Investigating Psychological Safety in Requirements Engineering

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Abstract

Psychological safety has been recognized as an important factor affecting collaboration, learning, and team performance in software development. Despite this, its influence on Requirements Engineering (RE) activities remains poorly understood. This study aims to investigate how psychological safety manifests in RE by identifying antecedent factors, observable behavioral indicators, associated consequences, and strategies to foster it in practice. We conducted a qualitative study using semi-structured interviews with 17 software practitioners engaged in RE-related activities. The data were analyzed following the principles of the initial phases of a socio-technical grounded theory (STGT) approach. Our findings indicate that psychological safety in RE emerges from a set of antecedent factors distributed across five dimensions: individual factors, team environment and dynamics, organizational conditions, contextual conditions, and external stakeholder interaction. These factors shape behaviors such as speaking up, asking for help, and expressing uncertainty during RE activities. When psychological safety is high, participants reported improved collaboration, learning, and software quality. In contrast, when it is low, it is associated with disengagement, rework, and reduced knowledge sharing. We also identified practical strategies to support psychological safety, including encouraging collaborative practices, implementing agile social practices, and promoting regular feedback loops. Our results suggest that psychological safety in RE is a socio-technical, multi-level phenomenon that extends beyond team boundaries, particularly through interactions with external stakeholders, such as clients. This study contributes to the RE body of knowledge by offering a structured view of psychological safety in RE and by providing insights to improve both team dynamics and software outcomes.

Keywords

Human factors, Psychological Safety, Requirements Engineering, Software Engineering, Socio-technical Factors

1 Introduction

Requirements Engineering (RE) is a central activity in software development, involving understanding problems, defining system requirements, and aligning stakeholder expectations [28]. These activities rely heavily on interaction, involving discussions, negotiations, and decision-making under uncertainty [8]. In practice, RE is inherently social, requiring continuous communication among stakeholders with diverse perspectives, expertise, and interests [14].

During RE activities, professionals are expected to raise questions, surface uncertainties, and challenge perspectives to refine requirements [30, 31]. However, these interactions may be perceived as risky, especially in environments where individuals fear negative judgment [8, 12, 23]. As a result, critical information may remain unspoken, ambiguities may persist, and decisions may rely on unchallenged viewpoints [2, 26]. Therefore, psychological safety becomes particularly relevant, as it shapes whether individuals feel comfortable speaking up, asking questions, and expressing concerns without fear of negative consequences [7]. In this study, we adopt the definition of *"a shared belief among team members that it is safe to take interpersonal risks in the workplace"* [7].

Although psychological safety has been increasingly studied in Software Engineering (SE), most research examines it at a general team level [27], offering limited insight into how it unfolds within specific technical activities. This limitation is particularly relevant in RE, where activities such as elicitation, negotiation, and validation require intensive interaction and continuous clarification [13, 14]. Despite this, its role in shaping these interactions remains underexplored, limiting our understanding of how communication challenges emerge in RE practice.

This study investigates how psychological safety manifests in RE by examining its antecedent factors, observable behavioral indicators, associated consequences, and strategies to foster it in practice. To the best of our knowledge, this is the first study to explore psychological safety specifically within the context of RE. We conducted semi-structured interviews with 17 software practitioners involved in RE activities, including elicitation, analysis (negotiation), specification, prioritization, validation, and management. The results reveal that psychological safety in RE is not only reflected in interpersonal dynamics but also closely associated with how technical practices structure interactions, influencing participation, communication, and the emergence of misalignment. Overall, these findings provide a structured and fine-grained view of how psychological safety is experienced and enacted in everyday RE activities.

The remainder of this article is organized as follows: section 2 presents the background and related work; section 3 describes the research method; section 4 presents the findings; section 5 discusses the insights and implications; subsection 5.3 presents threats to validity; and section 6 concludes the study.

2 Background and Related Work

In SE, psychological safety has been recognized as a key factor for effective teamwork, particularly in contexts characterized by uncertainty, interdependence, and continuous change. Such environments rely on collaboration, open communication, and frequent feedback, making psychological safety a critical enabler of team interactions and outcomes [2, 5, 17]. Prior studies have examined psychological safety from different perspectives, highlighting both its antecedents and its role in team dynamics. For example, Alami et al. [2] identifies inclusive leadership and collective decision-making as key antecedents in agile teams. In contrast, Buvik and Tkalich [5] shows that team autonomy positively influences psychological safety, with limited impact from role clarity. Psychological safety has been associated with key team processes and outcomes. For instance, Kakar [17] shows that it facilitates knowledge sharing and team cohesion, supporting more open communication. Overall, it contributes to collaboration and team effectiveness in software development. Despite this growing body of research, most studies focus on general software development contexts, particularly agile teams. Unlike previous studies, our work provides an empirical characterization of psychological safety in RE by identifying its antecedents, observable behavioral indicators, consequences, and strategies for fostering psychologically safe interactions.

3 Research Method

This research investigates psychological safety in RE, examining how it manifests in practice and shapes interactions among professionals. We conducted semi-structured interviews with 17 software practitioners in Brazil involved in RE activities. This method is widely used in empirical SE to capture experiences, perceptions, and challenges related to complex socio-technical phenomena [29].

3.1 Research Questions

To achieve the main objective, we define the following research question: *RQ1. How does psychological safety manifest in requirements engineering activities?* We formulate sub-questions that further specify this objective and enable a more focused analysis.

- **RQ1.1.** What antecedent factors positively or negatively influence psychological safety in requirements engineering activities?
- **RQ1.2.** What observable behavioral indicators can be identified as evidence of psychological safety in requirements engineering activities?
- **RQ1.3.** What consequences associated with lower and higher levels of psychological safety are perceived in requirements engineering activities?
- **RQ1.4.** What strategies or practices can foster psychological safety in requirements engineering activities?

3.2 Semi-Structured Interviews

To conduct the semi-structured interviews, we prepared a set of materials: (i) an informed consent form, (ii) a characterization questionnaire, (iii) an interview guide, and (iv) slides with concepts of RE and psychological safety. We designed the semi-structured interview guide based on the conceptualization of psychological safety proposed by Edmondson [7]. Thus, the interview script was divided into two parts: (i) demographic questions; and (ii) questions aimed at exploring psychological safety in RE activities. Each question in the interview guide was designed to address the RQ presented in Section 3.1. The interview guide consisted of open-ended questions designed to prompt participants to describe concrete situations and lived experiences related to psychological safety in RE activities, rather than providing general opinions. The complete interview guide is available in the supplementary material available at https://doi.org/10.5281/zenodo.21420222.

