Integrating Polyvagal Theory With Agile Project Management

Geoffrey VanderPal
Purdue University Global

Randy Brazie
Purdue Global
University of Texas-Tyler

The modern project management environment has become more complex due to various influences. For instance, stress and trauma are recognized as powerful influences on employee behaviors and decision-making. Although past studies have attempted to understand the psychology behind this phenomenon, scarce research has been performed on the influence of the autonomic nervous system on project management outcomes. Accordingly, this paper investigates the underlying nervous system responses that shape project management activities in different organizations. It relies on the Polyvagal Theory to elucidate the neurobiological responses that emerge when project managers are faced with stressful, dangerous or life-threatening situations. Thus, the paper can offer feasible recommendations for optimizing project management outcomes by strengthening the link between the heart, mind, and body.

Keywords: Polyvagal Theory, Polyvagal ladder, autonomic nervous system (ANS), stress, trauma

INTRODUCTION

The field of project management has continuously evolved to embrace more adaptive and human-centered strategies or methodologies, predominantly reflected in agile practices. At the same time, Polyvagal Theory continues to offer groundbreaking insights into the neurophysiological basis of social behavior, stress responses, and the fundamental need for safety within the field of neuroscience. The paper was written to bridge these seemingly disparate domains, proposing a novel interaction of PVT within project management and agile strategies. By exploring the transdisciplinary knowledge and nature of PVT, the work delivers into how evolutionary and neurophysiological insights can profoundly influence team dynamics, stress management, and overall project success. Agile project management, known for its flexibility and responsiveness, benefits heavily from iterating and incorporating the deep human-centric insights provided by PVT. This integration promises to enhance efficiency and adaptability in managing projects and offer a more profound understanding and support of the human elements that drive project success.

Background on PVT

Originally developed by Dr. Stephen Porges, PVT provides a fascinating lens through which we can understand the human autonomic nervous system, especially regarding stress response and social

engagement. It suggests that our physiological state significantly influences how we interact, communicate, and collaborate with others – fundamental aspects in agile environments. According to Clarke and Gans (2019), the Polyvagal Theory, as developed by Dr. Stephen Porges, delineates a nuanced understanding of the human autonomic nervous system, focusing on three distinct evolutionary stages of response. As Clarke and Gans (2019) describe, the first stage is Immobilization, mediated by the dorsal vagus nerve. This stage represents the body's primal reaction to extreme danger, leading to a freeze response - a state of numbness and shutdown, contrary to merely slowing down. Clarke and Gans (2019) elaborate that this response is an overdrive of the parasympathetic nervous system, reflecting a deep-rooted survival mechanism. Progressing in the evolutionary hierarchy, the second stage, termed Mobilization by Clarke and Gans (2019), engages the sympathetic nervous system. This stage prepares the body for action - either to flee or fight in the face of danger, characterized by an adrenaline-fueled response. Clarke and Gans (2019) highlight this as an advancement over the immobilization response, demonstrating the body's adaptability to environmental challenges. The third and most evolved stage, as explained by Clarke and Gans (2019), is Social Engagement, governed by the ventral vagal pathway. This stage is activated in safe environments, facilitating calm, connection, and engagement. Clarke and Gans (2019) emphasize that this response underlines the importance of safety and social bonding for cooperative interactions. Through these stages, Clarke and Gans (2019) underscore the intricate design of our autonomic responses, offering a comprehensive framework to understand human behavior in various contexts, including agile project environments.

Overview of Agile Project Management

Agile Project Management (APM) represents a paradigm shift in how projects are managed and executed. As Arefazar et al. (2019) highlight, APM is characterized by its highly iterative and incremental process. Bergmann and Karwowski (2018) further explain that this approach involves close collaboration between stakeholders and developers to understand the domain, determine requirements, and prioritize functionalities. APM consists of numerous rapid iterative planning and development cycles, allowing for constant evaluation of interim results and subsequent adjustments based on users' and stakeholders' evolving needs and desires. Ideally, APM is a methodology that emphasizes customer value through adaptable planning, rapid feedback, continuous improvement, and high collaboration and engagement of project members. This methodology has evolved from various agile methods developed specifically for the software industry, such as Scrum, Lean Software Development, Crystal, and others, culminating in creating the "Manifesto for Agile Software Development" in 2001 (Arefazzar et al., 2019).

Furthermore, Arefazar et al. (2019) note that despite the diversity in agile methodologies, they all share primary objectives. These include replacing upfront planning with incremental planning, building quality from the onset, addressing technical risks early, and delivering continuous business value. This approach is conducive to immediate modifications of the product as new requirements emerge, thus ensuring a continuously refined product by the entire project team, including stakeholders. The growing trend of agile project management is significant, with a substantial percentage of projects worldwide being driven agilely. As Arefazar et al. (2019) and Bergmann and Karwowski (2018) suggest, agile methodologies pivot around principles such as entrusting and empowering staff, encouraging ongoing communication between business areas and project team members, and enhancing client involvement. These principles align well with project environments' dynamic and often unpredictable nature, ensuring that agile teams can respond swiftly and effectively to changing requirements and external factors. In summary, APM, as detailed by Arefazar et al. (2019) and Bergmann and Karwowski (2018) offers a flexible, responsive, and collaborative approach to project management. It is particularly well-suited to environments where requirements are fluid and stakeholder and customer engagement is paramount. The agile approach facilitates a deeper understanding and quicker adaptation to changing needs and fosters a culture of continuous improvement and team collaboration.

