed by post hoc analyses when necessary (Hair et al., 2019).

Before conducting the ANOVA, tests for homogeneity of variances (Levene's and Bartlett's) and normality (Shapiro-Wilk, Kolmogorov-Smirnov, and Anderson-Darling) were performed to ensure that the assumptions for applying these analyses were met (Hair et al., 2019). In cases of violation of these assumptions, we opted for appropriate non-parametric alternatives, such as Welch's ANOVA or the Kruskal-Wallis test, to ensure the validity of the tests.

For the analysis of Hypothesis 6, which explores the intersectionality of gender and field of expertise in the context of interaction with companies and market orientation, we employed Multiple Correspondence Analysis (MCA). This method was selected to unravel the complexity of the overlaps between the aforementioned social categories and their impacts on the dynamics of the interaction between academia and the business sector.

Ethical considerations

The study was conducted in accordance with the ethical principles for research involving human subjects. Participants were provided with clear information about the purpose of the research, its voluntary nature, and the assurance of confidentiality and anonymity of the information provided. Furthermore, informed consent was

obtained from the participants before they began completing the questionnaire. Those who requested to withdraw from the research had their data excluded and were not considered in the analysis.

RESULTS

Table 3 presents the correlation matrix between the study variables. Each cell in the table represents the Spearman's correlation coefficient (Spearman's Rho) between two pairs of variables. The interpretation of the results reveals a positive and statistically significant correlation between interaction with companies (INT) and researchers' market orientation (MO) (Rho = 0.505, $p < 0.001$), confirming the first hypothesis. This suggests that researchers who interact more with companies tend to have a higher market orientation.

Additionally, we observed significant correlations between the interaction with companies and gender (Rho = 0.122, $p = 0.002$). This indicates that this factor is also related to the level of interaction with companies and may be relevant.

Table 3
Correlation matrix

		INT[1]	MO[2]	Gender	Field
INT[1]	Spearman's Rho	—			
	p-value	—			
MO[2]	Spearman's Rho	0,505 ***	—		
	p-value	<0,001	—		
Gender	Spearman's Rho	0,122 **	0,024	—	
	p-value	0,002	0,551	—	
Field	Spearman's Rho	0,021	0,008	0,052	—
	p-value	0,592	0,832	0,194	—

Note. * $p < 0,05$, ** $p < 0,01$, *** $p < 0,001$

Fields of expertise

Data analysis, based on the statistical thresholds established by Cumming (2014), revealed significant differences in fields of expertise concerning interaction with companies (INT) and market orientation (MO), considering a significance level of 0.05. One-way ANOVA indicated a p-value < 0.001 for both variables (Table 4), confirming hypotheses 2 and 3.

Regarding the interaction with companies (INT), the fields of Engineering (3.15) and Agricultural Sciences (3.02) showed the highest levels, while Health Sciences (2.09) and Humanities (2.26) showed the lowest levels. The Games-Howell post hoc tests (Table 4) showed statistically significant differences between several fields of expertise. It was found that Agricultural Sciences and Biological Sciences showed a significant difference (p = 0.001), as well as Agricultural Sciences and Health Sciences (p < 0.001), and Agricultural Sciences and Humanities (p = 0.030). Similarly, the results indicated a significant difference between Engineering and Biological Sciences (p < 0.001), Engineering and Health Sciences (p < 0.001), Engineering and Humanities (p = 0.006), and between Engineering and Exact and Earth Sciences (p = 0.011).

In terms of market orientation (MO), Agricultural Sciences (4.53) and Engineering (4.37) achieved the highest levels. The Games-Howell post hoc tests indicated that the only significant difference occurred between Agricultural Sciences and Biological Sciences (p = 0.005). All other comparisons between the fields of expertise did not show significant differences (p > 0.05).

The tests for homogeneity of variances (Levene's and Bartlett's) did not show violations of the assumptions for INT (p = 0.362 and p = 0.583, respectively), but indicated a violation in Levene's test for MO (p < 0.001) and no violation in Bartlett's test (p = 0.102) for MO. However, the results of the non-parametric ANOVA (Kruskal-Wallis), proposed by Kruskal and Wallis (1952), confirmed the significant differences observed in the one-way ANOVA, with p < 0.001 for INT and p = 0.019 for MO.

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1   INT: interaction with companies.
2   MO: market orientation.

Table 4
One-way ANOVA results, field of expertise means, and post hoc tests.