- **Demographic questions**: In the first step, we collected demographic information about the participants who voluntarily agreed to participate and signed the consent form, including work modality (on-site, remote, or hybrid), seniority level, gender, years of experience, number of software projects, and role in those projects. We also asked participants which activities related to RE they had performed in order to confirm their experience in RE.
- **Psychological safety in RE**: in the second step, we provided each participant with a definition of psychological safety[1] and RE[2]. We presented these definitions to ensure clarity and avoid any confusion or ambiguity about the meaning of each term used in the interviews. Then, we asked the interviewees about their experiences with psychological safety in RE activities, including situations involving communication, collaboration, and decision-making. The interview questions were designed to capture participants' lived experiences regarding antecedent factors, observable behaviors, perceived consequences, and practices adopted to foster or hinder psychological safety, rather than abstract opinions or general beliefs, while minimizing bias in their responses. Table 1 presents examples of the questions used to guide the interviews. To structure the discussion of RE activities, we followed the classification proposed in the ISO/IEC/IEEE 29148 [1]. The complete interview protocol is available in the supplementary material.

Pilot. To validate these materials and the estimated duration, we conducted a pilot study with two RE professionals, both with more than 4 years of field experience. The participants were selected through convenience sampling based on their availability and prior experience in RE activities. As selection criteria, we considered professionals with practical experience in RE activities (e.g., elicitation, analysis, and validation) to ensure they were familiar with the interview context. The pilot helped assess the clarity and understanding of the questions, as well as the estimated time required to complete the interviews (the pilot data were not included in the analysis). We also gathered suggestions to improve the execution of the interviews. Based on the feedback obtained, we refined the interview guide by clarifying the wording of some questions and including a definition of psychological safety to ensure a shared understanding among participants. All materials used and generated are available in the supplementary material[3].

[1] "A shared belief among team members that it is safe to take interpersonal risks in the workplace" [7].
[2] Requirements Engineering involves activities such as elicitation, analysis, specification, validation, and management of requirements [1].
[3] https://doi.org/10.5281/zenodo.21420222

Table 1: Example Interview Questions

Theme	Example Questions
Manifestations of Psychological Safety	Do you feel it is safe to express your opinions or doubts during RE activities in your team? Can you provide an example of a situation in which you felt comfortable (or not) speaking up? Do you feel it is safe to disagree with or question decisions related to RE? Do you feel it is safe to admit mistakes or ask for help?
Influencing Factors (Antecedents)	What makes you feel safe or unsafe about speaking up during requirements discussions?
Consequences	What happens when people do not feel comfortable expressing their opinions, asking for help, or disagreeing? How does this affect project outcomes? Can you provide an example?
Promotion Strategies	What practices help people feel safe expressing their opinions, asking for help, or disagreeing? What could be improved in this regard in your team?

Characterization of participants. The target population of this study comprises industry software professionals in technical roles who perform RE-related activities. Technical roles include developers, architects, and designers, who can contribute perspectives on feasibility, solution detailing, and cost. Requirements engineers are expected to act as primary stakeholders responsible for RE activities. Testers and quality assurance (QA) professionals are also considered, as they need to understand requirements to validate the system. To reach this population, participants were recruited through direct invitations sent via email[4] and social and communication platforms (e.g., LinkedIn[5]). The invitations were targeted to professionals with prior experience in RE-related activities. In addition, we employed snowball sampling, in which initial participants were asked to recommend other professionals to participate in the study [4]. Ethical procedures were followed throughout the study. Participants were informed, through an informed consent form provided before the interviews and in accordance with the Brazilian Data Protection Law (LGPD)[6], that their participation was voluntary, that they could withdraw at any time, and that their responses would be removed upon request. All data were anonymized, and only the researchers involved in this study had access to them, which were securely stored and handled in compliance with data protection principles. The main characteristics of the interviewees are summarized in Table 2, where each participant is identified by a code used throughout this paper (see column "Participants").

Conducting semi-structured interviews. The interviews were conducted between March 22 and April 14, 2026. Each session lasted approximately 30 to 60 minutes and was conducted remotely via Google Meet[7], which was also used to record the interviews with participants' consent. The recordings were subsequently transcribed to support the analysis process. Although automatic transcription tools were used as an initial step, all transcripts were carefully reviewed and refined by the researchers to ensure accuracy and completeness. The results of this process, including quotations from each interviewee, are available in the supplementary material. The interviews were guided by a semi-structured protocol designed to explore participants' experiences with psychological safety in RE activities, including perceived antecedent factors, observable behaviors, perceived consequences, and practices adopted to foster or hinder psychological safety. As the interviews were conducted in Portuguese, the quotations were translated into English and subsequently reviewed by two authors.

[4]Gmail: https://mail.google.com
[5]LinkedIn: https://linkedin.com/
[6]LGPD: https://tinyurl.com/57sbuxnr
[7]https://meet.google.com/

3.3 Coding Process

To address the RQs, we employed a qualitative data analysis approach based on the interview data. We applied open and axial coding, inspired by the initial procedures of Socio-Technical Grounded Theory (STGT) [15, 16], enabling us to capture both social and technical aspects that influence RE activities. The interview transcripts were read in detail, and relevant excerpts were segmented into **raw data** units (*e.g.*, sentences or paragraphs). To ensure consistency in data extraction and coding, we adopted an alignment procedure among the researchers to establish a shared understanding of the RQs and the coding approach. The initial open coding was conducted in an inductive (bottom-up) manner [15, 16], supported by the QDA Miner[8] tool.

Each code was grounded directly in participants' statements, and representative excerpts were systematically linked to codes to ensure traceability between the raw data, codes, and higher-level categories. The initial open **coding** was conducted by the first author[9] and subsequently reviewed by the other authors. The second author[10] reviewed and refined the analysis through seven iterative cycles. Throughout the process, we continuously revisited the interview data. As new interviews were analyzed and new codes or insights emerged, we revisited previously coded transcripts to examine whether similar patterns could be identified. This iterative process supported code refinement and ensured that the resulting concepts were consistently grounded in the data.