Rationale for Integration

To comprehend the application of Polyvagal Theory (PVT) in Agile Project Management (APM) environments, it is essential to recognize how these environments impact the human element. Project management, inherently associated with high stress, social and psychological challenges, demands a nuanced understanding of human responses. Govindaras et al. (2023) articulate the high-pressure nature of project teams' work environments. A project, defined as a time-bound endeavor to meet the requirements of diverse stakeholders, faces the constant challenge of balancing the iron triangle of timeline, scope, and budget. This balancing act, prevalent in various methodologies from Waterfall to Agile, inevitably increases stress. Organizations often stretch budgets, expand project scopes, reduce timelines, and intensify focus on quality, which can exacerbate stress levels. As a result, creating a sustainable environment to mitigate burnout and attrition becomes critical. Strategies to foster a healthy work environment, such as promoting work-life balance and providing necessary support and resources, are vital in building a sustainable climate that minimizes fatigue and turnover in project management teams.

Stress in the project management environment can significantly impact decision-making and leadership. Project managers, often viewed as leaders due to their role in guiding and coordinating teams, face challenges in maintaining effective leadership under stress. Their capacity to provide vision and direction while meeting project objectives is crucial. However, as Jepson et al. (2017) highlight, negative psychological influences can undermine decision-making abilities and the effectiveness of leadership strategies. Traditional leadership theories have focused predominantly on the leader's traits, but emerging research underscores the importance of context, including the managers' intellectual and personal attributes and interpersonal relationships. Jepson et al. (2017) further note that project managers with varied personalities perceive risk and other project factors differently, thus influencing their leadership strategies and project outcomes. Given this backdrop, the role of PVT becomes increasingly relevant in the APM environment. By understanding the neurophysiological responses to stress and social interactions, as explained by PVT, project managers can better navigate the high-pressure landscape of project management. The insights from PVT about the human autonomic nervous system's response mechanisms can guide project managers in fostering an environment conducive to reducing stress and enhancing team performance. This understanding can also aid in developing leadership strategies responsive to the varied personalities and perceptions within a project team. Therefore, integrating PVT into APM has the potential to enhance project outcomes and contribute significantly to the well-being and effectiveness of project teams. This paper seeks to delve deeper into these aspects to bridge the gap between neuroscience and project management. By exploring the influences of cognitive and somatic psychology on project management activities and outcomes and the role of PVT in shaping leadership strategies and decision-making processes, this investigation aspires to provide crucial insights for the evolution of APM practices.

The impetus for integrating Polyvagal Theory (PVT) with Agile Project Management (APM) stems from a shared focus on adaptability, human-centeredness, and responsiveness to change. While APM revolutionizes project management with its iterative processes and stakeholder collaboration, as detailed by Arefazar et al. (2019) and Bergmann and Karwowski (2018), PVT offers groundbreaking insights into the neurophysiological underpinnings of human behavior, particularly in terms of stress responses and social engagement, as elucidated by Clarke and Gans (2019).Integrating PVT within the agile framework is more than a mere theoretical exploration; it is a practical approach to enhancing the human elements in project management. PVT's understanding of the autonomic nervous system's evolutionary stages – immobilization, mobilization, and social engagement – aligns closely with the dynamic and often unpredictable nature of project environments that APM addresses.

By applying the principles of PVT, agile teams can gain a deeper understanding of team dynamics, stress management, and the importance of creating a safe and supportive environment for collaboration and innovation. Moreover, the principles of APM, with their emphasis on continuous improvement, adaptability, and stakeholder engagement, provide an ideal platform for applying PVT insights. The neurophysiological understanding of PVT can significantly enhance the way agile teams interact, make decisions, and respond to stress, leading to more effective communication, improved team cohesion, and increased overall project success. In essence, this integration promises to advance the efficiency and

adaptability of managing projects through APM and deepen the understanding and support of the human factors that are fundamental to project success. It is an exploration into how transdisciplinary knowledge, encompassing evolutionary and neurophysiological insights, can profoundly influence project management outcomes. This paper aims to bridge the gap between neuroscience and project management, proposing innovative strategies for applying PVT within agile methodologies to foster more resilient, responsive, and emotionally intelligent project teams.

Paper Purpose and Structure

The primary purpose of this paper is to explore the integration of Polyvagal Theory (PVT) with Agile Project Management (APM) and its implications for enhancing project management practices. This investigation is driven by the recognition that modern project management faces complex challenges, including stress and trauma, which significantly impact employee behavior and decision-making processes. Despite extensive research in psychological aspects, there has been limited exploration into how the autonomic nervous system influences project management outcomes. Therefore, this paper aims to bridge this gap by applying the insights of PVT, which focuses on the neurophysiological basis of social behavior and stress responses, to APM's dynamic and adaptive nature.