Variable[3]	Welch's F	df1	df2	p	Field[4]	N	Mean	Std. Dev.	Std. Error		Games-Howell post hoc 1	2	3	4	5	6	7
INT	8,85	6	224	< ,001	1	114	3,02	1,40	0,131	≠ mean	-	0,729**	0,928***	0,489	-0,137	0,758*	0,235
										p-value	-	0,001	<,001	0,092	0,991	0,030	0,968
					2	97	2,29	1,21	0,123	≠ mean		-	0,199	-0,240	-0,866***	0,029	-0,494
										p-value		-	0,916	0,802	<,001	1,000	0,442
					3	112	2,09	1,33	0,126	≠ mean			-	-0,439	-1,065***	-0,169	-0,693
										p-value			-	0,155	<,001	0,990	0,100
					4	112	2,53	1,27	0,120	≠ mean				-	-0,626*	0,269	-0,254
										p-value				-	0,011	0,903	0,948
					5	110	3,15	1,41	0,135	≠ mean					-	0,895**	0,372
										p-value					-	0,006	0, 774
					6	44	2,26	1,30	0,197	≠ mean						-	-0,524
										p-value						-	0,565
					7	46	2,78	1,48	0,219	≠ mean							-
										p-value							-
MO	3,00	6	224	0,008	1	114	4,53	1,39	0,130	≠ mean	-	0,784**	0,566	0,284	0,159	0,466	0,163
										p-value	-	0,005	0,101	0,737	0,979	0,682	0,994
					2	97	3,74	1,65	0,167	≠ mean		-	-0,218	-0,500	-0,624	-0,317	-0,620
										p-value		-	0,967	0,238	0,063	0,947	0,256
					3	112	3,96	1,73	0,164	≠ mean			-	-0,282	-0,407	-0,099	-0,402
										p-value			-	0,838	0,476	1,000	0,744
					4	112	4,24	1,43	0,135	≠ mean				-	-0,124	0,182	-0,120
										p-value				-	0,995	0,996	0,999
					5	110	4,37	1,42	0,136	≠ mean					-	0,306	0,004
										p-value					-	0,942	1,000
					6	44	4,06	1,73	0,261	≠ mean						-	-0,302
										p-value						-	0,971
					7	46	4,36	1,44	0,212	≠ mean							-
										p-value							-

Note. * p < 0,05, ** p < 0,01, *** p < 0,001

Gender

When analyzing the gender variable, we found significant differences in the interaction with companies (INT) between male and female researchers. One-way ANOVA (Welch's ANOVA) revealed a p-value = 0.005 for INT, indicating statistically significant differences between genders, confirming Hypothesis 4.

Male researchers (2.74) exhibited significantly higher levels than female researchers (2.43). However, the variance analysis for market orientation (MO) did not reveal significant differences between genders, with a p-value = 0.717 (Table 5), rejecting Hypothesis 5.

Table 5
One-way ANOVA (Welch)

Variable[5]	Gender[6]	N	Mean	Std. dev	Std. error	F	df1	df2	p
INT	1	255	2,43	1,35	0,0843	7,775	1	561	0,005
INT	2	379	2,74	1,41	0,0724				
MO	1	255	4,22	1,62	0,1018	0,132	1	515	0,717
MO	2	379	4,17	1,50	0,0770				

The tests for homogeneity of variances (Levene's and Bartlett's) did not indicate violations of the assumptions for INT (p = 0.370 and p = 0.431, respectively) and MO (p = 0.225 and p = 0.161, respectively). Additionally, normality tests (Shapiro-Wilk, Kolmogorov-Smirnov, and Anderson-Darling) showed that the data distributions did not follow a normal distribution, with p-values < 0.001 for all tests on both variables.

Given the non-normality of the data, we also performed non-parametric analyses using the Kruskal-Wallis test. The results confirmed significant differences in the interaction with companies (INT) between genders, with $\chi^2 = 9.043$, 1 degree of freedom, and p = 0.003. However, no significant differences were found in market orientation (MO) between genders, with $\chi^2 = 0.432$, 1 degree of freedom, and p = 0.511.

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3   INT: interaction with companies; MO: market orientation.

4   Fields: 1- agricultural sciences; 2- biological sciences; 3- health sciences; 4- exact and earth sciences; 5- engineering; 6- humanities; e 7- applied social sciences.

5   INT: interaction with companies; MO: market orientation.
6   Gênero: 1- Feminino; 2- Masculino.

Multiple correspondence analysis

The variance explained by the two main dimensions in Figure 2 is significant, with the first axis (Dimension 1) explaining 51.78% of the variance and the second axis (Dimension 2) explaining 40.86%, totaling a combined contribution of 92.64% to the total variance, suggesting strong representativeness of the model for the observed data. The quality measures of representation, such as Cronbach's Alpha value, were 0.958 for Dimension 1 and 0.934 for Dimension 2, indicating the high internal reliability of the dimensions identified in the MCA.