After open coding, we applied axial coding to group the codes into higher-level **concepts** and **categories** through constant comparison. To support this process, we organized the codes into a structured codebook, which was iteratively refined through discussions among the authors. The level of agreement and divergence among coders was assessed during consensus meetings before finalizing the codebook, leading to refinements of codes, concepts, and categories. The last author[11] was consulted in cases of disagreement. This iterative and collaborative process enhanced the credibility and consistency of the analysis.

Data collection and analysis proceeded iteratively until theoretical saturation was achieved, that is, when no new codes or relevant insights emerged from consecutive interviews and existing categories were sufficiently well-developed and stable. We adopted the concept of "saturation" to determine the number of interviews

[8]QDA Miner: https://provalisresearch.com/.
[9]The first coder (author 1) is a PhD student with experience in qualitative analysis and empirical SE.
[10]The second coder (author 2) is a PhD student with experience in qualitative analysis and empirical SE.
[11]The last author is a professor with a PhD in Computer Science and over 20 years of experience in experimental SE, as well as qualitative and quantitative analysis

Table 2: Participants Profile

Participants	Gender	RE-Related Experience	Current Role	Projects	Activities Involved	Work Modality	Skills
P01	Woman	3 to less than 5 years	Mid-Level	1	Prioritization and Changes	Remote	Designer UX/UI
P02	Woman	1 to less than 3 years	Mid-Level	2–3	All activities related to requirements	On-site	Requirements Engineer
P03	Woman	3 to less than 5 years	Mid-Level	1	Elicitation, Specification, Prioritization, and Changes	Hybrid	Quality Analyst
P04	Man	1 to less than 3 years	Mid-Level	2–3	Prioritization and Changes	Hybrid	Developer
P05	Man	1 to less than 3 years	Mid-Level	More than 5	All activities related to requirements	On-site	Requirements Engineer
P06	Man	5 to less than 7 years	Mid-Level	2–3	Prioritization and Changes	Remote	Developer
P07	Man	Less than 1 year	Intern/Trainee	2–3	All activities related to requirements	On-site	Requirements Engineer
P08	Woman	5 to less than 7 years	Senior	4–5	Prioritization and Changes	Hybrid	Quality Analyst
P09	Woman	1 to less than 3 years	Intern/Trainee	4–5	All activities related to requirements	Hybrid	Designer UX/UI
P10	Woman	1 to less than 3 years	Intern/Trainee	2–3	All activities related to requirements	Hybrid	Requirements Engineer
P11	Woman	3 to less than 5 years	Junior	2–3	All activities related to requirements	Hybrid	Requirements Engineer
P12	Man	Less than 1 year	Intern/Trainee	1	All activities related to requirements	Hybrid	Requirements Engineer
P13	Man	3 to less than 5 years	Senior	2–3	All activities related to requirements	Hybrid	Requirements Engineer
P14	Man	3 to less than 5 years	Junior	1	Prioritization and Changes	Remote	Developer
P15	Man	5 to less than 7 years	Senior	2–3	Prioritization, Negotiation, and Change	Remote	Developer
P16	Woman	3 to less than 5 years	Junior	More than 5	All activities related to requirements	Hybrid	Developer
P17	Man	5 to less than 7 years	Senior	More than 5	Prioritization, Negotiation, and Change	Remote	Developer

required in this study. Saturation is considered achieved when additional interviews no longer yield new codings or insights [6].

4 Results

After conducting the interviews, we organized and analyzed the data collected from all 17 participants to address our research question: *"RQ1: How does psychological safety manifest in requirements engineering activities?"*. The Figure 1 presents an overview of the results. The raw data are available in the supplementary material[12].

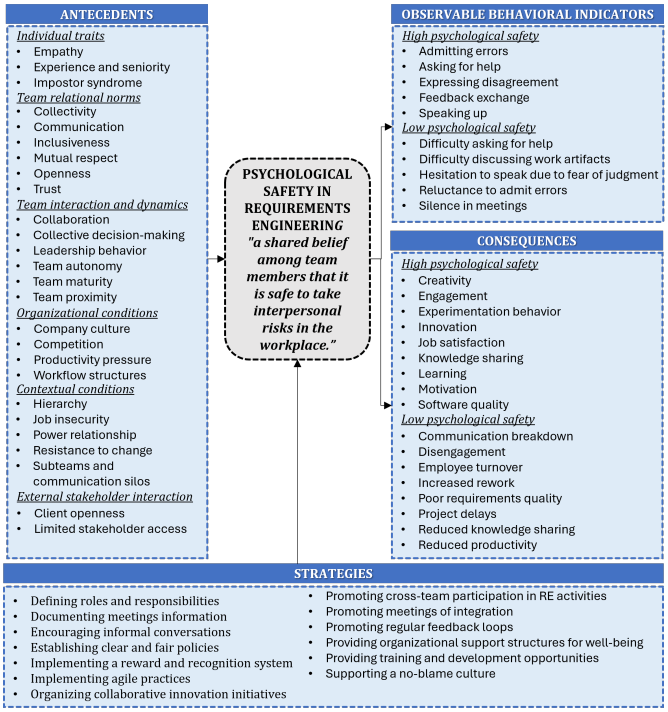

Figure 1: Overview of the Results

[12]https://doi.org/10.5281/zenodo.21420222

4.1 Antecedent Factors of Psychological Safety in RE

During the interviews (Section 3.2), participants reported antecedent factors that influence psychological safety in RE, addressing *RQ1.1: What antecedent factors positively or negatively influence psychological safety in requirements engineering activities?* We organized these factors into five categories: individual factors, team relational norms, team structure and dynamics, organizational conditions, and contextual and external stakeholder conditions. Although this categorization reflects our interpretation of the data, alternative groupings are possible. Given the open-ended nature of the interviews, we do not report frequency counts; instead, we provide a mapping between participants and factors in our dataset. The following sections describe each category and its factors.

4.1.1 Individual Traits. The individual traits category includes personal characteristics that influence psychological safety in RE activities. **Empathy** helps practitioners understand others' perspectives and stakeholders' needs, supporting more careful and aligned requirements. It also improves collaboration by helping teams navigate the social aspects of RE activities (P6). P6 shared: *"an environment where there is a strong sense of empathy, [...] fosters good communication, empathy, and a willingness to help others."* **Experience and seniority** influence confidence in RE activities, affecting individuals' willingness to express opinions, ask questions, and handle uncertainty. Less experienced practitioners tend to feel more insecure and hesitant to contribute, whereas more experienced individuals report greater confidence and openness (P7, P11, P13, and P15). For example, P13 stated: *"I had the impression that more junior people were more afraid of making mistakes, whereas senior people didn't have"*. **Impostor syndrome** reflects individuals' tendency to question their own competence and abilities, influencing how confidently they engage in RE activities. This condition may limit individuals' willingness to express opinions, ask questions, or participate in discussions (P6 and P7). P6 stated: *"we often experience impostor syndrome, where people feel they are not capable, that they cannot deliver, or they constantly doubt themselves or others doubt them"*, indicating how self-doubt can constrain participation.