The outline of the paper is structured to facilitate a comprehensive understanding of both PVT and APM and their intersection:

1. **Introduction**: This section provides an overview of the evolving landscape of project management and the emerging importance of understanding the autonomic nervous system's role in this context.
2. **Background on PVT**: Here, we delve into the origins and key concepts of Polyvagal Theory, elucidating its relevance in explaining the autonomic nervous system's role in human behavior, particularly under stress.
3. **Overview of Agile Project Management**: This part outlines the principles of APM, highlighting its iterative and collaborative approach, and its suitability for today's rapidly changing project environments.
4. **Rationale for Integration**: This segment discusses the need for integrating PVT with APM, focusing on how this integration can address project management's psychological and physiological aspects.
5. **Literature Review**: A comprehensive review of existing literature is presented to lay the foundation for the paper's primary thesis, examining key studies and findings related to PVT and APM.
6. **Discussion on the Integration of PVT and APM**: This crucial section explores how the principles of PVT can be applied within the context of APM to improve team dynamics, stress management, and overall project success.
7. **Conclusion**: The paper concludes by summarizing the key insights gained from integrating PVT with APM and outlining potential future research directions and applications in project management.

Through this structured approach, the paper aims to provide a novel perspective on project management, emphasizing the importance of considering the autonomic nervous system's role in shaping effective project management strategies.

LITERATURE REVIEW

The Polyvagal Theory

The Polyvagal Theory can be traced to Charles Darwin's theories of evolution. In 1872, Darwin emphasized a significant relationship between the heart and the brain that allows for mutual action and reaction between the two most important organs of the human body (Porges, 2009). Therefore, the Polyvagal Theory introduced a new approach to explaining the correlation between autonomic nervous functions and human behaviors. Stephen W. Porges founded the concept in the 1990s (Schoeter, 2017).

Porges is a prominent neuroscientist specializing in the neurobiology of human behavior. According to Porges (2007), the theory offers a new approach for identifying the neural circuits involved in regulating a person's autonomic state and interpreting the adaptive responses when faced with different levels of threats. Although many neurophysiological models and technologies are designed to explain the neural circuits controlling a person's autonomic state, the Polyvagal Theory emerged as a reliable approach for linking the heart, mind, and body (Porges, 2007). The theory offers groundbreaking contributions to the modern understanding of human nervous system functions and their importance for regulating the visceral or autonomic nervous systems (ANS).

Theories involving the ANS have evolved significantly over the years. Schroeter (2017) states that the ANS underwent three key evolutionary stages. The first stage, characterized as the most ancient concept, is shared by humans and reptiles and referred to as "the lizard brain" (Schroeter, 2017). It implied that the ANS was primarily responsible for reproduction and feeding in order to manage oxygen and the transportation of resources across the body. The subsequent stage, the sympathetic system, manifests in higher-level mammals, often likened to "the mouse brain" (Schroeter, 2017). This phase is based on discovering more sophisticated responses enabling mobility for defense, reproduction, and feeding. Finally, the third stage, displaying the highest level of refinement and complexity, is predominantly developed in humans. This particular realm, often denoted as the "new" domain, has been the primary focus of Porges' examination, profoundly shaping humanity's comprehension of the ANS's functioning. It offers a more comprehensive elaboration of the responses supporting cortical development and social interactions in different environments. Hence, theories surrounding the ANS emphasize the existence of a hierarchical structure for determining a human being's response toward safe and dangerous situations.

Various theories have been conceptualized for several decades linking the central nervous system to autonomic nervous functions. The outdated view of the autonomic nervous system was based on the assumption that the visceral system is a dual antagonistic system with two main responses resembling a see-saw (Schroeter, 2017). On one end, the first system focuses on hyperarousal to dangers that are not life-threatening, while the second system focuses on hyperarousal to life-threatening dangers. Nonetheless, Porges's theory highlights that the ANS has three critical branches. The third branch supports social engagement as a new and evolutionary branch of the visceral system (Schroeter, 2017). The three circuits provide a comprehensive response system for regulating human behaviors and their psychological adaptation to safe, dangerous, and life-threatening situations.

Another important concept in the Polyvagal Theory is neuroception. The ANS enables ongoing monitoring and adjustment of bodily functions, contributing to maintaining internal equilibrium through homeostasis and neuroception (Porges, 2022). It has a pivotal role in preserving internal balance and overall well-being. Regulating vital functions without conscious intervention fosters the harmonious collaboration of various bodily systems to support optimal health. The Polyvagal Theory postulates that assessing risk and safety within the nervous system can elicit automatic adjustments in the autonomic state, even without conscious awareness. To emphasize this neural mechanism of discerning safe, perilous, or life-threatening elements in the environment and internally, the concept of "neuroception" was introduced (Porges, 2021). The detection of threats is a common trait among vertebrate species. Still, mammals possess an expanded neuroception capacity, enabling them to respond instantaneously not only to threats but also to indicators of safety (Porges, 2021).

The Branches of the Autonomic Nervous System

The autonomic nervous system (ANS), or the visceral system, explains the intricate network of nerves responsible for regulating and controlling internal organ functions. Operating subconsciously, it governs essential processes such as heart rate, digestion, respiration, blood pressure, and temperature regulation (Porges, 2011). It comprises two primary divisions, namely the sympathetic nervous system (SNS) and the parasympathetic nervous system (PNS), that coordinate the body's responses to different situations. The SNS activates the fight-or-flight response, preparing the body for action during times of stress or perceived threats. Conversely, the PNS triggers the "rest-and-digest" response, fostering relaxation and facilitating restorative processes (De Looff et al., 2018). Functioning through an intricate web of nerves that link the

brain, spinal cord, organs, and glands, the visceral system ensures a continuous exchange of signals and feedback between the central nervous system and the body's internal structures.