The data analysis through MCA provides substantial empirical support for Hypothesis 6. The results suggest that interaction with companies and market orientation among academic researchers in Brazil exhibit distinct patterns when analyzed through the lens of intersectionality.

The fields of 'Engineering,' 'Applied Social Sciences,' 'Exact and Earth Sciences,' and 'Agricultural Sciences' are significantly more aligned with medium to high levels of interaction with companies and market orientation, a trend that is amplified among male researchers. In contrast, the 'Health Sciences,' especially when associated with the female gender, show comparatively lower involvement in these activities, potentially reflecting the structural and cultural nuances that shape collaboration between academia and industry.

The fields of 'Biological Sciences' and 'Humanities,' which are not clearly aligned with any gender in the chart, may indicate gender neutrality in terms of collaboration with companies or individual variation within the field that is not captured by MCA. The representation of the fields of 'Engineering,' 'Applied Social Sciences,' 'Exact and Earth Sciences,' and 'Agricultural Sciences' near the points of greater interaction with companies and market orientation aligns with the notion that these disciplines are more prone to collaborations with the productive sector and research commercialization.

The findings of the MCA respond to Hypothesis 6 by demonstrating the existence of significant disparities in how different groups of academic researchers interact with the market. Such disparities are influenced by intersectional factors and highlight the importance of targeted policies and interventions that can balance these differences, promoting inclusion and expanding opportunities for collaboration for all categories of researchers, regardless of gender or field of expertise.

Figure 2
Multiple correspondence analysis
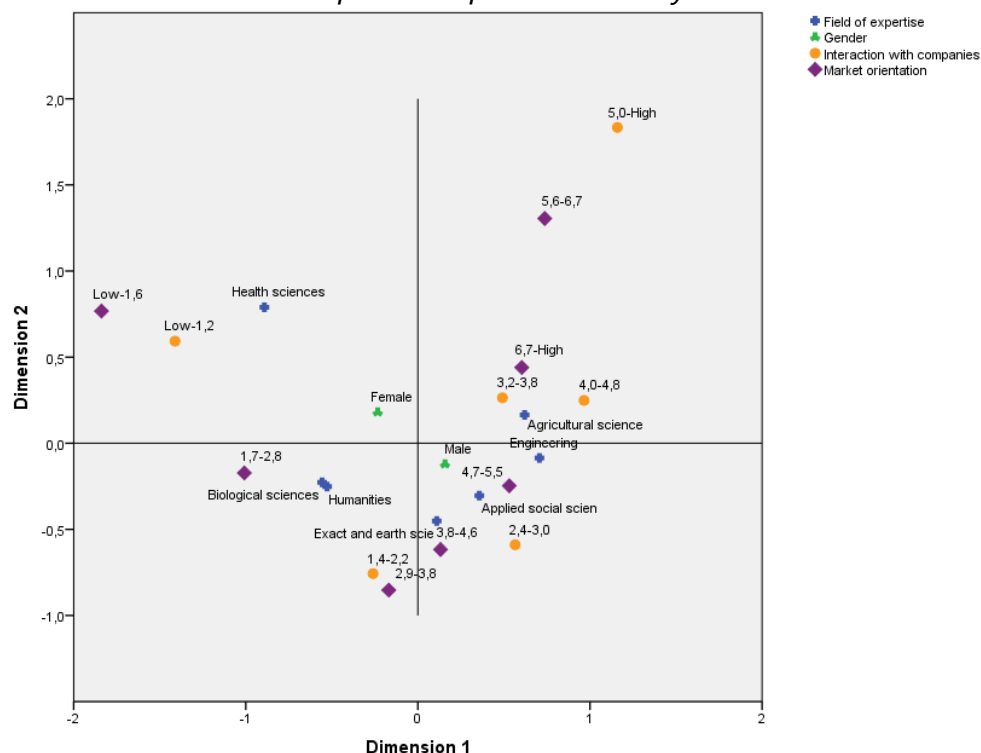
Following the data analysis and detailed presentation of the results, Table 6 compiles and summarizes the significant correlations between the key variables of this study, serving as a synthesis of the tested hypotheses and their respective outcomes.

