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Review

The Neurobiology of Effective Leadership: Integrating Polyvagal Theory with the Coaching Leadership Style

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Abstract

The contemporary volatile business environment demands a shift from directive oversight to developmental leadership, given the complexity and rapid technological advancement characterizing modern workplaces. The Coaching Leadership Style (CLS) has emerged as a critical approach, linking extensively to enhanced employee engagement, performance, innovation, and psychological safety. However, the mechanisms by which coaching behaviors create these outcomes, especially the foundational element of safety, remain under-specified. Existing leadership research often lacks a replicable, mechanistic, and neurobiologically grounded model. This conceptual paper bridges this gap by integrating leadership science with interpersonal neurobiology. We propose Polyvagal Theory (PVT), a framework explaining the neurophysiology of safety and connection, as the missing mechanism that explains the effectiveness of CLS. We argue that the relational cues of a coaching leader (e.g., vocal prosody, attuned listening) are non-consciously detected via neuroception, shaping an employee's autonomic state. We propose that these cues create physiological safety, which is the biological prerequisite that enables the interpersonal risk-taking and voice behaviors that constitute psychological safety. We then operationalize this synthesis by embedding PVT principles within the established 5E Coaching Model (Engage, Explore, Explain, Execute, Evaluate), offering a practical, state-aware framework for leaders. This paper contributes a testable, micro-to-macro pathway from leader autonomic co-regulation to team-level high-performance outcomes.

Keywords: coaching leadership; polyvagal theory; physiological safety; psychological safety; co-regulation; 5E coaching; leadership development

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1. Introduction

1.1. The Shift to Coaching Leadership in Modern Organizations

The contemporary organizational context is characterized by unprecedented volatility, rapid technological advancements such as artificial intelligence (Brynjolfsson et al., 2025), and increasingly complex workflows. This dynamic environment is further shaped by evolving workforce expectations, particularly a demand for flexibility, purpose, and continuous development (Lyons et al., 2015). Within this landscape, traditional 'command-and-control' leadership models are proving increasingly inadequate (Northouse, 2022). Such directive approaches often stifle the adaptability, innovation, and employee well-being that are essential for organizational resilience and success (Jiang & Ali, 2024). In response, a Coaching Leadership Style (CLS) has emerged as a critical and effective alternative

(Ladegård & Gjerde, 2014). CLS is defined as a developmental approach where managers guide, support, and inspire their teams rather than merely directing them (Huang, 2019), representing a fundamental shift from authority-based oversight to an inquiry-based model designed to unlock human potential (Hamlin et al., 2006).

1.2. The Demonstrated Value of the Coaching Leadership Style

A robust and growing body of empirical evidence confirms the significant positive impact of CLS on organizational outcomes. Multiple meta-analyses demonstrate that workplace coaching interventions lead to significant gains in performance, well-being, work attitudes, and goal-directed self-regulation (Jones et al., 2016; Theeboom et al., 2014). Leaders who provide coaching foster higher work engagement (S. Kim, 2014) by offering guidance and support in goal achievement. CLS also improves performance and skill development; by focusing on personal growth and leveraging strengths, it increases both individual task performance and overall business outcomes (Zuberbühler et al., 2020). Furthermore, CLS is a catalyst for creating a learning culture (Park et al., 2008). It promotes knowledge-sharing, constructive voice, and creative performance (Hwang et al., 2023), thus facilitating the development of a 'learning organization.' Most critically, CLS is strongly linked to fostering psychological safety (Edmondson & Lei, 2014). It creates environments where employees feel secure to take interpersonal risks (Edmondson, 1999) without fear of embarrassment or punishment, which is a critical factor in collaboration and innovation.