In addition, the vagus nerve, known as the polyvagal nerve due to its dual pathways, consists of the dorsal vagus and the ventral vagus (Dana, 2018). These pathways diverge at the diaphragm and exhibit distinct anatomical and functional characteristics. Both branches originate nearby within the medulla oblongata, the part of the brain stem that connects to the spinal cord. The dorsal vagus, the older component of the autonomic nervous system, emerges from the dorsal nucleus of the vagus. On the other hand, the ventral vagus, the newer part of the autonomic nervous system, originates in the nucleus ambiguous (Dana, 2018). Although the dorsal and ventral vagal fibers exit the brain stem together, they follow separate courses above and below the diaphragm. The region below the diaphragm, known as the subdiaphragmatic region, is primarily associated with the dorsal vagus. Conversely, the area above the diaphragm, the supradiaphragmatic region, is predominantly influenced by the ventral vagus (Dana, 2018). These components are essential for controlling the mobilization and immobilization of the human body when exposed to an intense threat.

Social Engagement

In the ventral vagal state, the Social Engagement System takes precedence. This system emerges through the cranial nerve pathways connecting the face, head, and ventral vagus in the brainstem (Dana, 2018). The integration allows close alignment between the brain and heart. The Social Engagement System serves as a means to detect and respond to safety cues. From birth, this "safety circuit" regulates behavior ranging from social engagement to vigilance (Dana, 2018). It communicates safety signals and extends invitations for connection through various cues, including the tone of voice, facial expressions, and head movements. Acting as a surveillance system, the Social Engagement System assesses the cues perceived from another person's face, voice, and gestures to determine if they indicate safety or danger (Dana, 2018). When the cues indicate safety, it affirms the possibility of connection. However, if the cues indicate danger, it shifts into heightened watchfulness. Through the Social Engagement System, human beings can discern whether others are approachable and friendly or if they pose a threat.

Mobilization

The sympathetic nervous system (SNS) is primarily responsible for mobilizing the body in response to emergencies or stressors. It prepares the body by increasing cardiac output, activating sweat glands for skin protection, and inhibiting the metabolically demanding gastrointestinal tract (Porges, 2001). The SNS is evolutionarily linked to the spinal cord segmentation, with preganglionic sympathetic motor neurons located in the spinal cord. Traditionally associated with emotion and stress, the sympathetic nervous system has been labeled as "sympathetic" to differentiate it from the parasympathetic nervous system, which is associated with guarding against one's feelings (Porges, 2001). Compared to the Dorsal Vagal Complex (DVC – see below), which involves the project managers' immobilization response to life-threatening threats, the SNS activates when it perceives danger that requires the flight-or-fight response.

Immobilization

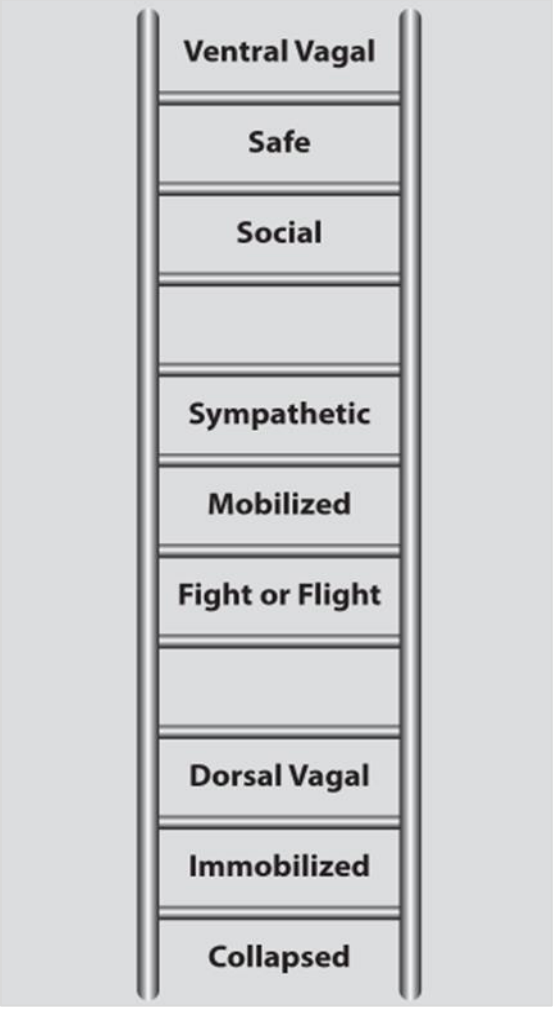
In comparison, the dorsal vagal complex (DVC) is primarily associated with immobilization. Its primary objective is to control digestive functions, taste perception, and responses to low oxygen levels in mammals (Porges, 2001). When an individual perceives a significant threat or danger, the DVC is activated and triggers physiological responses to conserve energy and minimize harm. These responses include decreased heart rate, blood pressure, respiration, and overall body activity. The immobilization response observed in the face of a life-threatening threat is an important characteristic of the DVC, akin to the freeze or stillness observed in reptiles. This state is believed to be an adaptive mechanism to protect oneself when fight-or-flight responses are not feasible. Under normal conditions, the DVC maintains gut function and supports digestion processes. However, if the DVC becomes overactive or over-regulated, it can contribute to pathological conditions such as excessive gastric secretion leading to ulcers or the development of colitis

(Porges, 2001). In conclusion, the DVC can cause project managers to freeze when faced with intense threats that significantly harm their lives.