Table 6
Summary of the hypotheses

Hypothesis	Description	Result	Significance (p-value)	Comments
H-1	Positive correlation between INT and MO	Confirmed	p < 0,001	A strong correlation indicates that higher interaction with companies is associated with higher MO.
H-2	Differences in the fields of expertise regarding INT	Confirmed	p < 0,001	Engineering and Agricultural Sciences show higher levels of INT.
H-3	Differences in the fields of expertise regarding MO	Confirmed	p < 0,001	Agricultural Sciences and Engineering with higher levels of MO.
H-4	Gender differences in interaction with companies	Confirmed	p = 0,005	Male researchers show higher INT than females.
H-5	Gender differences in market orientation	Not confirmed	p = 0,717	No significant gender differences were found in MO.
H-6	Distinct patterns of interaction with companies and market orientation analyzed through intersectionality	Confirmed	N/A	MCA showed that fields such as 'Engineering' and 'Agricultural Sciences' tend to have higher interaction and market orientation, especially among male researchers.

DISCUSSION

The results revealed significant differences in the interaction with companies and market orientation across the analyzed fields of expertise. According to the findings, the fields of Engineering and Agricultural Sciences exhibited the highest levels of interaction with companies and market orientation, while Health Sciences, Humanities, and Biological Sciences displayed the lowest levels. These differences can be partially explained by the nature of the fields of expertise and the types of projects and research conducted within them.

The literature suggests that the fields of Engineering and Agricultural Sciences tend to have greater interaction with the productive sector, as their research projects often involve the direct application of new technologies and innovations in the market (Etzkowitz & Leydesdorff, 2000; Fernández-Pérez de la Lastra et al., 2023; Mowery et al., 2004). This interaction is crucial for the development of products and services that meet market needs and contribute to economic growth (Rothaermel et al., 2007). These fields are also more aligned with technology transfer practices, where frequent collaboration with industry facilitates the practical application of the generated knowledge (Bozeman, 2000; Rogers, 2003). For example, the frequent requests for information and contacts initiated by researchers in these fields illustrate how these interactions can lead to practical innovations applicable in the market.

On the other hand, the fields of Health Sciences, Humanities, and Biological Sciences may have less interaction with companies and a less pronounced market orientation due to the more fundamental nature of much of their research, which may not have immediate market applications (Fernández-Pérez de la Lastra et al., 2023; Stokes, 1997). However, it is important to emphasize that collaboration between academia

and industry in these fields remains fundamental for the development of new medicines and treatments that can improve people's quality of life (Cohen et al., 2002; O'Dwyer et al., 2023). Focusing specifically on the Humanities, interaction with companies may be less direct, as much of the research focuses on understanding social, cultural, and individual phenomena, which do not always readily translate into commercial products or services (Hessels & van Lente, 2008). Nonetheless, it is undeniable that the contributions of this research are essential for public policy formulation, the development of social programs, and understanding fundamental aspects of society and the individual (Shi & Wang, 2023). Thus, despite the challenges, technology transfer in these areas can be promoted through policies that encourage the translation of basic research into practical applications (Stokes, 1997).

The intersectionality of gender and field of expertise significantly influences the dynamics of interaction with companies and market orientation among academics. Male researchers, especially those in more applied fields such as Engineering and Agricultural Sciences, demonstrate significantly higher levels of interaction with companies compared to female researchers, who are more present in fields such as Humanities and Health Sciences. This difference can be attributed to sociocultural and historical factors, as well as systemic barriers and persistent gender stereotypes in academia and industry engagement, which influence the participation of men and women in different fields of expertise and their interactions with the market. Xie and Shauman (1998) highlight additional challenges for women in the applied sciences, such as a lower likelihood of external collaboration, directly impacting their recognition and career advancement. Etzkowitz and Gupta (2006) expand on this discussion, showing that the organizational culture in research institutions often promotes masculinized approaches to innovation, adversely affecting female researchers' career trajectories. Despite these challenges, Tartari and Salter (2015) emphasize that even in fields with high industry interaction, female researchers face a substantial 'engagement gap,' indicating that gender disparities persist regardless of the field of study. These dynamics highlight the urgent need for institutional policies and practices that recognize and actively mitigate gender barriers in university-industry collaboration, thereby promoting broader and more equitable inclusion. This is especially relevant for technology transfer, where the inclusion of diverse perspectives can enrich the innovation process and increase the applicability of research outcomes in the market (Bozeman, 2000; Rogers, 2003). Academia-industry collaboration, which is essential for promoting innovation and economic growth, can significantly benefit from a more inclusive and diverse research environment (Rothaermel et al., 2007).