4.1.2 Team Relational Norms. The identified team relational norms reveal interconnected factors that jointly shape psychological safety in RE activities. **Collectivity** reflects shared goals and collaborative

engagement among team members, supporting alignment across levels of expertise (P1, P4, and P6). P6 stated: *"We have people at different levels, but everyone is focused on achieving the objective... that awareness creates a safer environment"*. In parallel, **communication** enables the effective exchange of information, allowing individuals to express doubts and concerns, while poor communication may lead to insecurity and hesitation (P5, P6, P11, and P12). As P5 shared: *"I believe that our internal communication, in itself, already helps create a safe environment"*, and P6 further added: *"communication is also fundamental, both for discussing technical aspects and for addressing human aspects to understanding others and putting yourself in their position"*.

In this context, **inclusiveness** ensures that different perspectives are considered, enabling individuals to participate more actively in discussions (P3, P8, and P10). P3 explained: *"When you listen to only one person or one group, you end up leaving other groups at the mercy of what that group thinks. To have a broader perspective, you need to understand the whole"*. These conditions are further reinforced by **mutual respect**, which reduces pressure and prevents negative evaluations by acknowledging differences in skills and working pace. P6 stated: *"there is no pressure like, 'But this requirement is easy—why are you taking so long?' ... It is an environment that strongly respects each person's pace."*

Building on these elements, **openness** enables team members to express concerns, discuss issues, and explore solutions collaboratively, supporting continuous alignment and adaptation (P1, P2, P3, P6, P7, P8, P10, P11, P12, P13, P14, and P15). As P12 explained: *"I felt more confident because they were always very open and receptive to my ideas and prototypes, and we discussed improvements openly"*. Finally, **trust** enables individuals to express ideas and take initiative without fear of negative consequences. Its absence may lead to hesitation and reduced participation (P1, P5, P7, P9, P15, and P16). P9 explained: *"he made us feel very confident and assigned us tasks, trusting that we could complete them, even as interns."*

4.1.3 Team Interaction and Dynamics. The identified team interaction and dynamics factors reveal how coordination, collaboration, and decision-making practices jointly shape psychological safety in RE activities. **Collaboration** is a foundational element, supporting shared understanding and problem-solving as team members discuss, refine, and implement requirements in refinement meetings, design sessions, and other complex RE activities (P2, P4, P6, P8, and P12). P2 stated: *"in the team, collaboration is very strong. There is no situation where one analyst refuses to share with another."*

Building on this, **collective decision-making** enables multiple team members to participate in discussing and structuring decisions, contributing to more consistent and shared outcomes (P1 and P8). P8 explained: *"we schedule a meeting to discuss how the process will work, what will happen at each stage. We map out the flow together"*. These interactions are strongly influenced by **leadership behavior**, which shapes how communication and decision-making occur within the team and emerges as a central factor influencing psychological safety. Supportive leadership fosters an environment in which individuals feel comfortable expressing ideas and participating in discussions, whereas more hierarchical dynamics may limit communication and create hesitation (P2, P3, P6, P7, P9, P10, P11, P12, P13, P15, and P16). P12 added: *"that a sense of safety primarily comes from our leader, as they are very understanding and highly supportive of the team."*

In this context, **team autonomy** supports active participation by allowing individuals to propose ideas and organize their work (P1, P7, P8, and P16). P1 stated: *"I had the freedom to suggest new ideas... I could still propose improvements"*, indicating that autonomy encourages participation. Additionally, interaction patterns are shaped by the team's level of familiarity over time. **Team maturity** reduces interaction barriers and supports alignment, as more experienced teams tend to interact more confidently, whereas newer teams may be more hesitant (P4, P5, and P8). P4 explained: *"a team that has worked together longer tends to develop a stronger affinity, and these barriers become smaller. In contrast, in a newer team, people who have just joined may feel somewhat shy when it comes to addressing issues"*, highlighting the role of maturity in participation. Complementing this, **team proximity** enables more open communication and ease of interaction among members (P5 and P13). P5 stated: *"I have a close relationship with them. I can talk about requirements analysis and share everything openly"*, indicating that closer relationships foster communication and engagement in activities.

4.1.4 Organizational Conditions. The identified organizational conditions capture how the organization's structural and cultural aspects shape psychological safety in RE activities. **Company culture** shapes how errors, communication, and accountability are handled, influencing psychological safety in RE. In more punitive environments, individuals may avoid expressing concerns or admitting mistakes because errors are associated with blame (P1, P2, and P10). P2 stated: *"the first step is always to identify who caused the issue..., and then it becomes a lesson learned, and the work continues"*. P1 added: *"I saw cases where a team member failed to deliver a specific feature or component. Instead of treating it as a project issue, they would replace that person, and the individual would be informally 'punished' by being reassigned to tasks they didn't like or that were outside their area of interest"*. These dynamics are reinforced by **competition**, which may limit collaboration and reduce individuals' willingness to seek help or share information (P7 and P9). P7 stated: *"many times, when we faced a problem, we didn't ask other teams for help. It wasn't exactly a conflict, but more a mindset of 'if we solve it ourselves, they will get the credit,' so teams avoided collaborating"*.

In parallel, **productivity pressure** constrains interaction by emphasizing continuous delivery over reflection and discussion. In these contexts, individuals may prioritize speed over questioning requirements or seeking clarification (P1, P7, and P16). P1 stated: *"We kept producing continuously... requirements and products would arrive, we had to implement them, deliver, and move on"*. Finally, these conditions are shaped by **workflow structures**, which define how RE activities are organized and executed (P1, P5, P6, P7, and P9). Well-defined structures can support communication and alignment, whereas poorly implemented processes may limit interaction and coordination. P9 stated: *"they said they followed Agile, but in practice it didn't work very well"*.

4.1.5 Contextual Conditions. The identified contextual conditions capture situational factors that shape interactions beyond immediate team control and influence psychological safety in RE activities.