The Polyvagal Ladder and Stress Responses

The Polyvagal Ladder is a graphical depiction employed within the framework of the Polyvagal Theory to visually convey the hierarchical arrangement of the autonomic nervous system (ANS) and its impact on human beings' physiological and behavioral reactions. This ladder symbolizes three distinct states that humans shift between based on their perception of safety or threat. At the bottom of the ladder is the "immobilization" state, commonly referred to as the freeze response. A heightened perception of threat marks this state and manifests as bodily shutdown or paralysis, akin to the behavior observed in reptiles. In comparison, at the middle position on the ladder is the "mobilization" state, also known as the fight-or-flight response. Within this state, the body readies itself for action and responds to perceived threats by mobilizing energy for physical exertion or defensive reactions. Lastly, at the pinnacle is the "social engagement" state, characterized by a sense of safety, connection, and the capacity to interact with others. In this state, the autonomic nervous system actively supports social behaviors, encompassing effective communication, cooperation, and empathy.

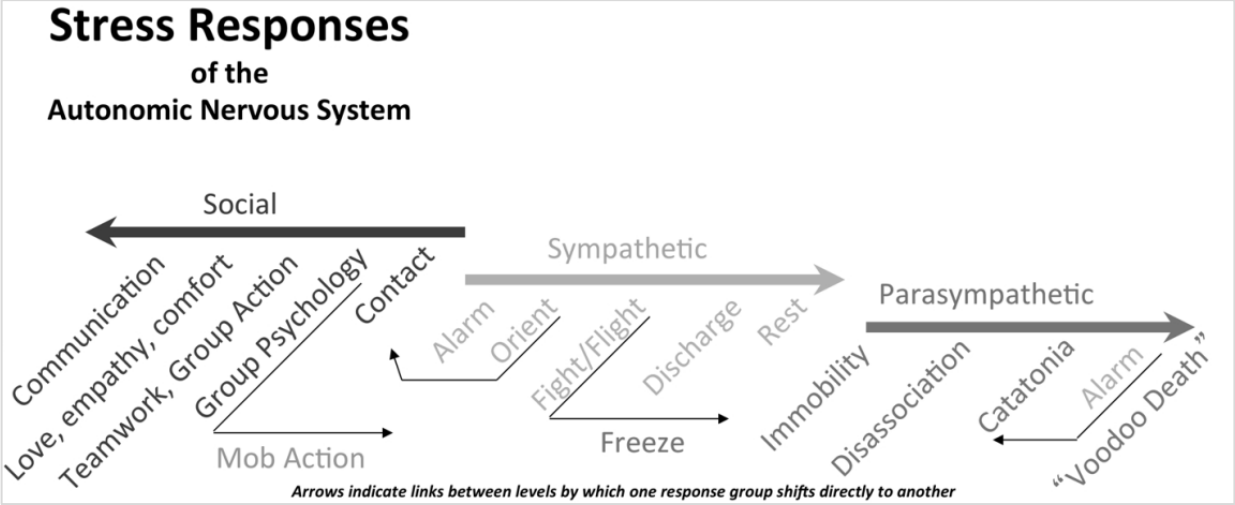
FIGURE 1
POLYVAGAL LADDER



(Dana, 2018)

The theoretical framework for investigating the stressors affecting project management is investigated by the Polyvagal Theory. The theory has evolved significantly over the years, allowing it to explain various employee behaviors. The three levels of the Polyvagal Ladder can be categorized according to the social, sympathetic, and parasympathetic states, as illustrated in the figure below. The framework is essential for categorizing project managers' responses to stress and other negative psychological influences.

FIGURE 2
FRAMEWORK FOR INVESTIGATING THE IMPACTS OF STRESS DERIVED FROM



Schroeter, 2017

Project Success Inhibitors in Agile Project Management

Significant research has been performed highlighting the negative impacts of stress on project management outcomes. For instance, Bowen et al. (2020) argue that occupational stress is strongly associated with reduced employee performance. In modern project management environments, most workers are expected to complete demanding tasks with limited resources, which can be a major source of stress for the project manager. Research reveals that although external factors can trigger stress within a worker, the most likely cause of stress is work-related problems (Patching & Best, 2014). Similarly, Bowen et al. (2020) explain that the project-driven nature of the sector encourages stakeholders to demand that projects are delivered on time, within the required standards, and within the stipulated budget. These requirements tend to exacerbate workplace work pressures, stress, and uncertainty (Bowen et al., 2020). In other cases, it can lead to employee conflicts. Thus, stress is a critical barrier to achieving optimal project management outcomes, leading to reduced employee productivity and organizational performance. Stress can also adversely affect project managers' interpersonal outcomes. According to Ahmad et al. (2022), leadership is considered the most vital soft skill for project managers because it allows an individual to avoid consistent project failures and deal with uncertainty in their respective environments. Harms et al. (2016) support this argument. The authors posit that stress and leadership are inextricably linked to each other. While some groups believe that stress is the most important moment for allowing a leader's true character to shine, others argue that stress is essential for nurturing essential leadership competencies (Harms et al., 2016). Despite these arguments, excessive stress levels tend to negatively affect employee outcomes. In conclusion, stress reduces employee job satisfaction and contentment with the undertaking.