It is important to emphasize that gender equity in science and interaction with companies is essential to ensure that different perspectives and approaches are considered in the development of new technologies and innovations (Nielsen et al., 2017). Therefore, policies and actions that promote equal opportunities and the engagement of researchers of all genders and fields of expertise in interaction with companies are fundamental for the advancement of science and society as a whole (Larivière et al., 2013).

In this context, it is crucial that policies and strategies be developed to promote the interaction between researchers from different institutions and companies, to stimulate knowledge and technology transfer, and to ensure that research results are effectively applied in practice (Y. S. Lee, 2000). These policies may include encouraging the creation of public-private partnerships, promoting collaborative research projects with companies, and establishing mechanisms for the commercialization of technologies and innovations generated by academic research (Etzkowitz et al., 2000; Philbin, 2008).

FINAL REMARKS

The aim of this study was to explore market orientation and interaction with companies among academic researchers in Brazil, examining how these aspects vary according to fields of expertise and gender. The results demonstrated that these variations are significant and directly influence the effectiveness of interactions between academia and industry. The data collected confirmed that fields such as Engi-

neering and Agricultural Sciences have a greater market orientation and interact more frequently with companies, while Health Sciences and Humanities exhibit lower levels of interaction. Additionally, the gender analysis revealed disparities that need to be addressed to promote greater equity in academic-industrial collaborations.

This study revealed important details about how academic researchers in Brazil engage with the business world, showing that both the willingness to interact with companies and the adaptation to market needs vary significantly across different fields of expertise and genders. We observed that researchers who collaborate more with the business sector tend to be more attentive to market demands. This finding not only validates our initial hypothesis but also highlights how academia can be aligned or misaligned with commercial requirements.

Our analysis indicated that fields such as Engineering and Agricultural Sciences interact more frequently with companies and are more strongly oriented toward market demands. This may be due to the practical nature of their research, which often results in direct technological innovations and developments. In contrast, fields such as Health Sciences and Humanities showed lower levels of interaction, possibly reflecting a more theoretical or basic focus in their research.

Moreover, it was interesting to note a marked gender difference in the interaction with companies, with men participating more actively than women. This finding is concerning as it suggests that there are barriers that may be limiting women's participation in collaborations with industry, particularly in fields traditionally dominated by men. This disparity challenges us to reflect on how we can create a more inclusive and equitable academic and business environment.

The theoretical contributions of this study lie in its unique approach to investigating the interaction between academic researchers and companies in the context of an emerging country. It broadened the understanding of university-industry collaboration, providing relevant insights into the variations between fields of expertise and gender in interaction with companies and market orientation. The research also added to the existing literature by analyzing specific fac-

tors that may influence this interaction, especially in a distinct sociocultural and economic context.

In practical terms, this study offers guidance for the implementation of policies and actions aimed at promoting equal opportunities, stimulating collaboration between academia and industry, and facilitating knowledge and technology transfer. Identifying the discrepancies between different groups of researchers and the potential reasons for these differences can inform the design of more effective strategies to foster collaboration between academic researchers and companies, which is essential for the advancement of science and society in Brazil. Additionally, the gender barriers identified in academia-industry interactions highlight the need for institutional policies that promote gender inclusion and equity. Specific programs can be developed to support female researchers in building collaboration networks and accessing resources that facilitate technology transfer.

The results of this study also have significant social implications. By promoting greater collaboration between universities and companies, it is possible to foster the development of innovations that benefit society as a whole. Policies that encourage gender equity and inclusion in academia-industry collaborations can contribute to a fairer and more equitable society, where different perspectives are valued and integrated into the innovation process.

However, this study has some limitations that should be considered. The main limitation is the generalization of the results, given that the sample was exclusively drawn from the Brazilian context. Additionally, factors such as specific government policies and Brazil's socioeconomic characteristics may limit the applicability of the results to other emerging countries. Furthermore, the study focused on quantitative variables, excluding the exploration of qualitative factors that may also influence the interaction between academic researchers and companies. Other limitations include the low response rate from researchers, which may have affected the representativeness of the data, and the possible lack of representation in some specific fields of expertise, which may have impacted the results or their interpretation.

Future research is encouraged to further explore the influence of the field of expertise and gender on the effectiveness of interactions between academic researchers and companies, as well as on market orientation. Future studies may also focus on analyzing specific strategies that have been more effective in overcoming gender barriers and promoting greater inclusion and diversity in academia-industry collaborations. The conduction of complementary qualitative studies, which could provide deeper insights into the factors affecting these interactions, would also be of great value.

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