1.3. The Theoretical Gap: A Missing Mechanistic, Neurobiological Model

Despite this strong correlational evidence, a significant theoretical gap persists. The existing leadership literature documents what outcomes CLS achieves but provides a less-specified account of the mechanisms by which it achieves them (Liu et al., 2024). Many leadership frameworks describe effective behaviors but say little about how a leader's moment-to-moment signals are received and processed by employees' nervous systems. For example, the literature provides strong evidence that the CLS fosters psychological safety (Edmondson & Lei, 2014), but it does not fully articulate the physiological pathways through which this safety is felt by employees. Building on contemporary work on the neurobiology of the autonomic nervous system (Porges, 2025a, 2025b), there is a clear need for a mechanistic, neurobiologically grounded model that connects observable leadership cues to autonomic nervous system (ANS) processes and, in turn, to organizational outcomes.

1.4. Purpose and Contribution: A Polyvagal-Informed Framework for CLS

This conceptual paper aims to fill this theoretical gap by integrating the CLS (Theeboom et al., 2014), Polyvagal Theory (PVT) (Porges, 1995, 2022, 2025a), and the 5E Coaching Model (Colgate, 2016; Colgate, 2025). Drawing on Porges's concept of cues of safety that are nonconsciously detected via neuroception (Porges, 2007), we propose that CLS relational behaviors are effective because they provide such cues. This process, facilitated through co-regulation, can support a shift in the employee's autonomic state toward ventral vagal activation and a greater sense of physiological safety (Porges, 2025a). We propose that this individual physiological state is the necessary foundation, or biological prerequisite, for the shared, team-level belief of psychological safety (Edmondson, 1999).

2. A Review of Core Constructs

2.1. The Coaching Leadership Style (CLS): Behaviors and Business Outcomes

CLS is a developmental, inquiry-based approach where leaders focus on guiding, supporting, and empowering employees (Huang, 2019). This style is considered to be at the heart of effective management practices (Hamlin et al., 2006) and stands in sharp con-

trast to command-and-control approaches, which negatively impact climate and decrease motivation (Goleman, 2000).

A robust body of literature confirms that CLS strongly enhances employee engagement (Ladyshewsky & Taplin, 2018), improves employee performance and skill development (Zuberbühler et al., 2020), and acts as a catalyst for organizational learning and innovation (Hwang et al., 2023). Furthermore, practicing CLS benefits the leader by improving their own job performance, work engagement, and psychological capital (Zuberbühler et al., 2020), and fostering their emotional intelligence (Goleman, 2004).

2.2. Psychological Safety as a Cornerstone of High-Performing Teams

Psychological safety is a primary outcome of CLS (Edmondson & Lei, 2014) and is defined as 'a shared belief that the team is safe for interpersonal risk taking' (Edmondson, 1999, p. 354). Its function is to link leadership behavior to learning and performance by enabling employees to speak up, admit errors, and experiment without fear of punishment (Edmondson & Lei, 2014). Meta-analytic evidence confirms its positive association with information sharing and task performance (Frazier et al., 2017). Leaders are pivotal in creating these conditions through CLS behaviors such as inclusiveness, respectful inquiry, and openness to input (Nembhard & Edmondson, 2006).

2.3. Polyvagal Theory: The Neurobiology of Safety and Connection

PVT, developed by Porges, offers a neurobiological account of how relational signals shape our autonomic state and capacity for social behavior (Porges, 1995, 2022).

The Autonomic Hierarchy: Ventral Vagal, Sympathetic, and Dorsal Vagal States.

PVT reframes the autonomic nervous system into a phylogenetically ordered, three-part hierarchy that responds to environmental cues (Porges, 2001, 2003, 2007, 2022, 2025b). First is the Ventral Vagal Complex (VVC), the system of physiological safety and social engagement (Porges, 2001, 2007). This regulated state is associated with connection, curiosity, and flexible behavior and is the only state where openness, trust, and reflective learning are fully accessible (Porges, 2025a). Second is the Sympathetic Nervous System (SNS), the mobilization circuit activated by danger cues, leading to fight or flight (Porges, 2001, 2007). This manifests in the workplace as anxiety or defensiveness and can be misinterpreted as willful resistance or emotional volatility (Porges, 2025a). Third is the Dorsal Vagal Complex (DVC), the shutdown or immobilization system (Porges, 2001, 2007). This manifests as disengagement, collapse, emotional numbness and can be misread as a lack of motivation or apathy (Porges, 2025a).