In addition, it is essential to mention that some industries are more susceptible to stress than others. For instance, project management in the construction industry requires workers to deal with inadequate project information, poor flow of communication, onerous paperwork, and excessive workloads (Bowen et al., 2020). These factors are leading causes of stress in the sector. Furthermore, workers also need to cope with a lack of autonomy, organizational bureaucracy, and low levels of rewards (Bowen et al., 2020). Jepson et

al. (2017) outlined similar findings in their study, which claimed a significant relationship between occupational stress and poor work-life balance, the need to 'prove oneself' and support from their superiors during demanding work situations (Jepson et al., 2017).

Furthermore, job burnout is another common characteristic of the construction sector. Construction project managers are often required to complete many complicated and variable tasks with limited time (Wu et al., 2019). As a result, they frequently face multiple pressures from their projects and interpersonal relationships, which amplify negative feelings such as emotional exhaustion, low productivity, and cynicism (Wu et al., 2019). Although the project management sector is recognized as a high-stress working environment that poses different impacts on employees' emotions and behaviors, construction is recognized as one of the most stress-inducing work environments for project managers. Other stress-inducing project management industries include the Information and Technology and healthcare sectors. Pinto et al. (2014) explain that the IT sector is characterized by high employee burnout due to issues involving their projects' demands, control, and support. In addition to these issues, IT project managers often handle fast-paced and dynamic projects with endless constraints and problems throughout their lifecycle, thereby worsening conflict and stress in their professions (Pinto et al., 2014). Burnout tends to have dysfunctional outcomes on employees through increased turnover, absenteeism, and reduced work performance. As a result, these issues negatively affect the employee's productivity and the organization's overall outcomes (Pinto et al., 2014). Other project management professions that involve high stress levels and burnout include the nursing and healthcare industries. Concerning the healthcare industry, burnout is often associated with low levels of organizational commitment, decreased job satisfaction, and reduced creativity, innovation, and problem-solving (Pinto et al., 2014). In brief, the IT and healthcare sectors are renowned for high levels of stress and burnout, which can negatively affect the employees' autonomic state.

In addition, the project manager's stress levels can be caused by intrinsic factors such as personal motivation, social expectations, or the desire for more control in a project. Research reveals that personal ambition and social expectations can influence a project manager's stress levels (Jepson et al., 2017). While personal motivation can drive project managers to excel and achieve their goals, it can also increase stress. High personal expectations and a desire for excellence can create pressure to perform at a consistently high level. About social expectations, project managers often experience considerable pressure from different stakeholders, such as their superiors, clients, team members, and project stakeholders.

Furthermore, there is a negative correlation between the amount of control held over the project and the levels of perceived stress. In other words, low control can increase project managers' stress, whereas high control can reduce it (Jepson et al., 2017). However, the reality of project management is that some numerous variables and uncertainties can challenge this sense of control. Therefore, the project manager's opinions and perceptions can significantly cause stress in their respective fields. The completion of a project can also result in new stressors for the project manager. Jepson et al. (2017) explain that certain stakeholders are held accountable for the outcomes of their projects. For instance, if the project meets the deliverables, the project manager will be appreciated for their effort in completing the undertaking. However, if the project is unsuccessful or if it fails to fulfill the deliverables, the project manager will experience additional stress. Significant evidence highlights that a person's experience and cognitive perception of a situation can impact their stress levels (Jepson et al., 2017). In addition, completing a project involves additional challenges, such as budget and resource constraints that may cause unforeseen consequences in a project. Leach (2014) argues that the issues that cause stress and project managers' stress vary. For instance, the stressors may be immediate responses to certain stressors, delayed or complex reactions to chronic stress (Leach, 2014). Therefore, project managers need to be aware of the different stress causes in their respective work environments.

In addition to occupational stress, trauma is a common problem in the modern project management environment. Patching and Best (2014) reveal that countries such as the United States have been experiencing a rise in employee compensation claims attributed to cumulative trauma. In this context, cumulative trauma is a mental illness that emerges due to continual exposure to occupational stress in the workplace. For instance, there is a strong relationship between the employee's work hours and ill health (Patching & Best, 2014). Bowen et al. (2020) contend that project management activities, such as

construction, are highly demanding to the extent of encouraging employees to work long and arduous hours to complete their respective projects. As a result, this trend is a major root cause of occupational stress and poor health of the subordinate workers. Similarly, Sage et al. (2014) outline that failure can cause persistent trauma within project-based organizations. According to the scholar, there are many scenarios where a project fails, leading to severe consequences for the project manager and the entire organization (Sage et al., 2014). The employee's traumatic experiences can push them to experience a flight-or-fight response depending on the intensity of the danger.

Polyvagal Theory and Its Relationship in Agile Environments

Project management, particularly within the agile framework, can be analogized to a collaborative sport or team activity. It's a dynamic process where each individual contributes significantly to the team's success. Agarwal and Anantatmula (2023) highlight the crucial role of psychological safety among team members, noting that its absence can hinder knowledge-sharing behavior, an essential component of team-based projects. Similarly, Khan et al. (2020) emphasize the importance of psychological safety, illustrating how inclusive team leadership enhances it, thereby fostering project success. These insights suggest a psychological underpinning to team behavior, which, intriguingly, extends into a neurobiological dimension. Porges (2022) delves into this neurobiological aspect, particularly in play and socialization. He explains how humans, through evolutionary processes, have developed mechanisms to assess safety levels in social interactions, a fundamental aspect before engaging in collaborative or playful activities. According to Porges, play's roots are linked to the evolution of neural mechanisms that enable mammals to toggle between mobilized fight-flight states and calm, socially engaging states. This evolution was crucial for survival, as it involved rapidly discerning whether an interaction with a conspecific was safe or dangerous. Neuroception, a term coined by Porges, refers to this instant evaluation of risk, which occurs outside conscious awareness. It's a neural function through which the body reacts to environmental cues and shifts physiological state to address potential risks. This process does not necessitate awareness; it is more about the body's reaction to perceived safety or danger cues.