Hierarchy emerges as a key factor influencing how individuals interact and participate, as formal power structures may limit open discussion and reduce individuals' willingness to question decisions or express concerns (P1, P4, P5, P7, P9, and P12). P12 stated: *"the lack of documentation, combined with hierarchy, has an impact"*. In this context, **job insecurity** further constrains participation, as individuals may avoid disagreement or questioning of decisions to reduce the risks associated with their positions (P12 and P16). P12 stated: *"in some cases, people can be dismissed, as has already happened... This creates a fear of being replaced"*, evidencing that fear of replacement limits participation.

These dynamics are reinforced by **power relationships**, which shape how decisions are negotiated and how freely individuals can express concerns, particularly when one party holds decision-making authority (P7, P10, and P12). P7 explained: *"they were the ones funding the tools we used ...had authority over the process....because of that, I didn't feel comfortable sharing my ideas"*. Similarly, **resistance to change** may limit discussion and reduce individuals' willingness to propose improvements or challenge existing practices (P5 and P12). P5 stated: *"I have participated in meetings with company leaders where we proposed adopting a workflow to improve client processes... he argued that modifications would not be beneficial..., arguing that it would not work given the nature of the clients"*. Finally, **subteams and communication silos** fragment interactions across groups, restricting communication and reducing knowledge sharing (P4, P5, P7, P9, P11, P14, and P16). P14 stated: *"communication silos occur when... team remains separate as well..., there is no interaction between teams"*.

4.1.6 External Stakeholder Interaction. The identified external stakeholder interaction factors capture how stakeholder interactions, particularly with clients, shape psychological safety in RE activities. **Client openness** is a key factor, as clients' receptiveness to dialogue, questions, and alternative perspectives influences practitioners' comfort in discussions. Lower openness may limit communication and willingness to express concerns. P10 stated: *"when it involves adding new features or initiating a new procurement process... they often impose difficulties in accepting changes"*, indicating that a lack of openness can generate insecurity and constrain participation. In this context, **limited stakeholder access** further restricts interaction, as the lack of direct communication with stakeholders, particularly end users, reduces confidence in the understanding of requirements and the willingness to engage in discussions. P1 stated: *"we didn't have direct contact with the end user... I didn't feel confident"*.

4.2 Observable Behavioral Indicators of Psychological Safety in RE

During the interviews, participants reported observable behavioral indicators of psychological safety in RE, addressing RQ1.2: What observable behavioral indicators can be identified as evidence of psychological safety in RE activities? Interviewees were asked to describe situations involving behaviors associated with psychological safety, such as speaking up, asking for help, admitting mistakes, and disagreeing. Through qualitative coding informed by the psychological safety literature [7, 9, 19, 24], these situations were interpreted as evidence for mapping different levels of psychological safety, ranging from psychologically safe interactions to constrained interaction patterns associated with lower psychological safety.

4.2.1 High Psychological Safety. Behaviors associated with high psychological safety in RE include active participation, openness, and collaboration. They reflect environments in which individuals feel comfortable expressing ideas, engaging in discussions, and interacting with others. **Admitting errors** reflects the willingness to acknowledge mistakes during RE activities, supporting learning and continuous improvement. It is associated with environments where errors are treated as opportunities for growth rather than sources of blame (P4, P6, P8, and P14). P6 stated: *"I do not see any problem in admitting a mistake, needing to redo something, or seeking improvement"*. Similarly, P8 explained: *"making mistakes and correcting them is something quite normal"*, highlighting the normalization of errors within the team.

In this context, **asking for help** reflects the willingness to seek support when facing challenges in RE, fostering collaboration and knowledge sharing. It is associated with environments where individuals feel comfortable expressing doubts and relying on others (P3, P4, P5, P6, P8, P10, P11, P12, P13, and P15). P5 stated: *"I always ask for help when I do not know something or when I am facing difficulties"*. Similarly, P6 explained: *"they create a comfortable environment where you can express your opinion"*, highlighting a supportive environment that encourages help-seeking behavior.

Building on these interactions, **expressing disagreement** reflects individuals' willingness to question ideas and engage in constructive debate during RE activities. This behavior supports the exploration of alternative perspectives and contributes to more informed and shared decisions (P3, P4, P5, P6, and P7). P3 stated: *"we were always very open with each other, and agreeing or disagreeing... everyone was thinking in the same direction"*. Similarly, P6 explained: *"I feel very comfortable raising a point, disagreeing, or even admitting that I do not fully understand what I am doing"*.

These exchanges are reinforced by **feedback exchange**, which reflects the willingness to give and receive feedback in RE, thereby supporting alignment and continuous improvement. It is associated with environments where individuals feel safe discussing ideas and collaboratively evaluating work. P6 stated: *"both for discussions and for providing feedback..., I feel in a safe environment"*, indicating that a psychologically safe environment enables open feedback interactions.

Finally, **speaking up** reflects individuals' willingness to openly express ideas and raise questions during RE activities, even when they are uncertain. This behavior supports active participation and continuous dialogue within the team (P3, P4, P5, P6, P8, P11, and P16). P3 stated: *"I have always felt very comfortable saying when I did not understand"*. Similarly, P6 explained: *"we are able to express our opinions, even when we are not entirely confident"*, highlighting that individuals feel safe speaking up even in the face of uncertainty.

4.2.2 Low Psychological Safety. Behaviors associated with low psychological safety in RE reflect constrained interaction, hesitation, and reduced participation. They emerge when individuals feel uncomfortable expressing ideas, engaging in discussions, or interacting openly, often due to fear of negative evaluation, limited openness, or low trust. **Difficulty asking for help** refers to individuals' reluctance to seek support when facing challenges during

RE activities, which limits collaboration and knowledge sharing. P7 stated: *"some people would solve a problem and boast about it... my team sometimes tried to solve problems on our own, without seeking support from others"*, suggesting that social dynamics may discourage help-seeking.

In this context, **difficulty discussing work artifacts** reflects challenges in discussing requirements, particularly when clarification is needed. It is characterized by hesitation to ask further questions despite incomplete understanding, due to discomfort or potential tension in interactions. P1 stated: *"sometimes it was tiring to have to ask for so many explanations"*, suggesting that discomfort with repeated questioning may limit deeper discussion and understanding.