Neuroception and Co-Regulation as Relational Processes.

Neuroception is the detection mechanism, a nonconscious scan for safety or danger (Porges, 2001, 2007, 2022, 2025b). It is highly sensitive to relational signals such as vocal prosody, facial expression, and pace of speech (Dana, 2018; Porges, 2022). A calm voice (CLS hallmark) is neurocepted as safety, supporting ventral engagement (Porges, 2025a).

Co-regulation is the intervention process, by which social engagement signals convey safety and reduce defensive activation in another person (Dana, 2018; Porges, 2022, 2025a). Building on this account of co-regulation, we conceptualize CLS behaviors as neurobiological acts of co-regulation.

Theoretical Reflexivity: Recognizing the Limits of Universal Cues.

While PVT provides a universal mechanism for biological response, the specific cues of safety are unlikely to be universally effective in all contexts. In this paper, we assume that their effectiveness could be shaped by cultural context, power dynamics, and neurodiversity. This must be acknowledged early to enhance theoretical reflexivity (Homer & Lim, 2024).

2.4. The Foundational Link: From Physiological Safety to Psychological Safety

This synthesis proposes a new, two-level causal chain linking CLS to psychological safety, mediated by physiology:

1. Micro-Level: A leader enacts a CLS behavior. The employee's nervous system may neurocept this as a cue of safety, supporting a shift toward ventral vagal activation and a greater sense of physiological safety (Porges, 2007).
2. Enabling Behavior: This felt sense of safety biologically enables the employee to perform the risk-taking behaviors (Edmondson, 1999), as they are no longer biologically constrained by defensive states (Porges, 2025a).
3. Macro-Level: Repeated moments of physiological safety accumulate, coalescing into a shared belief of psychological safety at the team level (Edmondson, 1999).

Therefore, we posit that physiological safety is the biological prerequisite for psychological safety.

3. The 5E Coaching Model: An Applied Framework for Polyvagal-Informed Leadership

3.1. The 5E Model as a Relational Coaching Structure

The established 5E Coaching Model (Engage, Explore, Explain, Execute, and Evaluate) (Colgate, 2016) is proposed as the ideal structure for operationalizing a polyvagal-informed CLS. The model's cyclical, predictable structure (Colgate, 2016) functions as a regulatory anchor because predictability and transparency are powerful cues of safety for neuroception (Porges, 2025a). Please see Table 1 for a summary of the integration of Polyvagal principles and the 5E coaching model which we describe below.

Table 1. A Conceptual Operationalization Model of Polyvagal-Informed Coaching via the 5E Framework.

5E Coaching Phase	Polyvagal Principle	PVT-Informed Leader Behaviors	Desired Employee Autonomic State	Resulting Climate & Business Outcomes
Engage	Establish neuroceptive safety	Warm prosody, open posture, genuine welcome, transparent process, attuned check-in (Colgate, 2025; Porges, 2022).	Ventral Engagement Regulated, connected, felt safety (Dana, 2018; Porges, 2022).	Psychological Safety (Edmondson, 1999). Trust in Leader.
Explore	Attunement and pacing	Open, invitational questions; allow pauses; reflect meanings; notice state shifts (agitation/withdrawal) (Colgate, 2025).	Ventral Engagement (Sustained) Agency, feeling heard, reflective (Dana, 2018; Porges, 2025a).	Employee Engagement (Ladyshewsky & Taplin, 2018). Constructive Voice (Hwang et al., 2023).
Explain	Threat-reduced feedback	Seek permission; use collaborative, non-judgmental language; focus on behavior, not identity; normalize defensiveness (Colgate, 2025; Porges, 2025a).	Lowered Sympathetic Mobilization Openness to learning, reduced fear of speaking up (Porges, 2022, 2025a).	Personal Learning & Skill Growth (Park et al., 2008). Organizational Learning Culture (Khan et al., 2024).
Execute	Co-regulate during action and setbacks	Break work into small, manageable steps; frame setbacks as information; reassure and celebrate progress (Colgate, 2025).	Regulated Mobilization (Ventral + SNS) Vigor, resilience, self-efficacy (Porges, 2022).	Task Performance (Zuberbühler et al., 2020). Creative Performance & Innovation (Hwang et al., 2023).
Evaluate	Anchor growth and reinforce safety	Recognize effort and outcomes; review with curiosity not judgment; co-create next steps (Colgate, 2016, 2025).	Reinforced Ventral Pathways Commitment, growing self-regulation (Porges, 2025a).	Leader Effectiveness (Goleman, 2004; Zuberbühler et al., 2020). Higher Retention/Lower Turnover (Anderson, 2001).