In agile project management, similar neurobiological processes might be at play. Team members often unknowingly assess psychological safety within their environment, influencing their willingness to share knowledge, take risks, and fully engage in collaborative tasks. This assessment can be seen as a form of neuroception, where the team and project environment cues influence individual comfort levels and participation. Just like in Porges' example of the peek-a-boo game, where cues of safety and danger are alternated, agile team members may experience similar fluctuations in their perception of safety within the project environment. This fluctuation can impact their behavior and, by extension, the project's success. Therefore, understanding and fostering a sense of safety, both psychological and neurobiological, becomes crucial in agile project management. It's not just about the tasks and goals but also about creating an environment where team members can effectively engage, collaborate, and innovate without apprehension, much like they would in a playful and safe setting. Recent studies by Porges (2022) and Tan and Tan (2020) have shed light on the critical role of neurobiology, particularly the autonomic nervous system, in shaping team behavior, decision-making, and communication. Porges (2022) introduces the concept of Polyvagal Theory, which identifies neural circuits that regulate reactions to threats and cues of safety. This theory is especially pertinent in agile environments where creating a sense of safety enhances social engagement and cooperation among team members. Tan and Tan (2020) elaborate on this by demonstrating how emotional safety, a key aspect of Polyvagal Theory, is crucial in creating effective team dynamics. They exemplify this through a case study where cogenerative dialogues (cogen) were instrumental in resolving conflicts, highlighting the importance of understanding the autonomic state of team members for effective team management. Porges (2022) also touches upon the importance of feelings of safety in supporting interpersonal accessibility and homeostatic functions, which are vital in agile decision-making processes. Applying Polyvagal Theory principles can foster environments conducive to effective decision-making by ensuring team members are not operating from a defensive state. This is echoed in Tan and Tan's (2020) case study, which illustrates the negative impact of emotional outbursts on team decisions, stemming from a lack of safety. Conversely, they observed that transforming the emotional climate through respectful

communication, in line with Polyvagal Theory's emphasis on safety, positively influenced decision-making in agile teams.

Enhancing team communication and collaboration is another area where Polyvagal Theory proves insightful. Porges (2022) discusses the significant influence of the quest for safety on mental and physical health, social relationships, and cognitive processes. He suggests strategies for improving team communication that focus on creating a work environment signaling safety and trust. This involves considering the physical environment, interpersonal dynamics, and organizational culture. Furthermore, the importance of co-regulation in building strong, cohesive teams is highlighted, as facilitating co-regulatory processes can lead to a supportive and collaborative team environment. Tan and Tan (2020) reinforce this by underscoring the role of emotional regulation and safety in enhancing communication and collaboration. They describe how the shift from emotional conflict to more controlled discussions, facilitated by cogen sessions, mirrors Polyvagal Theory's principles on fostering safety for better social engagement. The "Lucy incident" in their study exemplifies how maintaining an emotionally safe environment can lead to more effective communication and collaboration within a team. Overall, integrating Polyvagal Theory into Agile Project Management offers profound insights into how the autonomic nervous system influences team dynamics, decision-making, and communication. These studies highlight the importance of creating an emotional safety and trust environment, underscoring the interconnectedness of neurobiological states and effective agile management practices.

Social communication plays a fundamental role in the human ability to coregulate interactions, making it a valuable aspect of social engagement systems and project management. Porges (2021) avers that "Depending on physiological state, the same cues will be reflexively evaluated as neutral, positive, or threatening. Functionally, a change in state will shift access to different structures in the brain and support either social communication or the defensive behaviors of fight-flight or shutdown." Now, in agile-related projects, close and frequent communication substitutes predetermined plans. Furthermore, Luong et al. (2021) argue that this communication is present when dealing with clients and a team. In most cases, this communication will determine the next course of action. Therefore, there has to be safe, high-quality and focused social communication, which will elicit a feeling of comfort and trust between the communicating parties. Consequently, to successfully transfer tacit knowledge, the agile team members need to possess many characteristics, such as empathy and the ability to articulate and communicate enough (Luong, et al. 2021). Porges (2021), when discussing PVT explains that social interaction and the capacity for mutual regulation in social contexts contribute to a sense of connection, a crucial element of human experience. The Polyvagal Theory posits that our physiological state is intrinsically linked to our emotions and mood rather than merely being a consequence of them. This theory highlights the interconnectedness of the brain and body, explaining the influence of thoughts on our physical state and vice versa. Therefore, engaging in contemplative activities is contingent on our physiological state, which in turn is shaped by these mental activities. Changes in facial expressions, voice tone, breathing patterns, and posture are not just expressions of our state but also actively modify our physiology, primarily by influencing the myelinated vagus nerve's function, which connects to the heart. In Agile project management, this understanding of the Polyvagal Theory can be applied to enhance team dynamics and effectiveness. The theory suggests that by fostering a physiological state conducive to social engagement—through empathy, active listening, and clear communication—teams can create an environment where members feel safe and connected. This environment is essential for Agile teams, where adaptability and responsiveness to change are key. By recognizing and positively influencing each other's physiological states, team members can improve their collaboration, decision-making, and overall project success, thereby integrating the neurobiological insights of PVT into the practical realm of Agile project management.