Closely related, **hesitation to speak due to fear of judgment** reflects individuals' tendency to limit participation, avoid repeated questions, and hesitate to express opinions in RE due to concerns about negative evaluation (P1, P5, P6, and P14). P6 stated: *"you become hesitant to express yourself and fear judgment or reprimand"*. P14 added: *"a degree of embarrassment, and a fear of being judged when admitting that I do not know something"*, reinforcing how fear of judgment restricts participation.

This constrained interaction is reflected in **reluctance to admit errors**, which captures hesitation to acknowledge mistakes in RE, limiting discussion and learning. It is often associated with environments where errors are hidden, discouraged, or punished (P1, P2, P5, P7, and P13). P1 stated: *"It was quite difficult to be in a meeting and see someone acknowledge an error, because people tended to hide it"*. Similarly, P2 explained: *"is not well received, because people are afraid to admit errors"*.

Finally, **silence in meetings** reflects individuals' reluctance to participate in discussions, particularly in group settings, limiting the expression of ideas and concerns during RE activities. This behavior is often associated with discomfort, fear of negative evaluation, or a perceived lack of openness in the environment (P2, P3, and P4). P4 stated: *"people feel less secure about turning on the microphone and speaking"*. Similarly, P3 explained: *"was fear of possible consequences, such as even being dismissed"*, highlighting how a lack of psychological safety constrains participation in meetings.

4.3 Consequences of Psychological Safety in RE

During the interviews, participants reported the perceived consequences of different levels of psychological safety in RE, addressing *RQ1.3: What consequences associated with lower and higher levels of psychological safety are perceived in RE activities?* The identified consequences affect communication, collaboration, decision-making, and work outcomes, especially in contexts involving uncertainty, coordination, and problem-solving.

4.3.1 High Psychological Safety. Consequences of higher psychological safety in RE activities include more effective interaction patterns, enabling teams to collaborate, communicate, and make decisions more efficiently. In such contexts, **creativity** emerges as a key outcome, as individuals feel encouraged to propose ideas and improvements. This enables teams to explore alternatives and adapt their practices based on collective input. P16 stated: *"if you have an idea and say, 'I think we can do it this way' it is very unlikely that it will be dismissed"*. The participant further explained: *"I have shared several ideas with the team that were adopted..., so we decided to move forward with them"*.

This openness is closely related to increased **engagement**, as individuals become more willing to participate, ask questions, and contribute to discussions. P15 stated: *"It is also beneficial for the person who asks questions, as it can draw the attention of leadership and show that this individual can express themselves, ask questions, and contribute"*. Building on this, psychological safety enables **experimentation behavior** (P14 and P16), as individuals feel comfortable exploring new approaches and learning from mistakes. P14 stated: *"there is a strong emphasis on experimentation, and I feel comfortable with that"*.

In turn, this environment supports **innovation**, as new ideas are not only proposed but also implemented. P16 stated: *"they give us the freedom to experiment, as well as the freedom to innovate and bring new ideas and creativity"*, highlighting how psychological safety enables the adoption of novel solutions. These interaction patterns also contribute to **job satisfaction** (P10 and P14), as individuals feel comfortable and integrated within the team. P10 stated: *"having a good relationship... helps you feel much better in your job..., you will feel comfortable working within the team"*.

Furthermore, psychological safety enables **knowledge sharing** (P2, P6, and P16), as individuals feel comfortable exchanging information and collaborating across roles. P2 stated: *"the team is highly collaborative..., they exchange information frequently"*, while P6 explained: *"an open environment where I can adapt quickly... good communication, strategies that facilitate knowledge sharing, and mutual support... contributes to a safe environment"*. This continuous interaction also fosters **learning**, as individuals and teams reflect on experiences and improve over time (P5, P6, P8, P9, P10, P11, P13, P15, and P16). P13 explained: *"we focus on identifying what went wrong and learning from it to avoid repeating the same mistakes"*.

At the same time, these conditions increase **motivation**, as individuals feel that their contributions are recognized and valued. P16 stated: *"it gives you the motivation to want to work more"*. Ultimately, these factors contribute to improved **software quality**, as better communication, alignment, and continuous learning reduce defects and enhance system reliability (P4, P6, and P9). P4 stated: *"the number of trivial defects in the application is significantly reduced... when the team is more aligned"*, while P6 explained: *"we know that everything delivered meets quality standards. If any issue arises after delivery, we treat it as an opportunity for learning"*.

4.3.2 Low Psychological Safety. Consequences of lower psychological safety in RE activities include constrained interaction patterns that limit individuals' participation, communication, and engagement. These interaction limitations also result in **communication breakdown**, reflected in unclear, delayed, or less effective exchanges of information during RE activities. P3 stated: *"we used to talk and work throughout the day,... so things that used to feel normal became uncomfortable"*. Similarly, P14 explained: *"communication becomes less effective. Answers that I could get quickly and clearly end up being delayed"*, highlighting how reduced psychological safety negatively affects communication efficiency and clarity.

These communication issues contribute to **disengagement**, as individuals gradually withdraw from RE. It is associated with environments in which repeated disagreements remain unresolved

or openness is lacking (P1, P2, and P6). P1 stated: *"we often had disagreements, which is normal... There were moments when I felt very tired of debating... I would just adjust and deliver"*. In more severe cases, these conditions may lead to **employee turnover**, associated with environments where individuals feel unable to express opinions or contribute meaningfully (P2 and P16). P2 stated: *"the team tends to have high turnover, many people have left... we're told we can express our opinions, but in practice, that doesn't happen"*, highlighting how a lack of openness leads to dissatisfaction and turnover.

These interaction limitations also contribute to **increased rework**, as misunderstandings and misalignment require revisiting previously defined requirements or implemented features (P2, P4, and P10). P2 stated: *"rework happens frequently. It occurs either because the analyst misses details in a use case or because the developer interprets it differently"*. As a consequence, these limitations impact the quality of RE outputs, resulting in **poor requirements quality**. P12 stated: *"the requirements had been poorly defined. I was aware of this, but I didn't feel comfortable approaching them to suggest modifications"*.

These issues accumulate and contribute to **project delays**, as unresolved questions, rework, and limited interaction slow down delivery and disrupt the development process. P14 stated: *"delays occur, information needs to be repeated, or we fail to properly understand certain issues"*, while P15 explained that hesitation to ask questions may lead to *"make mistakes during implementation, which can lead to rework and delays"*. At the same time, these conditions contribute to **reduced knowledge sharing**, limiting information exchange and collaboration among team members. P7 stated: *"since I was still early in my career, I would share my ideas... it felt like 'Who are you to speak about this?"*.

