

REPORT 3

Artifact for Analyzing, Understanding, and Proposing Trends through Wearable Sensors to Ensure Psychological Safety

[ANONYMIZED REPORT – NO IDENTIFYING INFORMATION]

Abstract

Psychological safety was defined by Amy Edmondson as the “belief that the environment is safe for interaction and expression without fear of judgment or retaliation.” In agile frameworks, communication and expression are part of the success factors and are often hindered by psychological and psychosocial factors. This study aims to understand how psychological safety can affect the performance of team members in agile teams.

1. Introduction

Schein and Bennis (1960) describe psychological safety as the degree to which people feel confident and secure in their abilities to cope with change. Psychological safety has been researched in terms of its causes and effects across multiple contexts. In contemporary organizational environments, psychological safety has become a crucial theme for team success and well-being.

Psychological safety in agile teams is particularly important due to the need for open and honest communication and collaboration, accountability, and innovation within agile contexts. Teams must be able to take risks and make decisions without fear of retaliation.

This study seeks to understand the concept of psychological safety and its antecedents, as well as its relevance for agile teams. The methodology adopted is a literature review covering scientific articles, books, and reference materials on psychological safety. Data analysis is qualitative, focusing on identifying patterns and trends in the reviewed research.

Section 2 presents the theoretical foundations for understanding psychological safety in agile cultures; Section 3 presents the

state of the art. In Sections 4, 5, and 6, two speculative design tools are used to generate ideas for possible futures addressing the proposed problem, starting from an understanding of where we are, moving toward where we are going, and considering epistemological observations and the literature review. Section 6 presents where we want to arrive based on the ideas generated through speculative design, including the speculation of technologies that could address the problems identified in the theoretical foundations and state of the art.

2. Theoretical Foundations

Gren, Goldman, and Jacobsson (2020) present an agile approach to software project management and team practices from a psychological perspective. The authors show that agile practices are closely linked to team maturity. Based on a sample of 34 groups and 200 respondents across two countries, they concluded that groups with lower maturity applied fewer agile practices and failed to meet stakeholder expectations. Groups with higher maturity demonstrated better implementation of iterative development and greater responsiveness to change.

Team maturity can be defined by the level of development of its members in terms of interpersonal skills, their ability to work together, and their capacity to manage conflicts effectively (Schein & Schein, 2019).

Agh and Ramsin (2021) show that Scrum, although prescriptive regarding ceremonies, does not specify exactly how interactions should be implemented, leaving it to the Scrum Master to manage communication and interactions. The methodology is not capable of defining all relevant variables and situations, especially those related to interpersonal relationships.

As a high-level framework, Scrum allows activities, roles, and outputs to be developed in any domain, regardless of the delivered product. However, it does not explicitly address daily psychological and psychosocial aspects. Issues such as product maintainability, scalability, adaptability, and the explicit communication of value may not be perceived by developers. These observations reinforce that communication and openness are fundamental to successful delivery.

Catlin and Watkins (2021) emphasize culture as a key factor in agile implementation. They raise questions that directly or indirectly influence decision-making and may be grounded in the individual's level of psychological safety. Key aspects highlighted include:

- The "tone" used among individuals across organizational hierarchies;
- How responsibility is assigned;
- Whether conflict-of-interest policies, risk management, job descriptions, training, certifications, and strategic plans are updated and communicated;
- Whether codes of ethics and conduct are established, communicated, followed, and aligned with organizational mission, vision, objectives, and values;
- How reporting and supervision are handled;
- Whether communication and information flow are transparent across all organizational levels;
- The level of urgency within the organization.

Hall (1980) defines culture as a system of communication shared by a group of people. Hofstede (1980) defines culture as the collective mental programming of a group, manifested in habits, values, norms, and institutions. Culture fosters a sense of belonging, facilitating interpersonal relationships that act as antecedents of psychological safety, such as communication and openness.

Communication is directly linked to openness and autonomy. These aspects were explored by Alami, Zahedi, and Krancher (2023), who identified several antecedents of psychological safety through semi-structured interviews.

Key antecedents include:

- **Individual characteristics:** personality, values, beliefs, and prior experiences;
- **Interpersonal factors:** team dynamics, communication, collaboration, and feedback;

- **Leadership:** leadership style, empathy, openness to feedback, and promotion of inclusive environments;
- **Organizational factors:** organizational culture, policies, hierarchical structures, and management practices;
- **Work context:** type of work, performance pressure, ambiguity, and uncertainty.