3.2. Integrating Polyvagal Principles into the 5E Coaching Phases

Engage: Establishing Neuroceptive Safety.

The Engage phase focuses on establishing neuroceptive safety to create the biological state of trust (Porges, 2022). In PVT terms, a leader first attends to their own regulation, and

from this regulated state they can access and express cues of safety such as warm, melodic vocal prosody and open, welcoming body language (Porges, 2022, 2025a).

Explore: Attunement and Supporting Autonomic Flexibility.

The Explore phase, which is the coachee's chance to talk, emphasizes attunement and pacing (Colgate, 2025). Drawing on work on co-regulation and clinical attunement (Dana, 2018; Porges, 2022), the leader tracks shifts toward defensive activation in the employee's voice, posture, and narrative. When these shifts surface, the leader slows the pace, adjusts questions, and offers cues of safety so the employee remains engaged and retains a sense of choice over what is explored.

Explain: Delivering Threat-Reduced Feedback.

Because feedback can be experienced as a threat, it may trigger sympathetic activation of the autonomic nervous system (Porges, 2025a). The goal is threat-reduced feedback (Colgate, 2025) that keeps the nervous system within reach of regulation. The leader seeks permission, uses collaborative non-judgmental language, focuses on behavior not identity, and briefly normalizes defensiveness as an understandable response.

Execute: Co-Regulating Action and Setbacks.

The Execute phase supports action and commitments from the coachee while recognizing that defensiveness, avoidance, and procrastination can, in PVT terms, reflect sympathetic or dorsal defensive states (Porges, 2025a). The goal is to co-regulate during both action and setbacks (Colgate, 2025). The leader breaks work into small, manageable steps, frames setbacks as information rather than failure, and reassures and celebrates progress to support resilience (Colgate, 2025).

Evaluate: Anchoring Growth and Reinforcing Safety.

The Evaluate phase anchors learning and reinforces safety (Colgate, 2016, 2025). The leader recognizes both effort and outcomes through follow-ups, and reviews the work with curiosity rather than judgment (Colgate, 2025). In PVT terms, this supports neural pathways associated with ventral vagal states and a growing capacity for self-regulation (Porges, 2022, 2025a). Together, leader and employee co-create next steps, so progress is linked to a continued sense of safety.

4. Discussion

4.1. General Synthesis: Providing a Mechanistic Lens

This integrated framework offers a necessary synthesis by providing the mechanistic grounding for psychological safety that was previously absent. Our model explicitly links micro-level relational behaviors to macro-level organizational outcomes through physiological safety. We model organizational culture as a measurable pattern of collective nervous system regulation. A command-and-control culture (Goleman, 2000) fosters chronic sympathetic activation, while a CLS-driven culture cultivates ventral vagal engagement. This framework provides a unifying mechanism for human-centered leadership styles, suggesting their effectiveness stems from providing reliable cues of safety that settle autonomic arousal and support social engagement (Porges, 2022).

4.2. Theoretical Contributions and Formal Propositions

This paper contributes to theory development by providing a strong link that uses progressive layers of research (Homer & Lim, 2024). Effective theory development requires the symbiotic use of micro and macro perspectives to navigate complexity (Homer & Lim, 2024). Macro theories, like a wide-angle lens, generalize principles but 'shed contextual specifics' (Homer & Lim, 2024, p. 130), whereas micro theories, like a microscope, 'delve into particularities' (Homer & Lim, 2024, p. 128).