These effects also manifest at the individual level through **reduced productivity**, as individuals become less motivated and less proactive in their work. P7 stated: *"you may not feel like doing the task and become somewhat unmotivated, maybe even a bit sluggish..., it does not impact the quality... you still produce well-done work"*.

4.4 Strategies to Foster Psychological Safety in RE

During the interviews, participants reported strategies and practices to foster psychological safety in RE, addressing *RQ1.4: What strategies or practices can foster psychological safety in RE activities?* The identified strategies promote open interaction and reduce barriers to communication and collaboration in situations involving uncertainty, disagreement, and decision-making.

At a structural level, **defining roles and responsibilities** helps reduce ambiguity and improve coordination by establishing clear expectations among team members. This clarity supports psychological safety by reducing dependency on specific individuals and enabling more predictable interactions. P9 stated: *"we assumed that having a Scrum Master would make everything easier. Previously, a QA also acted as Scrum Master, but when he left, the team lost direction"*, highlighting how unclear role distribution can negatively affect team stability.

Similarly, practices that enhance transparency and alignment also contribute to psychological safety. **Documenting meeting information** ensures that decisions, discussions, and changes are recorded and shared, reducing uncertainty and improving confidence in interactions (P1, P14, and P15). P1 noted: *"I started creating documentation. I documented everything... to justify the changes that were taking place"*, while P14 emphasized that documentation *"helped us improve communication... align it with my own work"*.

Beyond formal structures, participants emphasized the importance of more natural interactions. **Encouraging informal conversations** reduces social barriers and strengthens relationships, making individuals more comfortable expressing themselves during RE activities (P1, P3, P4, P5, P9, and P15). P1 explained that informal moments *organizing a happy hour or informal moments"*, while P3 highlighted that exchanging information and discussing ongoing situations is *fundamental"* for openness.

At the organizational level, **establishing clear and fair policies** provides explicit norms that encourage openness and clarify expectations. These policies reinforce a non-punitive environment and reduce hesitation in participation (P3, P11, and P15). P3 noted that individuals are encouraged to *"we should feel comfortable expressing how we feel... or have doubts"*, while P11 emphasized that such norms *"give a sense of security"*.

In addition, organizations can reinforce positive behaviors by **Implementing a reward and recognition system** that acknowledges contributions and increases motivation. P3 explained that recognition *"it motivates us. It shows that we are doing a good job and that we work well as a team"*, while P16 reported formal reward initiatives that reinforce engagement.

From a process perspective, **implementing agile practices** supports psychological safety by creating regular opportunities for communication and alignment. Practices such as short meetings enable individuals to raise questions and discuss issues promptly. As P8 noted, *"we hold quick ceremonies, such as short check-ins, where if someone has a question about a functionality"*, highlighting how continuous interaction supports openness.

Participants pointed to the role of **Organizing collaborative innovation initiatives**, such as hackathons, in encouraging participation and idea generation. P16 described these initiatives as opportunities where *"Hackathons. The idea is to present a problem to a group, have them work on solutions"*. However, the findings also suggest that their effectiveness depends on broader organizational conditions, particularly trust and perceived job security.

These interactions are further strengthened by **promoting cross-team participation in RE activities**, thereby broadening involvement and enabling knowledge exchange across teams. P8 explained that involving multiple teams allows individuals to share past experiences, noting that *"someone from another team can step in and say, 'I have already solved this in this way"*, thereby preventing redundant work and improving decision-making.

Complementing this, **promoting meetings of integration** provides recurring spaces for discussion, reflection, and alignment. These meetings ensure that individuals feel heard and have opportunities to express concerns. P3 highlighted that such moments *"we felt comfortable, and whether anything unpleasant had occurred"*, while P6 emphasized that even less experienced members *"having these moments for discussion"*.

In line with this, **promoting regular feedback loops** is central to sustaining open communication. Continuous feedback enables

individuals to reflect on their work and reduces fear of negative evaluation (P4, P6, P10, P11, and P15). P4 noted that leadership engagement *"it makes us feel more comfortable speaking up if something is still pending"*, while P15 emphasized that feedback delivered in a supportive manner *"helps you understand where you stand"*.

Beyond interaction practices, participants also highlighted broader organizational support mechanisms. **Providing organizational support structures for well-being** ensures that individuals have access to dedicated teams, channels, and initiatives that support their well-being. P16 described the presence of a "people" team that is *"they are constantly looking after us... monthly campaigns, for example"*, reinforcing a sense of care and security.

Similarly, **providing training and development opportunities** helps individuals build confidence and improve both technical and interpersonal skills required for participation. P15 noted that some individuals *"require specific training, while others do not"*, and emphasized that support can also come from peers, reinforcing a collaborative learning environment.

Finally, at the cultural level, **supporting a no-blame culture** is fundamental to psychological safety. By focusing on problem resolution rather than individual fault, teams reduce fear of judgment and encourage open discussion of mistakes. P3 stated that *"we didn't try to find someone to blame... we just worked to fix it"*, while P4 highlighted a shift toward resolving problems rather than assigning blame.

5 Discussion

This study investigated how psychological safety manifests in RE activities by examining its antecedents, observable behavioral indicators, consequences, and strategies for its promotion. Our findings provide a structured view of psychological safety in RE, highlighting its multi-level nature and its strong connection to both social and technical aspects of software development.

5.1 Situating Findings Within the Literature

Our findings reinforce a central claim: psychological safety in RE is inherently socio-technical. While prior work conceptualizes psychological safety as a team-level construct [7], our results show that, in RE, it emerges from the interplay between social dynamics and technical practices. This extends previous work [8, 14] by demonstrating that RE practices and artifacts can enable or constrain psychologically safe interactions, with practices such as documenting decisions and structuring refinement meetings reducing ambiguity and fostering inclusive participation.

Within the context of psychological safety in RE, which is the focus of this study, we did not identify antecedents related to spontaneous interactions, group, gender, effectiveness, or cultural differences, although these have been reported in studies on psychological safety in SE [2, 27]. In particular, Santana et al. [27] argue that the absence of spontaneous interactions undermines psychological safety, whereas their presence strengthens it. Therefore, although these factors did not emerge in our study, they represent potentially relevant aspects of RE and warrant further investigation. In contrast, we identified antecedents not reported in previous studies on psychological safety in SE [2, 18, 27], including customer openness, limited access to customers, power dynamics, hierarchical relationships, impostor syndrome, and productivity pressure. These antecedents may reflect characteristics specific to RE, as this activity requires intensive interaction with stakeholders, negotiation, and decision-making across multiple organizational levels.