3. State of the Art

Psychological safety has become a relevant topic in organizational environments, especially in agile teams and innovation contexts. Research explores its nuances, impacts, and strategies for fostering it.

Edmondson (1999) defined psychological safety as a shared belief that team members can take interpersonal risks at work without fear of negative consequences. Schein (1990) considers psychological safety part of organizational culture, where individuals feel free to express ideas, take responsibility, and learn from mistakes.

Alami, Zahedi, and Krancher (2023) investigated antecedents of psychological safety in agile software development teams using a mixed-methods approach. The qualitative phase involved 18 software professionals from different countries and contexts, addressing topics such as safety experiences, error admission, and support for initiative-taking. The analysis generated codes and patterns used to formulate hypotheses for the quantitative phase.

The quantitative phase involved a survey with 43 questions, validated through a pilot test. The results indicated that openness, autonomy, leadership support, and collective decision-making promote psychological safety. Openness was identified as crucial when team members are willing to listen to and experiment with others' ideas and accept criticism.

The hypotheses proposed by Alami, Zahedi, and Krancher (2023) include:

- Leadership ownership of psychological safety;

- Team autonomy;
- Collective decision-making;
- Allowing time off;
- Adoption of engineering practices as safety nets;
- Non-blaming of errors;
- Openness.

The results show that collective decision-making, non-blaming of errors, and openness are the most impactful factors, strongly correlated with high levels of psychological safety.

4. Where Are We?

Technological advances in artificial intelligence, machine learning, data lakes, IoT, programming languages, and infrastructure have been significant. However, humans—who orchestrate these technologies—are often not the central focus.

Information systems technologies are frequently designed to solve business problems or generate competitive advantage. The growing adoption of agile frameworks aims to deliver value rapidly, sometimes placing financial opportunity ahead of human considerations.

Diagnoses of work-related stress, anxiety, panic, and depression have increased. Work-related mental disorders are the third leading cause of work leave, with management models potentially linked to the lack of psychological safety (Pereira & Scatolin, 2020).

Psychological safety remains poorly disseminated in organizational environments, often due to lack of awareness or because people are not seen as part of organizational strategy. Understanding psychological safety levels could open opportunities for professional development, creativity, and problem-solving.

The speculative design tools *Future Scenario Maker* and *Innovation Map* were used in subsequent sections.

5. Where Are We Going?

Without proper attention, the lack of psychological safety restricts expression, idea generation, conflict resolution, and responsibility-taking (Alami, Zahedi & Krancher, 2023).

Leadership styles may overload more collaborative employees, while less expressive or less experienced team members may be harmed both technically and personally.

Currently, there is limited technology to assess these behaviors conclusively. However, biological signal measurement technologies—such as heart rate, blood pressure, stress, and energy levels—can contribute to anticipating psychological and technical damage caused by poor leadership relationships.

6. Where Do We Want to Go?

Using the *Future Scenario Maker*, a speculative AI system called **EmotionAI Revolution** was envisioned for 2045. This system uses wearable sensors to detect not only emotions but also real-time psychological indicators related to psychological safety.

These sensors could be embedded in wearables such as watches, rings, earrings, pendants, hair accessories, or ties. They would collect data on temperature, breathing, hormones (e.g., cortisol, dopamine), pressure, and other indicators, storing them in individual historical databases.

With data cross-analysis, the system could identify trends and assess whether interactions are affected by psychological safety antecedents. Individuals could optionally share insights with organizations to support leadership development, innovation, and prevention of mental disorders.

Using the *Innovation Map*, a further speculative technology was proposed: brain-to-brain communication devices to translate emotional states empathetically and reduce communication barriers.

Governance frameworks, ethical policies, and updated data protection, labor, and civil laws would be required to prevent misuse, privacy invasion, or coercion.

7. Conclusion

Through speculative design tools (*Innovation Map* and *Future Scenario Maker*), this study proposed scenarios in which psychological safety could be analyzed, understood, leveraged, and regulated through emerging technologies. Such approaches could generate strategic, tactical, and operational benefits for organizations that ensure high levels of psychological safety.

Although current wearable technologies remain limited, advances in microprocessors suggest future possibilities for highly integrated and mobile sensing systems.

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