DISCUSSION AND CONCLUSION

Integrating Polyvagal Theory (PVT) into Agile Project Management (APM) brings a significant focus on the human element in project management. Understanding the autonomic nervous system's reactions, particularly to stress, is pivotal in enhancing the effectiveness of project management. This integration

emphasizes the critical role of human neurophysiology in shaping team dynamics and stress responses. Applying PVT principles offers deep insights into how the physiological states of team members influence their behavior, communication, and decision-making. Recognizing signs of stress and creating a supportive environment are crucial steps toward improving team functionality and achieving successful project outcomes. In stress management, a common challenge in project management, PVT provides a comprehensive framework for understanding and managing stress at a physiological level. This understanding is vital in developing strategies that mitigate the adverse effects of stress on team performance and overall project health.

Stress profoundly impacts project outcomes, affecting decision-making, leadership effectiveness, and the overall success of a project. The way project managers and their teams respond to stress determines the project's success or failure. PVT offers valuable insights into how different stress levels influence the autonomic nervous system and, consequently, individual behaviors under pressure. These insights are instrumental in predicting and managing team responses to the various challenges encountered in a project. To effectively manage stress, integrating PVT into project management involves adopting practices that reduce stress triggers and foster a supportive environment. This could include mindful communication, regular check-ins, and establishing a culture of openness and empathy. In agile environments, emotional safety is paramount. It facilitates open communication, encourages risk-taking, and fosters innovation. PVT provides a roadmap for creating environments where team members feel secure, valued, and understood, which is critical for effective team functioning. Teams that experience a high level of emotional safety are more likely to engage effectively, share ideas freely, and collaborate more efficiently. This directly impacts the agility and adaptability of the team, which are key components of APM. Implementing emotional safety in agile teams involves establishing clear communication channels, promoting positive feedback, and recognizing the individual needs of team members. Leaders must be trained to recognize and respond appropriately to the emotional states of their team members to create a more cohesive and supportive work environment.

Leadership in agile environments demands adaptability and a deep sensitivity to team members' emotional and psychological states. PVT can guide leaders in understanding these states and adapting their leadership style accordingly. By understanding and applying the principles of PVT, leaders can create a work culture that enhances team well-being and effectiveness, which is particularly crucial in fast-paced and high-stress agile environments. Practical leadership strategies include the implementation of regular team-building activities, stress management workshops, and personal development sessions. These strategies help team members regulate their autonomic responses and foster a healthier, more productive work environment. Through these approaches, leaders can significantly contribute to developing a team that is not only high-performing but also resilient and adaptable to the dynamic nature of agile projects.

Exploring Polyvagal Theory (PVT) in the context of Agile Project Management (APM) has marked a significant advancement in understanding and improving team dynamics, leadership, and stress management within project environments. This integration offers a fresh and insightful perspective on the neurobiological aspects of team behavior, underscoring the importance of fostering an emotionally safe and supportive work environment. By delving into the intricacies of the autonomic nervous system and its influence on human responses, particularly under stress, PVT provides a framework that goes beyond traditional project management approaches. Further, the application of PVT within the realm of APM represents a paradigm shift from conventional project management practices. It directs attention towards the often-neglected human elements – emotional and physiological responses – which play a crucial role in the success of any project. This approach advocates for a more holistic view of project management. It emphasizes not just the achievement of deadlines and objectives but also prioritizes team members' well-being and optimal performance. This perspective is transformative, as it aligns project goals with the health and efficiency of the team, thereby fostering a more sustainable and humane approach to project management.

Incorporating PVT into APM enhances team dynamics and communication. Project managers and team members are equipped to develop more effective communication and collaboration strategies by fostering a deeper understanding of how the autonomic nervous system impacts behavior. Teams that comprehend

and apply these principles demonstrate greater adaptability to changes, more effective stress management, and high levels of productivity and innovation. This improved dynamic is crucial in the agile framework, where flexibility and rapid response to change are key to project success. The insights from PVT empower leaders with the necessary tools to recognize and appropriately respond to their stress responses and those of their team members. Integrating these insights into their leadership styles enables project managers to enhance their emotional intelligence. This leads to more empathetic, responsive, and effective leadership. Such leadership is invaluable in agile teams, where the complexities of projects require leaders who are not only technically proficient but also adept in managing the emotional landscape of their teams.

Future Directions and Applications

Integrating PVT into APM has broad implications and potential applications beyond the immediate scope of project management. It opens up possibilities for its application in various aspects of organizational behavior, leadership development, and team management. The future of this integration looks promising, with potential for further research and practical application of these principles. This ongoing exploration is expected to yield more refined strategies and tools, enhancing agile project management practices' effectiveness and human-centric focus. In conclusion, incorporating Polyvagal Theory into Agile Project Management is not just an innovation in project management methodologies; it represents a significant step toward more empathetic, responsive, and human-centric approaches in the professional world.

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