Regarding the consequences, we did not identify factors previously reported by Santana et al. [27], including team reflexivity, team capabilities, and transactive memory systems. According to Santana et al. [27], psychological safety promotes open discussions about failures, fosters innovation, and supports continuous learning, thereby strengthening team effectiveness and technical excellence. In contrast, we identified consequences that were not reported in their study [27], including learning, creativity, and project delays, suggesting that these aspects may be particularly relevant to RE.

We also identified observable behavioral indicators that reflect different levels of psychological safety in RE. While prior studies often treat psychological safety as a latent construct [7], the present study indicates that, in the context of RE, it becomes visible through behaviors such as speaking up, asking for help, admitting errors, and expressing disagreement. In contrast, lower psychological safety is reflected in constrained interaction patterns, such as silence, hesitation to question requirements, and reluctance to engage. These behaviors have been associated with voice and learning in teams in prior work [22, 27], and the present study reinforces and contextualizes these observations within RE activities. To the best of our knowledge, this is one of the first studies to identify observable behavioral indicators of psychological safety in RE. These findings move the assessment of psychological safety from abstract perceptions to observable evidence grounded in practice.

Finally, we identified a set of strategies to foster psychological safety in RE, spanning structural, social, and organizational dimensions. These include defining roles, promoting participation, encouraging informal interactions, and fostering a no-blame culture. Consistent with prior work [3, 22], our findings suggest that psychological safety emerges from the combination of practices rather than isolated interventions. This reinforces the view that psychological safety is a systemic property of the work environment, shaped by multiple interacting factors.

5.2 Implications for Software Researchers and Practitioners

The results of this study offer relevant implications for both the academic community and SE practitioners.

Advancing research on psychological safety in RE. Our findings suggest that psychological safety should be examined in relation to specific SE activities, rather than only at a general team level. Given the intensive communication, negotiation, and decision-making involved in RE, future studies may investigate how psychological safety varies across tasks, roles, and interaction settings, as well as its relationship with outcomes such as requirements clarity, alignment, and stability.

Operationalizing psychological safety through empirical research. Identifying antecedents, observable behaviors, consequences, and strategies provides a foundation for empirical investigations. These elements may support the design of instruments, experiments, longitudinal studies, and mixed-methods studies to better understand psychological safety across RE contexts.

Towards context-aware approaches to psychological safety. Finally, our findings highlight the importance of context-aware approaches. Factors such as team structure, project characteristics, and organizational context may shape psychological safety in RE, motivating future research on how these variables interact to support more adaptive interventions.

5.3 Threats to Credibility and Reliability

In qualitative research, concerns about validity and reliability are typically addressed through criteria of credibility and trustworthiness [10]. These aspects depend on the rigor, transparency, and consistency adopted throughout data collection and analysis.

Internal credibility refers to the extent to which the interpretations accurately represent participants' perspectives within the studied context [25]. A potential threat in this study is interpretive bias, where researchers may unintentionally impose their own assumptions during data analysis. To mitigate this threat, we designed clear and structured interview questions and encouraged participants to provide detailed reflections on their experiences. Additionally, although the first author conducted the primary coding, the other authors were actively involved in reviewing and cross-checking the results through multiple iterative cycles, ensuring consistency and alignment in the interpretation of the data. Another potential threat is participant bias, as individuals may emphasize role-specific aspects (e.g., quality assurance professionals focusing on quality-related concerns). To mitigate this, we included participants with diverse roles and backgrounds in RE, capturing a broader range of experiences.

External credibility concerns the extent to which the findings can be applicable across different contexts [25]. A potential limitation of this study relates to the number, diversity, and experience of participants. In total, we conducted 17 interviews. To mitigate this threat, we followed established recommendations in qualitative research indicating that saturation in semi-structured interviews can be achieved with approximately 12 participants [11], a practice also adopted in prior interview-based studies in SE [8, 10, 20]. Data collection continued until saturation was reached, that is, when no new codes or insights emerged from consecutive interviews. Saturation was monitored during the iterative coding process through constant comparison and refinement of the codebook. Data saturation was reached in the 13th interview and was considered achieved when successive interviews yielded no new codes or required modifications to existing categories, in line with prior qualitative SE studies [8, 10, 21]. In addition, we included participants with diverse backgrounds, experience levels, and roles in RE activities, strengthening the robustness of the findings.

Reliability (dependability) refers to the consistency of the research process over time. To enhance reliability, we followed a systematic, well-documented coding process that included a codebook, iterative refinement cycles, and consensus meetings among the researchers. In addition, all interview data, coding decisions, and materials are available in the supplementary package, allowing transparency and potential replication of the analysis process.

6 Conclusion

This study investigated psychological safety in RE by examining its antecedents, observable behavioral indicators, consequences, and strategies for its promotion. Based on practitioners' perspectives, we provide an empirical understanding of how psychological safety manifests in RE activities. Our findings indicate that psychological safety is a socio-technical phenomenon emerging from the interplay between interpersonal dynamics and technical practices. We also identify observable behavioral indicators that make psychological safety visible through interaction patterns, moving beyond perception-based assessments. In addition, the results suggest that psychological safety is associated with key RE outcomes, including engagement, knowledge sharing, learning, and software quality. At the same time, its absence is linked to disengagement, communication breakdown, rework, and project delays.

We further identify strategies that may foster psychological safety in RE, spanning structural, social, and organizational dimensions. These findings suggest that psychological safety should be understood as a systemic property supported by complementary practices, such as role clarity, continuous communication, feedback mechanisms, and a no-blame culture. This study contributes to research by providing a structured view of psychological safety in RE, helping bridge the gap between general psychological safety literature and its application in SE. For practitioners, our findings offer actionable insights to support collaboration, improve requirements quality, and enhance project outcomes. As future work, we plan to investigate further how psychological safety evolves in RE activities and to develop and evaluate instruments and guidelines to support its assessment and promotion. We also encourage future research to explore its relationship with objective project outcomes and across different software development contexts.

Artifact Availability

The raw data and all the steps necessary to reproduce the study are detailed in the supplementary material located at https://doi.org/10.5281/zenodo.21420222.

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