Our integration establishes PVT as a foundational micro theory (individual physiology) that constructs a meso/macro theory (team psychological safety and organizational culture) (Homer & Lim, 2024). This model helps bridge the friction between broad generalizability and context-specific precision (Homer & Lim, 2024).

We utilize Coleman's boat metaphor (Coleman, 1990; Cowen et al., 2022) to establish the causal chain:

1. Micro-level Action-Formation Mechanism: Leader micro-behaviors can shape employees' physiological state, supporting ventral vagal activation in the moment of interaction.
2. Micro-to-Macro Transformational Mechanism: The aggregation of these repetitive micro-interactions (physiological safety moments) leads to a durable transformational mechanism that establishes a shared, team-level belief in psychological safety and defines the organizational culture (Homer & Lim, 2024).

To guide future empirical validation, we offer the following explicit propositions:

Proposition 1. *Coaching Leadership Style (CLS) behaviors (e.g., use of warm prosody, attuned listening) are positively associated with the activation of an employee's individual ventral vagal state and a greater sense of physiological safety.*

Proposition 2. *Employee physiological safety, indexed by ventral vagal activation and measured with physiological indices such as heart rate variability (HRV) (H. G. Kim et al., 2018), mediates the relationship between leader co-regulatory behaviors and employees' interpersonal risk-taking behaviors, a behavioral indicator of psychological safety.*

Proposition 3. *The consistent accumulation of physiological safety moments across a team, facilitated by CLS, is positively associated with the emergence of a high level of shared belief in psychological safety and subsequent team performance outcomes.*

4.3. Illustrating Applicability: Meso-Level Examples

The framework can be illustrated through meso-level contexts (Homer & Lim, 2024) to show how the micro theory adapts as it moves through various organizational layers (Homer & Lim, 2024).

Health Systems: A leader coaching a clinical team (micro) to manage stress influences team dynamics (meso), which in turn affect broader policy frameworks and societal determinants (macro) that shape the efficiency and fairness of health systems (Homer & Lim, 2024).

Organizational Change: During a digital transformation, department leads (meso) use co-regulation to manage the team's collective autonomic state, mitigating the external factors like economic dynamics (macro) that guide the transformation efforts (Homer & Lim, 2024).

4.4. Practical Recommendations

We argue that effective leadership development should move beyond behavioral scripts and intentionally include autonomic state awareness as a foundation (Porges, 2025a). Leadership development can be strengthened by training leaders to notice their own state and practice self-regulation, enabling more effective co-regulation with their teams (Porges, 2022, 2025a; Zuberbühler et al., 2020). The 5E model provides the micro-coaching moments (Colgate, 2016) and a default rhythm for leaders to institutionalize these state-aware practices (Colgate, 2025).

4.5. Policy Recommendations

Organizational policies should support the integration of autonomic state-awareness training into all management curricula. Performance reviews should explicitly assess managers' proficiency in co-regulation. Governmental/industry policies could outline standards for organizational climate (Homer & Lim, 2024) that emphasize physiological safety as a precursor to ethical conduct and well-being (Porges, 2025b).

5. Conclusions

The effectiveness of the Coaching Leadership Style (CLS) in driving engagement, performance, and innovation is robust. This paper integrated leadership science with interpersonal neurobiology to propose a novel mechanistic answer: CLS works because its core relational behaviors are neurocepted as cues of safety. When these cues are offered by a regulated leader, they can help co-regulate employees' autonomic nervous systems, supporting ventral vagal activation and a felt sense of physiological safety. This individual, embodied sense of safety provides a biological foundation for the psychological safety that unlocks team collaboration and performance.

The 5E Coaching Model provides a practical structure for applying these principles systematically. This integrated framework redefines leadership not as cognitive directives, but as an embodied, relational nervous-system partnership. It positions the modern leader's primary role as shaping conditions for performance by first shaping the autonomic conditions for safety, connection, and trust. By advocating for a conceptual progression from micro-level physiology (PVT) to macro-level culture, this paper paves the way for a more comprehensive and nuanced theoretical understanding, ensuring that research remains relevant and robust in the diverse realities of the contemporary organizational environment.

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